Solicitation No. - N° de l'invitation	Amd. No. - N° de la modif.	Buyer ID - Id de l'acheteur
9F023-20230215-B		xxxxx
Client Ref. No. - N° de réf. du client	File No. - N° du dossier	CCC No./N° CCC - FMS No./N° VME
9F023-20230215-B	9F023-20230215-B	

REQUEST FOR PROPOSAL (RFP)

FOR THE REQUIREMENT OF

HIGH VOLTAGE MAINTENANCE SERVICES at the David Florida Laboratory (DFL) in Ottawa

Bid Submission Deadline: February 29, 2024 at 2:00 PM (EST)

Submit Bids to: Canada Post Corporation's (CPC) Connect service

or

by fax 819-997-9776

Reference: CSA File No. **9F023-20230215-B**

Note: Please read this Request for Proposal carefully for further details on the requirements and bid submission instructions.

February 15, 2024

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PART 1 - GENERAL INFORMATION

This bid solicitation cancels and supersedes previous bid solicitation number 9F023-20230215 dated January 8, 2024 with a closing of January 24, 2024 at 2:00 pm. A debriefing or feedback session will be provided upon request to bidders/offerors/suppliers who bid on the previous solicitation.

1.1 Summary

High Voltage Maintenance services are required at the David Florida Laboratory (DFL) in Ottawa. The work to be performed is detailed under Annex “A” Statement of Work.

- **Period of the Contract**
  From April 1, 2024 to March 31, 2025.

- **Work location**
  All sessions are to be held on-site at the David Florida Laboratory, 3701 Carling Ave, Ottawa, ON K2K 2Y7. Free parking is available to the instructor providing the on-site training.

- **Travel**
  No travel expenses will be reimbursed.

- **Language**
  The Bidder must be able to provide resources capable of providing services in English at an Intermediate level. See Part 5, point 5.1.8

1.2 Statement of Work

The Work to be performed is detailed Annex “A” Statement of Work of the resulting contract clauses.

1.3 Trade Agreements

This procurement is subject to the Canadian Free Trade Agreement (CFTA).

1.4 Debriefings

Bidders may request a debriefing on the results of the bid solicitation process. Bidders should make the request to the Contracting Authority within 15 working days from receipt of the results of the bid solicitation process. The debriefing may be in writing, by telephone or in person.

1.5 Canada Post Corporation’s (CPC) Connect service

This bid solicitation allows bidders to use the CPC Connect service provided by Canada Post Corporation to transmit their bid electronically. Bidders must refer to Part 2 entitled Bidder Instructions, and Part 3 entitled Bid Preparation Instructions, of the bid solicitation, for further information.

PART 2 - BIDDER INSTRUCTIONS

2.1 Standard Instructions, Clauses and Conditions

All instructions, clauses and conditions identified in the bid solicitation by number, date and title are set out in the Standard Acquisition Clauses and Conditions Manual (https://buyandsell.gc.ca/policy-and-guidelines/standard-acquisition-clauses-and-conditions-manual) issued by Public Works and Government Services Canada.

Bidders who submit a bid agree to be bound by the instructions, clauses and conditions of the bid solicitation and accept the clauses and conditions of the resulting contract.

The 2003 (2023-06-08) Standard Instructions - Goods or Services - Competitive Requirements, are incorporated by reference into and form part of the bid solicitation.

Subsection 5.4 of 2003, Standard Instructions - Goods or Services - Competitive Requirements, is amended as follows:

Delete: 60 days
Insert: 90 days

2.2 Technical Difficulties of Bid Transmission

Despite anything to the contrary in (05), (06) or (08) of the Standard Instructions, where a Bidder has commenced transmission of its bid through an electronic submission method (such as facsimile or Canada Post Corporation's (CPC) Connect service, or other online service) in advance of the bid solicitation closing date and time, but due to technical difficulties, Canada was unable to receive or decode the entirety of the Bid by the deadline, Canada may nonetheless accept the entirety of the Bid received after the bid solicitation closing date and time, provided that the Bidder can demonstrate the following:

(i)The bidder contacted Canada in advance of the bid solicitation closing date and time to attempt to resolve its technical difficulties; OR

(ii) The electronic properties of the Bid documentation clearly indicate that all components of the Bid were prepared in advance of the bid solicitation closing date and time.

2.3 Completeness of the Bid

After the closing date and time of this bid solicitation, Canada will examine the Bid to determine completeness. The review for completeness will be limited to identifying whether any information submitted as part of the bid can be accessed, opened, and/or decoded. This review does not constitute an evaluation of the content, will not assess whether the Bid meets any standard or is responsive to all solicitation requirements, but will be solely limited to assessing completeness. Canada will provide the Bidder with the opportunity to submit information found to be missing or incomplete in this review within two business days of notice.

Specifically, the bid will be reviewed and deemed to be complete when the following elements have been submitted by the bidder:

That certifications and securities required at bid closing are included.

1. That bids are properly signed, that the bidder is properly identified.
2. Acceptance of the terms and conditions of the bid solicitation and resulting contract.
3. That all documents created prior to bid closing but due to technical difficulties Canada was unable to receive them, have been properly submitted and received by Canada.

All certifications, declarations and proofs created prior to bid closing but due to technical difficulties Can

2.4 Submission of Bids

This bid solicitation allows bidders to use the epost Connect service provided by Canada Post Corporation to transmit their bid electronically. Bidders must refer to Part 2 entitled Bidder Instructions, and Part 3 entitled Bid Preparation Instructions, of the bid solicitation, for further information.

Bids must only be submitted to:

- By Canada Post Corporation's (CPC) Connect service:
  https://www.canadapost-postescanada.ca/cpc/en/business/postal-services/digital-mail/connect.page

  Canada Post Corporation's (CPC) Connect service: Section 08 (2023-06-08) - Transmission by CPV Connect service **of document 2003 (2023-06-08)** – Standard Instructions - Goods or Services - Competitive Requirements
  Section 1.2003 - Standard Instructions - Goods or Services - Buyandsell.gc.ca

Or

- By Fax 819-997-9776

at the date, time and place indicated on the front page of this solicitation.

2.5 Enquiries - Bid Solicitation

All enquiries must be submitted BY E-MAIL ONLY to the Contracting Authority no later than five (5) calendar days before the bid closing date. Enquiries received after that time may not be answered.

Bidders should reference as accurately as possible the numbered item of the bid solicitation to which the enquiry relates. Care should be taken by Bidders to explain each question in sufficient detail in order to enable Canada to provide an accurate answer. Technical enquiries that are of a proprietary nature must be clearly marked "proprietary" at each relevant item. Items identified as "proprietary" will be treated as such except where Canada determines that the enquiry is not of a proprietary nature. Canada may edit the question(s) or may request that the Bidder do so, so that the proprietary nature of the question(s) is eliminated, and the enquiry can be answered to all Bidders. Enquiries not submitted in a form that can be distributed to all Bidders may not be answered by Canada.

2.6 Applicable Laws

Any resulting contract must be interpreted and governed, and the relations between the parties determined, by the laws in force in the Province of Ontario.

Bidders may, at their discretion, substitute the applicable laws of a Canadian province or territory of their choice without affecting the validity of their bid, by deleting the name of the Canadian province or territory specified and inserting the name of the Canadian province or territory of their choice. If no change is made, it acknowledges that the applicable laws specified are acceptable to the Bidders.

2.7 Bid Challenge and Recourse Mechanisms

(a) Several mechanisms are available to potential suppliers to challenge aspects of the procurement process up to and including contract award.

(b) Canada encourages suppliers to first bring their concerns to the attention of the Contracting Authority. Canada's Buy and Sell website, under the heading "Bid Challenge and Recourse Mechanisms" contains information on potential complaint bodies such as:

- Office of the Procurement Ombudsman (OPO)
- Canadian International Trade Tribunal (CITT)

(c) Suppliers should note that there are **strict deadlines** for filing complaints, and the time periods vary depending on the complaint body in question. Suppliers should therefore act quickly when they want to challenge any aspect of the procurement process.

2.8 Accessibility Standards

In accordance with the Treasury Board Contracting Policy and the Accessible Canada Act, federal departments and agencies must consider accessibility criteria and features when procuring goods or services. Therefore, bidders are encouraged to highlight all the accessibility features and components of their proposal for this requirement and must:

a) demonstrate how the proposed goods and/or services meet the accessibility requirement at delivery; or
b) describe how it would deliver the proposed goods and/or services under any resulting contract in a way that satisfies the mandatory requirement.

PART 3 - BID PREPARATION INSTRUCTIONS

3.1 Bid Preparation Instructions

Canada requests that the Bidders provide their bid in separate sections as follows:

Section I: Technical Offer
Section II: Financial Offer
Section III: Certifications and Additional Information

Prices must appear in the financial offer only. No prices must be indicated in any other section of the offer.

Canada requests that bidders follow the format instructions described below in the preparation of their bid:

(a) 3 separate documents;
(b) use 8.5 x 11 inch (216 mm x 279 mm) format;
(c) use a numbering system that corresponds to the bid solicitation.

In order to assist Canada in meeting the objectives of the Policy on Green Procurement when feasible bidders should prepare and submit their bid as follows:

1) Include all environmental certification(s) relevant to your organization (such as ISO 14001, Leadership in Energy and Environmental Design (LEED), Carbon Disclosure Project, etc.).
2) Include all third party environmental certification(s) or Environmental Product Declaration(s) (EPD) specific to your product/service (such as Canadian Standards Association (CSA Group), Underwriters Laboratories (ULSolutions); Forest Stewardship Council (FSC), ENERGYSTAR, etc.).

Canada is committed to achieving net zero greenhouse gas (GHG) emissions by 2050 in an effort to position Canada for success in a green economy and to mitigate climate change impacts. As a result, future solicitations may include the following:

- there may be evaluation criteria or other instructions in the solicitation or contract documents related to measuring and disclosing your company's GHG emissions;
- you may be requested or required to join one of the following initiatives to submit a bid, offer or arrangement or if you are awarded the contract:
  - Canada's Net-Zero Challenge;
  - the United Nations Race to Zero;
  - the Science-based Targets Initiative;
  - the Carbon Disclosure Project;
  - the International Organization for Standardization;
- you may be required to provide other evidence of your company's commitment and actions toward meeting net zero targets by 2050.

Section I: Technical Bid

In their technical bid, Bidders should explain and demonstrate how they propose to meet the requirements and how they will carry out the Work.

Section II: Financial Bid

Bidders must submit their financial bid in accordance with the Pricing Schedule detailed in Attachment 1 to Part 3.

Solicitation No. - N° de l'invitation	Amd. No. - N° de la modif.	Buyer ID - Id de l'acheteur
9F023-20230215-B		xxxxx
Client Ref. No. - N° de réf. du client	File No. - N° du dossier	CCC No./N° CCC - FMS No./N° VME
9F023-20230215-B	9F023-20230215-B	

Section III: Certifications and Additional Information

Bidders must submit the certifications and additional information required under Part 5.

ATTACHMENT 1 TO PART 3 – PRICING SCHEDULE

The financial proposal will be opened only for Bidders demonstrating they meet the mandatory requirements and those with a minimum technical score of 19/68.

The Bidder must complete this pricing schedule and include it in its financial bid. At a minimum, the Bidder must respond to this pricing schedule by inserting in its financial bid for each of the periods specified below.

a) The Bidder must quote a firm all-inclusive, in Canadian dollars, applicable taxes excluded, FOB destination, Canadian customs duties and excise taxes included.
b) The Bidder must provide rates for the initial term, as well as rates for the optional years. If no rates are proposed for Option Year 1, 2, 3 & 4, the rates provided for the Initial Period will be used for the Option Year.
c) Not travel fee will be reimbursed for this service.
d) The estimated number of hours are estimates only. These estimates are for the purpose of evaluation only and the evaluation will be conducted for the total five (5) years.
e) Increases in rates will not be permitted during the contract period.

Initial Contract Period – April 1, 2024 to March 31, 2025			
Service A	Firm rate B	Estimated number of hours per year C	Estimated total (excluding tax) D = ((B x C)
Annual High Voltage Maintenance, Equipment Survey & Testing of Sub Stations 65A & 65B	$ _____/year		$ _____/year
Single-Line Diagram Updating	$ _____/year		$ _____/year
Arc Flash Hazard Analysis, Coordination Study & Short Circuit Analysis	$ _____/year		$ _____/year
Arc-Flash Hazard Report, Identification & Labelling	$ _____/year		$ _____/year
Hourly rate – Monday to Friday 7:00am to 4:00pm			
Licensed Professional Engineer	$_____ /hour	10	$ _____/year
Licensed Electrician	$_____ /hour	24	$ _____/year
Apprentice Electrician	$_____ /hour	10	$ _____/year
Overtime – Monday to Friday 4:00pm to 7:00am			
Licensed Professional Engineer	$_____ /hour	2	$ _____/year
Licensed Electrician	$_____ /hour	20	$ _____/year
Apprentice Electrician	$_____ /hour	10	$ _____/year
Overtime – Saturday, Sunday and holidays (4:00pm Friday through 7:00am Monday and holidays)			
Licensed Professional Engineer	$_____ /hour	2	$_____ /hour
Licensed Electrician	$_____ /hour	20	$_____ /hour
Apprentice Electrician	$_____ /hour	10	$_____ /hour
Emergency Work – 24/7 (maximum 3 hour response time)			
Licensed Professional Engineer	$_____ /hour	2	$_____ /hour
Licensed Electrician	$_____ /hour	4	$_____ /hour
Apprentice Electrician	$_____ /hour	2	$_____ /hour
Total estimated price for the Initial Contract Period (excluding tax)			$ _____/year

Service A	Number of Hours B	Estimated Number of Calls C	Firm Hourly Rate for a licensed electrician during regular working hours D	Total (excluding tax) E = (B x C x D)
Additional Services				
Minimum hour(s) billed per service call	_____ hour(s)	2	$_____	$_____
Total Service Call Estimate for Initial Contract Period (excluding taxes)				$_____

Service A	Firm Percentage Mark-up B	Estimated Value of materials/parts, specialized and unusual equipment and tools C	Total Estimate (excluding tax) D = (C + B)
Materials and Supplies			
Mark-up on materials/parts, specialized and unusual equipment and tools	_____%	$2,000	$_____
Total Materials and Supplies Estimate for Initial Contract Period (excluding taxes)			$_____

Total Price for Initial Contract Period (excluding taxes)	
Total estimated price for the Initial Contract Period (excluding taxes)	$_____
Total Service Call Estimate for Initial Contract Period (excluding taxes)	$_____
Total Materials and Supplies Estimate for Initial Contract Period (excluding taxes)	$_____
Total Price for Initial Contract Period (excluding taxes)	**$**_____

Option Year 1 – April 1, 2025 to March 31, 2026			
Service A	Firm rate B	Estimated number of hours per year C	Estimated total (excluding tax) D = ((B x C)
Annual High Voltage Maintenance, Equipment Survey & Testing of Sub Stations 65A & 65B	$ _____/year		$ _____/year
Single-Line Diagram Updating			
Arc Flash Hazard Analysis, Coordination Study & Short Circuit Analysis			
Arc-Flash Hazard Report, Identification & Labelling			
Hourly rate – Monday to Friday 7:00am to 4:00pm			
Licensed Professional Engineer	$_____ /hour	10	$ _____/year
Licensed Electrician	$_____ /hour	24	$ _____/year
Apprentice Electrician	$_____ /hour	10	$ _____/year
Overtime – Monday to Friday 4:00pm to 7:00am			
Licensed Professional Engineer	$_____ /hour	2	$ _____/year
Licensed Electrician	$_____ /hour	20	$ _____/year
Apprentice Electrician	$_____ /hour	10	$ _____/year
Overtime – Saturday, Sunday and holidays (4:00pm Friday through 7:00am Monday and holidays)			
Licensed Professional Engineer	$_____ /hour	2	$_____ /hour
Licensed Electrician	$_____ /hour	20	$_____ /hour
Apprentice Electrician	$_____ /hour	10	$_____ /hour
Emergency Work – 24/7 (maximum 3 hour response time)			
Licensed Professional Engineer	$_____ /hour	2	$_____ /hour
Licensed Electrician	$_____ /hour	4	$_____ /hour
Apprentice Electrician	$_____ /hour	2	$_____ /hour
Total estimated price for Option Year 1 (excluding tax)			$ _____/year

Service A	Number of Hours B	Estimated Number of Calls C	Firm Hourly Rate for a licensed electrician during regular working hours D	Total (excluding tax) E = (B x C x D)
Additional Services				
Minimum hour(s) billed per service call	_____ hour(s)	2	$_____	$_____
Total Service Call Estimate for Option Year 1 (excluding taxes)				$_____

Service A	Firm Percentage Mark-up B	Estimated Value of materials/parts, specialized and unusual equipment and tools C	Total Estimate (excluding tax) D = (C + B)
Materials and Supplies			
Mark-up on materials/parts, specialized and unusual equipment and tools	_____%	$2,000	$_____
Total Materials and Supplies Estimate for Option Year 1 (excluding taxes)			$_____

Total Price for Option Year 1 (excluding taxes)	
Total estimated price for the Option Year 1 (excluding taxes)	$_____
Total Service Call Estimate for Option Year 1 (excluding taxes)	$_____
Total Materials and Supplies Estimate for Option Year 1 (excluding taxes)	$_____
Total Price for Option Year 1 (excluding taxes)	**$**_____

Option Year 2 – April 1, 2026 to March 31, 2027			
Service A	Firm rate B	Estimated number of hours per year C	Estimated total (excluding tax) D = ((B x C)
Annual High Voltage Maintenance, Equipment Survey & Testing of Sub Stations 65A & 65B	$ _____/year		$ _____/year
Single-Line Diagram Updating			
Arc Flash Hazard Analysis, Coordination Study & Short Circuit Analysis			
Arc-Flash Hazard Report, Identification & Labelling			
Hourly rate – Monday to Friday 7:00am to 4:00pm			
Licensed Professional Engineer	$_____ /hour	10	$ _____/year
Licensed Electrician	$_____ /hour	24	$ _____/year
Apprentice Electrician	$_____ /hour	10	$ _____/year
Overtime – Monday to Friday 4:00pm to 7:00am			
Licensed Professional Engineer	$_____ /hour	2	$ _____/year
Licensed Electrician	$_____ /hour	20	$ _____/year
Apprentice Electrician	$_____ /hour	10	$ _____/year
Overtime – Saturday, Sunday and holidays (4:00pm Friday through 7:00am Monday and holidays)			
Licensed Professional Engineer	$_____ /hour	2	$_____ /hour
Licensed Electrician	$_____ /hour	20	$_____ /hour
Apprentice Electrician	$_____ /hour	10	$_____ /hour
Emergency Work – 24/7 (maximum 3 hour response time)			
Licensed Professional Engineer	$_____ /hour	2	$_____ /hour
Licensed Electrician	$_____ /hour	4	$_____ /hour
Apprentice Electrician	$_____ /hour	2	$_____ /hour
Total estimated price for Option Year 2 (excluding tax)			$ _____/year

Service A	Number of Hours B	Estimated Number of Calls C	Firm Hourly Rate for a licensed electrician during regular working hours D	Total (excluding tax) E = (B x C x D)
Additional Services				
Minimum hour(s) billed per service call	_____ hour(s)	2	$_____	$_____
Total Service Call Estimate for Option Year 2 (excluding taxes)				$_____

Service A	Firm Percentage Mark-up B	Estimated Value of materials/parts, specialized and unusual equipment and tools C	Total Estimate (excluding tax) D = (C + B)
Materials and Supplies			
Mark-up on materials/parts, specialized and unusual equipment and tools	_____%	$2,000	$_____
Total Materials and Supplies Estimate for Option Year 2 (excluding taxes)			$_____

Total Price for Option Year 2 (excluding taxes)	
Total estimated price for the Option Year 2 (excluding taxes)	$_____
Total Service Call Estimate for Option Year 2 (excluding taxes)	$_____
Total Materials and Supplies Estimate for Option Year 2 (excluding taxes)	$_____
Total Price for Option Year 2 (excluding taxes)	**$**_____

Option Year 3 – April 1, 2027 to March 31, 2028			
Service A	Firm rate B	Estimated number of hours per year C	Estimated total (excluding tax) D = ((B x C)
Annual High Voltage Maintenance, Equipment Survey & Testing of Sub Stations 65A & 65B	$ _____/year		$ _____/year
Single-Line Diagram Updating			
Arc Flash Hazard Analysis, Coordination Study & Short Circuit Analysis			
Arc-Flash Hazard Report, Identification & Labelling			
Hourly rate – Monday to Friday 7:00am to 4:00pm			
Licensed Professional Engineer	$_____ /hour	10	$ _____/year
Licensed Electrician	$_____ /hour	24	$ _____/year
Apprentice Electrician	$_____ /hour	10	$ _____/year
Overtime – Monday to Friday 4:00pm to 7:00am			
Licensed Professional Engineer	$_____ /hour	2	$ _____/year
Licensed Electrician	$_____ /hour	20	$ _____/year
Apprentice Electrician	$_____ /hour	10	$ _____/year
Overtime – Saturday, Sunday and holidays (4:00pm Friday through 7:00am Monday and holidays)			
Licensed Professional Engineer	$_____ /hour	2	$_____ /hour
Licensed Electrician	$_____ /hour	20	$_____ /hour
Apprentice Electrician	$_____ /hour	10	$_____ /hour
Emergency Work – 24/7 (maximum 3 hour response time)			
Licensed Professional Engineer	$_____ /hour	2	$_____ /hour
Licensed Electrician	$_____ /hour	4	$_____ /hour
Apprentice Electrician	$_____ /hour	2	$_____ /hour
Total estimated price for Option Year 3 (excluding tax)			$ _____/year

Service A	Number of Hours B	Estimated Number of Calls C	Firm Hourly Rate for a licensed electrician during regular working hours D	Total (excluding tax) E = (B x C x D)
Additional Services				
Minimum hour(s) billed per service call	_____ hour(s)	2	$_____	$_____
Total Service Call Estimate for Option Year 3 (excluding taxes)				$_____

Service A	Firm Percentage Mark-up B	Estimated Value of materials/parts, specialized and unusual equipment and tools C	Total Estimate (excluding tax) D = (C + B)
Materials and Supplies			
Mark-up on materials/parts, specialized and unusual equipment and tools	_____%	$2,000	$_____
Total Materials and Supplies Estimate for Option Year 3 (excluding taxes)			$_____

