



Alberni Valley Regional Airport (CBS8)
Runway Extension - Electrical Works
Class 'A' Estimate of Probable Costs
Runway 30 Extension 324m (1063 ft)

February 27, 2015

Item	Estimate of Probable Costs Summary				Total
1.00	Electrical General Requirements				\$ 70,000
2.00	Electrical Site Works				\$ 1,218,200
	Total Estimate of Probable Construction Costs				\$ 1,288,200
3.00	Estimated Engineering Costs - Design, Construction Inspection (rounded)			4%	\$ 51,500
4.00	Project Contingencies (rounded)			10%	\$ 128,800
	Total Estimate of Probable Project Costs				\$ 1,468,500

Item	Description	Unit	Est. Quantity	Unit Price	Total Price
1.00	Electrical General Requirements				
1.01	Temporary Facilities - Mob / Demob, Survey, Insurance, Bonding etc.	Lump Sum	1	\$ 60,000	\$ 60,000
1.02	Conduct Testing and Commissioning	Lump Sum	1	\$ 2,500	\$ 2,500
1.03	Supply of Operations and Maintenance Manuals, Spare Parts	Lump Sum	1	\$ 7,500	\$ 7,500
	Subtotal General Requirements				\$ 70,000
2.00	Electrical Site Works				
	Rwy 12 Precision Approach Path Indicators (PAPI)				
2.01	Trenching, RPVC Ducts, #8 ASLC Power Cable etc.	Lin.m.	50	\$ 100	\$ 5,000
2.02	New Pull Pits (Junction Boxes)	Each	5	\$ 600	\$ 3,000
2.03	PAPI Fixtures, Concrete Bases etc.	Lump Sum	1	\$ 40,000	\$ 40,000
	Rwy 30 Precision Approach Path Indicators (PAPI)				
2.04	Trenching, RPVC Ducts, #8 ASLC Power Cable etc.	Lin.m.	50	\$ 100	\$ 5,000
2.05	New Pull Pits (Junction Boxes)	Each	5	\$ 600	\$ 3,000
2.06	PAPI Fixtures, Concrete Bases etc.	Lump Sum	1	\$ 40,000	\$ 40,000
	Airfield Lighting, Signage and Windsocks				
2.07	Trenching, RPVC Ducts, #8 ASLC Power Cables etc.	Lin.m.	5,400	\$ 120	\$ 648,000
2.08	New Pull Pits (Junction Boxes)	Each	130	\$ 600	\$ 78,000
2.09	Illuminated Windsock Assemblies c.w. Concrete Base	Each	2	\$ 10,000	\$ 20,000
2.10	Relocate/Install Single Sided Illuminated LED Airfield Signage c.w. Concrete Base	Each	6	\$ 10,000	\$ 60,000
2.11	Two Sided Illuminated LED Airfield Signage c.w. Concrete Base	Each	2	\$ 11,000	\$ 22,000
2.12	LED Threshold/Runway End Light Fixtures	Each	12	\$ 1,400	\$ 16,800
2.13	LED Runway Edge Light Fixtures	Each	53	\$ 1,200	\$ 63,600
2.14	LED Taxiway Edge Light Fixtures	Each	37	\$ 1,200	\$ 44,400
2.15	LED Apron Edge Light Fixtures	Each	12	\$ 1,200	\$ 14,400
	Field Electrical Centre (FEC) and Lighting Control				
2.16	New Field Electrical Centre Building c.w. Three (3) Constant Current Regulators, Aerodrome Beacon	Lump Sum	1	\$ 150,000	\$ 150,000
2.17	Aircraft Control of Aerodrome Lighting (ARCAL) System	Lump Sum	1	\$ 5,000	\$ 5,000
	Subtotal Electrical Works				\$ 1,218,200

Notes:

- 1.0 Costs noted above are estimates based on similar works completed over the past five years. It is not to be interpreted as a guarantee by
- 2.0 The estimates include 2-5% contingency to account for fluctuations between assumptions made and actual ground conditions.
- 3.0 Temporary Facilities have been estimated at 5%(rounded) of the Subtotal Civil & Electrical Site Works.

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 Section 26 05 00 - Common Work Results for Electrical
- .2 Section 26 05 14 - Power Cable and Overhead
- .3 Section 26 05 20 - Wire and Box Connectors 0-1000V
- .4 Section 26 05 21 - Wires and Cables 0-1000V
- .5 Section 26 05 22 - Connectors and Terminations
- .6 Section 26 05 28 - Grounding - Secondary
- .7 Section 25 06 31 - Splitters, Junction, Pull Boxes and Cabinets
- .8 Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings
- .9 Section 26 05 43.01 - Installation of Cables in Trenches and in Ducts
- .10 Section 31 23 33.01 - Excavating, Trenching and Specification
- .11 Section 33 65.76 - Direct Buried Underground Cable Ducts
- .12 Section 34 43 05 - Airfield Lighting - General
- .13 Section 34 43 10 - Airfield Illuminated
- .14 Section 34 43 13.19 - Elevated Edge Lighting for Airport Runways
- .15 Section 34 43 16.36 - Airfield Precision – Approach
- .16 Section 34 43 26.23 – Airfield Lighting Regulator

1.2 DESCRIPTIONS

- .1 All addenda or corrections issued during the time of bidding become part of the contract documents, and shall be covered in the Contractor's bid.

1.3 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.1-09, Canadian Electrical Code, Part 1 (21st Edition), Safety Standard for Electrical Installations, latest edition.
 - .2 CAN3-C235-83(R2006), Preferred Voltage Levels for AC Systems, 0 to 50,000 V, latest edition.
- .2 Institute of Electrical and Electronics (IEEE)/National Electrical Safety Code Product Line (NESC)
 - .1 IEEE SP1122, "The Authoritative Dictionary of IEEE Standards Terms", 7th Edition, latest edition.

1.4 MEASUREMENT FOR PAYMENT

- .1 Electrical work shall be measured as Lump Sum or unit price Items as described in attached table. Payment at the tendered Lump Sum or unit price shall be full compensation for supply of all materials and labour required to complete the work as described in the Contract Documents. There is no separate payment for work under this section. Includes the costs associated with work in lump sum or unit price items table.

1.5 INTERPRETATION OF DRAWING

- .1 The drawings and specifications provide together a complete and workable facility, with all components in satisfactory and operating condition. These drawings and specifications shall form a basis for the bid price and shall be used to provide a complete electrical installation as directed in each or both documents. Do not scale from electrical drawings.
- .2 All notes on drawings, which make exception to these specifications, have precedence except addenda where specific reference is made.

1.6 ACCEPTANCE TESTING

- .1 The acceptance testing and commissioning shall include, but not be limited to, the following: Submit test results on standard form to consultant for approval. Four (4) copies of all test results to be included in operation and maintenance manual.
- .2 Check and inspect all the installed equipment, wiring, cables and connectors.
- .3 Check all pullpits, isolating transformers, primary, secondary, counterpoise and ground connections.
- .4 Check all new taxiway lights for proper lenses and lamps as per specifications.
- .5 Check new airfield signs for proper operation.
- .6 Check all other electrical systems for proper operation.
- .7 Megger all circuits and record readings. Results shall comply with the requirements of the Canadian Electrical Code (latest Edition), and the local inspection authority. Submit results of tests to the Electrical Consultant.
- .8 Record the resistance of the series circuit to ground.
- .9 Record the loop resistance immediately after the insulation resistance test. Note the ambient temperature and weather conditions at the time of test.
- .10 Calibrate and adjust the settings of the existing regulators, used under this project, as per manufacturer's recommendations. Ensure the supply voltage corresponds to the input tap. Check that the open circuit protector de-energizes the circuit within two or three seconds when load is disconnected.

1.7 CARE, OPERATION AND START-UP

- .1 Instruct Consultant and Owner in the operation, care and maintenance of equipment.
- .2 Arrange and pay for services of a manufacturer's factory service representatives to supervise start-up of installation, check, adjust, balance and calibrate components.
- .3 Provide these components for such a period and for as many visits as necessary, to put equipment in operation and ensure that the Owner is conversant with all aspects of its care and operation.

1.8 WORKMANSHIP STANDARDS

- .1 All phases of the electrical installation shall be executed in a satisfactory workmanlike manner and shall present a neat mechanical appearance when completed. The work considered unsatisfactory to the Engineer shall be corrected at the Contractor's expense.
- .2 Keep on the job during its progress, a competent foreman, holding a First Class Journeymen Certificate, and necessary assistants, all satisfactory to the Airport Authority. The foreman shall not be changed, except with the consent of the Engineer, unless he proves to be unsatisfactory and ceases to be an employee of the Contractor.
- .3 The foreman shall represent the Contractor in his absence and all directions given to him shall be held as being given to the Contractor. Give efficient supervision to the work, using skill and attention.

1.9 CONDUIT AND CABLE IDENTIFICATION

- .1 Colour code shall be put on all conduits, junction boxes and metallic sheathed cables in accordance with colour code specified.
- .2 Code with a plastic tape or painting at points within 300 mm where conduits or cable enter wall, ceiling, or floor, and at 15 m intervals where conduits or cable run exposed or through accessible ceiling spaces.
- .3 Colours: 25 mm wide prime colour and 20 mm wide auxiliary colour:

	<u>Prime</u>	<u>Auxiliary</u>
up to 250 V	yellow	
up to 600 V	yellow	green
up to 5 kV	yellow	blue
- .4 Underground cables
 - .1 Provide stainless steel tags for each cable entering and leaving pullpit or vault to match the underground cable schedule on the drawing, or as directed by the engineer. This includes any straight through cable.
 - .2 Fasten tags with black UV resistant tie wraps.

1.10 CONDUIT AND CABLE INSTALLATION

- .1 Install conduit and sleeves prior to pouring of concrete. Sleeves through concrete: plastic, sized for free passage of conduits, and protruding through 50 mm.
- .2 Install neatly cables, conduits and fittings to be embedded or plastered over.
- .3 Conduit and cables penetrations through exterior walls shall be sealed internally with duct seal and externally with silicone sealant.

1.11 CHANGES IN WORK

- .1 The Engineer, without invalidating the contract, may alter, add to or deduct from the work, the contract sum being adjusted accordingly. All such changes shall be governed by the conditions of the original contract.
- .2 All changes involving costs shall be approved by the Engineer prior to any actual work being proceeded with.
- .3 All supplemental cost proposals by the Contractor shall be accompanied by a complete itemized breakdown of labour and materials. NO EXCEPTIONS will be made. At the Engineer's request, Contractor's estimating sheets for supplemental cost proposals shall be submitted. Labour must be broken out and allocated to each item of work included in the Notice of Change. Submissions must itemize all material used and shall show labour units assigned to each item of material.
- .4 Location of any device may be changed to within three (3) metres of the position indicated on the drawings, without an extra, providing the Contractor is advised of the change in ample time to avoid removal of any equipment or material installed.

1.12 SHOP DRAWINGS

- .1 Shop drawings of all major electrical equipment (being supplied under this contract) shall be submitted to the Engineer for review, prior to installation of same. Such equipment shall include, but not be limited to, transformers, lighting fixtures (cuts or catalogue sheets for all fixtures to be installed with the fixture type indicated), pullpits, airfield guidance sign, electrical ducts, cables, lamp-post, lamps, obstruction lights, contactors, and other equipment.
- .2 In addition to the above requirements, shop drawings must consist of at least one (1) sepia or other type of reproducible transparency. Where shop drawings consist simply of typewritten letter size pages, clear original bond copies may be submitted for review. Binders must have labelled tabs indexing the shop drawings and must include a list of all shop drawings being submitted at a later date. The contractor, upon receipt of stamped reviewed sepias, shall ensure that sufficient copies of same are supplied to the Trade Contractor, as well as his suppliers. The original shop drawings shall be used to make up the operating and maintenance manuals.
- .3 All shop drawings must be certified by the manufacturer and carefully checked by the Trade Contractor noting all changes required and shall bear the Trade Contractor's approval stamp and signature. Shop drawings must be clearly labelled as to job,

contractor and manufacturer. All stamps and labelling shall appear on the front of the shop drawings in order to reproduce properly. Drawings shall incorporate a minimum 100 mm x 75 mm space to accept the Engineer's review stamp.