Total Price for Option Year 3 (excluding taxes)	
Total estimated price for the Option Year 3 (excluding taxes)	$_____
Total Service Call Estimate for Option Year 3 (excluding taxes)	$_____
Total Materials and Supplies Estimate for Option Year 3 (excluding taxes)	$_____
Total Price for Option Year 3 (excluding taxes)	**$**_____

Option Year 4 – April 1, 2028 to March 31, 2029			
Service A	Firm rate B	Estimated number of hours per year C	Estimated total (excluding tax) D = ((B x C)
Annual High Voltage Maintenance, Equipment Survey & Testing of Sub Stations 65A & 65B	$ _____/year		$ _____/year
Single-Line Diagram Updating			
Arc Flash Hazard Analysis, Coordination Study & Short Circuit Analysis			
Arc-Flash Hazard Report, Identification & Labelling			
Hourly rate – Monday to Friday 7:00am to 4:00pm			
Licensed Professional Engineer	$_____ /hour	10	$ _____/year
Licensed Electrician	$_____ /hour	24	$ _____/year
Apprentice Electrician	$_____ /hour	10	$ _____/year
Overtime – Monday to Friday 4:00pm to 7:00am			
Licensed Professional Engineer	$_____ /hour	2	$ _____/year
Licensed Electrician	$_____ /hour	20	$ _____/year
Apprentice Electrician	$_____ /hour	10	$ _____/year
Overtime – Saturday, Sunday and holidays (4:00pm Friday through 7:00am Monday and holidays)			
Licensed Professional Engineer	$_____ /hour	2	$_____ /hour
Licensed Electrician	$_____ /hour	20	$_____ /hour
Apprentice Electrician	$_____ /hour	10	$_____ /hour
Emergency Work – 24/7 (maximum 3 hour response time)			
Licensed Professional Engineer	$_____ /hour	2	$_____ /hour
Licensed Electrician	$_____ /hour	4	$_____ /hour
Apprentice Electrician	$_____ /hour	2	$_____ /hour
Total estimated price for Option Year 4 (excluding tax)			$ _____/year

Service A	Number of Hours B	Estimated Number of Calls C	Firm Hourly Rate for a licensed electrician during regular working hours D	Total (excluding tax) E = (B x C x D)
Additional Services				
Minimum hour(s) billed per service call	_____ hour(s)	2	$_____	$_____
Total Service Call Estimate for Option Year 4 (excluding taxes)				$_____

Service A	Firm Percentage Mark-up B	Estimated Value of materials/parts, specialized and unusual equipment and tools C	Total Estimate (excluding tax) D = (C + B)
Materials and Supplies			
Mark-up on materials/parts, specialized and unusual equipment and tools	_____%	$2,000	$_____
Total Materials and Supplies Estimate for Option Year 4 (excluding taxes)			$_____

Total Price for Option Year 1 (excluding taxes)	
Total estimated price for the Option Year 4 (excluding taxes)	$_____
Total Service Call Estimate for Option Year 4 (excluding taxes)	$_____
Total Materials and Supplies Estimate for Option Year 4 (excluding taxes)	$_____
Total Price for Option Year 4 (excluding taxes)	**$**_____

Total Price for Evaluation Purposes Only	
Total Price for Initial Contract Period (excluding taxes)	$ _____
Total Price for Option Year 1 (excluding taxes)	$_____
Total Price for Option Year 2 (excluding taxes)	$_____
Total Price for Option Year 3 (excluding taxes)	$_____
Total Price for Option Year 4 (excluding taxes)	$_____
Total Financial Bid (excluding taxes)	**$**_____

PART 4 - EVALUATION PROCEDURES AND BASIS OF SELECTION

4.1 Evaluation Procedures

(a) Bids will be assessed in accordance with the entire requirement of the bid solicitation including technical and financial evaluation criteria.

(b) An evaluation team composed of representatives of Canada will evaluate the bids.

4.1.1 Technical Evaluation

4.1.1.1 Mandatory Technical Criteria

Refer to Attachment 1 of Part 4 Mandatory and Point Rated Technical Criteria.

4.1.1.2 Point Rated Technical Criteria

Refer to Attachment 1 of Part 4 Mandatory and Point Rated Technical Criteria.

4.1.2 Financial Evaluation

SACC Manual Clause A0220T (2014-06-26), Evaluation of Price-Bid

Refer to Attachment 1 of Part 3 - Pricing Schedule

4.2 Basis of Selection – Highest Combined Rating of Technical Merit and Price 60/40

SACC Manual Clause A0027T , Basis of Selection – Highest Combined Rating of Technical Merit and Price

1. To be declared responsive, a bid must:
   a. comply with all the requirements of the bid solicitation; and
   b. meet all mandatory criteria; and
   c. obtain the required minimum of 19 points overall for the technical evaluation criteria which are subject to point rating.
   The rating is performed on a scale of 68 points.
2. Bids not meeting (a) or (b) or (c) will be declared non-responsive.
3. The selection will be based on the highest responsive combined rating of technical merit and price. The ratio will be 60 % for the technical merit and 40 % for the price.
4. To establish the technical merit score, the overall technical score for each responsive bid will be determined as follows: total number of points obtained / maximum number of points available multiplied by the ratio of 60 %.
5. To establish the pricing score, each responsive bid will be prorated against the lowest evaluated price and the ratio of 40 %.
6. For each responsive bid, the technical merit score and the pricing score will be added to determine its combined rating.

7. Neither the responsive bid obtaining the highest technical score nor the one with the lowest evaluated price will necessarily be accepted. The responsive bid with the highest combined rating of technical merit and price will be recommended for award of a contract.

The table below illustrates an example where all three bids are responsive and the selection of the contractor is determined by a 60/40 ratio of technical merit and price, respectively. The total available points equals 135 and the lowest evaluated price is $45,000 (45).

Basis of Selection - Highest Combined Rating Technical Merit (60%) and Price (40%)

		Bidder 1	Bidder 2	Bidder 3
Overall Technical Score		115/135	89/135	92/135
Bid Evaluated Price		$55,000.00	$50,000.00	$45,000.00
Calculations	**Technical Merit Score**	115/135 x 60 = 51.11	89/135 x 60 = 39.56	92/135 x 60 = 40.89
	Pricing Score	45/55 x 40 = 32.73	45/50 x 40 = 36.00	45/45 x 40 = 40.00
Combined Rating		83.84	75.56	80.89
Overall Rating		1st	3rd	2nd

ATTACHMENT 1 TO PART 4 – MANDATORY AND POINT RATED TECHNICAL CRITERIA

Mandatory Criteria

The Mandatory Criteria listed below will be evaluated on a simple pass/fail basis.

NOTES: Proposals which fail to meet the mandatory criteria will be deemed non-responsive.

Proposals MUST demonstrate compliance with all of the following Mandatory Requirements and MUST provide the necessary documentation to support compliance. Each category should be addressed separately.

		Pass	Fail
MANDATORY BIDDER EXPERIENCE			
M1	The Bidder must present licenses required to perform work in Province of Ontario as a licensed electrical contractor. *To demonstrate compliance with this criterion, the Bidder must include a business license and company electrical license to perform work in the Province of Ontario.		
M2	The Bidder must prove that it has been in business for at least the last five (5) years / sixty (60) months from the closing date of this RFP. *To demonstrate compliance with this criterion, the Bidder must include within their proposal the documented proof of its status (certificate of incorporation or business registration confirming the number of months it has been in business).		
MANDATORY PROPOSED RESOURCE EXPERIENCE			
M3	**Electrical Engineer** Minimum ten (10) years of recent work experience in electrical field and licensed by Professional Engineers of Ontario (PEO), including a minimum of five (5) years of experience conducting short circuit studies and analysis. * Recent is defined as within the last twelve (12) years from this RFP closing date. To demonstrate compliance with this criterion, the Bidder must include within their proposal a detailed Curriculum Vitae (CV) for the proposed resource(s), including a valid copy of their license as a Professional Engineer in the PEO.		

M4	**Licensed Electrician** Minimum ten (10) years recent high voltage work experience in commercial and/or industrial buildings and who holds a valid certified electrician license. * Recent is defined as within the last twelve (12) years from this RFP closing date. To demonstrate compliance with this criterion, the Bidder must include within their proposal a detailed Curriculum Vitae (CV) for the proposed resource(s), including a valid copy of their license as a certified electrician.		
M5	**Apprentice Electrician** Minimum three (3) years training in commercial and/or industrial environment and eligible for certification in accordance with authorities having jurisdiction as per the conditions of Provincial Act respecting manpower vocational training and qualification. * Recent is defined as within the last five (5) years from this RFP closing date. To demonstrate compliance with this criterion, the Bidder must include within their proposal a detailed Curriculum Vitae (CV) for the proposed resource(s), including a valid copy of their license as an apprentice electrician.		

Point Rated Technical Criteria

Bids, which meet all the mandatory technical criteria, will be evaluated and scored as specified in the tables below.

The Bidder MUST achieve a minimum score of 19 points overall of the Point- Rated Criteria. Any bid, which fails to meet the minimum required score on the Point-Rated Criteria, will be deemed noncompliant and given no further consideration.

Each point rated technical criterion should be addressed separately.

POINT RATED TECHNICAL CRITERIA (PRTC)		**Minimum Points Required**	**Maximum Total Points**
PRTC1	The Bidder should submit a copy of the company's profile & background underlining years in business, size and profile - **Related Experience**: 1 point for every year up to a maximum of 15 points - **Business size**: 16 or more = 5 points 1-15 employees = 3 points	10	20
PRTC2	The Bidder should provide evidence of its recent experience and past performance by referencing **three (3)** similar projects/contracts within the last eight (8) years from this RFP closing date, whereby the organization has performed satisfactorily in government or private organizations. The Bidder will have to prove that the company possesses experience working in hi-tech/laboratory industry. To demonstrate this experience, the following information is required for each of the three (3) referenced projects completed by the Bidder: 1. Project Name 2. Proponent's Name, Title and Organization 3. Proponent's Contact Information 4. Date of Completion 5. Cost of Project 6. Summary of Project (Approximately 100 words or less) 1 point per item 1 through 6 = 6 points maximum per project **Notes:** • If the Bidder submits projects in excess of the stated requirement, only the first three (3) projects listed in the proposal will be considered for evaluation.	9	18
PRTC3	**Inclusion of an EDI policy** This criterion determines whether the bidder includes in their bid		10

	a copy of their policy to encourage the recruitment and hiring of individuals from underrepresented groups in the personnel assigned to execute the bid, in accordance with the Canadian employment equity documentation. https://www.canada.ca/fr/commission-fonction-publique/emplois/services/emplois-gc/equite-matiere-emploi.html ➢ **0 points:** The tender does not contain an equity, diversity and inclusion policy. ➢ **10 points:** The tender does contain an equity, diversity and inclusion policy.		
PRTC4	**Indigenous employees or subcontractor** This criterion is used to determine whether the bidder has Indigenous employees, is considering hiring Indigenous employees or using an Indigenous subcontractor. * ➢ **0 points:** The organization does not have any Indigenous employees **AND** does not plan to hire Indigenous employees or use an Indigenous subcontractor as part of the resources to perform the requested work. ➢ **10 points:** The bidder's organization certifies that it has 5% or more Indigenous employees in its workforce ➢ **20 points:** The bidder's organization certifies that it has 5% or more Indigenous employees in its workforce **AND** is considering the use of an Indigenous subcontractor as part of the resources provided to perform the requested work. https://www.sac-isc.gc.ca/REA-IBD/eng/reset		20
	Total Score	**19**	**68**

PART 5 – CERTIFICATIONS AND ADDITIONAL INFORMATION

Bidders must provide the required certifications and additional information to be awarded a contract.

The certifications provided by Bidders to Canada are subject to verification by Canada at all times. Unless specified otherwise, Canada will declare a bid non-responsive, or will declare a contractor in default if any certification made by the Bidder is found to be untrue whether made knowingly or unknowingly, during the bid evaluation period or during the contract period.

The Contracting Authority will have the right to ask for additional information to verify the Bidder's certifications. Failure to comply and to cooperate with any request or requirement imposed by the Contracting Authority will render the bid non-responsive or constitute a default under the Contract.

5.1 Certifications Required with the Bid

Bidders must submit the following duly completed certifications as part of their bid.

5.1.1 Integrity Provisions - Declaration of Convicted Offences

In accordance with the Integrity Provisions of the Standard Instructions, all bidders must provide with their bid, **if applicable**, the declaration form available on the Forms for the Integrity Regime website (http://www.tpsgc-pwgsc.gc.ca/ci-if/declaration-eng.html), to be given further consideration in the procurement process.

5.1.2 Former Public Servant

Contracts awarded to former public servants (FPS) in receipt of a pension or of a lump sum payment must bear the closest public scrutiny, and reflect fairness in the spending of public funds. In order to comply with Treasury Board policies and directives on contracts with FPS, bidders must provide the information required below before contract award.

5.1.2.1 Definitions

For the purposes of this clause,
"former public servant" is any former member of a department as defined in the *Financial Administration Act*, R.S., 1985, c. F-11, a former member of the Canadian Armed Forces or a former member of the Royal Canadian Mounted Police. A former public servant may be:

a. an individual;
b. an individual who has incorporated;
c. a partnership made of former public servants; or
d. a sole proprietorship or entity where the affected individual has a controlling or major interest in the entity.

"lump sum payment period" means the period measured in weeks of salary, for which payment has been made to facilitate the transition to retirement or to other employment as a result of the implementation of various programs to reduce the size of the Public Service. The lump sum payment period does not include the period of severance pay, which is measured in a like manner.

"pension" means a pension or annual allowance paid under the *Public Service Superannuation Act* (PSSA), R.S., 1985, c.P-36, and any increases paid pursuant to the *Supplementary Retirement Benefits Act*, R.S., 1985, c.S-24 as it affects the PSSA. It does not include pensions payable pursuant to the *Canadian Forces Superannuation Act*, R.S., 1985, c.C-17, the*Defence Services Pension*

Continuation Act, 1970, c.D-3, the *Royal Canadian Mounted Police Pension Continuation Act* , 1970, c.R-10, and the *Royal Canadian Mounted Police Superannuation Act*, R.S., 1985, c.R-11, the*Members of Parliament Retiring Allowances Act* , R.S., 1985, c.M-5, and that portion of pension payable to the*Canada Pension Plan Act*, R.S., 1985, c.C-8.

5.1.2.2 Former Public Servant in Receipt of a Pension

As per the above definitions, is the Bidder a FPS in receipt of a pension?

Yes ( ) **No** ( )

If so, the Bidder must provide the following information, for all FPS in receipt of a pension, as applicable:

a. name of former public servant;
b. date of termination of employment or retirement from the Public Service.

By providing this information, Bidders agree that the successful Bidder's status, with respect to being a former public servant in receipt of a pension, will be reported on departmental websites as part of the published proactive disclosure reports in accordance with Contracting Policy Notice: 2012-2 and the Guidelines on the Proactive Disclosure of Contracts.

5.1.2.3 Work Force Adjustment Directive

Is the Bidder a FPS who received a lump sum payment pursuant to the terms of the Work Force Adjustment Directive?

Yes ( ) **No** ( )

If so, the Bidder must provide the following information:

a. name of former public servant;
b. conditions of the lump sum payment incentive;
c. date of termination of employment;
d. amount of lump sum payment;
e. rate of pay on which lump sum payment is based;
f. period of lump sum payment including start date, end date and number of weeks;
g. number and amount (professional fees) of other contracts subject to the restrictions of a work force adjustment program.

5.1.3 Ineligibility and Suspension Policy

Bidders, offerors or suppliers certify to the following when submitting a bid:

- they have read and understand the **Ineligibility and Suspension Policy**; http://www.tpsgc-pwgsc.gc.ca/ci-if/politique-policy-eng.html
- they understand that certain domestic and foreign criminal charges and convictions, and other circumstances, will or may result in a determination of ineligibility or suspension;
- they are aware that Canada may request additional information, certifications and validations for the purposes of making a determination of ineligibility or suspension;
- they have provided a list of all foreign criminal charges and convictions;
- none of the domestic criminal offences and other circumstances described in the Policy applies to them, their affiliates and their first tier subcontractors; and
- they are not aware of a determination of ineligibility or suspension that applies to them.

5.1.4 Integrity Provisions – List of Names

Bidders who are incorporated, including those bidding as a joint venture, **must provide a complete list of names of all individuals who are currently directors** of the Bidder. **(See Annex D - Integrity Form)**.

Bidders bidding as sole proprietorship, as well as those bidding as a joint venture, **must provide the name of the owner(s)**. **(See Annex D - Integrity Form)**.

Bidders bidding as societies, firms or partnerships do not need to provide lists of names.

5.1.5 Status and Availability of Resources

The Bidder certifies that, should it be awarded a contract as a result of the bid solicitation, every individual proposed in its bid will be available to perform the Work as required by Canada's representatives and at the time specified in the bid solicitation or agreed to with Canada's representatives. If for reasons beyond its control, the Bidder is unable to provide the services of an individual named in its bid, the Bidder may propose a substitute with similar qualifications and experience. The Bidder must advise the Contracting Authority of the reason for the substitution and provide the name, qualifications and experience of the proposed replacement. For the purposes of this clause, only the following reasons will be considered as beyond the control of the Bidder: death, sickness, maternity and parental leave, retirement, resignation, dismissal for cause or termination of an agreement for default.

If the Bidder has proposed any individual who is not an employee of the Bidder, the Bidder certifies that it has the permission from that individual to propose his/her services in relation to the Work to be performed and to submit his/her résumé to Canada. The Bidder must, upon request from the Contracting Authority, provide a written confirmation, signed by the individual, of the permission given to the Bidder and of his/her availability.

5.1.6 Education and Experience

The Bidder certifies that all the information provided in the résumés and supporting material submitted with its bid, particularly the information pertaining to education, achievements, experience and work history, has been verified by the Bidder to be true and accurate. Furthermore, the Bidder warrants that every individual proposed by the Bidder for the requirement is capable of performing the Work described in the resulting contract.

5.1.7 Federal Contractors Program for Employment Equity

By submitting a bid, the Bidder certifies that the Bidder, and any of the Bidder's members if the Bidder is a Joint Venture, is not named on the Federal Contractors Program (FCP) for employment equity "FCP Limited Eligibility to Bid" list (http://www.labour.gc.ca/eng/standards_equity/eq/emp/fcp/list/inelig.shtml) available from Employment and Social Development Canada (ESDC) - Labour's website.

Canada will have the right to declare a bid non-responsive if the Bidder, or any member of the Bidder if the Bidder is a Joint Venture, appears on the "FCP Limited Eligibility to Bid " list at the time of contract award.

5.1.8 Language Proficiency

The Bidder certifies that the proposed resource is capable of providing services in English at an Intermediate level.

Language Proficiency Grid			
Legend	**Oral**	**Comprehension**	**Written**
Basic	A person speaking at this level can: • ask and answer simple questions; • give simple instructions; • and give uncomplicated directions relating to routine work situations.	A person reading at this level can: • fully understand very simple texts; • grasp the main idea of texts about familiar topics; and • read and understand elementary points of information such as dates, numbers, or names from relatively more complex texts to perform routine job-related tasks	A person writing at this level can: • write isolated words, phrases, simple statements or questions on very familiar topics using words of time, place or person.
Intermediate	**A person speaking at this level can:** • **sustain a conversation on concrete topics; report on actions taken;** • **give straightforward instructions to employees; and** • **provide factual descriptions and explanations.**	• **A person reading at this level can:** • **grasp the main idea of most work-related texts;** • **identify specific details; and** • **distinguish main from subsidiary ideas.**	**A person writing at this level can:** • **deal with explicit information on work-related topics since they have sufficient mastery of grammar and vocabulary.**
Advanced	A person speaking at this level can: • support opinions; and understand and express hypothetical and conditional ideas	A person reading at this level can: • understand most complex details, inferences and fine points of meaning; and • have a good comprehension of specialized or less familiar material.	A person writing at this level can: • write texts where ideas are developed and presented in a coherent manner.

5.1.9 Procurement Business Number

Suppliers are required to have a Procurement Business Number (PBN) before contract award. Suppliers may register for a PBN online at Supplier Registration Information https://srisupplier.contractscanada.gc.ca/.

For non-Internet registration, suppliers may contact the InfoLine at 1-800-811-1148 to obtain the telephone number of the nearest Supplier Registration Agent.

Procurement Business Number (PBN): _____

Company Legal Name: _____

Company invoicing address : _____

_____

Financial contact : _____

Phone number : _____

E-mail address : _____

5.1.10 Certification and Information Verification

Compliance with the certifications bidders provide to Canada is subject to verification by Canada during the bid evaluation period (before award of a contract) and after contract award. The Contracting Authority will have the right to ask for additional information to verify bidders' compliance with the certifications before award of a contract. The bid will be declared non-responsive if any certification made by the Bidder is untrue, whether made knowingly or unknowingly. Failure to comply with the certifications or to comply with the request of the Contracting Authority for additional information will also render the bid non-responsive.

5.1.11 Insurance Requirements

The Bidder must provide a letter from an insurance broker or an insurance company licensed to operate in Canada stating that the Bidder, if awarded a contract as a result of the bid solicitation, can be insured in accordance with the Insurance Requirements specified in **Annex E**.

If the information is not provided in the bid, the Contracting Authority will so inform the Bidder and provide the Bidder with a time frame within which to meet the requirement. Failure to comply with the request of the Contracting Authority and meet the requirement within that time period will render the bid non-responsive.

Solicitation No. - N° de l'invitation	Amd. No. - N° de la modif.	Buyer ID - Id de l'acheteur
9F023-20230215-B		xxxxx
Client Ref. No. - N° de réf. du client	File No. - N° du dossier	CCC No./N° CCC - FMS No./N° VME
9F023-20230215-B	9F023-20230215-B	

CERTIFICTAION WITH SIGNATURE

We hereby certify compliance with the above noted certification requirements for:

5.1.1 Integrity Provisions - Declaration of Convicted Offences
5.1.2 Former Public Servant
5.1.3 Ineligibility and Suspension Policy
5.1.4 Integrity Provisions – List of Names
5.1.5 Status of Availability of Resources
5.1.6 Education and Experience
5.1.7 Federal Contractors Program for Employment Equity – Bid Certification
5.1.8 Language Proficiency
5.1.9 Procurement Business Number
5.1.10 Certification and Information Verification
5.1.11 Insruance Requirements

Signature

Date

Name (print or type) of person authorized to sign on behalf of the Organization

Phone : _____

E-Mail : _____

PART 6 - RESULTING CONTRACT CLAUSES

The following clauses and conditions apply to and form part of any contract resulting from the bid solicitation.

6.1 Security Requirements

There is no security requirement applicable to the Contract.

6.2 Statement of Work

The Contractor must perform the Work in accordance with the Statement of Work at Annex "A".

6.3 Standard Clauses and Conditions

All clauses and conditions identified in the Contract by number, date and title are set out in the Standard Acquisition Clauses and Conditions Manual (https://buyandsell.gc.ca/policy-and-guidelines/standard-acquisition-clauses-and-conditions-manual) issued by Public Works and Government Services Canada.

6.3.1 General Conditions

2010C(2022-12-01), General Conditions - Professional Services (Medium Complexity) apply to and form part of the Contract.

6.4 Term of Contract

6.4.1 Period of the Contract

The period of the Contract is from April 1, 2024 to March 31, 2025 inclusive.

6.4.2 Option to Extend the Contract

The Contractor grants to Canada the irrevocable option to extend the term of the Contract by **four (4) additional periods, of one (1) year each**, under the same terms and conditions. The Contractor agrees that, during the extended period of the Contract, it will be paid in accordance with the applicable provisions as set out in appendix B Terms of Payment.

Canada may exercise any or all option years to be awarded at any time during the contract period by sending a written notice to the Contractor before the Contract expiry date.

The option may only be exercised by the Contracting Authority, and will be evidenced for administrative purposes only, through a contract amendment.

6.5 Authorities

6.5.1 Contracting Authority

The Contracting Authority for the Contract is:

Mélanie Séguin
Procurement Specialist
Canadian Space Agency
Procurement & Contract Administration
6767 route de l’Aéroport

Saint-Hubert, QC, J3Y 8Y9
Telephone: (438) 364-1399
E-mail address: melanie.seguin@asc-csa.gc.ca

The Contracting Authority is responsible for the management of the Contract and any changes to the Contract must be authorized in writing by the Contracting Authority. The Contractor must not perform work in excess of or outside the scope of the Contract based on verbal or written requests or instructions from anybody other than the Contracting Authority.

6.5.2 Project Authority

The Project Authority for the Contract is: *(To be inserted at contract award)*

Name: _____
Title: _____
Organization: Canadian Space Agency
Address: _____
Telephone: ___ ___ _____
E-mail address: _____

The Project Authority is the representative of the department or agency for whom the Work is being carried out under the Contract and is responsible for all matters concerning the technical content of the Work under the Contract. Technical matters may be discussed with the Project Authority; however, the Project Authority has no authority to authorize changes to the scope of the Work. Changes to the scope of the Work can only be made through a contract amendment issued by the Contracting Authority.

6.5.3 Contractor's Representative

The Contractor's Representative for the Contract is: *(To be inserted at contract award)*

Name: _____
Address: _____
Telephone: ___ ___ _____
E-mail address: _____

6.6 Proactive Disclosure of Contracts with Former Public Servants

By providing information on its status, with respect to being a former public servant in receipt of a ***Public Service Superannuation Act*** (PSSA) pension, the Contractor has agreed that this information will be reported on departmental websites as part of the published proactive disclosure reports, in accordance with **Contracting Policy Notice: 2019-01** of the Treasury Board Secretariat of Canada.

6.7 Payment

6.7.1 Basis of Payment – Firm Prices

For the Work described in the Statement of Work in **Annex A:**

In consideration of the Contractor satisfactorily completing its obligations under the Contract, the Contractor will be paid firm prices for a cost of $_____ (*insert the amount at contract award*). Customs duties are included and Applicable Taxes are extra.

For the firm price portion of the Work only, Canada will not pay the Contractor for any design changes, modifications or interpretations of the Work unless they have been approved, in writing, by the Contracting Authority before their incorporation into the Work.

6.7.2 Limitation of expenditure

For the Work described in the Statement of Work in **Annex A**, the Contractor will be reimbursed for the costs reasonably and properly incurred in the performance of the Work, as determined in accordance with the Basis of Payment in **Annex B**, to a limitation of expenditure of $ _____ *(insert the amount at contract award)*. Customs duty is included and Goods and Services Tax or Harmonized Sales Tax is extra, if applicable.

No increase in the total liability of Canada or in the price of the Work resulting from any design changes, modifications or interpretations of the Work, will be authorized or paid to the Contractor unless these design changes, modifications or interpretations have been approved, in writing, by the Contracting Authority before their incorporation into the Work. The Contractor must not perform any work or provide any service that would result in Canada's total liability being exceeded before obtaining the written approval of the Contracting Authority. The Contractor must notify the Contracting Authority in writing as to the adequacy of this sum:

a) when it is 75 percent committed, or
b) four (4) months before the Contract expiry date, or
c) As soon as the Contractor considers that the contract funds provided are inadequate for the completion of the Work,

whichever comes first.

If the notification is for inadequate contract funds, the Contractor must provide to the Contracting Authority a written estimate for the additional funds required. Provision of such information by the Contractor does not increase Canada's liability.

6.7.3 Terms of Payment – Monthly Payment

Canada will pay the Contractor on a monthly basis for work performed during the month covered by the invoice in accordance with the payment provisions of the Contract if:

a. an accurate and complete invoice and any other documents required by the Contract have been submitted in accordance with the invoicing instructions provided in the Contract;

b. all such documents have been verified by Canada;

c. the Work performed has been accepted by Canada.

6.7.4 Electronic Payment of Invoices – Contract

The Government of Canada is phasing out paper cheques in favour of Direct Deposit for all payments issued by the Receiver General. Direct Deposit is a secure and reliable method of receiving payment, eliminating the risk of lost or stolen cheques. You will find all the information to enrol in direct deposit with Canadian Space Agency at : http://www.asc-csa.gc.ca/eng/forms/vendor-direct-depot-form.asp

6.8 Invoicing Instructions

The Contractor must submit invoices in accordance with the section entitled "Invoice Submission" of the general conditions.

Invoices cannot be submitted until all work identified in the invoice is completed.

Each invoice must be supported by:

a) a copy of time sheets to support the time claimed (breakdown of work performed including hours and percent completion);
b) a copy of the release document and any other documents as specified in the Contract (back-up invoices from suppliers and sub-trades showing actual amount paid and discounts, a Workplace Safety & Insurance Board (WSIB) certificate and statutory declaration for the second and all subsequent invoices);
c) a copy of the monthly progress report.

Invoices must be distributed as follows:

One (1) copy must be forwarded to the following address for certification and payment

CANADIAN SPACE AGENCY
9F023 – FINANCIAL SERVICES
Facturation-invoicing@asc-csa.gc.ca

One (1) copy must be forwarded to the Project Authority.

6.9 Applicable Laws

The Contract must be interpreted and governed, and the relations between the parties determined, by the laws in force in _____. *(To be inserted at contract award)*

6.10 Priority of Documents

If there is a discrepancy between the wording of any documents that appear on the list, the wording of the document that first appears on the list has priority over the wording of any document that subsequently appears on the list.

(a) the Articles of Agreement;
(b) the general conditions 2010C (2022-12-01), Services (Medium Complexity);
(c) Annex A, Statement of Work;
(d) Annex B, Basis of Payment;
(e) Annex E, Insurance Requirements
(f) the Contractor's bid dated _____. *(To be inserted at contract award)*

6.11 Replacement of Specific Individuals

If specific individuals are identified in the Contract to perform the Work, the Contractor must provide the services of those individuals unless the Contractor is unable to do so for reasons beyond its control.

If the Contractor is unable to provide the services of any specific individual identified in the Contract, it must provide a replacement with similar qualifications and experience. The replacement must meet the criteria used in the selection of the Contractor and be acceptable to Canada. The Contractor must, as soon as possible, give notice to the Contracting Authority of the reason for replacing the individual and provide:

(a) the name, qualifications and experience of the proposed replacement; and
(b) proof that the proposed replacement has the required security clearance granted by Canada, if applicable.

The Contractor must not, in any event, allow performance of the Work by unauthorized replacement persons. The Contracting Authority may order that a replacement stop performing the Work. In such a case, the Contractor must immediately comply with the order and secure a further replacement in accordance with subsection 2. The fact that the Contracting Authority does not order that a replacement stop performing the Work does not relieve the Contractor from its responsibility to meet the requirements of the Contract

6.12 Insurance – Commercial General Liability Insurance

SACC Manual clause G2001C (2018-06-21) Commercial General Liability Insurance

The Contractor must comply with the insurance requirements specified in **Annex E**. The Contractor must maintain the required insurance coverage for the duration of the Contract. Compliance with the insurance requirements does not release the Contractor from or reduce its liability under the Contract.

The Contractor is responsible for deciding if additional insurance coverage is necessary to fulfill its obligation under the Contract and to ensure compliance with any applicable law. Any additional insurance coverage is at the Contractor's expense, and for its own benefit and protection.

The Contractor must forward to the Contracting Authority within ten (10) days after the date of award of the Contract, a Certificate of Insurance evidencing the insurance coverage and confirming that the insurance policy complying with the requirements is in force. For Canadian-based Contractors, coverage must be placed with an Insurer licensed to carry out business in Canada, however, for Foreign-based Contractors, coverage must be placed with an Insurer with an A.M. Best Rating no less than “A-”. The Contractor must, if requested by the Contracting Authority, forward to Canada a certified true copy of all applicable insurance policies.

6.13 Performance Evaluation

Contractor must take note that the performance of the Contractor during and upon completion of the work must be evaluated by the Government of Canada. Should the Contractor's performance be considered unsatisfactory more than once, the Contractor's bidding privileges on future work may be suspended for a period of 18 months or 36 months.

Contractor Performance Evaluation Report Form is used to record the performance. See **ANNEX C**.

6.14 Dispute Resolution

(a) The parties agree to maintain open and honest communication about the Work throughout and after the performance of the contract.

(b) The parties agree to consult and co-operate with each other in the furtherance of the contract and promptly notify the other party or parties and attempt to resolve problems or differences that may arise.

(c) If the parties cannot resolve a dispute through consultation and cooperation, the parties agree to consult a neutral third party offering alternative dispute resolution services to attempt to address the dispute.

(d) Options of alternative dispute resolution services can be found on Canada’s Buy and Sell website under the heading “Dispute Resolution”.

ANNEX A - STATEMENT OF WORK

1. TITLE

High Voltage Maintenance Services

2. OBJECTIVE

The project objective is to provide labour and materials to perform high voltage maintenance services at the David Florida Laboratory (DFL) in Ottawa.

3. BACKGROUND

The David Florida Laboratory (DFL) is Canada's world-class spacecraft assembly, integration and testing center. The Laboratory is maintained and operated by the Canadian Space Agency (CSA). The facilities are located at 3701 Carling Avenue in Ottawa, Ontario as part of a shared, secure campus operated by Communications Research Centre Canada (CRC). The DFL comprises 13,000 m^2, spread over four levels with a mixed-use space primarily consisting of high bay laboratory clean room environments and office accommodations.

Built in 1971, the building is home to slightly more than 100 researchers, managers and clients employed by the Canadian space program. Due to aging infrastructure, CSA/DFL electrical systems require increased High and Medium Voltage Maintenance work for the building's main sub stations.

4. TYPICALLY REQUESTD SERVICES

Supply equipment, personnel protective equipment (PPE), materials, tools and labour to perform, repairs and/or maintenance work in accordance requirements in Appendix 1 "Specifications – Substation 65A/65B HV Maintenance Package" and perform testing and maintenance as per specifications and other documents included in this package.

In the absence of detailed specifications, execute work according to standard CSA/DFL quality standards and written work description provided by and the CSA/DFL Project Authority's instructions.

5. SCOPE (Contractor's responsibility)

CSA/DFL requires High and Medium Voltage Maintenance work for the building's main sub stations. The intent of this contract to provide additional resources in the form of personnel and materials to complete projects for repairs, maintenance, new installation, retrofits and all other related work.

Prior to the maintenance work, the Contractor must provide an updated electrical Single-Line Diagram, Arc Flash Hazard Analysis, Coordination Study and Short Circuit Analysis for the David Florida Laboratory based on an in depth site survey and investigation.

5.1 Labour (the resources)

Assign qualified personnel to provide labour, parts, materials, tools and equipment, for the provision of electrical services on an "**as and when requested**" basis at the David Florida Laboratory.

5.2 Equipment, tools and safety equipment

Supply equipment and tools to complete the work as per Project Authority instructions and/or Statement of Work; these have to be up to date, in good standing and CSA approved. CSA/DFL will not provide, rent or lend any tools and equipment to complete any portion of the work assigned to the contractor.

5.3 Materials

Unless otherwise specified, supply, deliver and install all materials required for project execution. All materials to be new with manufacturer's seal intact and label; all materials and equipments used must be ULC or CSA approved for designated application

The Contractor must be responsible for having its materials delivered to the CSA/DFL loading dock, then transporting said materials from the loading dock to the work site within 12 hours of delivery.

CSA/DFL reserves the right to supply materials and parts. The Contractor must be responsible for transporting said materials from the warehouse to the work site.

5.4 Removal of debris

Contractor must remove from the work site at the end of each work shift or as instructed by the Project Authority all building rubbish or debris as resulted from the work activity. Contractor will be responsible to clean the work area and any other space that has been affected by his activity. All debris must be disposed into appropriate bins (i.e. metal, paper, garbage) provided by the CSA/DFL.

5.5 Health and safety

Appropriate behaviour must be displayed by Contractors and any Sub-Contractor at all times in order to protect their own health and safety and of those working with and around them.

Working while impaired is strictly prohibited in all areas of the building, regardless of the substance, legal or otherwise. Smoking or vaping, including cannabis, is banned in all federal workplaces. Any worker in breach of this will be escorted off the campus immediately.

If cannabis is used by any personnel under this contract for any medical-prescribed reason, it must not impact the ability to perform the work safely, just like any other medication.

Ensure that all labour assigned to projects has received occupational health and safety training required by federal and provincial laws for construction and work in industrial and commercial sites, including but not limited to fall protection, working at heights, confined spaces and lift operation certification.

The purpose of these requirements is to minimize or eliminate risk to personnel health & safety and to the environment. All Contractors and Sub-Contractors performing work at CSA/DFL facilities are expected to comply with CSA/DFL applicable health and safety guidelines applicable laws and regulations that pertain to environmental, health and safety standards and/or work practices.

All labour must implement Lock Out/Tag Out that meets applicable laws and regulations that pertain to environmental, health and safety standards and/or work practices to include electrical and other forms of hazardous energy as necessary. All labour must have received prior training and will be briefed on in-house Lock Out/Tag Out (LOTO) procedure by their assigned Project Authority. Procedures must be strictly followed

All LOTO activities MUST be coordinated with the CSA/DFL Project Authority.

5.6 Service Availability

Ensure that labour is capable and available to perform the work according to the schedule agreed upon by the Contractor and the CSA/DFL within 24 hours from receipt of request, including 24-hour emergency service with a response time not to exceed three (3) hours.

Ensure that the personnel are capable and available to perform the work according to the schedule agreed upon by the Contractor and CSA/DFL Project Authority. Any repairs found during the inspections must be reported to the CSA/DFL Project Authority and provide a price to perform the repairs based on contract rates. If CSA/DFL Project Authority agrees to proceed with the repairs, work must be completed promptly upon receipt of approval.

A 24-hour emergency service is included in this contract with a response time not to exceed (3) three hours from when the call is placed to the arrival of a service technician.

The Contractor is to provide a single telephone contact for emergency services.

The minimum hours billed will be as per number indicated in Annex B – Basis of Payment.

5.7 Training

Assign trained, qualified labour. Ensure that all resources assigned to projects have the training, certificates or licenses of qualification require by law prior to performing any work.

5.8 Permits, Licenses and Certificates

All permits, licences and certificates of approval required for the Work to be completed under federal, provincial or municipal legislation must be obtained by contractor prior or after project completion whatever the case might be; the Contractor must be responsible for any charges imposed by such regulation or legislation. Upon request, CSA/DFL Project Authority might ask for a copy of such permit, licence or certificate.

5.9 Government Site Regulations

The Contractor must comply with all regulations, instructions and directives in force on the site where the Work is performed and is not limited to those mentioned in this RFP.

5.10 Building Security

All staff employed by the Contractor, regardless of hours of work, MUST sign IN and OUT and, enter the times of arrival and departure in registers or on sheets provided in a specific designated area. In the event of a dispute and the absence of other evidence, the Register will be regarded as evidence of hours of work. Failure to "sign in or out" will render the entry invalid.

Visitor badge must be prominently displayed at all times.

No audio/visual equipment or cameras are permitted in the buildings.

No cellular phones, 2-way radios or wireless phones are permitted in cleanroom areas.

5.11 Estimates

Begin work and/or any extra’s, only after receiving written approval issued by the CSA/DFL Project Authority. This approval to proceed must be issued only after the CSA/DFL Project Authority and the Contractor have agreed on the cost of work. The Contractor must advise CSA/DFL Project Authority if the cost of the work will exceed the initial amount agreed upon in writing before continuing any work. Revised written instructions will be provided by the CSA/DFL Project Authority confirming approval.

If such approval is not received in writing by the CSA/DFL Project Authority confirming the revised repair amount, CSA/DFL will not be responsible to pay any amount exceeding the initial repair cost that was agreed upon.

The CSA/DFL Project Authority can request the Contractor to provide a free estimate for different Work on the Facility premises as repairs, new installations, retrofits but not limited to. Quoted work might not necessarily be approved to proceed. If work is agreed upon, the invoice must be billed according to the above instructions with the necessary breakdown.

5.12 Pre-Commencement Meeting

A pre-commencement meeting is mandatory for the Contractor prior to commencing any work and minutes of the meeting will be taken. The time and place of this meeting will be determined by the Technical Authority.

6. SCHEDULE, TASKS & SPECIFICATIONS

6.1 Work schedule

Regular working hours (Monday to Friday from 7:00 am to 4:00 pm) - for executing the repairs/maintenance/test in and area where the CSA/DFL may be continuing their activities.

Work performed outside regular working hours (Monday to Friday from 4:00 pm to 7:00 am and Saturday, Sunday and holidays from 4:00pm Friday through 7:00am Monday and holidays) – for executing repairs/maintenance/test afterhours/overnight.

Emergency work – work performed on an emergency basis. Response time not to exceed 3 hours

6.2 Electrical Vaults Maintenance – see Appendix 1 (specifications)

Every job must be carried out subsequent to a request made on the prescribed requisition form or as the regular maintenance schedule.

The following is intended to demonstrate typical services and materials used by CSA/DFL and must not be construed as a complete list. The contractor must provide labor, tools and equipment to perform these and other tasks:

CSA/DFL building has an incoming service of 13.2kV which was upgraded from 8.3kV in 2011. The main service transformer is a 13.2kV-600/347V, 2250kVA, Skyway transformer.

Substation 65A is a 2500A, 85kA rated, 600V substation; switchgear is Commercial Switchgear Limited (CSL) and was installed in 1998 c/w an integral Automatic Transfer Switch (ATS) fed by a 1,500 kW building emergency generator.

Substation 65B contains the DFL building’s second main transformer, a 3000 kVA, 13.2kV-600/347V liquid filled transformer.

Substation 65A and 65B are connected together through a triple #500MCM bus and the incoming 13.2kV transformers are controlled by a Kirk Key Tie.

Other miscellaneous items: approximately forty-five (45) transformers of varying makes, models and ratings, busbars – medium to high voltage, lightning arrestors, load break switches, circuit breakers (120V-13.2KV), tie breaker, switchgear, switchboard, motor control centers and approximately 130 electrical distribution and branch panels.

ANNEX B – BASIS OF PAYMENT

During the Contract period, the Contractor will be paid as specified below, for Work performed in accordance with the Contract.

All-inclusive rates for work specified in the statement of work presented in Annex C. The all-inclusive rate includes all labour, materials, overhead, profits, related costs, etc. Customs duties are included and Applicable Taxes are extra.

Rates as offered per period will remain fixed during the course of the contract. Increases in yearly/hourly/m² rates will not be permitted during the contract period.