- .4 The Electrical Consultant's review of shop drawings is for general design only, and does not relieve the Trade Contractor, Trade Sub-Contractor or suppliers from their responsibilities for errors, proper fittings, construction of the work and furnishing of materials. The review shall not be construed as approving departures from the contract document requirements, where such departures are not specifically noted in a covering letter accompanying such drawings. Any work done prior to the return of properly reviewed shop drawings is done at the risk of the Contractor.
- .5 Note that a MINIMUM of seven (7) working days is required by the Electrical Consultant to process shop drawings. The Trade Contractor is, therefore, requested to submit all shop drawings with this in mind in ample time in order to avoid unnecessary delay of shipment of materials or construction.

1.13 CUTTING, PATCHING,ETC,

- .1 Structural members shall not be cut without the consent of the structural engineers. For all necessary cutting, channelling, core drilling, sleeving, etc., provide own forces and necessary equipment required to complete the electrical facilities.
- .2 Explicitly notes that any cutting of wood, block, concrete, etc. for conduit shall be done with utmost care and that channelling and opening through walls, etc. shall not exceed the diameter of the conduit by more than 25 mm. All cutting, patching, painting, etc. shall be done at this Contractor's expense under the direction of the Construction Manager and to the satisfaction of the Consultant or Owner.

1.14 COORDINATION OF PROTECTIVE DEVICES

- .1 Ensure to install to required values and settings the circuit protective devices, such as over-current trips, relays and fuses.

1.15 EQUIPMENT IDENTIFICATION

- .1 Identify electrical equipment with nameplates and labels as follows:
 - .1 Nameplates: lamicoid 3 mm thick plastic engraving sheet, white face, black core, mechanically attached with self tapping screws.
 - .2 Sizes as follows:

NAMEPLATE SIZES

Size 1	10 x 50 mm	1 line	3 mm high letters
Size 2	12 x 70 mm	1 line	5 mm high letters
Size 3	12 x 70 mm	2 lines	3 mm high letters
Size 4	20 x 90 mm	1 line	8 mm high letters
Size 5	20 x 90 mm	2 lines	5 mm high letters
Size 6	25 x 100 mm	1 line	12 mm high letters
Size 7	25 x 100 mm	2 lines	6 mm high letters

- .2 Labels: embossed plastic labels with 6 mm high letters unless specified otherwise.
- .3 Wording on nameplates and labels to be approved by Consultant prior to manufacture.
- .4 Allow for average of twenty-five (25) letters per nameplate and label.
- .5 Identification shall be in English.
- .6 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.
- .7 Disconnects, starters and contactors: indicate equipment being controlled and voltage.
- .8 Terminal cabinets and pull boxes: indicate system and voltage.
- .9 Transformers: indicate capacity, primary and secondary voltages.

1.16 EQUIPMENT PROTECTION

- .1 Keep all conduit openings closed by means of plugs or caps to prevent the entrance of foreign matter. Protect all conduit, fixtures, equipment, etc. against dirty water, chemical or mechanical damage both before and after installation. Any such equipment damaged prior to final acceptance of the work shall be restored to its original condition or replaced at the expense of the Contractor.
- .2 Equipment standing on the job site shall be covered or otherwise suitably protected at the direction of, and to the satisfaction of, the Consultant. If coverings become torn, etc., they shall be replaced until the equipment is connected and operating.

1.17 FIELD QUALITY CONTROL

- .1 Conduct and pay for following tests:
 - .1 Power distribution system including phasing, voltage, grounding and load balancing.
 - .2 Circuits originating from branch distribution panels.
 - .3 Aerodrome lighting and its control.
- .2 Insulation resistance testing.
 - .1 Megger circuits, feeders and equipment up to 350 V with a 500 V instrument.
 - .2 Megger 350-600 V circuits, feeders and equipment with a 1000 V instrument.
 - .3 Megger 2500 V circuits with a 2500 V instrument.
 - .4 Megger 5000 V circuits with a 5000 V instrument.
 - .5 Check resistance to ground before energizing.
- .3 Visual Testing.
 - .1 Prior to installation of cable in ducts or polytubing inspect cables for insulation damage (nicks, scratches, peeling).
 - .2 Examine pullpits for the presence of insulation residue after installation.
- .4 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.
- .5 Submit test results for Consultant's review.
- .6 If defective material is found, Contractor to replace defective material, install properly and retest.

1.18 FINISHES

- .1 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two (2) coats of finish enamel.
 - .1 Paint outdoor electrical equipment "international orange" finish to EEMAC Y1-1 unless otherwise specified.
 - .2 Paint indoor switchgear and distribution enclosures light gray to EEMAC 2Y-1.
- .2 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.
- .3 Clean and prime exposed non-galvanized hangers, racks and fastenings to prevent rusting.

1.19 LOAD BALANCE

- .1 Measure phase current to panelboards with normal loads (lighting) operating at the time of acceptance. Adjust branch circuit connections as required to obtain best balance of current between phases and record changes.
- .2 Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment.

1.20 MANUFACTURERS AND CSA LABELS

- .1 Visible and legible has been installed after equipment.

1.21 MATERIAL STANDARDS AND ALTERNATIVES

- .1 All material supplied shall be new of the quality specified. All equipment shall conform to the standards of the Canadian Standards Association and shall bear the necessary CSA approval label. For any material not CSA approved, obtain the approval of the Local Inspection Authority and bear all inspection charges levied and any modification costs required for this CSA Approval by Special Inspection.
- .2 Make known in writing to the Engineer five (5) calendar days prior to sub-trade bid closing any material specified or required to complete the work which is not currently available or will not be available for use as called for herein.
- .3 Unless otherwise specifically called for in the specifications, uniformity of manufacturer shall be maintained for any particular type of equipment throughout the project.
- .4 All materials shall be ordered within thirty (30) days from date of awarding of contract, providing that delivery of materials will not compromise completion date. Show the proof to the Engineer of material orders, at the Engineer's request.

1.22 SUBSTITUTION

- .1 Notwithstanding the General Conditions, the following shall apply.
- .2 No substitutions will be permitted without prior written approval by Engineer.
- .3 Proposals for substitutions may be submitted ONLY AFTER award of contract. Such request must include statements of respective costs of items originally specified and proposed substitutions.
- .4 Substitution proposals will be considered by the Electrical Consultant ONLY IF:
 - .1 Products selected by the Trade Contractor from those specified are not available.

- .2 Delivery date of products selected from those specified is not available for reasons beyond the Trade Contractor's control, which he could not reasonably have anticipated, and provided that the Trade Contractor diligently verified availability at the commencement of the contract, or
- .3 Alternative products to those specified, which are brought to the attention of and considered by the Electrical Engineer as alternative to those specified, will result in a credit to the contract amount.
- .5 Should proposed substitution be accepted either in part or in whole, assumes full responsibility and costs when substitution affects other works on the project.
- .6 All credits arising from approval of substitutions will be credited to contract in such amounts as may be determined by the Design Manager and contract price will be adjusted accordingly.

1.23 PERMITS, CODES AND INSPECTIONS

- .1 Submit to the Electrical Inspection Department and Supply Authority necessary number of drawings and specifications for examination and approval prior to commencement of work.
- .2 Pay the associated fees.
- .3 Consultant will provide the drawings and specifications required by the Electrical Inspection Department and Supply Authority at no cost.
- .4 Notify Consultant of the changes required by the Electrical Inspection Department prior to making changes.
- .5 Installation shall comply with the requirements of the latest edition of the Canadian Electrical Code and all relevant by-laws of a local electrical authority.
- .6 Obtain all permits required and, after completion of the work, furnish to the Engineer a Certificate of Final Inspection and Approval from the Inspection Department. Take out all permits required at the beginning of the work.

1.24 SCHEDULING

- .1 Project work will be governed by the fact that the other disciplines will be conducting work at the same time as the electrical work is being undertaken. Include in the tender amount all costs associated with the required scheduling. All necessary power shutdowns must be co-ordinated with the Owner.
- .2 Requests for power shut downs shall be submitted in writing a minimum of forty-eight (48) hours prior to scheduled shutdown. Requests shall indicate scope of work, area, circuits, panels affected, as well as the date and time of requested shutdown.

1.25 VOLTAGE RATINGS

- .1 Operating voltages: to CAN3-C235-85.
- .2 All electrical devices and equipment shall operate at 60 HZ within normal operating limits established by above standard. Equipment shall operate in extreme operating conditions established in above standard without damage to equipment.

1.26 WIRING IDENTIFICATIONS

- .1 Identify wiring with permanent indelible markers, either numbered or coloured plastic tapes, on both ends of phase conductors of feeders and branch circuit wiring.
- .2 Maintain the phase sequence and colour coding throughout.
- .3 Colour code: to the Canadian Electrical Code, C22.1.
- .4 Use colour coded wires in communication cables, matched throughout system.

1.27 WIRING TERMINATIONS

- .1 Lugs, terminals, screws used for termination of wiring to be suitable for either copper or aluminum conductors.

1.28 WORK COORDINATION

- .1 Where location of work depends upon equipment being installed by others, confirm location of all such equipment with the trade concerned prior to installing any conduit, outlets, etc. Where equipment is being supplied that is being built-in with work of other Contractors, supply the equipment or necessary dimensions to the respective trades concerned.
- .2 Give the work personal supervision, lay out own work, do all necessary levelling and measuring or employ a competent Engineer to do so. Figures, full size and detail drawings shall take precedence over scaled measurements off drawings. No plea as to the actions and directions of other than the Consultant will be accepted in justification of any error in construction where a departure is made from the drawings, specifications or contract; it shall remain the duty of the Contractor to take his own measurements of the work.
- .3 Correct all work completed contrary to the intent of the drawings and specifications and bear all costs for same. Where the intent of the drawings and specifications is not clear, obtain clarification from the Consultant before proceeding with the work.

- .4 Prior to commencing work, check the drawings and specifications of other trades for conflicts with the electrical work. Any such conflicts shall be reported to the Consultant and a written ruling obtained before proceeding with this work. Failure to report such conflicts will result in the Contractor's responsibility to make whatever adjustments are required.
- .5 All anchors, sleeves, inserts, etc. required for the electrical portion of the contract shall be installed at the proper time and when required to co-ordinate job progress with other trades.

1.29 SEALING OF WALL AND OPENINGS

- .1 All conduit and cable entries through outside walls of building, through partitions walls separating electrical rooms from other areas, through fire separations, and through floors above grade shall be sealed to prevent passage of moisture, dust gasses, flame, or to maintain pressurization.
- .2 Openings shall be sealed when all wiring entries shown on drawings have been completed.
- .3 Sealing materials shall be fire resistant and shall not contain any compounds which will chemically affect the wiring jacket insulating material. Cable penetrations through fire separations shall be sealed to meet ULC CAN 4S115 and installed in to meet manufacturer's recommendations.

1.30 CLEAN-UP

- .1 This Trade Contractor and/or his sub-contractor shall be responsible for daily cleaning of all debris accumulated during the course of the work, upon completion of the contract and whenever directed by the Owner. The complete installation shall be maintained in a neat and tidy manner during its entire course.

1.31 GUARANTEE

- .1 Furnish a written guarantee/warranty countersigned and guaranteed by the Trade Contractor stating:
 - .1 That all work executed under this contract will be free from defects of workmanship and materials for a period of one (1) year from the date of final acceptance of this work, except for incandescent lamps, which shall be for a period of six (6) months.
 - .2 The above parties further agree that they will, at their own expense, repair and replace all such defective work and other work damaged thereby, which fails or becomes defective during the term of the guarantee/warranty provided that such failure is not due to improper usage.
 - .3 The period of the guarantee specified shall in no way supplant any other guarantee of a longer period but shall be binding on work not otherwise covered.

1.32 FINAL

- .1 Specifically note that the Civil drawings shall be checked for device locations before junction boxes and conduits are roughed-in. If this is not done and that conflict occurs, the outlets and/or conduits shall be moved and any repairs made at the expense of the Trade Contractor.
- .2 Points not specifically mentioned shall be in strict accordance with the Canadian Electrical Code and regulations of the Electrical Inspection Department from which the permit was obtained. The latest revisions and/or amendments to this code with applicable date restrictions shall also govern work on this contract.
- .3 It is the intent that these drawings and specifications provide for an electrical installation complete and in operating condition and the contractor shall be responsible for supplying and installing all material and work necessary to accomplish this, except where specifically noted that such work or material is not included.
- .4 These drawings and specifications are to be read in conjunction with the civil drawings and specifications and what may be called for in another shall be binding on this contract.
- .5 Leave the work complete to the approval of the Owner.