Firm Yearly Price	**Initial Contract Period** **April 1st, 2024 until March 31st, 2025**	**Option Year 1** **April 1st, 2025 until March 31st, 2026**	**Option Year 2** **April 1st, 2026 until March 31st, 2027**	**Option Year 3** **April 1st, 2027 until March 31st, 2028**	**Option Year 4** **April 1st, 2028 until March 31st, 2029**
Annual High Voltage Maintenance, Equipment Survey & Testing of Sub Stations 65A & 65B	$ _____	$ _____	$ _____	$ _____	$ _____
Single-Line Diagram Updating	$ _____	n/a	n/a	n/a	n/a
Arc Flash Hazard Analysis, Coordination Study & Short Circuit Analysis	$ _____	n/a	n/a	n/a	n/a
Arc Flash Hazard Report, Identification & Labelling	$ _____	n/a	n/a	n/a	n/a

Hourly rate – Monday to Friday 7:00am to 4:00pm					
Licensed Professional Engineer	$ _____	$ _____	$ _____	$ _____	$ _____
Licensed Electrician	$ _____	$ _____	$ _____	$ _____	$ _____
Apprentice Electrician	$ _____	$ _____	$ _____	$ _____	$ _____
Overtime – Monday to Friday 4:00pm to 7:00am					
Licensed Professional Engineer	$ _____	$ _____	$ _____	$ _____	$ _____
Licensed Electrician	$ _____	$ _____	$ _____	$ _____	$ _____
Apprentice Electrician	$ _____	$ _____	$ _____	$ _____	$ _____
Overtime – Saturday, Sunday and holidays (4:00pm Friday through 7:00am Monday and holidays)					
Licensed Professional Engineer	$ _____	$ _____	$ _____	$ _____	$ _____
Licensed Electrician	$ _____	$ _____	$ _____	$ _____	$ _____
Apprentice Electrician	$ _____	$ _____	$ _____	$ _____	$ _____
Emergency Work – 24/7 (maximum 3 hour response time)					
Licensed Professional Engineer	$ _____	$ _____	$ _____	$ _____	$ _____
Licensed Electrician	$ _____	$ _____	$ _____	$ _____	$ _____
Apprentice Electrician	$ _____	$ _____	$ _____	$ _____	$ _____
Other					
Minimum hours billed per services call	____ hour(s)	____ hour(s)	____ hour(s)	____ hour(s)	____ hour(s)
Percentage mark-up on materials (if applicable)	____ %	____ %	____ %	____ %	____ %
TOTALS					
Total limitation of Expenditure	$ _____	$ _____	$ _____	$ _____	$ _____
Taxes	$ _____	$ _____	$ _____	$ _____	$ _____
Total Limitation of Expenditure including Tax	$ _____	$ _____	$ _____	$ _____	$ _____

Solicitation No. - N° de l'invitation	Amd. No. - N° de la modif.	Buyer ID - Id de l'acheteur
9F023-20230215-B		xxxxx
Client Ref. No. - N° de réf. du client	File No. - N° du dossier	CCC No./N° CCC - FMS No./N° VME
9F023-20230215-B	9F023-20230215-B	

ANNEX C - PERFORMANCE EVALUATION REPORT

Contract #:		
Contractor's Name:	**Award Amt:**	**Award Date:**
Contractor's Address:	**Final Amt:**	**End Date:**
	Total Spent:	
	TA Contract:	☐ Yes ☐ No
Description of Work:	**Amendment History:**	
Client Department:		

Project Authority	**Procurement Authority**	**PWGSC Contracting Authority**
Name:	Name:	Name:
Telephone #:	Telephone #:	Telephone #
e-mail:	e-mail:	e-mail:

1. How do you rate the Contractor's overall performance?

☐ below expectations ☐ as expected ☐ above expectations

2. Resources

a. Did the Contractor provide the resources as identified in their Proposal?	☐ Yes	☐ No	
b. Did the Contractor's resources conduct their work in a professional manner?	☐ Yes	☐ No	
c. Were replacement resources required?	☐ Yes	☐ No	

3. Replacement Resources

a. Did the Contractor's request to replace the resources immediately after Contract Award?	☐ Yes	☐ No	☐ NA
b. Did the Replacement Resources meet the requirements of the RFP?	☐ Yes	☐ No	☐ NA
c. How many times were the Contractor's resources replaced?	☐ Yes	☐ No	☐ NA

4. Was the Contract completed wihin the predetermined:

a. Time Estimate?	☐ Yes	☐ No
b. Cost Estimate?	☐ Yes	☐ No

5. Were the required Reports and Deliverables:

a. In conformity with the Scope & Tasks of the SOW	☐ Yes	☐ No
b. Received in the specified time frame?	☐ Yes	☐ No

6. Contract Management

a. Did the Contractor deal with performance issues in a timely basis?	☐ Yes	☐ No	☐ NA
b. Did the Contractor submit the invoices in accordance with the Invoicing Instructions?	☐ Yes	☐ No	
c. Did the Contractor submit the invoices in accordance with the Basis of Payment?	☐ Yes	☐ No	
d. Did the Contractor submit the invoices in accordance with the Method of Payment?	☐ Yes	☐ No	
e. Did the Contractor respond to every TA Request?	☐ Yes	☐ No	☐ NA
f. Did the Contractor properly respond to every TA Request?	☐ Yes	☐ No	☐ NA

7. Remarks

ANNEX D - INTEGRITY FORM

To be included with certifications (Section III : Certifications):

Dénomination complète de l'entreprise / Complete Legal Name of Company	
Adresse de l'entreprise / Company's address	
NEA de l'entreprise / Company's PBN number	
Numéro de l'appel d'offre / Request for proposal's number	
Membres du conseil d'administration (Utilisez le format – Prénom, Nom **Board of Directors** (Use format – First name, Last name	
1. Membre / Director	
2. Membre / Director	
3. Membre / Director	
4. Membre / Director	
5. Membre / Director	
6. Membre / Director	
7. Membre / Director	
8. Membre / Director	
9. Membre / Director	
10. Membre / Director	
Autres Membres / Other members:	
Commentaires / Comments	

ANNEX E – INSURANCE REQUIREMENTS

1. The Contractor must obtain Commercial General Liability Insurance, and maintain it in force throughout the duration of the Contract, in an amount usual for a contract of this nature, but for not less than $2,000,000 per accident or occurrence and in the annual aggregate.

2. The Commercial General Liability policy must include the following:

   a. Additional Insured: Canada is added as an additional insured, but only with respect to liability arising out of the Contractor's performance of the Contract. The interest of Canada should read as follows: Canada, as represented by Public Works and Government Services Canada.

   b. Bodily Injury and Property Damage to third parties arising out of the operations of the Contractor.

   c. Products and Completed Operations: Coverage for bodily injury or property damage arising out of goods or products manufactured, sold, handled, or distributed by the Contractor and/or arising out of operations that have been completed by the Contractor.

   d. Personal Injury: While not limited to, the coverage must include Violation of Privacy, Libel and Slander, False Arrest, Detention or Imprisonment and Defamation of Character.

   e. Cross Liability/Separation of Insureds: Without increasing the limit of liability, the policy must protect all insured parties to the full extent of coverage provided. Further, the policy must apply to each Insured in the same manner and to the same extent as if a separate policy had been issued to each.

   f. Blanket Contractual Liability: The policy must, on a blanket basis or by specific reference to the Contract, extend to assumed liabilities with respect to contractual provisions.

   g. Employees and, if applicable, Volunteers must be included as Additional Insured.

   h. Employers' Liability (or confirmation that all employees are covered by Worker's compensation (WSIB) or similar program)

   i. Broad Form Property Damage including Completed Operations: Expands the Property Damage coverage to include certain losses that would otherwise be excluded by the standard care, custody or control exclusion found in a standard policy.

   j. Notice of Cancellation: The Contractor will provide the Contracting Authority thirty (30) days prior written notice of policy cancellation or any changes to the insurance policy.

   k. If the policy is written on a claims-made basis, coverage must be in place for a period of at least 12 months after the completion or termination of the Contract.

   l. Owners' or Contractors' Protective Liability: Covers the damages that the Contractor becomes legally obligated to pay arising out of the operations of a subcontractor.

   m. Sudden and Accidental Pollution Liability (minimum 120 hours): To protect the Contractor for liabilities arising from damages caused by accidental pollution incidents.

   n. Litigation Rights: Pursuant to subsection 5(d) of the Department of Justice Act, S.C. 1993, c. J-2, s.1, if a suit is instituted for or against Canada which the Insurer would, but for this clause, have the right to pursue or defend on behalf of

Canada as an Additional Named Insured under the insurance policy, the Insurer must promptly contact the Attorney General of Canada to agree on the legal strategies by sending a letter, by registered mail or by courier, with an acknowledgement of receipt.

For the province of Quebec, send to:

Director Business Law Directorate,
Quebec Regional Office (Ottawa),
Department of Justice,
284 Wellington Street, Room SAT-6042,
Ottawa, Ontario, K1A 0H8

For other provinces and territories, send to:

Senior General Counsel,
Civil Litigation Section,
Department of Justice
234 Wellington Street, East Tower
Ottawa, Ontario K1A 0H8

A copy of the letter must be sent to the Contracting Authority. Canada reserves the right to co-defend any action brought against Canada. All expenses incurred by Canada to co-defend such actions will be at Canada's expense. If Canada decides to co-defend any action brought against it, and Canada does not agree to a proposed settlement agreed to by the Contractor's insurer and the plaintiff(s) that would result in the settlement or dismissal of the action against Canada, then Canada will be responsible to the Contractor's insurer for any difference between the proposed settlement amount and the amount finally awarded or paid to the plaintiffs (inclusive of costs and interest) on behalf of Canada.

ANNEX F – CANADA POST'S INSTRUCTIONS

Public Services and Procurement Canada (PSPC) is moving forward on its Procurement Modernization Initiative, which aims to simplify the procurement process. The Bid Receiving Unit is launching an electronic bid submissions pilot using Canada Post's (CPC) Connect online service.

What is Canada Post Connect?

Canada Post Connect (CPC) is a secure, online service that allows users to share large, confidential files. Some of the service features include:

- large file transfers, allowing users to attach multiple 1 gigabyte (GB) files (any file type) in a single message
- the ability to track your electronic activity history
- privacy and security features that allow the processing of Protected B documents (which meet Government of Canada requirements).

Participants in the pilot project **will not incur any costs** for the use of the CPC**.**
Please note that a Canadian mailing address is required to use CPC. Should this be an issue for you, please contact us and we will be pleased to provide a work-around procedure to ensure you can still participate.

Benefits to businesses

Sending bid submission files via CPC means:

- a faster and more efficient bid submission process
- a green alternative to submitting paper files in-person, by mail or fax to a Bid Receiving Unit office
- a time and date stamp record for the upload of files in CPC

How to participate

Please confirm your participation to PSPC's Bid Receiving Unit at:
TPSGC.DGAreceptiondessoumissions-ABBidReceiving.PWGSC@tpsgc-pwgsc.gc.ca
Once you have confirmed your participation, the Bid Receiving Unit will explain the next steps and invite you to create a CPC account.

APPENDIX 1 – Specifications

Substation 65A/65B HV Maintenance Package

SECTION 26 05 00 - COMMON WORK RESULTS FOR ELECTRICAL

PART 1 GENERAL

1.1 SUMMARY

. 1 The contractor must perform testing and maintenance as per the drawings, specifications and other documents included in the package.

1.2 COMPLIANCES

.1 The work must comply with the latest addition of the following codes and standards. This list is not assumed to exhaustive; additional codes, standards or industry practices relevant to the work outlined herein must apply.

.1 Ontario Electrical Safety Code (OESC) and Bulletins.

.2 Any applicable local codes and requirements which govern the installation and maintenance of the equipment.

.3 CSA Certification Standards and Bulletins.

.4 CSA Z462. Workplace Electrical Safety Standard.

.5 NETA Maintenance Testing Specifications for Electrical Power Distribution Equipment and Systems.

.6 References given in 1.3 as applicable

.2 Where these codes, standards and references conflict, comply with the most stringent condition.

1.3 REFERENCES

.1 CSA C22.2 No. 0 General Requirements - Canadian Electrical Code - Part 2

.2 Electrical and Electronic Manufacturers Association of Canada (EEMAC)

.3 National Electrical Manufacturers Association (NEMA)

.4 Institute of the Electrical and Electronic Engineers (IEEE)

.5 Insulated Cable Engineers Association (ICEA)

.6 Canadian Standards Association (CSA)

.7 Underwriters Laboratories Canada (ULC)

.8 American National Standards Institute (ANSI)

.9 National Fire Protection Agency (NFPA)

.10 International Electrical Testing Association Inc (NETA)

1.4 DEFINITIONS

.1 The following are definitions used in Section 26.

.1 Inspection Authority means agent of any authority having jurisdiction over construction and safety standards associated with any part of electrical site work.

.2 Supply Authority means electrical power company or commission responsible for delivering electrical power to project site.

.3 OESC, Electrical Code or the Code means Ontario Electrical Safety Code in force at project location.

.4 CEC means latest edition of the Canadian Electrical Code.

.5 “Equipment Testing Sections” of this specification refers to the following specification sections:

.1 26 12 16 Dry Type, Medium Voltage Transformers
.2 26 13 18 Primary Switchgear Assembly to 15kV
.3 26 28 13 Fuses
.4 26 28 16 Circuit Breakers
.5 26 28 22 Load Break Switches

.6 “Equipment Testing” refers to the work performed in the sections noted in 1.4.1.5 above.

1.5 REQUIREMENTS

.1 Contract documents must have the following precedence:

.1 Drawings
.2 Specifications
.3 Test Sheets

.2 The contractor must:

.1 Assign a single point of contact Project Manager to the project. All project communications must be between this project manager and the owner’s delegate.

.2 Testing and maintenance will take place during the annual facility shutdown. The department representative or his delegate will coordinate the external disconnect and lockout of building services with the campus authority.

.3 Emergency Service interruptions must be coordinated with the department representative or his delegate and must be scheduled around the owner’s requirements and subject to the owner’s approval.

.4 Arrange and pay for Electrical Safety Authority inspections as required.

.5 Test and maintain equipment to the requirements of the specifications and drawings.

.6 Record test results on department representative provided test sheets. Test sheets must be provided in an electronic format (Word, Excel, or PDF.). Complete test sheets on portable computer at site while testing occurs. Provide department representative with CD copy of completed test sheets at the end of each day of work. The test sheets must be given back to the department representative in the same electronic format as given to the contractor.

.7 Test sheets have conditional formatting to indicate out of tolerance conditions. Where out of tolerance conditions are observed, (whether in a test sheet or other source) promptly consult with the onsite owner's delegate to determine appropriate action.

.8 All test equipment requiring calibration must be kept calibrated, in good standing, for the duration of the work. Provide calibration records.

.9 Where test sheets indicate tests that are not outlined in the specification, contractor to perform test as indicated on test sheet and record results.

.10 Create test sheet files from master sample files found in Appendix 2 for all equipment listed in the equipment inventory and any other equipment found within the substation switchgear during the Single-Line Diagram updating phase.

1.6 SUBMITTALS

.1 Schedule of Testing Equipment

.1 Submit within two (2) weeks of contract award, a typewritten list of testing equipment to be used. Include manufacturer name, equipment numbers, equipment name or description, copies of calibration certificates.

.2 Personnel

.1 Submit within two (2) weeks of contract award the qualifications of all personnel to be assigned to the project. Include personnel responsibilities, organizational and reporting structure.

.2 Qualifications of all indicated contractor personnel to perform the work.

.3 Notifications of testing personnel changes. These changes must be subject to the owner's acceptance and must be submitted, as a minimum, three (3) working days in advance for said acceptance.

.3 Cleaners and lubricants

.1 Submit within three (3) weeks of contract award, a typewritten list of cleaners and lubricants to be used complete with SDS sheets.

.4 Shop Drawings

.1 Submit shop drawings, catalogue cuts, descriptive literature of materials and Safety Data Sheets (such as insulating tape, cleaning materials, lubricants, solvents, etc) to be consumed on the project.

.5 Permits, Inspections, Test Reports, Certificates and Fees

.1 Submit to the department representative the necessary interim and final certificates of inspection and approval required by Inspection Authorities having jurisdiction over work, as evidence that work complies with laws and regulations of governing authorities.

.2 Notify Inspection Authorities in sufficient time to inspect work.

.3 Submit Inspection Authorities approval certificates.

.4 Pay associated fees and costs.

.6 Prior to starting equipment testing work Contractor must submit the following for approval:

.1 List of equipment to be used during testing.

.2 Copies of calibration certificate for each piece of equipment.

.3 Day-by-day testing schedule, based on owner's shutdown period. For each day on the schedule, provide a list of equipment to be tested and shutdown/re-energization times.

.4 Updated Single-Line Diagram, produced by the testing organization based on testing and verification – refer to subsection 1.15.2.1.

.5 Coordination Study based on Updated Single-Line Diagram.

.6 Arc-Flash Hazard Analysis Report.

.7 Test Report

.1 Contractor must submit a final compiled test report including:

.1 Updated Single-Line Diagram in AutoCAD format.

.2 Arc-Flash Hazard Analysis Report.

.3 Summary of Project.

.4 Description of equipment tested.

.5 Description of tests.

.6 Test data.

.7 Completed Test Sheets.

.8 Thermographic Survey Report.

.9 Description of Operations tests.

.10 Operational test reports.

.11 Analysis and recommendations.

.2 Test data records must include the following minimum requirements:

.1 Identification of the testing organization.

.2 Equipment identification.

.3 Humidity, temperature, and other conditions that may affect the results of the tests and/or calibrations.

.4 Date of inspections, tests, maintenance, and/or calibrations.

.5 Identification of the testing technician.

.6 Indication of inspections, tests, maintenance, and/or calibrations to be performed and recorded.

.7 Indication of expected results when calibrations are to be performed.

.8 Indication of "as-found" and "as-left" results, as applicable.

.9 Sufficient spaces to allow all results and comments to be indicated.

.3 The testing organization must furnish a copy or copies of the complete report to the department representative as specified in the acceptance testing contract.

.4 The final compiled test report must be supplied to the department representative in electronic format on CD at the completion of the project. The compiled report, as a minimum, must be given to the department representative in an OCR PDF format, without password protection.

1.7 EXECUTION

.1 Schedule work in consideration of the owner's operating schedule.

.1 Work must be scheduled during the owner's annual shutdown period. Coordinate exact dates with the department representative or his delegate.

.2 Regular work must be performed between 8am and 4pm, Monday through Friday. Power shut downs will most likely occur on weekends.

.3 Exact time of daily shutdown and re-energization must be coordinated with the department representative or his delegate. Contractor must complete daily work at least two (2) hours prior to anticipated re-energization time.

1.8 TESTS

.1 Test and check electrical systems for correct operation and compliance with statutory and regulatory authority requirements.

.2 Perform tests in the presence of the owner. Log, tabulate, sign and include test results in the Operation and Maintenance Manuals.

1.9 COORDINATION

.1 Coordinate the testing and maintenance work of electrical equipment with other Sections of this Contract.

.2 Coordinate the thermographic and ultrasonic survey planning with site electrician. The Contractor will be responsible for the actual removal of panels to open live equipment during surveys.

.3 Special requirements for live work:

.4 Contractor to clearly identify in the work schedule access requirements to the facilities and owner’s resources required to perform the live work.

.5 Contractor must provide ten (10) working days advance notice to the department representative so that the department representative can arrange for resources and access to the owner’s equipment/premises for the contractor to perform the live work.

.6 The Contractor is responsible for coordinating with the department representative all live work on energized equipment to facilitate parameter measurement and operational checks in the pre and post de-energized maintenance shutdown work.

.7 Contractor must be aware that any third party contractors already on site may delay the contractor’s anticipated schedule.

1.10 TEMPORARY POWER

.1 Contractor must be responsible to provide temporary power for testing during utility isolation periods.

1.11 ARC FLASH HAZARD

.1 It is noted that the majority of the existing equipment do not have arc flash labels affixed.

.2 Prior to the first shut down for maintenance testing, the contractor must perform an Arc Flash Hazard Analysis for the entire David Florida Laboratory Building in accordance with CSA Z462-12 and provide the associated report. Affix Arc Flash Hazard Labels to all equipment within the substations 65A and 65B. Arc Flash Hazard Labels must comply with CSA Z462-12 and include Shock Protection Data in addition to Arc Flash Hazard Data as per NFPA 70E.

.1 Arc Flash Hazard Analysis, Coordination Study and Short Circuit Analysis must be performed and stamped by a Professional Engineer licensed to practice Electrical Engineering in the province of Ontario (ie. licensed by Professional Engineers of Ontario – PEO).

.2 Arc Flash Hazard Report must be presented in an easy to understand format using spreadsheets, tables or drawings to identify Arc Flash Hazard Levels for each piece of equipment.

.3 Provide sample labels for approval by the department representative or his delegate prior to affixing labels to equipment.

.3 Arc Flash Hazard Analysis must be based on an updated Single-Line Diagram(s).

.1 Contractor must be responsible for updating the Single-Line Diagram(s) of the existing facility based on the existing Single-Line Diagram as provided by the department representative and by performing onsite testing and verification as required. Refer to subsection 1.15.2.1.

.2 Single-Line Diagrams must be updated prior to the Arc Flash Hazard Analysis.

.3 When it is that a panel be de-energized in order to confirm power source, the outage is to be coordinated with the department representative or his delegate. It must be noted that scheduling panel shutdowns may be difficult based on the programs active on site. Sufficient time must be allotted to ensure the Single-Line Diagrams and arc flash hazard analysis be completed prior to the annual shutdown.

.4 Provide the updated Single-Line Diagram to the department representative or his delegate in AutoCAD format.

.5 When performing testing for supply verification for Single-Line Diagram creation, contractor must provide PPE as recommended by CSA Z462 for work near unlabelled equipment.

.4 If the arc flash hazard category cannot be calculated, contractor must assume hazard/risk category is 4 or in accordance with CSA Z462.

.5 Contractor must provide to their own personnel and sub-contractors Personal Protective Equipment (PPE) required to suit the arc flash hazard/risk category (as calculated above) of the equipment being surveyed and/or tested in an energized state. Contractor must ensure personnel and sub-contractors use recommended tools in accordance with CSA Z462-12.

.6 No work on energized equipment must be permitted unless proper PPE and procedures are followed as outlined in CSA Z462.

.7 Arc Flash Hazard Analysis must be performed with software compliant to NFPA 70E and IEEE 1584. The Bidder must specify software used for Analysis at time of Tender bid submission for approval by the department representative or his delegate.

1.12 QUALITY ASSURANCE

.1 Qualifications: electrical work to be carried out by qualified, licensed electricians who hold valid Master Electrical Contractor license or apprentices in accordance with authorities having jurisdiction as per the conditions of Provincial Act respecting manpower vocational training and qualification.

.2 Employees registered in provincial apprentices program: permitted, under direct supervision of qualified licensed electrician, to perform specific tasks.

.3 Test Instrument Calibration

.1 The testing organization must have a calibration program which assures that all applicable test instruments are maintained within rated accuracy for each test instrument calibrated.

.2 The firm providing calibration service must maintain up-to-date instrument calibration instructions and procedures for each test instrument calibrated.

.3 The accuracy must be directly traceable to the National Research Council (NRC).

.4 Instruments must be calibrated in accordance with the following frequency schedule:

.1 Field instruments: Analog, 6 months maximum. Digital, 12 months maximum.

.2 Laboratory instruments: 12 months maximum.

.3 Leased speciality equipment: 12 months maximum.

.4 Dated calibration labels must be visible on all test equipment.

.5 Records, which show date and results of instruments calibrated or tested, must be kept up to date.

.6 Calibrating standard must be of better accuracy than that of the instrument tested.

1.13 QUALIFICATIONS OF TESTING AND MAINTENANCE ORGANIZATIONS AND PERSONNEL

.1 Testing and Maintenance Organization

.1 The organization must be an independent, third party entity which can function as an unbiased testing authority, professionally independent of the manufacturers, suppliers, and installers of equipment or systems being evaluated.

.2 The organization must be regularly engaged in the testing and maintenance of electrical equipment devices, installations, and systems.

.3 The organization must use technicians who are regularly employed for testing and maintenance services.

.4 The organization must use technicians/electricians trained to the requirements of The Electrical Utilities Safety Association’s Work Protection Code and qualified to hold Station or Outage guarantees from Hydro Ottawa.

.5 The organization must either be registered with the Electrical Safety Authorities Approved Contractor Program or obtain electrical permits for the work from the Electrical Safety Authority.

.6 The organization must submit appropriate documentation to demonstrate that it satisfactorily complies with these requirements.

.2 Testing Personnel

.1 Technicians performing these electrical tests, inspections and maintenance must be trained and experienced concerning the apparatus and systems being evaluated and serviced. These individuals must be capable of conducting the work in a safe manner and with complete knowledge of the hazards involved. They must evaluate the test data and make a judgment on the serviceability of the specific equipment.

1.14 SAFETY

.1 Safety and Precautions: All parties involved must be cognizant of applicable safety procedures. This document does not include any procedures, including specific safety procedures. It is recognized that an overwhelming majority of the tests and inspections recommended in these specifications are potentially hazardous. Individuals performing these tests must be capable of conducting the tests in a safe manner and with complete knowledge of the hazards involved.

.2 Safety practices must include, but are not limited to, the following requirements:

.1 All applicable provisions of the Occupational Safety and Health Act.

.2 Applicable Federal and Provincial safety operating procedures.

.3 Owner's safety practices.

.4 CAN/CSA Z462 Work Place Electrical Safety.

.5 CAN/CSA Z460 Control of Hazardous Energy, Lock Out and Other Methods

.6 CAN/CSA C225 Vehicle mounted aerial devices

.3 A safety lead person must be identified prior to commencement of work.

.4 A safety briefing must be conducted prior to the commencement of work.

.5 All tests must be performed with the apparatus de-energized and grounded except where otherwise specifically required to be ungrounded or energized for certain tests.

.6 The testing organization must have a designated safety representative on the project to supervise operations with respect to safety. This individual may be the same person described in Part 1.14.3.

1.15 DIVISION OF RESPONSIBILITY

.1 The department representative or his delegate must provide the testing organization with the following:

.1 Existing Single-Line Diagram for reference only.

.2 Drawings and instruction manuals applicable to the scope of work.

.3 Site-specific hazard notification and safety training.

.2 The testing organization must provide the following:

.1 Main Single-Line Diagram(s) to accurately reflect existing conditions at David Florida Laboratory. The testing organization must perform all required testing and verification to confirm source of all electrical equipment down to distribution panels including all sub-panels. This information must be reflected on the Single-Line Diagram.

.2 Arc Flash Hazard Analysis, Coordination Study and Short Circuit Analysis for David Florida Laboratory based on Main Single-Line Diagram as produced by testing organization. Refer to subsection 1.11.2.

.3 All field technical services, tooling, equipment, instrumentation, and technical supervision to perform such tests and inspections as outlined herein.

.4 A suitable and stable source of independent electrical power to support all testing and maintenance.

.5 Notification to the user prior to commencement of any testing.

.6 A timely notification of any system, material, or workmanship that is found deficient based on the results of the acceptance tests.

.7 A written record of all tests and a final report.

PART 2PRODUCTS

2.1 ACCEPTED MATERIALS

.1 Materials: CSA approved or by Agencies approved by ESA for use as installed. Where equipment or material is not CSA approved or certified, obtain and pay for special acceptance from Inspection Authorities.

.2 Wiring Accessories:

.1 Wire markers: Plastic slip-on, black letters on white background. Shur-Code by Thomas & Betts Ltd. Z-Type by Wieland Electric Inc.

.2 Cable phase markers: For cables or conductors greater than 13 mm diameter, mark phasing using colour coded electrical insulating tape.

.3 Low voltage (1000V and lower) terminations: Heat shrinkable connection kit, including sleeves, caps and sealant by Raychem Canada Ltd.

.4 Cable ties: Nylon, one-piece, self-locking type, by Thomas & Betts Ltd., Burndy Inc., Wieland Electric Inc. or approved equivalent.

.5 Electrical insulating tape: Scotch 33 by 3M Canada Inc. or approved equivalent.

2.2 SUITABILITY OF TEST EQUIPMENT

.1 All test equipment must meet the requirements in Part 1.12.3 and be in good mechanical and electrical condition.

.2 Field test metering used to check power system meter calibration must be more accurate than the instrument being tested.

.3 Accuracy of metering in test equipment must be appropriate for the test being performed.

.4 Waveshape and frequency of test equipment output waveforms must be appropriate for the test and the tested equipment.

.5 Poly phase metering and protective relaying equipment must be tested using integrated equipment capable of delivering three independent current sources and three independent Voltage sources. These sources must be capable of adjusting the phase relationship between all sources to simulate poly phase AC system phase rotation, power factor, etc. All sources must have adjustable magnitude and frequency.

PART 3EXECUTION

3.1 GENERAL

. 1 Test and maintain electrical equipment indicated on Single-Line Diagrams.

.1 Coordinate the service interruptions and testing hours with the department representative or his delegate. Cooperate with the owner's service staff to facilitate a controlled shut down and restart of the facility. The owner's staff must shut the facility processes down for the service interruption.

.2 Do not operate or interfere with equipment outside of the project scope of work.

.3 Respect the schedule provided in the work package. As critical infrastructure the facilities must return to service at times indicated as mandatory by the owner.

3.2 CONDUCTORS

.1 To facilitate electrical testing, it will be necessary to disconnect and connect electrical conductors. Appendix D, Power Cable Splicing & Terminating instructions must be used

as a guide for splicing and terminating cables. An alternate written procedure may be suggested and utilized by the contractor upon receipt of written approval from the owner.

.1 Replace taped insulated connections with same.

.2 Where heat shrinkable terminations have been opened, replace with new.

.3 Reuse “boot style” connection insulation assemblies.

3.3 EQUIPMENT TESTING

.1 Refer to subsequent Equipment Testing Sections for testing requirements.

3.4 SYSTEM FUNCTION TESTS

.1 It is the purpose of system function tests to prove the correct interaction of all sensing, processing, protection and action devices.

.2 Perform system function tests upon completion of the maintenance tests defined, as system conditions allow.

.1 System function tests involve the entire circuit; protection devices, current transformer primary and secondary windings (where applicable), relay coils(where applicable), trip and alarm circuits and SCADA system (where applicable).

.2 Develop test parameters and perform tests for the purpose of evaluating performance of all integral components and their functioning as a complete unit within design requirements and manufacturer’s published data.

.3 All tripping and alarm circuits must be tested by means of primary element injection in the associated devices, test results recorded and submitted in addition to all the test sheets found herein.

.4 Verify the correct operation and sequencing of all interlock safety devices for fail-safe functions in addition to design function.

.5 Verify that the correct circuit breakers are tripped. Record observations.

.6 Verify that the correct alarm circuits are energized. Record observations.

.7 Verify that the correct flag indications are given. Record observations.

.8 Verify the correct operation of all sensing devices, alarms, and indicating devices. Record observations.

.9 Verify that there is no maloperation of other apparatus that may be connected to the same master trip relay or circuit breaker. Record observations.

3.5 THERMOGRAPHIC AND ULTRASONIC SURVEY

.1 A thermographic survey must be performed on all operational electrical systems (in SUB 65A & SUB 65B, as a minimum, equipment to be inspected must include all current-carrying devices) in addition to and prior to commencing the equipment de-energization for Equipment Testing, as a means to identify issues to be further tested and corrected.

.2 The thermographic survey must be repeated upon re-energization, post completion of Equipment Testing Sections of this specification, on all operational electrical systems to be compared to the survey outlined in Part 3.5.1.

.3 Visual and Mechanical Inspection (Thermographic)

.1 The inspection of the physical and mechanical condition of equipment must be performed in accordance with Equipment Testing Sections of this document.

.2 Remove all necessary covers prior to thermographic inspection. Use appropriate caution, safety devices, and personal protective equipment.

.4 Thermographic Survey Report

.1 Provide a report which includes the following:

.2 Description of equipment to be tested, with reference to the Owner's equipment identifications found on the drawings and inspection & test sheets.

.3 Discrepancies.

.4 Temperature difference between the area of concern and the reference area.

.5 Probable cause of temperature difference.

.6 Areas inspected. Identify inaccessible and/or unobservable areas and/or equipment.

.7 Identify load conditions at time of inspection.

.8 Provide photographs and/or thermograms of all deficient areas.

.9 Provide recommended action for repair.

.10 Remove all necessary covers prior to thermographic inspection. Use appropriate caution, safety devices, and personal protective equipment as per Part 1.11.

.11 A comparison of survey results in Parts 3.5.1 and 3.5.2 identifying any changes in the thermograms must be included in the report.

.5 Thermographic Test Parameters

.1 Inspect distribution systems with imaging equipment capable of detecting a minimum temperature difference of 1° C at 30° C.

.2 Equipment must detect emitted radiation and convert detected radiation to visual signal.

.3 Thermographic surveys should be performed during periods of maximum possible loading. Refer to CSA Z462 and ANSI/NFPA 70B, Section 20.17.

.6 Thermographic Test Values

Suggested actions based on temperature rise can be found in Table 100.18.

.7 An Ultrasonic survey must be performed on all operational electrical systems (as a minimum, equipment to be inspected must include all insulators, overhead electrical lines, cables/conductors, switchgear, bus bars, bus ducts, contactors, transformers and bushings related to all equipment identified to be tested within the contract documents) in addition to and prior to commencing the equipment de-energization for Equipment Testing, as a means to identify arcing, corona and tracking issues to be further tested and corrected.

.8 Visual and Mechanical Inspection (Ultrasonic)

.1 The inspection of the physical and mechanical condition of equipment must be performed in accordance with Equipment Testing Sections of this document.

.2 Loosen all necessary covers prior to ultrasonic inspection. Use appropriate caution, safety devices, and personal protective equipment.

.9 Ultrasonic Test Parameters

.1 Contractor must determine severity of fault and level of acceptability based on best practice and typical industry ultrasonic test results.

.2 The consultant must provide and identify a level of quantitative acceptability for the measurements and test results.

10, Tighten lugs and connectors found to be loose during Ultrasonic and/or Thermographic inspections.

3.6 Energized (LIVE) Equipment Parameter Measurements

.1 The contractor is responsible for coordinating with the department representativeall live work on energized equipment to facilitate the measurement of operating parameters identified in the maintenance, inspection and test procedures and test sheets during the pre and post de-energized equipment state as indicated or required to prove the serviceability of the equipment.

.2 Examples of operational parameter measurements are current for power capacitors, transformer winding temperatures, line currents on conductors, battery charger voltage and current, etc. to compare to the nameplate data.

3.7 MAINTENANCE

.1 Refer to subsequent sections and manufacturer’s instructions for maintenance requirements.

3.8 WIRING IDENTIFICATION

.1 Identify existing control wiring being tested with new wire markers where original markers are illegible.

.2 Use David Florida Laboratory electrical color management system for marking existing wiring being tested where original markings are illegible.

END OF SECTION

SECTION 26 12 16 - DRY TYPE, MEDIUM VOLTAGE TRANSFORMERS

Part 1 GENERAL

1.1 SUMMARY

.1 The contractor must perform testing and maintenance as per the drawings, specifications and other documents included in the package.

1.2 SUBMITTALS

.1 Submit completed test sheets for all dry type, medium voltage transformers noted on the single line diagram and in the equipment inventory list.

PART 2 EXECUTION

2.1 INSPECTION, TESTING & MAINTENANCE

. 1 Visual and Mechanical Inspection

- .1 Inspect physical and mechanical condition including evidence of moisture and corona.
- .2 Inspect anchorage, alignment and grounding.
- .3 Prior to cleaning the unit, perform as-found tests, if required.
- .4 Clean the unit.
- .5 Verify that control and alarm settings on temperature indicators are as specified.
- .6 Verify that cooling fans operate correctly.
- .7 Verify all alarm points and temperature gauges are in good working condition and calibrate as required.
- .8 Inspect bolted electrical connections for high resistance using one of the following methods:
  - .1 Use of a low-resistance ohmmeter.
  - .2 Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer’s published data or Table 100.12 in Appendix 2.
- .9 Perform specific inspections and mechanical tests as recommended by the manufacturer.
- .10 Perform as-left tests.
- .11 Verify that as-left tap connections are as specified.
- .12 Verify the presence of surge arrestors.

. 2 Electrical Tests

- .1 Perform resistance measurements through bolted connections with a low-resistance ohmmeter, if applicable.
- .2 Perform insulation-resistance tests winding-to-winding and each winding-to-ground. Apply voltage in accordance with manufacturer’s published data. In the absence of manufacturer’s published data, use Table 100.5 in Appendix 2. Calculate polarization index.
- .3 Perform insulation power-factor or dissipation-factor tests on all windings in accordance with the test equipment manufacturer’s published data.
- .4 Perform turns-ratio tests at the designated tap position.
- .5 Perform an excitation-current test on each phase.

.6 Measure the resistance of each winding at the designated tap position.

.7 Measure core insulation resistance at 500 volts dc if the core is insulated and if the core ground strap is removable.

.8 Perform an applied voltage test on all high- and low-voltage windings-to-ground. See ANSI/IEEE C57.12.91.

.9 Verify correct secondary voltage phase-to-phase and phase-to-neutral after energization and prior to loading.

. 3 Test Values – Visual and Mechanical

.1 Control and alarm settings on temperature indicators should operate within manufacturer's recommendations for specified settings.

.2 Cooling fans should operate.

.3 Compare bolted connection resistance values to values of similar connections. Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.

.4 Bolt-torque levels should be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.12 in Appendix 2.

.5 Tap connections must be left as found unless otherwise specified.

. 4 Test Values – Electrical

.1 Compare bolted connection resistance values to values of similar connections. Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.

.2 Minimum insulation-resistance values of transformer insulation should be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.5 in Appendix 2. Values of insulation resistance less than this table or manufacturer's recommendations should be investigated. The polarization index must be compared to previously obtained results and should not be less than 1.0.

.3 CH and CL power-factor or dissipation-factor values will vary due to support insulators and bus work utilized on dry transformers. The following should be expected on CHL power factors:

- Power transformers: 2.0 percent or less
- Distribution transformers: 5.0 percent or less

Consult transformer manufacturer's or test equipment manufacturer's data for additional information.

.4 Power-factor or dissipation-factor tip-up exceeding 1.0 percent should be investigated.

.5 Turns-ratio test results should not deviate more than one-half percent from either the adjacent coils or the calculated ratio.

.6 The typical excitation current test data pattern for a three-legged core transformer is two similar current readings and one lower current reading.

.7 Temperature-corrected (to 75 degrees C) winding-resistance values (corrected for aluminum or copper windings, as required) should compare within one percent of previously-obtained results.

.8 Core insulation-resistance values should be comparable to previously-obtained results but not less than one megaohm at 500 volts dc.

.9 Phase-to-phase and phase-to-neutral secondary voltages should be in agreement with nameplate data.

.10 Test results for surge arresters must be in accordance with this specification, if applicable.

END OF SECTION

SECTION 26 13 18 - PRIMARY SWITCHGEAR ASSEMBLY TO 15kV

Part 1 GENERAL

1.1 SUMMARY

.1 The contractor must perform testing and maintenance as per the drawings, specifications and other documents included in the package.

1.2 SUBMITTALS

.1 Submit completed test sheets for all switchgear assemblies noted on the single line diagram and in the equipment inventory list.

PART 2 EXECUTION

2.1 INSPECTION, TESTING & MAINTENANCE

.1 Primary Switchgear Assembly to 15kV

.1 Visual and Mechanical Inspection

.1 Inspect physical electrical and mechanical condition including evidence of moisture or corona.

.2 Inspect anchorage, alignment, grounding and required clearances.

.3 Prior to cleaning the unit, perform as-found tests, if required.

.4 Clean the unit.

.5 Verify that fuse and/or circuit breaker sizes and types correspond to drawings and coordination study as well as to the circuit breaker’s address for microprocessor-communication packages.

.6 Verify that current and voltage transformer ratios correspond to drawings.

.7 Inspect bolted electrical connections for high resistance using the following method:

.1 Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer’s published data or Table 100.12 in Appendix 2.

.8 Confirm correct operation and sequencing of electrical and mechanical interlock systems.

.1 Attempt closure on locked-open devices. Attempt to open locked-closed devices.

.2 Make key exchange with all devices included in the interlock scheme as applicable.

.9 Use appropriate lubrication on moving current-carrying parts and on moving and sliding surfaces.

.10 Verify correct barrier and shutter installation and operation.

.11 Exercise all active components.

.12 Inspect mechanical indicating devices for correct operation.

.13 Verify that filters are in place and/or vents are clear.

.14 Perform visual and mechanical inspection of instrument transformers in accordance with this specification.

.15 Inspect control power transformers.

.1 Inspect for physical damage, cracked insulation, broken leads, tightness of connections, defective wiring, and overall general condition.

.2 Verify that primary and secondary fuse ratings or circuit breakers match drawings.

.3 Verify correct functioning of draw out disconnecting and grounding contacts and interlocks.

.16 Perform as-left tests.

.2 Electrical Tests

.1 Perform resistance measurements through bolted electrical connections with a low-resistance ohmmeter in accordance with this specification, if applicable.

.2 Perform insulation–resistance tests on each bus section, in accordance with this specification.

.3 Perform an over potential test on each bus section, in accordance with this specification.

.4 Perform insulation-resistance tests on control wiring with respect to ground. The applied potential must be 500 volts dc for 300-volt rated cable and 1000 volts dc for 600-volt rated cable. Test duration must be one minute. For units with solid-state components or control devices that cannot tolerate the applied voltage, follow manufacturer’s recommendation.

.5 Perform electrical tests on instrument transformers in accordance with this specification.

.6 Perform ground–resistance tests in accordance with this specification.

.7 Determine accuracy of all meters and calibrate watt-hour meters in accordance with this specification.

.8 Control Power Transformers

.1 Perform insulation-resistance tests in accordance with this specification.

.2 Verify correct function of control transfer relays located in switchgear with multiple power sources in accordance with this specification.

.9 Verify operation of switchgear/switchboard heaters and their controller, if applicable.

.10 Perform system function tests in accordance with this specification.

.3 Test Values – Visual and Mechanical

.1 Compare bolted connection resistance values to values of similar connections. Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.

.2 Bolt-torque levels should be in accordance with manufacturer’s published data. In the absence of

manufacturer's published data, use Table 100.12 in Appendix 2.

.4 Test Values – Electrical

.1 Compare bolted connection resistance values to values of similar connections. Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.

.2 Insulation-resistance values of bus insulation should be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 in Appendix 2. Values of insulation resistance less than this table or manufacturer's recommendations should be investigated. Over potential tests should not proceed until insulation-resistance levels are raised above minimum values.

.3 If no evidence of distress or insulation failure is observed by the end of the total time of voltage application during the over potential test, the test specimen is considered to have passed the test.

.4 Minimum insulation-resistance values of control wiring should be comparable to previously obtained results but not less than two megaohms.

.5 Results of electrical tests on instrument transformers should be in accordance with this specification.

.6 Results of ground resistance tests should be in accordance with this specification.

.7 Accuracy of meters should be in accordance with this specification.

.8 Control Power Transformers

.1 Insulation-resistance values of control power transformers should be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.5 in Appendix 2. Values of insulation resistance less than this table or manufacturer's recommendations should be investigated. Over potential tests should not proceed until insulation-resistance levels are raised above minimum values.

.2 Control transfer relays should perform as designed.

.9 Heaters should be operational.

.10 Results of system function tests must be in accordance with this specification.

.2 <u>Busbar, up to 750V</u>

.1 Visual and Mechanical Inspection

.1 Inspect physical and mechanical condition.

.2 Inspect anchorage, alignment, and grounding.

.3 Inspect installation, supports and insulation.

.4 Verify identification of phasing.

.5 Inspect bolted electrical connections for high resistance using one of the following methods:

.1 Use of a low-resistance ohmmeter.

.2 Verify tightness of accessible bolted electrical connections and bus joints by calibrated torque-wrench method in accordance with manufacturer's published data or Table 100.12 in Appendix 2.

.2 Electrical Tests

.1 Perform resistance measurements through bolted connections and bus joints with a low-resistance ohmmeter, if applicable.

.2 Perform phasing test on each bus way tie section energized by separate sources. Tests must be performed from their permanent sources. Mark each phase uniquely prior to disassembly for testing to ensure proper reassembly after testing.

.3 Perform insulation resistance tests on each bus duct for ten minutes, each phase-to-ground. Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 in Appendix 2.

.4 Verify operation of bus duct heaters, if applicable

.3 Test Values – Visual and Mechanical

.1 Compare bolted connection resistance values to values of similar connections. Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.

.2 Bolt-torque levels should be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.12 in Appendix 2.

.4 Test Values – Electrical

.1 Compare bolted connection resistance values to values of similar connections. Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.

.2 Insulation-resistance test voltages and resistance values must be in accordance with manufacturer's specifications or Table 100.1 in Appendix 2.

.3 Heaters should be operational.

.3 <u>Busbar, medium to high voltage</u>

.1 Visual and Mechanical Inspection

.1 Inspect physical and mechanical condition.

.2 Inspect anchorage, alignment, and grounding.

.3 Inspect installation, supports and insulation.

.4 Verify identification of phasing.

.5 Inspect bolted electrical connections for high resistance using one of the following methods:

.1 Use of a low-resistance ohmmeter.

.2 Verify tightness of accessible bolted electrical connections and bus joints by calibrated torque-wrench method in accordance with manufacturer's published data or Table 100.12 in Appendix 2.

.2 Electrical Tests

.1 Perform resistance measurements through bolted connections and bus joints with a low-resistance ohmmeter, if applicable.

.2 Perform phasing test on each bus way tie section energized by separate sources. Tests must be performed from their permanent sources. Mark each phase uniquely prior to disassembly for testing to ensure proper reassembly after testing.

.3 Perform insulation resistance tests on each bus duct for ten minutes, each phase-to-ground. Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 in Appendix 2.

.4 Perform an over potential test on each bus section, phase-to-ground with phases not under test grounded, in accordance with this manufacturer's published data. If manufacturer has no recommendation for this test it must be in accordance with table 100.17 in Appendix 2. The test voltage must be applied for 1 minute.

.5 Perform high voltage power factor / dissipation factor tests on each section of bus. Perform high voltage power factor / dissipation factor tests in accordance with manufacturer's instructions manual.

.6 Verify operation of bus duct heaters, if applicable

.3 Test Values – Visual and Mechanical

.1 Compare bolted connection resistance values to values of similar connections. Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.

.2 Bolt-torque levels should be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.12 in Appendix 2.

.4 Test Values – Electrical

.1 Compare bolted connection resistance values to values of similar connections. Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.

.2 Insulation-resistance test voltages and resistance values must be in accordance with manufacturer's specifications or Table 100.1 in Appendix 2. Over potential tests must not proceed until insulation-resistance levels are raised above minimum values.

.3 If no evidence of distress or insulation failure is observed by the end of the total time of voltage application during the

over potential test, the test specimen is considered to have passed the test.

.4 Compare high power factor / dissipation factor values with the manufacturer's specifications and other cables of similar construction.

.5 Heaters should be operational.