1.33 SCOPE OF WORK

- .1 The scope of work shall include, but not be limited to, the following:
 - .1 Supply and install new taxiway edge lighting for the new Apron enlargement and connecting to existing circuit.
 - .2 Supply and install two airfield signs.
 - .3 Re-routing of cables that cross the area of work, as indicated on the drawings, or as encountered in the field.
 - .4 Supply and install all ducts, cable, wire, connectors, panels, supplementary equipment, and all labor/work required to provide fully functional and operational systems under this contract.
 - .5 Supply all pullpits, grounding, granular material, duct banks, concrete base.
 - .6 Supply the spare parts and Operation & Maintenance (O&M) Manuals.
 - .7 Conduct all testing as required by the engineer/ owner, and as detailed in these specifications.
 - .8 Supply and install two sets of PAPI as per drawings.
 - .9 Supply and install a new Constant Current Regulator (CCR) for the PAPI feeding.
 - .10 Locate and mark on-site and record locations of all existing underground cables/utilities that could be disturbed during construction.
 - .11 Remove all systems and material made obsolete under this project. Direct buried cables made obsolete may be abandoned or removed by the contractor, at the discretion of the contractor. Cables in conduit/ducts made obsolete shall be removed from the conduit/duct and disposed of, off site, by the contractor.

1.34 RECORD PLANS/OPERATING AND MAINTENANCE MANUALS

- .1 In addition to and notwithstanding the "General requirement", the instructions identified in this Section are to be included.
- .2 One (1) complete set of white prints will be supplied, for job use only, on which shall be recorded accurately the location of all outlets and conduit runs has been installed on the site and has been at variance with the original drawings. These record plans shall include all pertinent notations, revised conductor counts, etc. and shall be kept up-to-date at all times on the job site. Record plans will be reviewed at job site meetings. If not up to date, they will be treated as a deficiency.
- .3 Obtain, at own expense from the Engineer's tracings, one (1) set of prints and, upon completion of the job and before final payment, provide it to the engineer. Record all changes to the original tender drawings covered by addendum, change orders, field changes, job conditions, etc. and return them back to the Engineer. Complete drawings shall be clearly marked as "As-Built" drawings. Record of information shall be done in a neat and organized fashion, suitable to the engineer.
- .4 Include in operations and maintenance datas :
 - .1 Details of design elements, construction features, component function and maintenance requirements, to permit effective start-up operation, maintenance, repair, modification, extension and expansion of any portion or feature of installation.
 - .2 Technical and product datas, supplemented by bulletins, component illustrations, exploded views, technical descriptions of items and parts lists, advertising or sales literature are not acceptable.
 - .3 Names and addresses of local suppliers for items are included in Maintenance Manual.
 - .4 Electrical Contractor's Guarantee.
 - .5 Operating Instructions for applicable systems.
 - .6 Copies of Panel Schedules for all affected panels.
- .5 Operation and Maintenance Data shall be contained within a 64 mm thick hard cover three ring binder. Binder shall be labelled on the front cover as well as the spine ("ELECTRICAL MAINTENANCE MANUAL – PROJECT NAME – YEAR") with gold embossed lettering.
 - .1 The following index tabs shall be contained within the binder:
 - .1 Cover page including project name, date, names of owner, architects, electrical consultant, and electrical contractor.
 - .2 Index page.
 - .3 Trade Contractor guarantee.
 - .4 List of manufacturers and suppliers for all items.
 - .5 Names and addresses of suppliers.
 - .2 The following index tabs shall be contained within the binder:
 - .1 Taxiway lighting.
 - .2 Airfield signs.
 - .3 Constant Current Regulator (CCR).

- .4 PAPI.
- .5 Other electrical equipment supplied and installed.
- .6 Divider tabs shall be plastic and coloured according to section.
- .6 Project record drawings and manuals shall be submitted to the Owner / Engineer within 20 working days of Substantial Completion.

END OF SECTION

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 Section 26 05 20 - Wire and Box Connectors 0-1000V.
- .2 Section 26 05 21 - Wires and Cables 0-1000V.
- .3 Section 26 05 22 - Connectors and Terminations.
- .4 Section 26 05 28 - Grounding – Secondary.
- .5 Section 26 05 43.01 – Installation of Cables in Trenches and in Ducts.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA)
 - .1 CSA C22.2 No.179-09, Airport Series Lighting Cables.

PART 2 PRODUCTS

2.1 AIRPORT CABLE

- .1 Single conductor stranded soft drawn copper, # 8 AWG, 5000 Volts, combined cross linked polyethylene insulated and jacket : CSA C22.2 No. 179.

2.2 TECK POWER CABLE (1001-15000 V)

- .1 Cable: to CSA-C22.2 No. 131 and in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Bare copper grounding conductor, size as indicated.
- .3 Copper circuit conductors, size and number as indicated.
- .4 Strand shielding.
- .5 Insulation: chemically cross-linked thermosetting polyethylene rated RW90 5kV.
- .6 Insulation shielding: semi-conducting non-metallic tape over insulation and served wire shield over tape to ICEA S-93-639/NEMA WC74.
- .7 Separator tape over conductor assembly.
- .8 Inner jacket of PVC.
- .9 Interlocked steel armour.
- .10 Overall PVC jacket rated minus 40 degrees C.

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Install power cable in ducts and manholes or as indicated and in accordance with manufacturer's instructions.
- .2 Install power cable in trenches as indicated.
- .3 Provide supports and accessories for installation of high voltage power cable.
- .4 Install stress cones, terminations and splices in accordance with manufacturer's instructions
- .5 Install grounding in accordance with local inspection authority having jurisdiction.
- .6 Provide cable identification tags and identify each phase conductor of power cable.

3.2 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Use of qualified tradespersons for installation, splicing, termination and testing of high voltage power cables.
- .3 Engage [an independent testing agent] to test high voltage power cable. Submit test result and inspection certificate.

END OF SECTION

PART 1 GENERAL

1.1 SECTION INCLUDES

- .1 Materials and installation for wire and box connectors.

1.2 RELATED SECTIONS

- .1 Section 01 74 21 - Construction/Demolition Waste Management And Disposal.

1.3 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CAN/CSA-C22.2No.18, Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware latest version.
 - .2 CSA C22.2No.65-, Wire Connectors latest version.
- .2 Electrical and Electronic Manufacturers' Association of Canada (EEMAC)
 - .1 EEMAC 1Y-2, 1961 Bushing Stud Connectors and Aluminum Adapters (1200 Ampere Maximum Rating).
- .3 National Electrical Manufacturers Association (NEMA)

1.4 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management And Disposal.
- .2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard packaging material in appropriate bins for recycling in accordance with Waste Management Plan.
- .4 Divert unused wiring materials from landfill to metal recycling facility as approved by Consultant.

1.5 MEASUREMENT FOR PAYMENT

- .1 No separate payment for work is included under this section. Include costs in the appropriate lump sum or unit price item indicated in Section 26 05 00 – Common Work Result for Electrical.

PART 2 PRODUCTS

2.1 MATERIALS

- .1 Pressure type wire connectors to: CSA C22.2No.65, with current carrying parts sized to fit conductors as required.
- .2 Fixture type splicing connectors to: CSA C22.2No.65, with current carrying parts sized to fit conductors 10 AWG or less.
- .3 Bushing stud connectors: to EEMAC 1Y-2 to consist of:
 - .1 Connector body and stud clamp for stranded, round, copper conductors.
 - .2 Clamp for stranded, round copper conductors.
 - .3 Stud clamp bolts.
 - .4 Bolts for copper conductors.
 - .5 Bolts for aluminum conductors.
 - .6 Sized for conductors as indicated.

Part 2 Execution

3.1 INSTALLATION

- .1 Remove insulation carefully from ends of conductors and:
 - .1 Install mechanical pressure type connectors and tighten screws [with appropriate compression tool recommended by manufacturer]. Installation shall meet secureness tests in accordance with CSA C22.2No.65.
 - .2 Install fixture type connectors and tighten. Replace insulating cap.
 - .3 Install bushing stud connectors in accordance with EEMAC 1Y-2.

END OF SECTION

PART 1 GENERAL

1.1 RELATED SECTIONS

1. Section 26 05 20 – Wire and box connectors 0-1000 V
2. Section 26 05 34 – Conduit fastenings and conduit fittings
3. Section 26 05 43.01 – Installation of cables in trenches and in ducts

1.2 REFERENCES

1. CSA C22.1-09, Canadian Electrical Code, Part 1 (21st Edition), Safety Standard for Electrical Installations (latest version).

1.3 SUBMITTAL

1. Submit product data in accordance with Section 01 33 00 - Submittal Procedures.

1.4 WASTER MANAGEMENT AND DISPOSE

1. Packaging Waste Management: remove for reuse and return of pallets, crates, padding and packaging materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

1.5 MEASUREMENT FOR PAYMENT

1. No separate payment for work is included under this section. Include costs in the appropriate lump sum or unit price item indicated in Section 26 05 00 – Common Work Result for Electrical.

PART 2 PRODUCTS

2.1 BUILDING WIRES

- .1 Conductors: stranded for 10 AWG and larger. Minimum size: 12 AWG.
- .2 Copper conductors: size as indicated, with 1000 V insulation of cross-linked thermosetting polyethylene material rated RW90 XLPE and RWU90 XLPE.
- .3 Copper conductors: size as indicated, with thermoplastic insulation type T90 Nylon rated at 600 V.

2.2 TECK 90 CABLE

- .1 Cable: in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Conductors:
 - .1 Grounding conductor: copper.
 - .2 Circuit conductors: copper, size as indicated.
- .3 Insulation:
 - .1 Cross-linked polyethylene XLPE.
 - .2 Rating: 1000 V.
- .4 Inner jacket: polyvinyl chloride material.
- .5 Armour: interlocking aluminum.
- .6 Overall covering: thermoplastic polyvinyl chloride.
- .7 Connectors:
 - .1 Watertight approved for TECK cable.

PART 3 EXECUTION

3.1 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Perform tests using method appropriate to site conditions and, to approval of Departmental Representative and local authority, having jurisdiction over installation.
- .3 Perform tests before energizing electrical system.

3.2 GENERAL CABLE INSTALLATION

- .1 Install cable in trenches in accordance with all section.
- .2 Cable Colour Coding: to Section 26 05 00 Common Work Results for Electrical.
- .3 Conductor length for parallel feeders to be identical.
- .4 Lace or clip groups of feeder cables at distribution centres, pull boxes, and termination points.

3.3 INSTALLATION OF BUILDING WIRES

- .1 Install wiring as follows:
 - .1 In conduit systems in accordance with Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.

1.4 INSTALLATION OF TECK 90 CABLE (0 -1000 V)

- .1 Install cable securely.

END OF SECTION

PART 1 GENERAL

1.1 SECTION INCLUDES

- .1 Materials and installation for connectors and terminations.

1.2 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 26 05 14 – Power Cable and Overhead
- .3 Section 26 05 21 – Wires and cables (0-1000 V).

1.3 REFERENCES

- .1 Canadian Standards Association (CSA International) (latest version apply)
 - .1 CSA C22.2 No.158-10, Terminal Blocks.
 - .2 CSA C22.2 No.41-M1987(R1999), Grounding and Bonding Equipment.

1.4 SUBMITTALS

- .1 Submit product data in accordance with Section 01 33 00 - Submittal Procedures.

1.5 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management And Disposal.
- .2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal paper, plastic, polystyrene and corrugated cardboard packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.
- .4 Divert unused metal and wiring materials from landfill to metal recycling facility as approved by Department Representative.

1.6 MEASUREMENT FOR PAYMENT

- .1 No separate payment for work is included under this section. Include costs in the appropriate lump sum or unit price item indicated in Section 26 05 00 – Common Work Result for Electrical.

PART 2 PRODUCTS

2.1 CONNECTORS AND TERMINATIONS

- .1 Copper short barrel compression connectors as required sized for conductors.
- .2 Contact aid for aluminum cables where applicable.

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Install stress cones, terminations, and splices in accordance with manufacturer's instructions.
- .2 Bond and ground as required to CSA C22.2No.41.