END OF SECTION

SECTION 26 28 13 - FUSES

Part 1 GENERAL

1.1 SUMMARY

.1 The contractor must perform testing and maintenance as per the drawings, specifications and other documents included in the package.

1.2 SUBMITTALS

.1 Submit completed test sheets for all fuses noted on the single line diagram and in the equipment inventory list.

PART 2 EXECUTION

2.1 INSPECTION, TESTING & MAINTENANCE

.1 Visual and Mechanical Inspection

- .1 Inspect physical and mechanical condition.
- .2 Inspect anchorage, alignment, and grounding, if applicable.
- .3 Prior to cleaning the unit, perform as-found tests.
- .4 Clean the unit.
- .5 Inspect bolted electrical connections for high resistance using one of the following methods:
  - .1 Use of a low-resistance ohmmeter.
  - .2 Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer’s published data. In the absence of manufacturer’s published data, use Table 100.12 in Appendix 2.
- .6 Verify correct blade alignment, blade penetration, travel stops, latching mechanism, and mechanical operation.
- .7 Verify that fuse size and types are in accordance with drawings, short-circuit study, and coordination study.
- .8 Verify that each fuse holder has adequate mechanical support and contact integrity.
- .9 Perform as-left tests.

.2 Electrical Tests

- .1 Perform resistance measurements through bolted connections with a low-resistance ohmmeter, if applicable.
- .2 Measure contact resistance across each cut-out.
- .3 Perform insulation-resistance tests for one minute on each pole, phase-to-ground and across each open pole. Apply voltage in accordance with manufacturer’s published data. In the absence of manufacturer’s published data, use Table 100.1 in Appendix 2.
- .4 Perform an overpotential test on each pole, phase to ground with cut-out open and with cut-out closed. Ground adjacent cut-outs, if

applicable. Test voltage must be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 in Appendix 2.

.3 Test Values – Visual and Mechanical

.1 Compare bolted connection resistance values to values of similar connections. Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.

.2 Bolt-torque levels should be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.12 in Appendix 2.

.4 Test Values – Electrical

.1 Compare bolted connection resistance values to values of similar connections. Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.

.2 Microhm or millivolt drop values should not exceed the high levels of the normal range as indicated in the manufacturer's published data. If manufacturer's data is not available, investigate values which deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.

.3 Insulation-resistance values should be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 in Appendix 2. Values of insulation resistance less than this table or manufacturer's recommendations should be investigated. Over potential tests should not proceed until insulation-resistance levels are raised above minimum values.

.4 If no evidence of distress or insulation failure is observed by the end of the total time of voltage application during the over potential test, the test specimen is considered to have passed the test.

END OF SECTION

CIRCUIT BREAKERS

Part 1 GENERAL

1.1 SUMMARY

.1 The contractor must perform testing and maintenance as per the drawings, specifications and other documents included in the package.

1.2 SUBMITTALS

.1 Submit completed test sheets for all surge arrestors noted on the single line diagram and in the equipment inventory list.

PART 2 EXECUTION

2.1 INSPECTION, TESTING & MAINTENANCE

.1 Circuit Breakers, Low Voltage, Molded/Insulated Case

.1 Visual and Mechanical Inspection

.1 Inspect physical and mechanical condition.

.2 Inspect anchorage and alignment.

.3 Prior to cleaning the unit, perform as-found tests, if required.

.4 Clean the unit.

.5 Operate the circuit breaker to insure smooth operation.

.6 Inspect bolted electrical connections for high resistance using one of the following methods:

.1 Use of a low-resistance ohmmeter.

.2 Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer’s published data or Table 100.12 in Appendix 2.

.7 Inspect operating mechanism, contacts, and arc chutes in unsealed units.

.8 Perform adjustments for final setting in accordance with coordination study provided by end user.

.9 Perform as-left tests.

.10 Reset all trip logs and indicators.

.2 Electrical Tests

.1 Perform resistance measurements through bolted connections with a low-resistance ohmmeter, if applicable.

.2 Perform insulation-resistance tests for one minute on each pole, phase-to-ground with the circuit breaker closed across each open pole and from each load side of ground with the circuit breaker open. Apply voltage in accordance with manufacturer’s published data. In the absence of manufacturer’s published data, use Table 100.1 in Appendix 2.

.3 Perform a contact/pole-resistance test.

.4 Determine long-time pickup and delay by primary current injection.

.5 Determine short-time pickup and delay by primary current injection.

.6 Determine ground-fault pickup delay by primary current injection.

.7 Determine instantaneous pickup current by primary injection.

.8 Perform minimum pickup voltage test on shunt trip and close coils in accordance with Table 100.20 in Appendix 2.

.9 Verify correct operation of auxiliary features such as trip and pickup indicators, zone interlocking, and trip unit battery condition.

.10 Verify correct operation of features such as electrical close and trip operation, trip-free, and antipump function. Reset all trip logs and indicators.

.3 Test Values – Visual and Mechanical

.1 Compare bolted connection resistance values to values of similar connections. Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.

.2 Bolt-torque levels should be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use 100.12 in Appendix 2.

.4 Test Values – Electrical

.1 Compare bolted connection resistance values to values of similar connections. Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.

.2 Insulation-resistance values should be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 in Appendix 2. Values of insulation resistance less than this table or manufacturer's recommendations should be investigated.

.3 Microhm or millivolt drop values should not exceed the high levels of the normal range as indicated in the manufacturer's published data. If manufacturer's data is not available, investigate values that deviate from adjacent poles or similar breakers by more than 50 percent of the lowest value.

.4 Insulation-resistance values of control wiring should be comparable to previously obtained results but not less than two megaohms.

.5 Long-time pickup values should be as specified, and the trip characteristic should not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors. If manufacturer's curves are not available, trip times should not exceed the value shown in Table 100.7 in Appendix 2. (Circuit breakers exceeding specified trip time must be tagged defective.)

.6 Short-time pickup values should be as specified, and the trip characteristic should not exceed manufacturer's published time-current tolerance band. (Circuit breakers exceeding specified trip time must be tagged defective.)

.7 Ground fault pickup values should be as specified, and the trip characteristic should not exceed manufacturer's published time-current tolerance band. (Circuit breakers exceeding specified trip time must be tagged defective.)

.8 Instantaneous pickup values of moulded-case circuit breakers should fall within manufacturer's published tolerances. In the absence of manufacturer's published tolerances, refer to Table 100.8 in Appendix 2. (Circuit breakers exceeding specified trip time must be tagged defective.)

.9 Pickup values and trip characteristics should be within manufacturer's published tolerances. (Circuit breakers exceeding specified trip time must be tagged defective.)

.10 Minimum pickup voltage on shunt trip and close coils should be in accordance with manufacturer's published data. In the absence of manufacturer's published data, refer to Table 100.20 in Appendix 2.

.11 Auxiliary features should function as designed.

.12 Breaker open, close, trip, trip-free, and antipump features should function as designed.

.2 Circuit Breakers and contactors, Low-Voltage, Air

.1 Visual and Mechanical Inspection

.1 Inspect physical and mechanical condition.

.2 Inspect anchorage, alignment, and grounding.

.3 Verify that all maintenance devices are available for servicing and operating the breaker.

.4 Prior to cleaning the unit, perform as-found tests, if required.

.5 Clean the unit.

.6 Inspect arc chutes.

.7 Inspect moving and stationary contacts for condition, wear, and alignment.

.8 Verify that primary and secondary contact wipe and other dimensions vital to satisfactory operation of the breaker are correct.

.9 Perform all mechanical operator and contact alignment tests on both the breaker and its operating mechanism in accordance with manufacturer's published data.

.10 Inspect bolted electrical connections for high resistance using one of the following methods:

.1 Use of a low-resistance ohmmeter.

.2 Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or Table 100.12 in Appendix 2.

.11 Verify cell fit and element alignment.

.12 Verify racking mechanism operation.

.13 Use appropriate lubrication on moving current-carrying parts and on moving and sliding surfaces.

.14 Perform as-left tests.

.15 Record as-found and as-left operation counter readings, if applicable.

.2 Electrical Tests

.1 Perform resistance measurements through bolted connections with a low-resistance ohmmeter, if applicable.

.2 Perform insulation-resistance tests for one minute on each pole, phase-to-ground with the circuit breaker closed across each open pole and from each load side to ground with the circuit breaker open. Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 in Appendix 2.

.3 Perform a contact/pole-resistance test.

.4 Determine long-time pickup and delay by primary current injection.

.5 Determine short-time pickup and delay by primary current injection.

.6 Determine ground-fault pickup and delay by primary current injection.

.7 Determine instantaneous pickup current by primary current injection.

.8 Perform minimum pickup voltage test on shunt trip and close coils in accordance with Table 100.20 in Appendix 2.

.9 Verify operation of charging mechanism.

.10 Verify correct operation of auxiliary features such as trip and pickup indicators, zone interlocking, electrical close and trip operation, trip-free, antipump function, and trip unit battery condition. Reset all trip logs and indicators.

.3 Test Values – Visual and Mechanical

.1 Compare bolted connection resistance values to values of similar connections. Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.

.2 Bolt-torque levels should be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.12 in Appendix 2.

.4 Test Values – Electrical

.1 Compare bolted connection resistance values to values of similar connections. Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.

.2 Insulation-resistance values of breakers should be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 in Appendix 2. Values of insulation resistance less than this table or manufacturer's recommendations should be investigated.

.3 Microhm or millivolt drop values should not exceed the high levels of the normal range as indicated in the manufacturer's published data. If manufacturer's data is not available, investigate values that deviate from adjacent poles or similar breakers by more than 50 percent of the lowest value.

.4 Insulation-resistance values of control wiring should be comparable to previously obtained results but not less than two megaohms.

.5 Long-time pickup values should be as specified, and the trip characteristic must not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors. If manufacturer's curves are not available, trip times must not exceed the value shown in Table 100.7 in Appendix 2. (Circuit breakers exceeding specified trip time must be tagged defective.)

.6 Short-time pickup values should be as specified, and the trip characteristic should not exceed manufacturer's published time-current tolerance band. (Circuit breakers exceeding specified trip time must be tagged defective.)

.7 Ground fault pickup values should be as specified, and the trip characteristic should not exceed manufacturer's published time-current tolerance band. (Circuit breakers exceeding specified trip time must be tagged defective.)

.8 Instantaneous pickup values should be within the tolerances of manufacturer's published data. In the absence of manufacturer's published data, refer to Table 100.8 in Appendix 2. (Circuit breakers exceeding specified trip time must be tagged defective.)

.9 Pickup values and trip characteristic should be as specified and within manufacturer's published tolerances. (Circuit breakers exceeding specified trip time must be tagged defective.)

.10 Minimum pickup voltage on shunt trip and close coils should be in accordance with manufacturer's published data. In the absence of manufacturer's published data, refer to Table 100.20 in Appendix 2.

.11 The charging mechanism should operate in accordance with manufacturer's published data.

.12 Auxiliary features should operate in accordance with manufacturer's published data.

.3 Circuit Breakers and Contactors, Medium-Voltage, Air

.1 Visual and Mechanical Inspection

.1 Inspect physical and mechanical condition.

.2 Inspect anchorage, alignment, and grounding.

.3 Verify that all maintenance devices are available for servicing and operating the breaker.

.4 Prior to cleaning the unit, perform as-found tests, if required.

.5 Clean the unit.

.6 Inspect arc chutes.

.7 Inspect moving and stationary contacts for condition, wear, and alignment.

.8 If recommended by manufacturer, slow close/open breaker and check for binding, friction, contact alignment, contact sequence, and penetration.

.9 Perform all mechanical operation tests on the operating mechanism in accordance with manufacturer's published data.

.10 Inspect bolted electrical connections for high resistance using one of the following methods:

.1 Use of a low-resistance ohmmeter.

.2 Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or Table 100.12 in Appendix 2.

.11 Verify cell fit and element alignment.

.12 Verify racking mechanism operation.

.13 Inspect puffer operation.

.14 Use appropriate lubrication on moving current-carrying parts and on moving and sliding surfaces.

.15 Perform as-left tests.

.16 Record as-found and as-left operation-counter readings.

.2 Electrical Tests

.1 Perform resistance measurements through bolted connections with a low-resistance ohmmeter, if applicable.

.2 Perform insulation-resistance tests on each pole, line side phase-to-ground with the circuit breaker closed, and across each open contact for one minute. Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 in Appendix 2. Calculate dielectric absorption.

.3 Perform insulation-resistance tests on all control wiring with respect to ground. The applied potential must be 500 volts dc for 300-volt rated cable and 1000 volts dc for 600-volt rated cable. Test duration must be one minute. For units with solid-state components or control devices that cannot tolerate the applied voltage, follow manufacturer's recommendation.

.4 Perform a contact/pole-resistance test.

.5 With the breaker in a test position, perform the following tests:

.1 Trip and close breaker with the control switch.

.2 Trip breaker/contactor by operating each of its protective relays by primary injection into its sensing device.

.3 Verify mechanism charge, trip-free, and antipump functions.

.6 Perform minimum pickup voltage tests on trip and close coils in accordance with Table 100.20 in Appendix 2.

.7 Perform power-factor or dissipation-factor tests with breaker in both the open and closed positions.

.8 Perform an overpotential test on each phase across the open contacts with the breaker open and from the line-side phase to ground with the circuit breaker closed and the poles not under test grounded. Test voltage should be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.19 in Appendix 2.

.9 Verify blowout coil circuit continuity.

.10 Verify operation of heaters, if applicable.

.3 Test Values – Visual and Mechanical

.1 Compare bolted connection resistance values to values of similar connections. Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.

.2 Bolt-torque levels should be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.12 in Appendix 2.

.3 Compare travel and velocity values to manufacturer's published data and previous test data.

.4 Test Values – Electrical

.1 Compare bolted connection resistance values to values of similar connections. Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.

.2 Circuit breaker insulation resistance should be in accordance with Table 100.1 in Appendix 2.

.3 Insulation-resistance values of circuit breakers should be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 in Appendix 2. Values of insulation resistance less than this table or manufacturer's recommendations should be investigated.

.4 Microhm or millivolt drop values must not exceed the high levels of the normal range as indicated in the manufacturer's published data. If manufacturer's data is not available, investigate values that deviate from adjacent poles or similar breakers by more than 50 percent of the lowest value.

.5 Breaker mechanism charge, close, open, trip, trip-free, and antipump features must function as designed.

.6 Minimum pickup for trip and close coils must be in accordance with manufacturer's published data. In the absence of manufacturer's data, refer to Table 100.20 in Appendix 2.

.7 Power-factor or dissipation-factor values must be compared with previous test results of similar breakers or manufacturer's published data.

.8 Power-factor or dissipation-factor and capacitance values should be within ten percent of nameplate rating for bushings. Hot collar tests are evaluated on a milliampere/milliwatt loss basis, and the results should be compared to values of similar bushings.

.9 If no evidence of distress or insulation failure is observed by the end of the total time of voltage application during the overpotential test, the circuit breaker is considered to have passed the test.

.10 The blowout coil circuit should exhibit continuity.

.11 Heaters should be operational.

END OF SECTION

SECTION 26 28 22 - LOAD BREAK SWITCHES

Part 1 GENERAL

1.1 SUMMARY

.1 The contractor must perform testing and maintenance as per the drawings, specifications and other documents included in the package.

1.2 SUBMITTALS

.1 Submit completed test sheets for all load break switches noted on the single line diagram and in the equipment inventory list.

PART 2 EXECUTION

2.1 INSPECTION, TESTING & MAINTENANCE

.1 Switches – 600V, Air

.1 Visual and Mechanical Inspection

.1 Inspect physical and mechanical condition.

.2 Inspect anchorage, alignment, grounding, and required clearances.

.3 Prior to cleaning the unit, perform as-found tests, if required.

.4 Clean the unit.

.5 Verify correct blade alignment, blade penetration, travel stops, and mechanical operation.

.6 Verify that fuse sizes and types are in accordance with drawings, short-circuit study and coordination study.

.7 Verify that each fuse has adequate mechanical support and contact integrity.

.8 Inspect bolted electrical connections for high resistance using one of the following methods:

.1 Use of a low-resistance ohmmeter.

.2 Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or Table 100.12 in Appendix 2.

.9 Verify operation and sequencing of interlocking systems.

.10 Verify phase-barrier mounting is intact.

.11 Verify correct operation of indicating and control devices.

.12 Use appropriate lubrication on moving current-carrying parts and on moving and sliding surfaces.

.13 Perform as-left tests.

.2 Electrical Tests

.1 Perform resistance measurements through bolted connections with a low-resistance ohmmeter, if applicable.

.2 Measure contact resistance across each switchblade and fuse holder.

.3 Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with switch closed and across each open pole. Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 in Appendix 2.

.4 Measure fuse resistance.

.5 Verify heater operation, if applicable.

.3 Test Values – Visual and Mechanical

.1 Compare bolted connection resistance values to values of similar connections. Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.

.2 Bolt-torque levels should be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.12 in Appendix 2.

.4 Test Values – Electrical

.1 Compare bolted connection resistance values to values of similar connections. Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.

.2 Insulation-resistance values should be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 in Appendix 2. Values of insulation resistance less than this table or manufacturer's recommendations should be investigated.

.3 Investigate fuse-resistance values that deviate from each other by more than 15 percent.

.4 Heaters should be operational.

.2 Switches – Medium and High Voltage, Metal-Enclosed

.1 Visual and Mechanical Inspection

.1 Inspect physical and mechanical condition.

.2 Inspect anchorage, alignment, grounding, and required clearances.

.3 Prior to cleaning the unit, perform as-found tests, if required.

.4 Clean the unit.

.5 Verify correct blade alignment, blade penetration, travel stops, arc interrupter operation, and mechanical operation.

.6 Verify that fuse sizes and types are in accordance with drawings, short-circuit studies, and coordination study.

.7 Verify that expulsion-limiting devices are in place on all fuses having expulsion-type elements.

.8 Verify that each fuse holder has adequate mechanical support and contact integrity.

.9 Inspect bolted electrical connections for high resistance using one of the following methods:

.1 Use of a low-resistance ohmmeter.

.2 Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or Table 100.12 in Appendix 2.

.10 Verify operation and sequencing of interlocking systems.

.11 Verify that phase-barrier mounting is intact.

.12 Verify correct operation of all indicating and control devices.

.13 Use appropriate lubrication on moving current-carrying parts and on moving and sliding surfaces.

.14 Perform as-left tests.

.2 Electrical Tests

.1 Perform resistance measurements through bolted connections with a low-resistance ohmmeter, if applicable.

.2 Measure contact resistance across each switchblade assembly, fuse holder and arc interrupter, where applicable.

.3 Perform insulation-resistance tests for one minute across each open pole. Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 in Appendix 2.

.4 Perform a DC overpotential test on each pole, open switchblade to bus. Test each pole with all other poles grounded. Test voltage must be in accordance with manufacturer's published data or Table 100.2 in Appendix 2.

.5 Measure fuse resistance.

.6 Verify heater operation, if applicable.

.3 Test Values – Visual and Mechanical

.1 Compare bolted connection resistance values to values of similar connections. Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.

.2 Bolt-torque levels should be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.12 in Appendix 2.

.4 Test Values – Electrical

.1 Compare bolted connection resistance values to values of similar connections. Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.

.2 Microhm or millivolt drop values should not exceed the high levels of the normal range as indicated in the manufacturer's published data. If manufacturer's data is not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.

.3 Insulation-resistance values should be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 in Appendix 2. Values of insulation resistance less than this table or manufacturer's recommendations should be investigated. Over potential tests must not proceed until insulation-resistance levels are raised above minimum values.

.4 If no evidence of distress or insulation failure is observed by the end of the total time of voltage application during the over potential test, the test specimen is considered to have passed the test.

.5 Investigate fuse resistance values that deviate from each other by more than 15 percent.

.6 Heaters should be operational.

.3 Switches – Medium and High Voltage, Open

.1 Visual and Mechanical Inspection

.1 Inspect physical and mechanical condition.

.2 Inspect anchorage, alignment, grounding, and required clearances.

.3 Prior to cleaning insulators, perform as-found tests, if required.

.4 Clean the insulators.

.5 Verify correct blade alignment, blade penetration, travel stops, arc interrupter operation, and mechanical operation.

.6 Verify that fuse sizes and types are in accordance with drawings, short-circuit studies, and coordination study.

.7 Verify that each fuse holder has adequate mechanical support and contact integrity.

.8 Inspect bolted electrical connections for high resistance using one of the following methods:

.1 Use of a low-resistance ohmmeter.

.2 Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or Table 100.12 in Appendix 2.

.9 Verify operation and sequencing of interlocking systems.

.10 Perform mechanical operator tests in accordance with manufacturer's published data, if applicable.

.11 Verify correct operation and adjustment of motor operator limit switches and mechanical interlocks, if applicable.

.12 Use appropriate lubrication on moving current-carrying parts and on moving and sliding surfaces.

.13 Perform as-left tests.

.2 Electrical Tests

.1 Perform resistance measurements through bolted connections with a low-resistance ohmmeter, if applicable.

.2 Perform a contact-resistance test across each switchblade, arc interrupter and fuse holder.

.3 Perform insulation-resistance tests for one minute on each pole and phase-to-ground with switch closed and across each open pole. Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 in Appendix 2.

.4 Perform insulation-resistance tests on all control wiring with respect to ground, if applicable. The applied potential must be 500 volts dc for 300-volt rated cable and 1000 volts dc for 600-volt rated cable. Test duration must be one minute. For units with solid-state components or control devices that cannot tolerate the applied voltage, follow manufacturer's recommendation.

.5 Perform an overpotential test on each pole with switch closed. Test each pole-to-ground with all other poles grounded. Test voltage must be in accordance with manufacturer's published data or Table 100.19 in Appendix 2.

.3 Test Values – Visual and Mechanical

.1 Compare bolted connection resistance values to values of similar connections. Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.

.2 Bolt-torque levels should be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.12 in Appendix 2.

.4 Test Values – Electrical

.1 Compare bolted connection resistance values to values of similar connections. Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.

.2 Microhm or millivolt drop values should not exceed the high levels of the normal range as indicated in the manufacturer's published data. If manufacturer's data is not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.

.3 Insulation-resistance values should be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 in Appendix 2. Values of insulation resistance less than this table or manufacturer's recommendations should be investigated. Overpotential tests should not proceed until insulation-resistance levels are raised above minimum values.

.4 Minimum insulation-resistance values of control wiring should be comparable to previously obtained results but not less than two megaohms.

.5 If no evidence of distress or insulation failure is observed by the end of the total time of voltage application during the overpotential test, the test specimen is considered to have passed the test.

END OF SECTION

SECTION 26 41 00 - SURGE ARRESTORS

Part 1 GENERAL

1.1 SUMMARY

.1 The contractor must perform testing and maintenance as per the drawings, specifications and other documents included in the package.

1.2 SUBMITTALS

.1 Submit completed test sheets for all surge arrestors noted on the single line diagram and in the equipment inventory list.

PART 2 EXECUTION

2.1 INSPECTION, TESTING & MAINTENANCE

.1 Surge Arresters, High-Voltage Surge Protection Devices

.1 Visual and Mechanical Inspection

.1 Inspect physical and mechanical condition.

.2 Inspect anchorage, alignment, and grounding.

.3 Prior to cleaning the unit, perform as-found tests.

.4 Clean the unit.

.5 Inspect bolted electrical connections for high resistance using one of the following methods:

.1 Use of a low-resistance ohmmeter.

.2 Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or Table 100.12 in Appendix 2.

.3 Perform a thermographic survey in accordance with Appendix B - Part 1 Common Work Results for Electrical.

.6 Verify that the ground lead on each device is individually attached to a ground bus or ground electrode.

.7 Verify that stroke counter, if present, is correctly mounted and electrically connected.

.8 Perform as-left tests.

.2 Electrical Tests

.1 Perform resistance measurements through bolted connections with a low-resistance ohmmeter, if applicable.

.2 Perform insulation-resistance test on each arrester, phase terminal to ground. Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 in Appendix 2.

.3 Test the grounding connection in accordance with this specification.

.3 Test Values – Visual and Mechanical

.1 Compare bolted connection resistance values to values of similar connections. Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.

.2 Bolt-torque levels should be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.12 in Appendix 2.

.3 Report of thermographic survey must be in accordance with Section 26 05 00 - Common Work Results for Electrical.

.4 Test Values – Electrical

.1 Compare bolted connection resistance values to values of similar connections. Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.

.2 Insulation-resistance values should be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 in Appendix 2. Values of insulation resistance less than this table or manufacturer's recommendations should be investigated

.3 Resistance between the arrester ground terminal and the ground system should be less than 0.5 ohm and in accordance with this specification.

END OF SECTION

APPENDIX 2 – Tables

TABLE 1

Insulation Resistance Test Values
Electrical Apparatus and Systems

Nominal Rating of Equipment in Volts	Minimum Test Voltage, DC	Recommended Minimum Insulation Resistance in Megohms
250	**500**	**25**
600	**1,000**	**100**
1,000	**1,000**	**100**
2,500	**1,000**	**500**
5,000	**2,500**	**1,000**
8,000	**2,500**	**2,000**
15,000	**2,500**	**5,000**
25,000	**5,000**	**20,000**
34,500 and above	**15,000**	**100,000**

In the absence of consensus standards dealing with insulation-resistance tests, the Standards Review Council suggests the above representative values.

See Table 100.14 for temperature correction factors.

Test results are dependent on the temperature of the insulating material and the humidity of the surrounding environment at the time of the test.

Insulation-resistance test data may be used to establish a trending pattern. Deviations from the baseline information permit evaluation of the insulation.

TABLE 2

Switchgear Withstand Test Voltages

Type of Switchgear	Rated Maximum Voltage (kV) (rms)	Maximum Test Voltage kV	
		AC	DC
Low-Voltage Power Circuit Breaker Switchgear	**.254/.508/.635**	**1.6**	**2.3**
Metal-Clad Switchgear	**4.76**	**14**	**20**
	8.25	**27**	**37**
	15.0	**27**	**37**
	27.0	**45**	**†**
	38.0	**60**	**†**
Station-Type Cubicle Switchgear	**15.5**	**37**	**†**
	38.0	**60**	**†**
	72.5	**120**	**†**
Metal Enclosed Interrupter Switchgear	**4.76**	**14**	**20**
	8.25	**19**	**27**
	15.0	**27**	**37**
	27.0	**45**	**†**
	38.0	**60**	**†**

Derived from ANSI/IEEE C37.20.1-1993, Paragraph 5.5, *Standard for Metal-Enclosed Low-Voltage Power Circuit-Breaker Switchgear*, C37.20.2-1993, Paragraph 5.5, *Standard for Metal-Clad and Station-Type Cubicle Switchgear* and C37.20.3-1987 (R1992), Paragraph 5.5, *Standard for Metal-Enclosed Interrupter Switchgear*, and includes 0.75 multiplier with fraction rounded down.

The column headed “DC” is given as a reference only for those using dc tests to verify the integrity of connected cable installations without disconnecting the cables from the switchgear. It represents values believed to be appropriate and approximately equivalent to the corresponding power frequency withstand test values specified for voltage rating of switchgear. The presence of this column in no way implies any requirement for a dc withstand test on ac equipment or that a dc withstand test represents an acceptable alternative to the low-frequency withstand tests specified in these specifications, either for design tests, production tests, conformance tests, or field tests. When making dc tests, the voltage should be raised to the test value in discrete steps and held for a period of one minute.

† Because of the variable voltage distribution encountered when making dc withstand tests, the manufacturer should be contacted for recommendations before applying dc withstand tests to the switchgear. Voltage transformers above 34.5kV should be disconnected when testing with dc. Refer to ANSI/IEEE C57.13-1993 (*IEEE Standard Requirements for Instrument Transformers*) paragraph 8.8.2.

TABLE 3

Maintenance Test Values
Recommended Dissipation Factor/Power Factor at 20° C
Liquid-Filled Transformers, Regulators, and Reactors

	Oil Maximum	Silicone Maximum	Tetrachloroethylene Maximum	High Fire Point Hydrocarbon Maximum
Power Transformers	1.0%	0.5%	3.0%	2.0%
Distribution Transformers	2.0%	0.5%	3.0%	3.0%

TABLE 4

Insulating Fluid Limits
Table 4.1

Mineral Oil [a]				
		Acceptable Values		
Test	**ASTM Method**	**69 kV and Below**	**Above 69 kV - Below 230 kV**	**230 kV and Above**
Dielectric breakdown, kV minimum [b]	D 877	26	26	26
Dielectric breakdown, kV minimum @ 1 mm (0.04”) gap	D 1816	23	28	30
Dielectric breakdown, kV minimum @ 2 mm (0.08") gap	D 1816	40	47	50
Interfacial tension mN/m minimum	D 971 or D 2285	25	30	32
Neutralization number, mg KOH/g maximum	D 974	0.20	0.15	0.10
Water content, ppm maximum @ 60º C [c]	D 1533	35	25	20
Power factor at 25° C, %	D 924	0.5	0.5	0.5
Power factor at 100° C, %	D 924	5.0	5.0	5.0
Color [d]	D 1500	3.5	3.5	3.5
Visual Condition	D 1524	Bright, clear and free of particles	Bright, clear and free of particles	Bright, clear and free of particles
Specific Gravity (Relative Density) @ 15º C Maximum [e]	D 1298	0.91	0.91	0.91

a. ANSI/IEEE C57.106-2002 Guide for Acceptance and Maintenance of Insulating Oil in Equipment, Table 7.

b. IEEE STD 637-1985 Guide for Reclamation of Insulating Oil and Criteria for Its Use, Table 1.

c. ANSI/IEEE C57.106-2002 Guide for Acceptance and Maintenance of Insulating Oil in Equipment, Table 5.

d. In the absence of consensus standards, NETA’s Standard Review Council suggests these values.

e. ANSI/IEEE C57.106 Guide for Acceptance and Maintenance of Insulating Oil in Equipment, Table 1.

TABLE 4 (cont'd)

Insulating Fluid Limits
Table 4.2

Suggested Limit for Less-Flammable Hydrocarbon Insulating Liquid		
Test	ASTM Method	Acceptable Values
Dielectric breakdown, kV minimum	**D877**	**24**
Dielectric breakdown voltage for 0.04 inch gap, kV minimum	**D1816**	**34**
Dielectric breakdown voltage for 0.08 inch gap, kV minimum	**D1816**	**24**
Water content, ppm maximum	**D1533 B**	**35**
Dissipation/power factor, 60 hertz, % max. @ 25° C	**D924**	**1.0**
Fire point, ° C, minimum	**D92**	**300**
Interfacial tension, mN/m, 25° C	**D971**	**24**
Neutralization number, mg KOH/g	**D 664**	**0.20**

ANSI/IEEE C57.121-1998 Guide for Acceptance and Maintenance of Less-Flammable Hydrocarbon Fluid in Transformers, Table 4.

The values in this table are considered typical for acceptable service-aged LFH fluids as a general class. If actual test analysis approaches the values shown, consult the fluid manufacturer for specific recommendations.

If the purpose of the HMWH installation is to comply with the NFPA 70 National Electrical Code, this value is the minimum for compliance with NEC Article 450.23.

Insulating Fluid Limits
Table 4.3

Suggested Limit for Service-Aged Silicone Insulating Liquid		
Test	**ASTM Method**	**Acceptable Values**
Dielectric breakdown, kV minimum	D 877	25
Visual	D 2129	Colorless, clear, free of particles
Water content, ppm maximum	D 1533	100
Dissipation/power factor, 60 hertz, maximum @ 25° C	D 924	0.2
Viscosity, cSt @ 25° C	D 445	47.5 – 52.5
Fire point, ° C, minimum	D 92	340
Neutralization number, mg KOH/g max.	D 974	0.2

ANSI/IEEE C57.111-1989 (R1995) Guide for Acceptance of Silicone Insulating Fluid and Its Maintenance in Transformers, Table 3.

Table 4.4

Suggested Limit for Service-Aged Tetrachloroethylene Insulating Fluid		
Test	**ASTM Method**	**Acceptable Values**
Dielectric breakdown, kV minimum	D 877	26
Visual	D 2129	Clear with purple iridescence
Water content, ppm maximum	D 1533	35
Dissipation/power factor, % maximum @ 25° C	D 924	12.0
Viscosity, cSt @ 25° C	D 445	0
Fire point, ° C, minimum	D 92	-
Neutralization number, mg KOH/g maximum	D 974	0.25
Neutralization number, mg KOH/g maximum	D 664	-
Interfacial tension, mN/m minimum @ 25º C	D 971	-

Instruction Book PC-2000 for Wecosol™ Fluid-Filled Primary and Secondary Unit Substation Transformers, ABB Power T&D.

TABLE 5

Transformer Insulation Resistance
Maintenance Testing

Transformer Coil Rating Type (Volts)	Minimum DC Test Voltage	Recommended Minimum Insulation Resistance (Megohms)	
		Liquid Filled	Dry
0-600	**1000**	**100**	**500**
601-5000	**2500**	**1000**	**5000**
Greater than 5000	**5000**	**5000**	**25000**

In the absence of consensus standards, the NETA Standards Review Council suggests the above representative values.

See Table 100.14 for temperature correction factors.

NOTE: Since insulation resistance depends on insulation rating (kV) and winding capacity (kVA), values obtained should be compared to manufacturer's published data.

TABLE 6.1

Medium-Voltage Cables
Maintenance Test Values
DC Test Voltages

Rated Voltage Phase-to-Phase (kV)	Conductor Size AWG or kcmil (mm)	Nominal Insulation Thickness mils (mm)		Maximum DC Field Test Voltages (kV) After Installation	
		100% Insulation Level	133% Insulation Level	100% Insulation Level	133% Insulation Level
5	8-1000 (8.4-507) Above 1000 (507)	90 (2.29) 140 (3.56)	115 (2.92) 140 (3.56)	19 19	19 19
8	6-1000 (13.3-507) Above 1000 (507)	115 (2.92) 175 (4.45)	140 (3.56) 175 (4.45)	26 26	26 26
15	2-1000 (33.6-507) Above 1000 (507)	175 (4.45) 220 (5.59)	220 (5.59) 220 (5.59)	41 41	49 49
25	1-2000 (42.4-1013)	260 (6.60)	320 (8.13)	60	75
28	1-2000 (42.4-1013)	280 (7.11)	345 (8.76)	64	64
35	1/0-2000 (53.5-1013)	345 (8.76)	420 (10.7)	100	124
46	4/0-2000 (107.2-1013)	445 (11.3)	580 (14.7)	132	172
69	4/0-2000 (107.2-1013)	--	650	--	195

Derived from ANSI/IEEE Standard 141-1993 IEEE Recommended Practice for Electrical Power Distribution for Industrial Plants (Red Book), Table 12-9; and by factoring the maximum dc test voltage by 75 percent.

NOTE:

NETA recognizes that the selection of appropriate dc test voltages is important to the evaluation of a cable system under test.

NETA offers two tables for this evaluation, 100.6.1.1 and 100.6.1.2. The selection of the appropriate dc test voltage will depend on many variables, such as specific condition, criticality, and reliability of the cable system under test. Prior to the application of the dc test voltage, the department representativeshould be consulted and advised as to the rationale for the specific test value. Caution should be used in selecting the maximum test voltage and performing the test since cable failure during the test will require repair or replacement prior to re-energizing.

TABLE 6.2

Medium-Voltage Cables
Maintenance Test Values
DC Test Voltages

Rated Voltage Phase-to-Phase (kV)	Conductor Size AWG or kcmil (mm)	Nominal Insulation Thickness mils (mm)		Maximum DC Field Test Voltages (kV) First 5 Years After Installation	
		100% Insulation Level	133% Insulation Level	100% Insulation Level	133% Insulation Level
5	8-1000 (8.4-507) Above 1000 (507)	90 (2.29) 140 (3.56)	115 (2.92) 140 (3.56)	9 9	11 11
8	6-1000 (13.3-507) Above 1000 (507)	115 (2.92) 175 (4.45)	140 (3.56) 175 (4.45)	11 11	14 14
15	2-1000 (33.6-507) Above 1000 (507)	175 (4.45) 220 (5.59)	220 (5.59) 220 (5.59)	18 18	20 20
25	1-2000 (42.4-1013)	260 (6.60)	320 (8.13)	25	30
28	1-2000 (42.4-1013)	280 (7.11)	345 (8.76)	26	31
35	1/0-2000 (53.5-1013)	345 (8.76)	420 (10.7)	31	39
46	4/0-2000 (107.2-1013)	445 (11.3)	580 (14.7)	41	54

Reproduction of tables from ICEA S-94-649-2000 *Standard for Concentric Neutral Cables Rated 5,000 – 46,000 Volts* and ICEA S-97-682-2000 *Utility Shielded Power Cables Rated 5,000 – 46,000 Volts*.

NOTE:

NETA recognizes that the selection of appropriate dc test voltages is important to the evaluation of a cable system under test.

NETA offers two tables for this evaluation, 100.6.1.1 and 100.6.1.2. The selection of the appropriate dc test voltage will depend on many variables, such as specific condition, criticality, and reliability of the cable system under test. Prior to the application of the dc test voltage, the department representativeshould be consulted and advised as to the rationale for the specific test value. Caution should be used in selecting the maximum test voltage and performing the test since cable failure during the test will require repair or replacement prior to re-energizing.

TABLE 7

Molded-Case Circuit Breakers
Inverse Time Trip Test
(At 300% of Rated Continuous Current of Circuit Breaker)

Range of Rated Continuous Current (Amperes)	Maximum Trip Time in Seconds For Each Maximum Frame Rating [a]	
	≤ 250 V	251 – 600 V
0-30	50	70
31-50	80	100
51-100	140	160
101-150	200	250
151-225	230	275
226-400	300	350
401-600	- - - - -	450
601-800	- - - - -	500
801-1000	- - - - -	600
1001 – 1200	- - - - -	700
1201-1600	- - - - -	775
1601-2000	- - - - -	800
2001-2500	- - - - -	850
2501-5000	- - - - -	900
6000	- - - - -	1000

Derived from Table 5-3, NEMA Standard AB 4-2000, *Guidelines for Inspection and Preventative Maintenance of Molded-Case Circuit Breaker Used in Commercial and Industrial Applications*.

a. Trip times may be substantially longer for integrally-fused circuit breakers if tested with the fuses replaced by solid links (shorting bars).

TABLE 8

Instantaneous Trip Tolerances for Field Testing of Circuit Breakers

		Tolerances of Manufacturer's Published Trip Range	
Breaker Type	Tolerance of Setting	High Side	Low Side
Adjustable [a]	**+ 40% - 30%**	**-----**	**-----**
Nonadjustable [b]	**-----**	**+ 25%**	**- 25%**

Reproduction of Table 5-4 from NEMA publication AB4-2000, Guidelines for Inspection and Preventive Maintenance of Molded-Case Circuit Breakers Used in Commercial and Industrial Applications.

NEMA AB4-2000 Guidelines for Inspection and Preventative Maintenance of Molded-Case Circuit Breaker Used in Commercial and Industrial Applications, Table 5-4.

a. Tolerances are based on variations from the nominal settings.
b. Tolerances are based on variations from the manufacturer's published trip band (i.e., -25% below the low side of the band, +25% above the high side of the band.)

TABLE 9

Instrument Transformer Dielectric Tests
Field Acceptance

Nominal System Voltage (kV)	BIL (kV)	Periodic Dielectric Withstand Test Field Test Voltage (kV)	
		AC	DC [b]
0.6	**10**	**2.6**	**4**
1.1	**30**	**6.5**	**10**
2.4	**45**	**9.7**	**15**
4.8	**60**	**12.3**	**19**
8.32	**75**	**16.9**	**26**
13.8	**95**	**22.1**	**34**
13.8	**110**	**22.1**	**34**
25	**125**	**26.0**	**40**
25	**150**	**32.5**	**50**
34.5	**150**	**32.5**	**50**
34.5	**200**	**45.5**	**70**
46	**250**	**61.7**	**a**
69	**350**	**91.0**	**a**
115	**450**	**120.0**	**a**
115	**550**	**149.0**	**a**
138	**550**	**149.0**	**a**
138	**650**	**178.0**	**a**
161	**650**	**178.0**	**a**
161	**750**	**211.0**	**a**
230	**900**	**256.0**	**a**
230	**1050**	**299.0**	**a**

Table is derived from Paragraph 8.8.2 and Tables 2 and 7 of ANSI/IEEE C57.13-1993, Standard Requirements for Instrument Transformers.

a. Periodic dc potential tests are not recommended for transformers rated higher than 34.5 kV.
b. Under some conditions transformers may be subjected to periodic insulation test using direct voltage. In such cases the test direct voltage should not exceed the original factory test rms alternating voltage. Periodic direct-voltage tests should not be applied to (instrument) transformers of higher than 34.5 kV voltage rating.

TABLE 10

Maximum Allowable Vibration Amplitude

RPM @ 60 Hz	Velocity in/s peak	Velocity mm/s	RPM @ 50 Hz	Velocity in/s peak	Velocity mm/s
3600	0.15	3.8	3000	0.15	3.8
1800	0.15	3.8	1500	0.15	3.8
1200	0.15	3.8	1000	0.13	3.3
900	0.12	3.0	750	0.10	2.5
720	0.09	2.3	600	0.08	2.0
600	0.08	2.0	500	0.07	1.7

Derived from NEMA publication MG 1-7.08, Table 7-1.

Table is unfiltered vibration limits for resiliently mounted machines. For machines with rigid mounting multiply the limiting values by 0.8.

TABLE 11

Periodic Electrical Test Values for Insulating Aerial Devices
Insulating Aerial Devices with a Lower Test Electrode System
(Category A and Category B)

Unit Rating	60 Hertz (rms) Test			Direct Current Test		
	Voltage (kV) (rms)	Maximum Allowable Current Microamperes	Time (minutes)	Voltage (kV)	Maximum Allowable Current Microamperes	Time (minutes)
46 kV & below	40	40	1	56	28	3
69 kV	60	60	1	84	42	3
138 kV	120	120	1	168	84	3
230 kV	200	200	1	240	120	3
345 kV	300	300	1	360	180	3
500 kV	430	430	1	602	301	3
765 kV	660	660	1	924	462	3

Insulating Aerial Devices without Lower Test Electrode System (Category C)

Unit Rating	60 Hertz (rms) Test			Direct Current Test		
	Voltage (kV) (rms)	Maximum Allowable Current Microamperes	Time (minutes)	Voltage (kV)	Maximum Allowable Current Microamperes	Time (minutes)
46 kV & below	40	400	1	56	56	3

Insulating Aerial Ladders and Insulating Vertical Aerial Towers

Unit Rating	60 Hertz (rms) Test			Direct Current Test		
	Voltage (kV) (rms)	Maximum Allowable Current Microamperes	Time (minutes)	Voltage (kV)	Maximum Allowable Current Microamperes	Time (minutes)
46 kV & below	40	400	1	56	56	3
20 kV & below	20	200	1	28	28	3

TABLE 11 (Continued)

Chassis Insulating Systems and Lower Insulated Booms

60 Hertz (rms) Test			Direct Current Test		
Voltage (kV) (rms)	**Maximum Allowable Current Milliamperes**	**Time (minutes)**	**Voltage (kV)**	**Maximum Allowable Current Microamperes**	**Time (minutes)**
35	3.0	3	50	50	3

Derived from ANSI/SIA A92-2-1990 Vehicle-Mounted Elevating and Rotating Aerial Devices.