END OF SECTION

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 Section 26 05 00 - Common Work Results – Electrical
- .2 Section 34 43 05 – Airfield Lighting – General

1.2 REFERENCES

- .1 Canadian Standards Association, (CSA International)

1.3 MEASUREMENT FOR PAYMENT

- .1 No separate payment for work is included under this section. Include costs in the appropriate lump sum or unit price item indicated in Section 26 05 00 – Common Work Result for Electrical.

PART 2 PRODUCTS

2.1 EQUIPMENT

- .1 Rod electrodes: copper clad steel 19 mm dia by 3 m long.
- .2 Grounding conductors: bare stranded copper, soft annealed, size as indicated.
- .3 Insulated grounding conductors: green, type TW.
- .4 Non-corroding accessories necessary for grounding system, type, size, material as indicated, including but not necessarily limited to:
 - .1 Grounding and bonding bushings.
 - .2 Protective type clamps.
 - .3 Bolted type conductor connectors.
 - .4 Thermanite welded type conductor connectors.
 - .5 Bonding jumpers, straps.
 - .6 Pressure wire connectors.

PART 3 EXECUTION

3.1 INSTALLATION GENERAL

- .1 Install complete permanent, continuous grounding system including, electrodes, conductors, connectors, accessories.
- .2 Install connectors in accordance with manufacturer's instructions.
- .3 Protect exposed grounding conductors from mechanical injury.

- .4 Make buried connections, and connections to conductive water main, electrodes, using copper welding by thermite process, permanent mechanical connectors, or inspectable wrought copper compression connectors to ANSI/IEEE 837.
- .5 Use mechanical connectors for grounding connections to equipment provided with lugs.
- .6 Soldered joints not permitted.
- .7 Install bonding wire for flexible conduit, connected at both ends to grounding bushing, solderless lug, clamp or cup washer and screw. Neatly cleat bonding wire to exterior of flexible conduit.
- .8 Install flexible ground straps for bus duct enclosure joints, where such bonding is not inherently provided with equipment.
- .9 Install separate ground conductor to outdoor lighting standards.
- .10 Make grounding connections in radial configuration only, with connections terminating at single grounding point. Avoid loop connections.
- .11 Ground secondary service pedestals.

3.2 ELECTRODES

- .1 Install rod electrodes and make grounding connections.
- .2 Bond separate, multiple electrodes together.

3.3 EQUIPMENT GROUNDING

- .1 Install grounding connections to typical equipment included in, but not necessarily limited to following list: Transformer, Airfield Lighting Fixtures, Pullpit Lids, Steel Base Cans.

3.4 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results - Electrical.
- .2 Perform ground continuity and resistance tests using method appropriate to site conditions and to approval of engineer and local authority having jurisdiction over installation.
- .3 Perform tests before energizing electrical system.

END OF SECTION

PART 1 GENERAL

1.1 RELATED SECTIONS

N/A

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International) (latest version)
- .1 CSA C22.1-09, Canadian Electrical Code, Part 1, 21th Edition.

1.3 SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Provide shop drawings: in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Provide drawings stamped and signed by professional engineer registered or licensed in Province of Saskatchewan, Canada.

1.4 MEASUREMENT FOR PAYMENT

- .1 No separate payment for work is included under this section. Shall include costs in the appropriate lump sum or unit price item indicated in Section 26 05 00 – Common Work Result for Electrical.

PART 2 PRODUCTS

2.1 JUNCTION AND PULL BOXES

- .1 Construction: welded steel enclosure.
- .2 Covers Flush Mounted: 25 mm minimum extension all around.
- .3 Covers Surface Mounted: screw-on flat covers.

2.2 CABINETS

- .1 Construction: welded sheet steel hinged door, handle, lock 2 keys and catch
- .2 Type E Empty: surface return flange mounting.

PART 3 EXECUTION

3.1 JUNCTION, PULL BOXES AND CABINETS INSTALLATION

- .1 Install pull boxes in inconspicuous but accessible locations.
- .2 Mount cabinets with top not higher than 2 m above finished floor except where indicated otherwise.
- .3 Only main junction and pull boxes are indicated. Install additional pull boxes as required by CSA C22.1.

3.2 IDENTIFICATION

- .1 Equipment Identification: to Section 26 05 00 - Common Work Results for Electrical.
- .2 Identification Labels: size 2 indicating system name voltage and phase or as indicated.

END OF SECTION

PART 1 GENERAL

1.1 RELATED SECTION

- .1 Section 26 05 00 – Common Work Results – Electrical.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International) (latest version)
 - .1 CAN/CSA C22.2 No. 18-98(R2003), Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware, A National Standard of Canada.
 - .2 CSA C22.2 No. 45-M1981(R2003), Rigid Metal Conduit.
 - .3 CSA C22.2 No. 56-04, Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
 - .4 CSA C22.2 No. 83-M1985(R2003), Electrical Metallic Tubing.
 - .5 CSA C22.2 No. 211.2-M1984(R2003), Rigid PVC (Unplasticized) Conduit.
 - .6 CAN/CSA C22.2 No. 227.3-05, Nonmetallic Mechanical Protection Tubing (NMPT), A National Standard of Canada (February 2006).

1.3 SUBMITTALS

- .1 Product data: submit manufacturer's printed product literature, specifications and datasheets.
 - .1 Submit cable manufacturing data.
- .2 Quality assurance submittals:
 - .1 Test reports: submit certified test reports.
 - .2 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .3 Instructions: submit manufacturer's installation instructions.

1.4 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .2 Place materials defined as hazardous or toxic waste in designated containers.
- .3 Ensure emptied containers are sealed and stored safely for disposal away from children.

1.5 MEASUREMENT FOR PAYMENT

- .1 No separate payment for work is included under this section. Include costs in the appropriate lump sum or unit price item indicated in Section 26 05 00 – Common Work Result for Electrical.

PART 2 PRODUCTS

2.1 CONDUITS

- .1 Rigid metal conduit: to CSA C22.2 No. 45, galvanized steel threaded.
- .2 Epoxy coated conduit: to CSA C22.2 No. 45, with zinc coating and corrosion resistant epoxy finish inside and outside.
- .3 Electrical metallic tubing (EMT): to CSA C22.2 No. 83, with couplings.
- .4 Rigid PVC conduit: to CSA C22.2 No. 211.2.
- .5 Flexible metal conduit: to CSA C22.2 No. 56, aluminum liquid-tight flexible metal.

2.2 CONDUIT FASTENINGS

- .1 One (1) galvanized hole straps to secure surface conduits 50 mm and smaller.
- .2 Two (2) holes steel straps for conduits larger than 50 mm.
- .3 Beam clamps to secure conduits to exposed steel work.

2.3 CONDUIT FITTINGS

- .1 Fittings: to CAN/CSA C22.2 No. 18, manufactured for use with conduit specified. Coating: same as conduit.
- .2 Ensure factory "ells" where 90 degrees bends for 25 mm and larger conduits.
- .3 Watertight connectors and couplings for EMT.
 - .1 Set-screws are not acceptable.

2.4 EXPANSION FITTINGS FOR RIGID CONDUIT

- .1 Weatherproof expansion fittings with internal bonding assembly suitable for 100 mm linear expansion.
- .2 Watertight expansion fittings with integral bonding jumper suitable for linear expansion and 19 mm deflection.
- .3 Weatherproof expansion fittings for linear expansion at entry to panel.

2.5 FISH CORD

- .1 Polypropylene 5 mm.

PART 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 INSTALLATION

- .1 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.
- .2 Conceal conduits except in mechanical and electrical service rooms and in unfinished areas.
- .3 Surface mount conduits except.
- .4 Use rigid galvanized steel PVC and EMT threaded conduit where specified.
- .5 Use rigid PVC conduit underground.
- .6 Minimum conduit size for lighting and power circuits: 19 mm.
- .7 Bend conduit cold:
 - .1 Replace conduit if kinked or flattened more than 1/10th of its original diameter.
- .8 Mechanically bend steel conduit over 19 mm diameter.
- .9 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.
- .10 Install fish cord in empty conduits.
- .11 Dry out conduits before installing wire.

3.3 SURFACE CONDUITS

- .1 Run parallel or perpendicular to building lines.
- .2 Locate conduits behind infrared or gas fired heaters with 1.5 m clearance.
- .3 Run conduits in flanged portion of structural steel.
- .4 Do not pass conduits through structural members except as indicated.
- .5 Do not locate conduits less than 75 mm parallel to steam or hot water lines with minimum of 25 mm at crossovers.

3.4 CONCEALED CONDUITS

- .1 Run parallel or perpendicular to building lines.
- .2 Do not install horizontal runs in masonry walls.
- .3 Do not install conduits in terrazzo or concrete toppings.

3.5 CONDUITS IN CAST-IN-PLACE CONCRETE

- .1 Locate to suit reinforcing steel.
 - .1 Install in centre one third of slab.
- .2 Protect conduits from damage where they stub out of concrete.
- .3 Install sleeves where conduits pass through slab or wall.
- .4 Provide oversized sleeve for conduits passing through waterproof membrane, before membrane is installed.
 - .1 Use cold mastic between sleeve and conduit.
- .5 Conduits in slabs: minimum slab thickness 4 times conduit diameter.
- .6 Encase conduits completely in concrete with minimum 25 mm concrete cover.
- .7 Organize conduits in slab to minimize cross-over.

3.6 CONDUITS IN CAST-IN-PLACES LABS ON GRADE

- .1 Run conduits 25 mm and larger below slab and encase in 75 mm concrete envelope.
 - .1 Provide 50 mm of sand over concrete envelope below floor slab.

3.7 CONDUITS UNDERGROUND

- .1 Slope conduits to provide drainage.
- .2 Waterproof joints (PVC excepted) with heavy coat of bituminous paint.

3.8 CLEANING

- .1 Proceed in accordance with Section 01 74 11 – Cleaning.
- .2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 Section 26 05 00 - Common Work Results – Electrical.
- .2 Section 26 05 21 – Wires and Cables (0-1000V)
- .3 Section 33 65 76 – Direct Buried Underground Cable Ducts
- .4 Section 34 43 05 – Airfield Lighting - General

1.2 REFERENCES

- .1 Canadian Standards Association, (CSA International)
- .2 Insulated Cable Engineers Association, Inc. (ICEA)

1.3 MEASUREMENT FOR PAYMENT

- .1 Note that the estimated quantities shown in the tender form are as scaled from the plans, plus an allowance for cable loops, offsets, elevation change and connection slack.
- .2 Payment for installation of cables in existing/new ducts and shall include:
 - .1 Supply and installation of cables. The Contractor shall note that cable supply shall include any extra cable necessary for cable loops, connections, fittings, splices, offsets, as well as all surplus cables brought above ground.
 - .2 All other accessories necessary to complete the installation to the satisfaction of the engineer.
- .3 Payment for these items shall be on basis of lineal metre of installed wiring measured horizontally along trenches and ducts from the cable source to the end use device. This cable length payment will be approximately equal to the length of trenching for the same device. It shall be this contractor's responsibility to factor the cost of all surplus cable and accessories required to make a complete system into his tendered price.
- .4 No separate payment for work is included under this section. Shall include costs in the appropriate lump sum or unit price item indicated in Section 26 05 00 – Common Work Result for Electrical.Products

1.4 NOT USED.

PART 2 EXECUTION

2.1 CABLE INSTALLATION IN DUCTS

- .1 Install cables as indicated in ducts.
 - .1 Do not pull spliced cables inside ducts.
- .2 Install multiple cables in duct simultaneously.
- .3 Use CSA approved lubricants of type compatible with cable jacket to reduce pulling tension.
- .4 Before pulling cable into ducts and until cables are properly terminated, seal ends of lead covered cables with wiping solder; seal ends of non-leaded cables with moisture seal tape.
- .5 After installation of cables, seal duct ends with duct sealing compound.

2.2 MARKERS

- .1 Mark cable every 150 m along cable / duct runs and changes in direction, in pullpits / manholes.
- .2 Where markers are removed to permit installation of additional cables, reinstall existing markers.

2.3 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results - Electrical.
- .2 Perform tests using qualified personnel. Provide necessary instruments and equipment.
- .3 Check each feeder for continuity, short circuits and grounds. Ensure resistance to ground of circuits is not less than 500 megohms.
- .4 Pre-acceptance tests.
 - .1 After installing cable, but before splicing and terminating, perform insulation resistance test with 5000 V megger on each phase conductor.
 - .2 Check insulation resistance after each splice and/or termination to ensure that cable system is ready for acceptance testing.
- .5 Provide owner/engineer with list of test results showing location at which each test was made, circuit tested and result of each test.
- .6 Remove and replace entire length of cable if cable fails to meet any of test criteria.

END OF SECTION

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 26 05 43.01 – Installation of Cables in Trenches and in Ducts.

1.2 REFERENCES

- .1 CSA C22.1-09, Canadian Electrical Code, Part 1 (21st Edition), Safety Standard for Electrical Installations (latest version).

1.3 EXISTING CONDITIONS

- .1 Examine soil before work.
- .2 Buried services:
 - .1 Before commencing work establish location of buried services on and adjacent to site.
 - .2 Arrange with appropriate authority for relocation of buried services that interfere with execution of work: pay costs of relocating services.
 - .3 Remove obsolete buried services within 2 m of foundations: cap cut-offs.
 - .4 Size, depth and location of existing utilities and structures as indicated are for guidance only. Completeness and accuracy are not guaranteed.
 - .5 Prior to beginning excavation Work, notify applicable authorities having jurisdiction establish location and state of use of buried utilities and structures. Authorities having jurisdiction to clearly mark such locations to prevent disturbance during Work.
 - .6 Confirm locations of buried utilities by careful test excavations.
 - .7 Maintain and protect from damage, water, sewer, gas, electric, telephone and other utilities and structures encountered.
 - .8 Where utility lines or structures exist in area of excavation, obtain direction of Consultant before re-routing.
 - .9 Record location of maintained, re-routed and abandoned underground lines.
 - .10 Confirm locations of recent excavations adjacent to area of excavation.

PART 2 EXECUTION

2.1 FILL TYPES AND COMPACTION

- .1 Use types of fill as indicated or specified in the specifications and drawings.

2.2 BACKFILLING

- .1 Do not proceed with backfilling operations until completion of following:
 - .1 Consultant has inspected and approved installations.
 - .2 Consultant has inspected and approved of construction below finish grade.

- .3 Inspection, testing, approval, and recording location of underground utilities.
 - .4 Removal of concrete formwork.
 - .5 Removal of shoring and bracing; backfilling of voids with satisfactory soil material.
- .2 Areas to be backfilled to be free from debris, snow, ice, water and frozen ground.
 - .3 Do not use backfill material which is frozen or contains ice, snow or debris.
 - .4 Place backfill material in uniform layers not exceeding 150 mm compacted thickness up to grades indicated. Compact each layer before placing succeeding layer.

2.3 RESTORATION

- .1 Replace topsoil as indicated.
- .2 Reinstate lawns to elevation which existed before excavation.
- .3 Clean and reinstate areas affected by Work as directed by Consultant.
- .4 Use temporary plating to support traffic loads over unshrinkable fill for initial 24 hours.
- .5 Protect newly graded areas from traffic and erosion and maintain free of trash or debris.

END OF SECTION

PART 1 GENERAL

1.1 RELATED SECTION

- .1 Section 26 05 00 - Common Work Results – Electrical
- .2 Section 31 23 10 – Excavating, Trenching and Backfilling
- .3 Section 34 43 05 – Airfield Lighting – General

1.2 MEASUREMENT FOR PAYMENT

- .1 No separate payment for work is included under this section. Include costs in the appropriate lump sum or unit price item indicated in Section 26 05 00 – Common Work Result for Electrical.

PART 2 PRODUCTS

2.1 PVC DUCTS AND FITTINGS

- .1 Rigid PVC duct: Schedule 40, with moulded fittings, for direct burial, sizes as indicated.
- .2 Rigid PVC bends, couplings, reducers, bell end fittings, plugs, caps, adaptors same product material as duct, to make a complete installation.
- .3 Rigid PVC 90 degrees, 45 degrees bends and 5 degrees angle couplings as required.

2.2 SOLVENT WELD COMPOUND

- .1 Solvent cement for PVC ducts joints.

2.3 CABLE PULLING EQUIPMENT

- .1 6 mm stranded nylon pull rope tensile strength 5 kN.

2.4 WARNING TAPE

- .1 Standard 4-mil polyethylene 76 mm wide tapes, yellow with black letters, imprinted with "CAUTION BURIED ELECTRIC CABLE BELOW ".

PART 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 INSTALLATION

- .1 Install duct in accordance with manufacturer's instructions and at elevations as indicated.
- .2 Clean inside of ducts before laying.
- .3 Slope ducts with 1 to 400 minimum slope.
- .4 Install plugs and cap both ends of ducts to prevent entrance of foreign materials during and after construction.
- .5 Pull through each duct wooden mandrel not less than 300 mm long and of diameter 6 mm less than internal diameter of duct, followed by stiff bristle brush to remove sand, earth and other foreign material.
 - .1 Pull stiff bristle brush through each duct immediately before pulling-in cables.
- .6 Install a pull rope continuous throughout each duct run with 3 m spare rope at each end.
- .7 Place continuous strip of warning tape 300 mm above duct before backfilling trenches.
- .8 Install markers as required.
- .9 Notify the owner/engineer for field review upon completion of direct buried ducts and obtain acceptance prior to backfill.

END OF SECTION

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 Section 26 05 00 – Common Work Results – Electrical
- .2 Section 34 43 10 – Illuminated Airport Guidance Signs
- .3 Section 34 43 13.19 – Elevated Edge Lighting for airport runways.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA)
 - .1 CSA C22.2 No.179-09, Airport Series Lighting Cables.
 - .2 CSA C22.2 No.180-FM1983(R2008) , Series Isolating Transformers for Airport Lighting.
- .2 Transport Canada
 - .1 Aerodrome Standards and Recommended Practices, TP312E, 4th Edition
- .3 The latest version of all applicable standards, codes and referenced documents shall apply.

1.3 SYSTEM DESCRIPTION

- .1 Medium intensity edge lighting on:
 - .1 Apron .
- .2 Illuminated airport guidance signs Runway 12-30.

1.4 SUBMITTALS

- .1 Provide written confirmation of compliance with CSA standard.

1.5 MAINTENANCE MATERIALS

- .1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
 - .1 Definitions
 - .1 Airport lighting is comprised of the manufactured products, and the required labour to install the individual components of the following systems.
 - .1 Approach lighting for Precision and Non-Precision approach runways.
 - .2 Runway Edge, End, Threshold and Centreline Lighting.
 - .3 Taxiway Edge and Centreline Lighting.
 - .4 Apron Edge and Flood Lighting.
 - .5 Approach Slope Indicator Systems.

- .6 Runway identification Lighting Systems.
- .7 Aerodrome Beacon.
- .8 Wind Direction Indicator.
- .9 Air Navigation Systems.
- .10 Airside illuminated and non-illuminated signs.
- .11 Hazard, obstruction and unserviceable area marker lights and beacons.
 - .1 Airport lighting control systems.
 - .2 Airport lighting regulator systems.
 - .3 Field Electric Centre Construction or Modification.

1.6 QUALIFICATIONS

- .1 Only electrical contractors with extensive experience in performing airfield lighting works shall be allowed to perform the airport lighting work under this project.

1.7 REFERENCE STANDARDS

- .1 National Building Code of Canada (NBC) and any other code of local application, including all amendments, up to tender closing date.
- .2 TP 16970 – E18, June 1996 – Transport Canada Approved Airport Equipment.
- .3 CSA C22.2 No. 179, Airport Series Lighting Cable.
- .4 CSA C22.2 No 180, Series Isolating Transformers for Airport Lighting.
- .5 Transport Canada Aerodrome Standards, No. TP-312E, latest issue.
- .6 C22.1 – Canadian Electrical Code, Part 1, latest issue.
- .7 The latest version of all applicable standards, codes and referenced documents shall apply.

1.8 TEST REPORTS

- .1 Submit at no cost to the Consultant, two (2) copies of factory production test data as requested, with each shipment of material.
- .2 Test reports shall show manufacturer's stock number, serial number, rating, quantity, manufacturer order number, data of manufacturer, type of test and duration.

1.9 MEASUREMENT FOR PAYMENT

- .1 Airfield Lighting shall be measured as Unit Price or Lump Sum Items as described in the unit price table. Payment at the tendered Unit Price of Lump Sum price shall be full compensation for supply of all materials, labour and equipment required to complete the work described in the Contract Documents. This includes, but is not limited, the scope of work described in Section 26 05 00 – Common Work Result for Electrical.

PART 2 PRODUCTS

2.1 PRIMARY CABLE

- .1 Single conductor stranded soft drawn copper, #8 AWG, 5000 volt, combined cross linked polyethylene insulation and jacket: CSA C22.2 No.179.
- .2 Approved Manufacturers: Canada Wire and Cable Ltd., Industrial Wire and Cable Co. Ltd., Northern Electric, Philips Electrical Co. Ltd., Pirelli Cable Ltd.

2.2 BREAKABLE COUPLING, TYPE 1

- .1 DOT specification K-300. Use for mounting of elevated taxiway and apron edge lighting fixtures and marker.
- .2 Approved product: Crouse Hinds P1Z0 AM377h03

2.3 PRIMARY PLUG RECEPTACLE CONNECTORS

- .1 Primary plug and receptacle connector kit, straight type, one male plug, one female plug, for use with isolating transformer or use for separable straight splice of #8 AWG primary cable.
- .2 Acceptable Product: Amerace Ltd. Model 54 Super Kit.

2.4 SECONDARY PLUG AND RECEPTACLE CONNECTORS

- .1 Secondary male plug connector kit; to field assemble secondary extension or terminate fixture lead, using 2 - #10 or 2 - #12 AWG type SOW secondary cable.
 - .1 Acceptable Product: Amerace Ltd. 91BP-F6
- .2 Secondary female receptacle connector kit; to field assemble secondary extension or repair transformer lead, using 2 - #10 or 2 - #12 AWG type SOW secondary cable.
 - .1 Acceptable Product: Amerace Ltd. 91BR-F6
- .3 Conversion adapter for use with two (2) singles conductors. Amerace Ltd. 92CA-B.
- .4 Factory assembled secondary extension, minimum 1.2 m long, #12 AWG, one (1) – two (2) conductor cable terminated with male connector on one end and female connector on other end, for long secondary runs between transformers and fixtures. Exact length to suit distance between light fixtures and transformer.
- .5 Field assembled secondary extensions: two (2)-1/C, 312 AWG RWU90 insulated conductors terminated with an Amerace type 90P plug on one end and a type 90R receptacle on the other. Exact length to suit distance between light fixtures and pullpits.

2.5 ISOLATING TRANSFORMER

- .1 Transformer and primary connecting kits have to be insulated for 5000 V.
- .2 Transformers and all connections have to be completely waterproof and suitable for mounting in any type of pullpit.

- .3 Transformers must be designed to allow continuous operation with the secondary open circuited, short-circuited or with a lamp in place.
- .4 Transformers have to be in rubber encapsulated complete with factory installed primary and secondary leads and shall conform to CSA spec. C22.2 180-M. Ensure secondary lead is equipped with a FAA L-823 receptacle.
- .5 Connections shall conform to Transport Canada spec. K-255 and shall be suitable for 5 kV non-screened cables and shall match the transformer manufacturer.
- .6 Transformer rating: as indicated, 6.6A primary, 6.6A secondary, 60HZ.
 - .1 elevated LED taxiway edgelight - 45W (or as required)
 - .2 airfield signs as required
- .7 Primary connectors, as specified in separate Clause below.
- .8 Secondary connectors, as specified in separate Clause below.
- .9 Approved Products
 - .1 Amerace

2.6 TRANSFORMER PULLPIT

- .1 Rigid polyethylene or PVC to Transport Canada specification K-303 .
 - .1 450 mm diameter, 450 mm depth.
 - .2 Steel covers to have a ground stud on underside.
 - .3 Acceptable products: Century Plastics, Polyrama, West Coast Engineering

2.7 POLYETHYLENE TUBING

- .1 Tubing: Heavy wall continuous length of flexible polyethylene pipe.
- .2 To CAN/CSA B137, Series 75 low density (PE 1404)
- .3 CAS approved couplings, reducers, plugs, cops, adapters, expansion joints and fittings as required to complete installation.
- .4 Duct Size 38mm or 50mm, 517 kPA.

2.8 LIGHT UNIT GROUND ANCHOR

- .1 Conduit anchor 50.8 mm diameter conduit, 1.500 m length, galvanized steel, threaded one end, with conduit coupling and ground connector, for mounting on steel base can lids.

2.9 CABLE MARKER

- .1 Slab type concrete as indicated in Contract Documents.
- .2 Words "cable", "joint" or "conduit" and circuit number impressed in top surface with arrows to indicate change in direction of run.

2.10 GROUND COUNTERPOISE WIRE

- .1 Single conductor #8 AWG, soft drawn copper wire:
 - .1 Solid bare for direct burial as counterpoise for airfield lighting circuits.
 - .2 Stranded with green TW insulation for placing in duct or conduit, as counterpoise for airfield lighting circuits buried beneath hard surfaces, and for power circuit insulated bonding conductors.

2.11 GROUND ROD

- .1 Copper clad steel 19 mm x 3000 mm long complete with ground connector.

2.12 OTHER MATERIAL

- .1 Cable Ties.
 - .1 Nylon black in colour.
 - .2 UV resistant if exposed to sunlight.
- .2 Conductor Markers
 - .1 Stainless steel metal tags with indented labels for field cables in each pullpit.
 - .1 Approved Product: Electrovalent Type A Size 9-11.
- .3 Splicing Sleeves
 - .1 Sigma Form APL-823A heat shrink type for 5 kV cable connectors.
- .4 Tape
 - .1 PVC Type.
 - .2 Approved Product: Scotch 88.

PART 3 EXECUTION

3.1 GENERAL

- .1 Install Airport Lighting underground circuitry in accordance with Canadian Electrical Code.

3.2 REMOVALS AND SALVAGE

- .1 Remove and salvage equipment as indicated in the contract documents.
- .2 Remove and dispose of equipment as indicated in the contract documents.
- .3 Existing obsolete direction buried cables may be abandoned in place or removed at the Contractor's discretion. Remove all obsolete cable from existing duct banks.
- .4 All salvaged equipment is to remain the property of the Airport Authority and is to be stored onsite as directed by the Consultant.

- .5 All equipment slated for removal and disposal shall become the property of the Contractor and shall be removed from the airport property and disposed of in accordance with all applicable laws.

3.3 RE-USE OF SALVAGED EQUIPMENT

- .1 Select salvage units suitable for re-installation from salvaged units for installation at new locations as indicated in the Contract Documents or as directed by the Consultant.
- .2 Clean and recondition salvaged equipment to near-new condition.

3.4 INSTALLATION OF LIGHT UNITS ANCHORS

- .1 .Install 50 mm diameter light unit anchors at locations indicated in the Contract Documents.
- .2 Set plumb and vertical with top of conduit coupling at the same elevation as the adjacent ground surface.

3.5 INSTALLATION OF PULLPITS

- .1 Install pullpits at locations indicated in the Contract Documents.
- .2 Install pullpits as detailed in the Contract Documents.
- .3 Excavate to size and depth indicated.
- .4 Cover bottom of excavation with granular bedding material, depth as indicated in the Contract Documents. In areas where pavement granulars drain into subdrains ensure positive drainage from pullpit bedding material to pavement granular structure.
- .5 Place pullpit so that cover is at the same elevation as the adjacent ground elevation.
- .6 Make holes in pullpit wall suitable for tubing used as detailed in the Contract Documents.
- .7 Install incoming and outgoing tubing and/or conduit.
- .8 Backfill with granular backfill or common backfill around the pullpit as indicated in the Contract Documents and compact to the same level and density as adjacent ground.
- .9 Install metal pullpit covers securely.

3.6 INSTALLATION OF ISOLATING TRANSFORMERS

- .1 Install isolating transformers of proper rating in pullpits at locations indicated on the Contract Documents.
- .2 Make connections to primary and secondary cables and ground counterpoise.
- .3 Ground the pullpit cover to the series circuit ground counterpoise.

- .4 Install metal pullpit cover securely.

3.7 INSTALLATION OF CABLE DUCTS AND POLYTUBING

- .1 Install cable ducts or polytubing along the routes indicated in the Contract Documents.
- .2 Install cable ducts or polytubing in accordance with Section 33 65 76 – Direct buried underground ducts.

3.8 INSTALLATION OF AIRPORT LIGHTING PRIMARY CABLE

- .1 Install airport lighting primary cable along the routes indicated in the Contract Documents.
- .2 Install airport lighting primary cable in polytubing or ducts as indicated in the Contract Documents.
- .3 Make connections using approved connectors as indicated in the Contract Documents.
- .4 Leave a 1000 mm loop of loose cable at each connection so as to avoid tension on the mechanical connector.
- .5 Carefully install connector to manufacturer's instruction. Ensure that the mating surfaces between the plugs and receptacles are kept dry and clean. Take specific care to ensure that the connector elements are completely mated and inserted until air has escaped. All plug/receptacle assemblies must be taped using waterproof 5 kV insulated electrical tape.
- .6 Install markers on cables identifying circuit numbers in each pullpit or vault.
- .7 Heat shrink sleeves to be installed over all splices. All splices to be in pullpits.
- .8 Install a ground counterpoise wire with all runs of airport lighting circuits.

3.9 INSTALLATION OF GROUND COUNTERPOISE

- .1 Install the 1/C #8 ground counterpoise wire with all runs of series lighting cable, in trench, in duct or above tubing at locations indicated in the Contract Documents.
- .2 Install counterpoise wire per the details in the Contract Documents.
- .3 Where polytubing is pulled in underground with a polytubing/cable plow, pull in a 1/C #8 SDBC ground wire above the polytubing run.
- .4 Use 1/C #8 solid SDBC wire above series cables in polytubing.
- .5 Use 1/C #8 TWU green insulation with series cable pulled in ducts.
- .6 Use appropriate ground connector and connect the ground counterpoise to:
- .7 Power supply system common ground.

- .8 Each light unit anchor and isolating transformer.
- .9 Each ground rod where installed.
- .10 Other ground wires in the same trench.
- .11 Install a 19 mm x 3000 ground rod in every fourth pullpit and connect to ground counterpoise.

3.10 INSTALLATION OF SECONDARY CABLES

- .1 Make connections using approved connectors as indicated in the Contract Documents.
- .2 Connect to isolating transformer secondary outlets.
- .3 Leave a 1000 mm loop of loose cable at connection to transformer.
- .4 Install secondary cables in rigid PVC conduit to light unit location and connect to light unit as detailed in the Contract Documents.
- .5 Backfill as indicated and compact material to same level and density as adjacent ground.

3.11 CONTROL SYSTEM MODIFICATIONS

- .1 Provide all control system modifications, as required, to add control functionality for the new PAPI to the existing ARCAL system (Type J).
- .2 Provide all wiring, programming, equipment, and work to facilitate the required control system modifications.
- .3 Connect the new Apron Edge Lighting system from the existing Apron circuit.

3.12 TESTING

- .1 Testing requirements.
 - .1 Assign tests to qualified personnel only.
 - .2 Provide necessary instruments and equipment to demonstrate that.
 - .1 Circuits are continuous, free of short circuits and unspecified grounds.
 - .2 Circuits are connected according to applicable wiring diagrams.
 - .3 Circuits perform designated functions in sequence and manner intended.
 - .4 Resistance to ground of circuits, measure with 5 Kv Megger is not less than 500 megohms.
 - .5 Circuits are operable by:
 - .1 Energizing and operating each circuit at each brightness setting

- .2 Energizing and operating each circuit at full load for continuous period of not less than eight hours.

- .2 Provide Consultant with list of test results indicating:
 - .1 Location at which test was made.
 - .2 Circuit number or designation of circuit tested.
 - .3 Individual test results.
- .3 Testing to be done under the supervision of and witnessed by the Consultant. Test results to be presented to the Consultant.
- .4 Replace defective material, install properly, and re-test.

END OF SECTION

PART 1 GENERAL

1.1 RELATED SECTION

- .1 Section 26 05 00 – Common Work Results – Electrical.

1.2 REFERENCES

- .1 CSA C22.1-09, Canadian Electrical Code, Part 1 (21st Edition), Safety Standard for Electrical Installations (latest version).
- .2 Transport Canada
 - .1 TP312-1993(R2005), Aerodrome Standards and Recommended Practices.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Test Reports: submit certified test reports from established third party testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.

1.4 DELIVERY, STORAGE AND HANDLING

- 1. Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labeled with manufacturer's name and address.
- .2 Storage and Handling Requirements:
 - .1 Store materials indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect illuminated airport guidance signs from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

PART 2 PRODUCTS

2.1 INTERNALLY ILLUMINATED SIGNS

- .1 Products to meet TP 312.
- .2 Airside Guidance signs, types and colours, size, quantity, mounting arrangements, as indicated. Number of lamps and wattage as indicated or in accordance with manufacturer's written requirements.
- .3 Mounting assembly frangible couplings with base mounting flanges for mounting on concrete pad.
- .4 Secondary lead assembly from sign, external SOW 2/C #12 cab tire and secondary male plug.

2.2 OTHER MATERIALS

- .1 Primary cable, single conductor #8 AWG.
- .2 Secondary cable in accordance with Section 34 43 05 - Common Work Results for Airfield Lighting.
- .3 Ground rod in accordance with Section 34 43 05 - Common Work Results for Airfield Lighting.
- .4 Ground counterpoise wire, bare copper, #8 AWG in accordance with Section 34 43 05 - Common Work Results for Airfield Lighting.
- .5 Breakable coupling in accordance with Section 34 43 05 - Common Work Results for Airfield Lighting.
- .6 Isolating transformer in accordance with Section 34 43 05 - Common Work Results for Airfield Lighting.
- .7 Transformer pullpit in accordance with Section 34 43 05 - Common Work Results for Airfield Lighting.

PART 3 EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for illuminated guidance signs installation in accordance with manufacturer's written instructions.
 - .1 Inform Consultant of unacceptable conditions immediately upon discovery.
 - .2 Proceed with installation only after unacceptable conditions have been remedied.

3.2 INSTALLATION PRIMARY CABLE

- .1 Install airport lighting primary cable in accordance with Section 34 43 05 - Common Work Results for Airfield Lighting as loop circuit for power supply to isolating transformers as indicated.
 - .1 Place cable in tubing.
 - .2 Splice loop circuit cable to primary feeder cable in pullpit.

3.3 INSTALLATION OF AIRPORT LIGHTING ISOLATING TRANSFORMERS

- .1 Install suitable approved isolating transformer, sized in accordance with manufacturer's written instructions sized as indicated, 6.6A/6.6A, in accordance with Section 34 43 05 - Common Work Results for Airfield Lighting, at locations indicated, place in transformer housing as indicated.
- .2 Number of isolating transformers per sign in accordance with manufacturer's written instructions.

3.4 INSTALLATION OF SIGNS

- .1 Mounting of signs, mount with flanges on concrete pad, as indicated, ensure that top of transition plate is flush with finished grade.
- .2 Ensure sign leg dimensions are not altered to affect or withstand frangibility characteristics of sign.
- .3 Properly align and level signs to approval of Consultant.

3.5 INSTALLATION OF CONCRETE PAD

- .1 Install at locations as indicated.
- .2 Cover bottom of excavation with layer of crushed stone, bedding material as indicated.
- .3 Install tubing or conduit for secondary feeder cables as indicated.
- .4 Obtain authorization of Consultant before starting erection of sign fixtures.

3.6 CONTROL OF SIGNS

- .1 Ensure lighted signs are energized from respective runway or taxiway light circuits as indicated.

3.7 FIELD QUALITY CONTROL

- .1 Perform tests as required in accordance with Section 34 43 05 - Common Work Results for Airfield Lighting.

3.8 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by illuminated guidance sign installation.

END OF SECTION

PART 1 GENERAL

1.1 RELATED SECTION

- .1 Section 34 43 10 – Airport Lighting General.

1.2 MEASUREMENT FOR PAYMENT

- .1 Payment includes connection of cabling, lighting unit, and mounting skate/conduit, protection of existing runway/taxiway/apron lighting fixtures, excavation and connection to the new airfield lighting circuits, as indicated on the drawing.
- .2 All new secondary cabling, connector kits, grounding rods, isolating transformers, lamps, stakes, couplings, and all other accessories as required to make a complete and fully functional installation shall be provided and installed to match the intensity of the fixture.
- .3 Payment for secondary trenching and duct will be measured and paid for under the Trenching and Ducts payment item.
- .4 Payment at the tendered price shall be full compensation to complete the work including bell ends, cover plates, light mounting plates, ground rods, supply and installation using the pulpits as shown on the drawings and described in the specifications.
- .5 Measurement will be on the basis of each pullpit installed.
- .6 No separate payment for work is included under this section. Include costs in the appropriate lump sum or unit price item indicated in Section 26 05 00 – Common Work Result for Electrical.

PART 2 PRODUCTS

2.1 LIGHT UNIT - TAXIWAY

- .1 Lamp – Unit with lamp of required rating.
- .2 Globe – BLUE – Taxiway Edge, as indicated.
- .3 External SOW cord assembly with male plug, Amerace 91-BP-F6.
- .4 Breakable coupling – new 133 mm high 50 mm diameter.
- .5 24" Reflective edge light marker.
- .6 Acceptable Products: Crouse-Hinds, Safegate, ADB Airfield, Youyang.

PART 3 EXECUTION

3.1 LIGHT UNIT INSTALLATION

- .1 Install at locations indicated and as directed by the Consultant.
- .2 Install to Section 34 43 10 – Airfield Lighting- General
- .3 On stake anchors.
- .4 Assemble in accordance with manufacturer's installation instructions. Connect isolating transformer secondary lead to light unit cord assembly by means of disconnecting plug and receptacle. Do not tape this connection.
- .5 Level as recommended by manufacturer.
- .6 Install lamp of proper rating as indicated.
- .7 Install globes as indicated.
- .8 Install reflective edge light marker.
- .9 Construct tapered gravel apron around each fixture.

END OF SECTION

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 Section 26 05 00 - Common Work Results – Electrical.
- .2 Section 34 43 10 – Airport Lighting General

1.2 ADMINISTRATIVE REQUIREMENTS

- .1 Pre-Installation Meetings:
 - .1 Convene pre-installation meeting one week prior to beginning work of this Section and on-site installation, with Contractor's Representative and Consultant.
to:
 - .1 Verify project requirements.
 - .2 Review installation and substrate conditions.
 - .3 Review manufacturer's written installation instructions and warranty requirements.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Certifications : submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .2 Test reports : submit certified test reports from established 3rd party testing laboratories attesting compliance with specifications for specified performance characteristics and physical properties.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .2 Storage and Handling Requirements:
 - .1 Store materials indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect airfield precision-approach path indicator equipment from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

PART 2 PRODUCTS

2.1 PAPI

- .1 PAPI system consists of following components:
 - .1 Four identical light units.
 - .2 Power and control unit (PCU).
 - .3 Aiming and calibration equipment.

- .2 Type:
 - .1 System consisting of 4 light units.
 - .3 Style:
 - .1 Style B - Current powered (series circuit) systems.
- .4 Class:
 - .1 Class II - Systems which operate down to -55 degrees C.
- .5 Options:
 - .1 Lamp bypass devices as specified.
 - .2 Isolation transformer consolidating harness for Style B systems.
 - .3 Heating unit for frost removal.

2.2 PAPI LIGHT UNITS

- .1 Products to: TP 312.
- .2 PAPI Light units 4-lamp unit.
- .3 Light Unit Construction: design each light unit to accommodate dynamic loading due to wind, or static loading due to snow, and not cause displacement of light pattern.
 - .1 Unit weight: 45 kg, unless the PCU is incorporated in light unit
 - .2 Unit height: 1 m when installed at minimum mounting height.
 - .3 Provide light unit with overhang or other means to inhibit rain or snow from reaching optical lens.
- .4 Mounting Provisions: adjustable mounting legs, designed to permit leveling where one side of unit is installed up to 25 mm higher or lower than opposite side.
 - .1 Legs: mounting and adjusting hardware, rigid galvanized steel conduit, frangible couplings, and flanges suitable for mounting on concrete pad.
 - .2 Adjusting hardware: designed to prevent displacement of optical system due to vibration.
 - .3 Alternate mounting systems may be proposed where equivalent rigidity, frangibility, and adjustability are provided.
- .6 Aiming: provide light units with integral adjustments to permit accurate vertical positioning of center of light beam at any elevation, between 2 and 6 degrees.
 - .1 Center of light beam is defined as transition band between red and white light indicating vertical angle of light beam center within accuracy of +3 minutes of arc.
 - .2 Aiming device: to indicate minutes of arc, and have at least 1 division every 10 minutes.
- .7 Tilt Switch: provide tilt switch system which de-energizes lamps in system when optical pattern of one light unit is inadvertently lowered between .025 and .050 degree or raised between .050 and 1.0 degree with respect to preset aiming angle.

3 EXECUTION

3.1 PREPARATION

- .1 Foundations for concrete mounting pads for PAPI units: extend foundation at least 0.3 m below frost line.
- .2 Construct reinforced concrete pad under each mounting leg for attachment of mounting flanges.
- .3 Extend pad or surface stabilization at least 0.3 m beyond light boxes to minimize damage from mowers.
- .4 Mount light boxes to foundation with frangible connections.
- .5 Style A systems: place splices or plugs in transformer housing.

3.2 INSTALLATION OF ELECTRICAL COMPONENTS

- .1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and data sheets.
- .2 Installation to applicable sections of Canadian Electrical Code Part I, C22.1.
- .3 Install electrical connections to PAPI unit using plugs and receptacles to allow unit to pull free if struck by aircraft.
- .4 House extra control circuitry enclosed and protected from environment.
- .5 Use splices or appropriately rated plugs for underground connections.

3.3 INSTALLATION OF PAPI UNITS

- .1 Locate PAPI units as indicated.
- .2 Install on concrete base with flanges as indicated.
- .3 Cut legs to length required to provide indicated PAPI height above ground.
- .4 Assemble units per manufacturer's instructions.
- .5 Install secondary cables from isolating transformers as indicated.
- .6 Install ground rods as indicated.
 - .1 Make connections to ground rods and equipment housings using wire and suitable ground connections.

- .7 Level units and adjust in accordance with manufacturer's written instructions and to angular settings as indicated Consultant.
 - .1 Align each PAPI unit so aperture is horizontal and at same elevation as other units.
 - .2 Utilize equipment supplied or specified by PAPI manufacturer for levelling and angular adjustments.

3.4 FIELD QUALITY CONTROL

- .1 Manufacturer's Field Services:
 - .1 Submit manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
 - .2 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product within 3 days of review, and submit, immediately, to Consultant.
 - .3 Ensure manufacturer's representative is present before and during testing.
 - .4 Schedule site visits, to review Work, at stages listed:
 - .1 After delivery and storage of products, and when preparatory Work is complete but before installation begins.
 - .2 Upon completion of Work, after cleaning is carried out.

3.5 CLEANING

- .1 Progress Cleaning :
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

END OF SECTION

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 Section 26 05 00 – Common Work Results for Electrical.
- .2 Section 34 43 10 – Airfield Illuminated.

1.2 REFERENCES

- .1 Transport Canada
 - .1 TP 312-1993(R2005), Aerodrome Standards and Recommended Practices.
- .2 CSA C22.1-09, Canadian Electrical Code, Part 1 (21st Edition), Safety Standard for Electrical Installations (latest version).

1.3 DELIVERY, STORAGE AND HANDLING

- .1 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .2 Storage and Handling Requirements:
 - .1 Store materials indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect regulator assembly from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

PART 2 PRODUCTS

2.1 REGULATOR ASSEMBLY

- .1 Indoor metal-clad regulator assembly, composed of 10 kW c.c. regulator 120/240 volt distribution control cubicles, input voltage 120/240 volts.

2.2 CONSTANT REGULATOR

- .1 Indoor constant current regulator, complete with pilot relays for 24 V DC remote control and copper wound input/output transformer.
- .2 10 kW rated.

PART 3 EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for regulator assembly installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Consultant.
 - .2 Inform Consultant of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Consultant.

3.2 INSTALLATION

- .1 Install as indicated and as directed by Consultant.
- .2 Make necessary electrical connections, of external wiring, as indicated.
- .3 Wire external control wiring to terminal blocks within control cubicle.
- .4 Ensure sufficient extra length on each control lead to allow for future changes.
- .5 Ensure bundled control lead are trained and laced.
- .6 Make connexion to the ARCAL system.

3.3 WIRE IDENTIFICATION

- .1 Install permanent wire markers for external control leads at termination points in control cubicle.
- .2 Use wire markings as indicated.

3.4 CARDS

- .1 Cards: where equipment is furnished with cardholders, provide and insert cards with printed designations as indicated.

3.5 WIRING DIAGRAM

- .1 Install wiring diagrams showing final connections and markings.
- .2 Mount framed diagram as directed by Consultant.

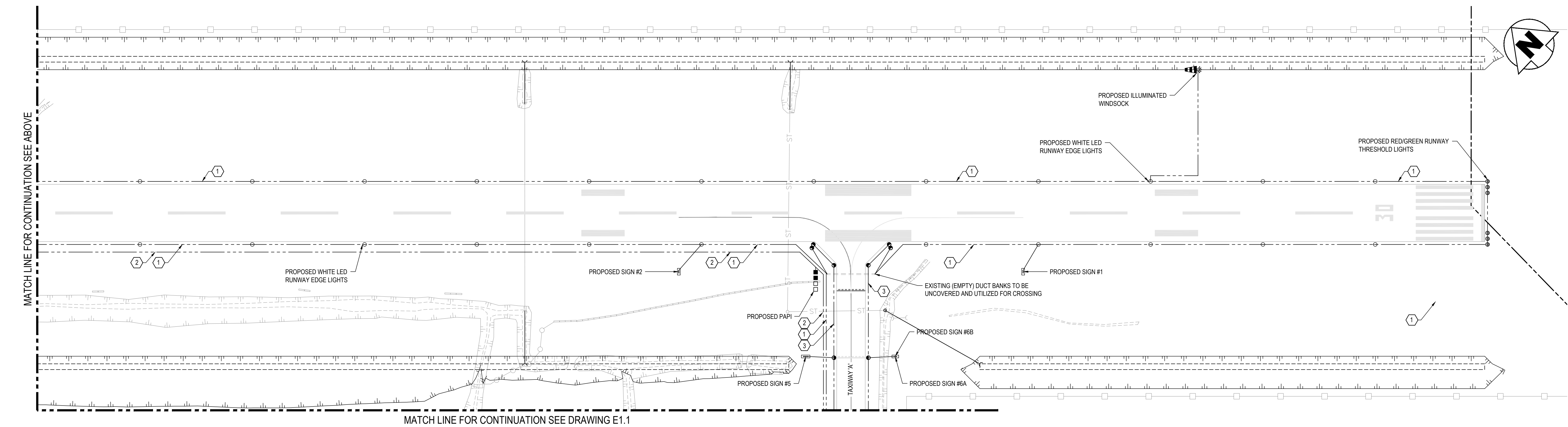
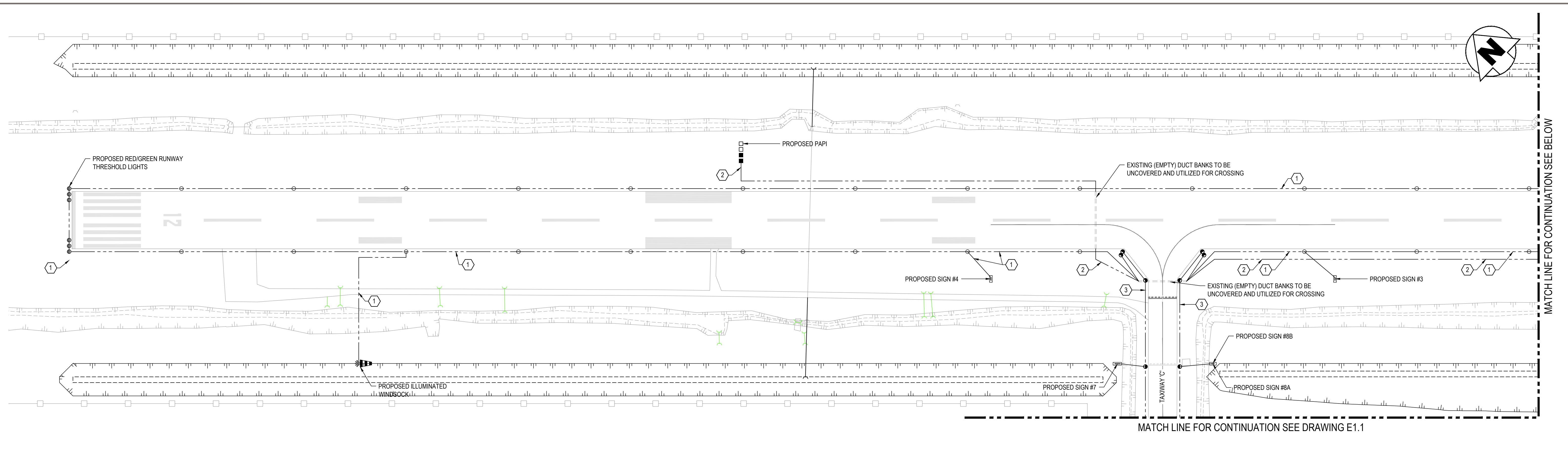
3.6 CLEANING

- .1 Progress Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

3.7 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by regulator assembly installation.

END OF SECTION



LEGEND

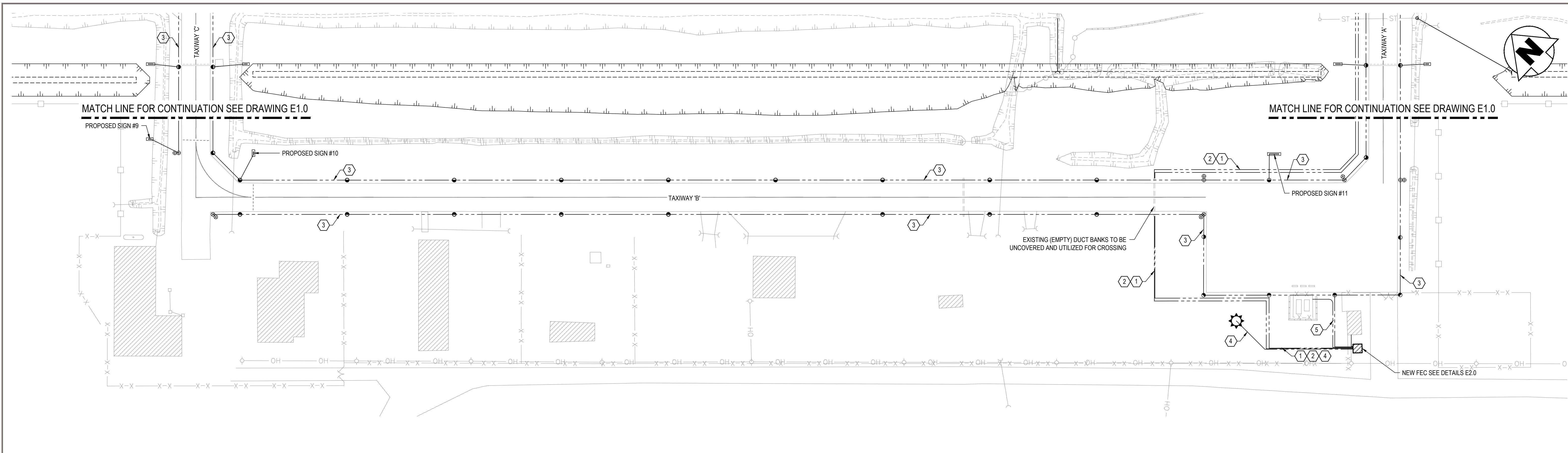
<ul style="list-style-type: none"> --- RUNWAY EXTENSION AND WIDENING - - - PROPERTY LINE - - - POST & RAIL WIRE FENCE - X - X - CHAIN LINK SECURITY FENCE - X - CHAIN LINK FENCE - O - STEEL TUBE FENCE - H - H - TOP OF SLOPE - - - TOE OF SLOPE - ST - STORM SEWER LINES -) - CULVERTS 	<ul style="list-style-type: none"> ◻ NON-ILLUMINATED WINDSOCK ◻ ILLUMINATED WINDSOCK - OH - OVERHEAD POWER - - - POWER CABLES - - - DUCT BANK ● RUNWAY END LIGHTS ○ RUNWAY EDGE LIGHTS ○ APRON/TAXIWAY EDGE LIGHTS ⊕ APRON ENTRANCE LIGHTS 	<ul style="list-style-type: none"> ◻ PRECISION APPROACH PATH INDICATOR (PAPI) ⊙ AIRPORT ROTATING BEACON
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Scale: 1:1,000 @ 22"x34"

REVISIONS				DRAWING STATUS			
NUM	DATE	DWN	CKD	APR	NUM	DATE	APR
1	2015/01/27	T.J.	S.S.	B.K.	A	2015/01/16	B.K.
0	2014/11/12	T.J.	S.S.	B.K.		APR	
UPDATE DRAWING PER CLIENT COMMENTS				ISSUED FOR 90% REVIEW			
INITIAL DESIGN							

	<p>CLIENT</p> <p>ALBERNI-CLAYOQUOT REGIONAL DISTRICT</p>	<p>PROJECT No. C31103399-002</p> <p>DATE: JANUARY 16, 2015</p>	<p>OFFICE CALGARY</p> <p>SHEET No. 1 of 3</p>	<p>DES B.K.</p> <p>DWN T.J.</p>	<p>CKD S.S.</p> <p>APP B.K.</p>	<p>REV 1</p> <p>STATUS A</p>	<p>DRAWING</p> <p>E1.0</p>
	<p>PERMIT</p>	<p>PROFESSIONAL SEAL</p>	<p>RUNWAY EXTENSION DESIGN ALBERNI VALLEY REGIONAL AIRPORT (CBS8) PORT ALBERNI, BC</p> <p>ELECTRICAL LAYOUT SHEET I</p>				

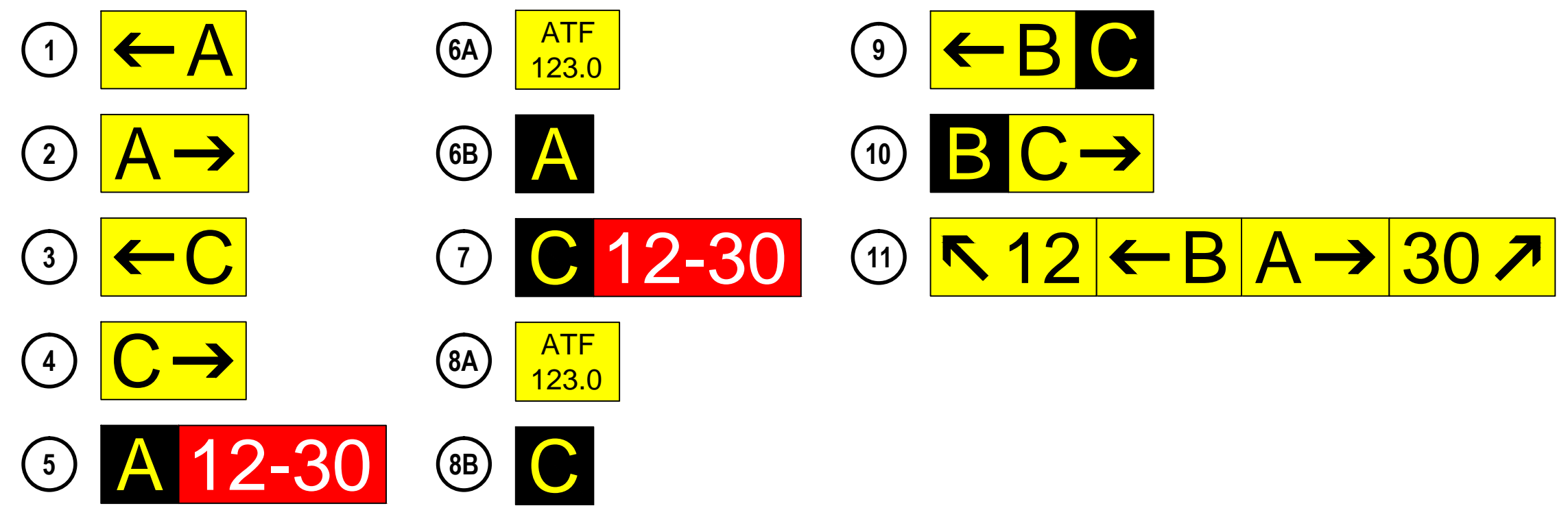
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SIGN SCHEDULE

SIGN #	SIGN FACE	BACKGROUND COLOUR	CHARACTER COLOUR	HEIGHT OF CHARACTER	CCT NO. CONNECTION	NOTES	ISOLATING TRANSFORMER SIZE
1	← A	YELLOW	BLACK	400	1	FACING SE	-
2	A →	YELLOW	BLACK	400	1	FACING NW	-
3	← C	YELLOW	BLACK	400	1	SE	-
4	C →	YELLOW	BLACK	400	1	NW	-
5	A 12-30	BLACK RED	YELLOW WHITE	400	3		-
6A	ATF 123.0	YELLOW	BLACK	400	3		-
6B	A	BLACK	YELLOW	400	3		-
7	C 12-30	BLACK RED	YELLOW WHITE	400	3		-
8A	ATF 123.0	YELLOW	BLACK	400	3		-
8B	C	BLACK	YELLOW	400	3		-
9	← B C	YELLOW BLACK	BLACK YELLOW	400	3	NE	-
10	B C →	BLACK YELLOW	YELLOW BLACK	400	3	SE	-
11	← 12 ← B A → 30 →	YELLOW	BLACK	400	3		-

CABLE TAG NO.	FROM	TO	TYPE
1	FEC-7.5KW REGULATOR	EDGE, THRESHOLD LIGHTS	1c #8 5KV ASLC (41mm POLYTUBE) c/w 1c #8 COUNTERPOISE
2	FEC-7.5KW REGULATOR-1	PAPI LIGHT UNITS	1c #8 5KV ASLC (41mm POLYTUBE) c/w 1c #8 COUNTERPOISE
3	FEC-7.5KW REGULATOR-2	EDGE, THRESHOLD LIGHTS	1c #8 5KV ASLC (41mm POLYTUBE) c/w 1c #8 COUNTERPOISE
4	FEC-7.5KW REGULATOR-3	BEACON	1c #8 5KV ASLC (41mm POLYTUBE) c/w 1c #8 COUNTERPOISE
5	FEC-7.5KW REGULATOR-4	FUEL TANKS, TERMINAL BUILDING	1c #8 5KV ASLC (41mm POLYTUBE) c/w 1c #8 COUNTERPOISE



LEGEND

- Runway Extension and Widening
- Property Line
- Post & Page Wire Fence
- Chain Link Security Fence
- Chain Link Fence
- Steel Tube Fence
- Top of Slope
- Toe of Slope
- Storm Sewer Lines
- Culverts
- Non-Illuminated Windsock
- Illuminated Windsock
- Overhead Power
- Power Cables
- Duct Bank
- Runway End Lights
- Runway Edge Lights
- Apron/Taxiway Edge Lights
- Apron Entrance Lights
- Precision Approach Path Indicator (PAPI)
- Airport Rotating Beacon

Scale: 1:1,000 @ 22"x34"

NUM	DATE	DWN	CKD	APR	DESCRIPTION	NUM	DATE	APR	DESCRIPTION
1	2015/01/27	T.J.	S.S.	B.K.	UPDATE DRAWING PER CLIENT COMMENTS	A	2015/01/16	B.K.	ISSUED FOR 90% REVIEW
0	2014/11/12	T.J.	S.S.	B.K.	INITIAL DESIGN				

CLIENT
ALBERNI-CLAYOQUOT REGIONAL DISTRICT

PROJECT
RUNWAY EXTENSION DESIGN
ALBERNI VALLEY REGIONAL AIRPORT (CBS8)
PORT ALBERNI, BC

ELECTRICAL LAYOUT SHEET II

TETRA TECH EBA

PROJECT No.	OFFICE	DES	CKD	REV	DRAWING
C31103399-002	CALGARY	B.K.	S.S.	1	
DATE:	SHEET No.	DWN	APP	STATUS	
JANUARY 16, 2015	2 of 3	T.J.	B.K.	A	

E1.1

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