A method of calculating test voltages for units rated other than those tabulated here is as follows:

The 60 Hz test values are equal to line to ground at the unit rating value time 1.5

TABLE 12

US Standard Fasteners[a]
Bolt-Torque Values for Electrical Connections

Table 100.12.1 Heat-Treated Steel – Cadmium or Zinc Plated				
Grade	**SAE 1&2**	**SAE 5**	**SAE 7**	**SAE 8**
Head Marking				
Minimum Tensile (Strength) (lbf/in^2)	64K	105K	133K	150K
Bolt Diameter in Inches	**Torque (Pound-Feet)**			
1/4	4	6	8	8
5/16	7	11	15	18
3/8	12	20	27	30
7/16	19	32	44	48
1/2	30	48	68	74
9/16	42	70	96	105
5/8	59	96	135	145
3/4	96	160	225	235
7/8	150	240	350	380
1.0	225	370	530	570

Table 100.12.2 Silicon Bronze Fasteners[b] Torque (Pound-Feet)		
Bolt Diameter in Inches	**Nonlubricated**	**Lubricated**
5/16	15	10
3/8	20	14
1/2	40	25
5/8	55	40
3/4	70	60

Table 100.12.3 Aluminum Alloy Fasteners[c] Torque (Pound-Feet)	
Bolt Diameter in Inches	**Lubricated**
5/16	8.0
3/8	11.2
1/2	20.0
5/8	32.0
3/4	48.0

Table 100.12.4 Stainless Steel Fasteners[d] Torque (Pound-Feet)	
Bolt Diameter in Inches	**Uncoated**
5/16	14
3/8	25
1/2	45
5/8	60
3/4	90

a. Consult manufacturer for equipment supplied with metric fasteners.
b. This table is based on bronze alloy bolts having a minimum tensile strength of 70,000lbs/sq.inch.
c. This table is based on aluminum alloy bolts having a minimum tensile strength of 55,000lbs/sq.inch.
d. This table is to be used for the following hardware types:
Bolts, cap screws, nuts, flat washers, locknuts (18-8 alloy); Belleville washers (302 alloy)

TABLE 13

SF_6 Gas Tests

Test	Method	Serviceability Limits[a]
Moisture	Hygrometer	Per manufacturer or $\geq$ 200 ppm[b]
SF_6 decomposition	ASTM D 2685	$\geq$ 500 ppm
Air	ASTM D 2685	$\geq$ 5000 ppm[c]
Dielectric breakdown Hemispherical contacts	0.10 inch gap at atmospheric pressure	11.5 – 13.5 kV[d]

a. In the absence of consensus standards dealing with SF_6 circuit breaker gas tests, the NETA Standards Review Council suggests the above representative values.

b. According to some manufacturers.

c. Dominelli, N. and Wilie, L., *Analysis of SF_6 Gas as a Diagnostic Technique for GIS,* Electric Power Research Institute, Substation Equipment Diagnostics Conference IV, February 1996.

d. Per Even, F.E., and Mani, G. Sulfur Fluorides, Kirk, *Othmer Encyclopedia of Chemical Technology*, 4th ed., 11,428, 1994.

Reference: IEC 61634 High-Voltage Switchgear and Controlgear – *Use and Handling of Sulfur Hexafluoride (SF_6) in High-Voltage Switchgear and Controlgear.*

TABLE 14

Insulation Resistance Conversion Factors (20ºC)

Table 14.1
Test Temperatures to 20ºC

Temperature		Multiplier	
ºC	**ºF**	**Apparatus Containing immersed Oil Insulation**	**Apparatus Containing Solid Insulation**
-10	14	0.125	0.25
-5	23	0.180	0.32
0	32	0.25	0.40
5	41	0.36	0.50
10	50	0.50	0.63
15	59	0.75	0.81
20	68	1.00	1.00
25	77	1.40	1.25
30	86	1.98	1.58
35	95	2.80	2.00
40	104	3.95	2.50
45	113	5.60	3.15
50	122	7.85	3.98
55	131	11.20	5.00
60	140	15.85	6.30
65	149	22.40	7.90
70	158	31.75	10.00
75	167	44.70	12.60
80	176	63.50	15.80
85	185	89.789	20.00
90	194	127.00	25.20
95	203	180.00	31.60
100	212	254.00	40.00
105	221	359.15	50.40
110	230	509.00	63.20

Derived from *Stitch in Time… The Complete Guide to Electrical Insulation Testing*, Meggar.

Formula:
$R_c = R_a \times K$
Where: R_c is resistance corrected to 20ºC
R_a is measured resistance at test temperature
K is applicable multiplier

Example: Resistance test on oil-immersion insulation at 104º
R_a = 2 megohms @ 104ºF
K = 3.95
$R_c = R_a \times K$
$R_c = 2.0 \times 3.95$
R_c = 7.90 megohms @ 20ºC

Insulation Resistance Conversion Factors (20ºC)

Table 14.2 Test Temperatures to 40ºC			
Temperature		**Multiplier**	
ºC	**ºF**	**Apparatus Containing immersed Oil Insulation**	**Apparatus Containing Solid Insulation**
-10	14	0.03	0.10
-5	23	0.04	0.13
0	32	0.06	0.16
5	41	0.09	0.20
10	50	0.13	0.25
15	59	0.18	0.31
20	68	0.25	0.40
25	77	0.35	0.50
30	86	0.50	0.63
35	95	0.71	0.79
40	104	1.00	1.00
45	113	1.41	1.26
50	122	2.00	1.59
55	131	2.83	2.00
60	140	4.00	2.52
65	149	5.66	3.17
70	158	8.00	4.00
75	167	11.31	5.04
80	176	16.00	6.35
85	185	22.63	8.00
90	194	32.00	10.08
95	203	45.25	12.70
100	212	64.00	16.00
105	221	90.51	20.16
110	230	128.00	25.40

Derived from Megger's *Stitch in Time… The Complete Guide to Electrical Insulation Testing* and ANSI/IEEE 43-2000, *IEEE Recommended Practice for Testing Insulation Resistance of Rotating Machinery.*

Notes: The insulation resistance coefficient is based on the halving of the insulation resistance to the change in temperature.
Apparatus Containing Immersed Oil Insulation Table uses 10ºC change with temperature halving.
Apparatus Containing Solid Insulation Table uses 15ºC change with temperature halving.

$R_c = R_a \times K$
Formula:
Where: R_c is resistance corrected to 40ºC
R_a is measured resistance at test temperature
K is applicable multiplier

Example: Resistance test on oil-immersion insulation at 68ºF/20ºC
R_a = 2 megohms @ 68ºF/20ºC
K = 0.40
$R_c = R_a \times K$
R_c = 2.0 x 0.40 = 0.8 megohms @ 40ºC

TABLE 15

High-Potential Test Voltage
Automatic Circuit Reclosers

Nominal Voltage Class (kV)	Maximum Voltage (kV)	Rated Impulse Withstand Voltage(kV)	Maximum AC[a] Field Test Voltage, (kV)
14.4 (1 ø and 3 ø)	15.0	95	26.2
14.4 (1 ø and 3 ø)	15.5	110	37.5
24.9 (1 ø and 3 ø)	27.0	150	45.5
34.5 (1 ø and 3 ø)	38.0	150	52.5
46.0 (3 ø)	48.3	250	78.7
69.0 (3 ø)	72.5	350	120.0

Derived from ANSI/IEEE C37.61-1973(R1992), *Standard Guide for the Application, Operation, and Maintenance of Automatic Circuit Reclosers* and from C37.60-1981(R1992), *Standard Requirements for Overhead, Pad-Mounted, Dry-Vault, and Submersible Automatic Circuit Reclosers and Fault interrupters for AC Systems,* Table 2, Column 5.

a. Derived from ANSI/IEEE C37.60-1981(R1992), Table 2, Column 5. In accordance with ANSI/IEEE C37.61, Section 6.2.2 (Servicing), a .75 multiplier has been applied to the values.

TABLE 16

High-Potential Test Voltage
for Periodic Test of Line Sectionalizers

Nominal Voltage Class (kV)	Maximum Voltage (kV)	Rated Impulse Withstand Voltage (kV)	Maximum AC Field Test Voltage (kV)	DC 15 Minute Withstand (kV)
14.4 (1 Ø)	15.0	95	26.2	39
14.4 (1 Ø)	15.0	125	31.5	39
14.4 (3 Ø)	15.5	110	37.5	39
24.9 (1 Ø)	27.0	125	45.0	58
34.5 (3 Ø)	38.0	150	52.5	77

Derived from ANSI/IEEE C37.63-1984(R1990) Table 2 (*Standard Requirements for Overhead, Pad-Mounted, Dry-Vault, and Submersible Automatic Line Sectionalizers of AC Systems*).

The table includes a 0.75 multiplier with fractions rounded down.

In the absence of consensus standards, the NETA Standards Review Council suggests the above representative values.

NOTE: Values of ac voltage given are dry test one minute factory test values.

TABLE 17

Dielectric Withstand Test Voltages
Metal-Enclosed Bus

Type of Bus	Rated kV	Maximum Test Voltage, kV	
		AC	DC
Isolated Phase for Generator Leads	24.5 29.5 34.5	37.0 45.0 60.0	52.0 -- --
Isolated Phase for Other than Generator Leads	15.5 25.8 38.0	37.0 45.0 60.0	52.0 -- --
Nonsegregated Phase	0.635 4.76 15.0 25.8 38.0	1.6 14.2 27.0 45.0 60.0	2.3 20.0 37.0 63.0 --
Segregated Phase	15.5 25.8 38.0	37.0 45.0 60.0	52.0 63.0 --
DC bus Duct	0.3 0.8 1.2 1.6 3.2	1.6 2.7 3.4 4.0 6.6	2.3 3.9 4.8 5.7 9.3

Derived from ANSI/IEEE C37.23-1987, Tables 3A, 3B, 3C, 3D and paragraph 6.4.2. The table includes a 0.75 multiplier with fractions rounded down.

NOTE:

a. The presence of the column headed “DC” does not imply any requirement for a dc withstand test on ac equipment. This column is given as a reference only for those using dc tests and represents values believed to be appropriate and approximately equivalent to the corresponding power frequency withstand test values specified for each class of bus.

   Direct current withstand tests are recommended for flexible bus to avoid the loss of insulation life that may result from the dielectric heating that occurs with rated frequency withstand testing.

   Because of the variable voltage distribution encountered when making dc withstand tests and variances in leakage currents associated with various insulation systems, the manufacturer should be consulted for recommendations before applying dc withstand tests to this equipment.

TABLE 18

Thermographic Survey Suggested Actions Based on Temperature Rise

Temperature difference (ΔT) based on comparisons between similar components under similar loading	Temperature difference (ΔT) based upon component and ambiant air temperatures	Recommended Action
1ºC – 3ºC	1ºC – 10ºC	Possible deficiency; warrants investigation
4ºC – 15ºC	11ºC – 20ºC	Indicates probable deficiency; repair as time permits
-- -- --	21ºC – 40ºC	Monitor until corrective measures can be accomplished
>15ºC	>40ºC	Major discrepancy; repair immediately

Temperature specifications vary depending on the exact type of equipment. Even in the same class of equipment (i.e., cables) there are various temperature ratings. Heating is generally related to the square of the current; therefore, the load current will have a major impact on ΔT, the values in this table will provide reasonable guidelines.

An alternative method of evaluation is the standards-based temperature rating system as discussed in Chapter 8.9.2, Conducting an IR Thermographic Inspection, *Electrical Power Systems Maintenance and Testing*, by Paul Gill, PE, 1998.

It is a necessary and valid requirement that the person performing the electrical inspection be thoroughly trained and experienced concerning the apparatus and systems being evaluated as well as knowledgeable of thermographic methodology.

TABLE 19

Overpotential Test Voltages Electrical Apparatus Other than Inductive Equipment

Nominal System (Line) Voltage[a] (kV)	Insulation Class	AC Factory Test (kV)	Maximum Field Applied AC Test (kV)	Maximum Field Applied DC Test (kV)
1.2	1.2	10	6.0	8.5
2.4	2.5	15	9.0	12.7
4.8	5.0	19	11.4	16.1
8.3	8.7	26	15.6	22.1
14.4	15.0	34	20.4	28.8
18.0	18.0	40	24.0	33.9
25.0	25.0	50	30.0	42.4
34.5	35.0	70	42.0	59.4
46.0	46.0	95	57.0	80.6
69.0	69.0	140	84.0	118.8

In the absence of consensus standards, the NETA Standards Review Council suggests the above representative values.

a. Intermediate voltage ratings are placed in the next higher insulation class.

TABLE 20

Rated Control Voltages and their Ranges for Circuit Breakers

Operating mechanisms are designed for rated control voltages listed with operational capability throughout the indicated voltage ranges to accommodate variations in source regulation, coupled with low charge levels, as well as high charge levels maintained with floating charges. The maximum voltage is measured at the point of user connection to the circuit breaker [see notes (12) and (13)] with no operating current flowing, and the minimum voltage is measured with maximum operating current flowing.

20.1
Rated Control Voltages and their Ranges for Circuit Breakers

(11) Rated Control Voltage	Direct Current Voltage Ranges (1)(2)(3)(5) Volts, dc (8)(9)		Opening Functions All Types	Rated Control Voltage (60Hz)	Alternating Current Voltage Ranges (1)(2)(3)(4)(8) Closing, Tripping, and Auxiliary Functions
	Closing and Auxiliary Functions				
	Indoor Circuit Breakers	Outdoor Circuit Breakers		Single Phase	Single Phase
24 (6) 48 (6) 125 250 --- ---	--- 38-56 100-140 200-280 --- ---	--- 36-56 90-140 180-280 --- ---	14-28 28-56 70-140 140-280 --- ---	120 240 Polyphase 208Y/120 240	104-127 (7) 208-254 (7) Polyphase 180Y/104-220Y/127 208-254

Derived from Table 8, ANSI C37.06-2000, *AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis – Preferred Ratings and Related Required Capabilities*.

Notes:
1. Electrically operated motors, contractors, solenoids, valves, and the like, need not carry a nameplate voltage rating that corresponds to the control voltage rating shown in the table as long as these components perform the intended duty cycle (usually intermittent) in the voltage range specified.
2. Relays, motors, or other auxiliary equipment that function as a part of the control for a device must be subject to the voltage limits imposed by this standard, whether mounted at the device or at a remote location.
3. Circuit breaker devices, in some applications, may be exposed to control voltages exceeding those specified here due to abnormal conditions such as abrupt changes in line loading. Such applications require specific study, and the manufacturer should be consulted. Also, application of switchgear devices containing solid-state control, exposed continuously to control voltages approaching the upper limits of ranges specified herein, require specific attention and the manufacturer should be consulted before application is made.
4. Includes supply for pump or compressor motors. Note that rated voltages for motors and their operating ranges are covered by ANSI/NEMA MG-1-1978.
5. It is recommended that the coils of closing, auxiliary, and tripping devices that are connected continually to one dc potential should be connected to the negative control bus so as to minimize electrolytic deterioration.
6. 24-Volt or 48-Volt tripping, closing, and auxiliary functions are recommended only when the device is located near the battery or where special effort is made to ensure the adequacy of conductors between battery and control terminals. 24-Volt closing is not recommended.
7. Includes heater circuits.

8. Voltage ranges apply to all closing and auxiliary devices when cold. Breakers utilizing standard auxiliary relays for control functions may not comply at lower extremes of voltage ranges when relay coils are hot, as after repeated or continuous operation.

Rated Control Voltages and their Ranges for Circuit Breakers

9. Direct current control voltage sources, such as those derived from rectified alternating current, may contain sufficient inherent ripple to modify the operation of control devices to the extent that they may not function over the entire specified voltage ranges.
10. This table also applies for circuit breakers in gas insulated substation installations.
11. In cases where other operational ratings are a function of the specific control voltage applied, tests in C37.09 may refer to the “Rated Control Voltage.” In these cases, tests must be performed at the levels in this column.
12. For an outdoor circuit breaker, the point of user connection to the circuit breaker is the secondary terminal block point at which the wires from the circuit breaker operating mechanism components are connected to the user’s control circuit wiring.
13. For an indoor circuit breaker, the point of user connection to the circuit breaker is either the secondary disconnecting contact (where the control power is connected from the stationary housing to the removable circuit breaker) or the terminal block point in the housing nearest to the secondary disconnecting contact.

Table 20.2
Rated Control Voltages and their Ranges for Circuit Breakers
Solenoid Operated Devices

Rated Voltage	Closing Voltage Range for Power Supply
125 dc 250 dc 230 ac	90-115 or 105-130 180-230 or 210-260 190-230 or 210-260

Some solenoid operating mechanisms are not capable of satisfactory performance over the range of voltage specified in the standard; moreover, two ranges of voltage may be required for such mechanisms to achieve an acceptable standard of performance.

The preferred method of obtaining the double range of closing voltage is by use of tapped coils. Otherwise it will be necessary to designate one of the two closing voltage ranges listed above as representing the condition existing at the device location due to battery or lead voltage drop or control power transformer regulation. Also, caution should be exercised to ensure that the maximum voltage of the range used is not exceeded.

TABLE 21
Accuracy of IEC Class TP Current Transformers Error Limit

Class	At Rated Current		At Accuracy Limit Condition
	Ratio Error (%)	Phase Displacement Minimum	Peak Instantaneous Error (%)
TPX	± 0.5	± 30	10
TPY	± 1.0	± 60	10
TPZ	± 1.0	180 ± 18	10 (see note)
NOTE – Alternating current component error.			

There are four different TP classifications to meet different functional requirements as follows:

1. Class TPS low leakage flux design ct.
2. Class TPX closed core ct for specified transient duty cycle.
3. Class TPY gapped (low remanance) ct for specified transient duty cycle
4. Class TPZ linear ct (no remanance).

The error limit for TPS ct in terms of turn ratio error is ± .25% and the excitation voltage under limiting conditions should not be less than the specified value; furthermore, this value is such that an increase of 10% in magnitude does not result in an increase in the corresponding peak instantaneous exciting current exceeding 100%. In other words, the ct should not be in saturated state at the specified maximum operating voltage.

The accuracy limit conditions are specified on the rating plate. The required rating plate information is shown in the table below. (The obvious information such as rated primary and secondary currents are not shown).

CT Class	TPS	TPX	TPY	TPZ
Symmetrical short-circuit current factor	x	x	x	x
Rated resistive burden (R_b)	x	x	x	x
Secondary winding resistance (at .. ^{o} C)	x	x	x	x
Rated Transient dimensioning factor	-	x	x	x
Steady-state error limit factor	x	-	-	-
Excitation limiting secondary voltage	x	-	-	-
Accuracy limiting secondary exciting current	x	-	-	-
Factor of construction*	-	x	x	x
Rated secondary loop time constant	-	-	x	-
Specified primary time constant (T_p)	-	x	x	x
Duty cycle	-	x	x	-

x = applicable, – = not applicable
*The factor construction is determined from the following ratio:

$$\frac{\text{Equivalent secondary accuracy limiting voltage } (V_{alc})}{\text{Equivalent secondary accuracy limiting e.m.f } (E_{alc})}$$

where
V_{alc} is the mts value of sinusoidal voltage of rated frequency, with, if applied to the secondary winding of a ct, would result in an exciting current corresponding to the maximum permissible error current appropriate to ct class
E_{alc} is the equivalent rms emf of rated frequency determined during test observed error current corresponds to the appropriate limit for the class Derived from C37.110

TABLE 22

Minimum Radii for Power Cable
Single & Multiple Conductor Cables with Interlocked Armor,
Smooth or Corrugated Aluminum Sheath or Lead Sheath

Cable Type	Overall Diameter of Cable					
	Inches 0.75 & less	**mm** 190 & less	**Inches** 0.76 to 150	**mm** 191 to 381	**Inches** 1.51 & larger	**mm** 382 & larger
	Minimum Bending Radius as a Multiple of Cable Diameter					
Smooth Aluminum Sheath Single Conductor Nonshielded, Multiple Conductor or Multiplexed, with Individually Shielded Conductors	10		12		15	
Single Conductor Shielded	12		12		15	
Multiple Conductor or Multiplexed, with Overall Shield	12		12		15	
Interlocked Armor or Corrugated Aluminum Sheath Nonshielded	7		7		7	
Multiple Conductor with Individually Shielded Conductor	12/7 [a]		12/7 [a]		12/7 [a]	
Multiple Conductor with Overall Shield	12		12		12	
Lead Sheath	12		12		12	

ANSI/ICEA S-93-639/NEMA WC 74-2000, 5-46 kV Shielded Power Cable for Use in the Transmission and Distribution of Electric Energy, Appendix I – Recommended Bending Radii for Cables and Table I1 – Minimum Radii for Power Cable.

a. 12 x individual shielded conductor diameter, or 7 x overall cable diameter, whichever is greater.

TABLE 22

Minimum Radii for Power Cable Single & Multiple Conductor Cables with Interlocked Armor, Smooth or Corrugated Aluminum Sheath or Lead Sheath

Notes

Specific references from Appendix I:

1. Interlocked-Armor and Metallic-Sheathed Cables

1.1 The minimum bending radius for interlocked-armored cables, smooth or corrugated aluminum sheath or lead sheath must be in accordance with Table 100.22.

2. Flat-Tape Armored or Wire-Armored Cables

2.1 The minimum bending radius for all flat-tape armored and all wire-armored cables is twelve times the overall diameter of cable.

3. Tape-Shielded Cables

3.1 The minimum bending radius for tape-shielded cables given above applies to helically applied flat or corrugated tape or longitudinally applied corrugated tape-shielded cables.

3.2 The minimum bending radius for a single-conductor cable is twelve times the overall diameter.

3.3 For multiple-conductor or multiplexed single-conductor cables having individually taped shielded conductors, the minimum bending radius is twelve times the diameter of the individual conductors or seven times the overall diameter, whichever is greater.

3.4 For multiple-conductor cables having an overall tape shield over the assembly, the minimum bending radius is twelve times the overall diameter of the cable.

4. Wire-Shielded Cables

4.1 The minimum bending radius for a single-conductor cable is eight times the overall diameter.

4.2 For multiple-conductor or multiplexed single-conductor cables having wire-shielded individual conductors, the minimum bending radius is eight times the diameter of the individual conductors or five times the overall diameter, whichever is greater.

4.3 For multiple-conductor cables having a wire shield over the assembly, the minimum bending radius is eight times the overall diameter of the cable.

Definitions

This document defines equipment voltage ratings in accordance with ANSI/NEMA C37.84.1 American National Standard for Electrical Power Systems and Equipment – Voltage Ratings (60 Hertz).

As-found

Condition of the equipment when taken out of service, prior to maintenance.

As-left

Condition of equipment at the completion of maintenance. As-left values refer to test values obtained after all maintenance has been performed on the device under test.

Electrical tests

Electrical tests involve application of electrical signals and observation of the response. It may be, for instance, applying a potential across an insulation system and measuring the resultant leakage current magnitude or power factor/dissipation factor. It may also involve application of voltage and/or current to metering and relaying equipment to check for correct response.

Equipment condition

Suitability of the equipment for continued operation in the intended environment as determined by evaluation of the results of inspections and tests.

Exercise

To operate equipment in such a manner that it performs all its intended functions to allow observation, testing, measurement, and diagnosis of its operational condition.

Extra-high voltage

A class of nominal system voltages greater than 230,000 volts.

High voltage

A class of nominal system voltages equal to or greater than 100,000 volts and equal to or less than 230,000 volts.

Inspection

Examination or measurement to verify whether an item or activity conforms to specified requirements.

Low voltage

A class of nominal system voltages 1000 volts or less.

Manufacturer’s published data

Data provided by the manufacturer concerning a specific piece of equipment.

Mechanical inspection

Observation of the mechanical operation of equipment not requiring electrical stimulation, such as manual operation of circuit breaker trip and close functions. It may also include tightening of hardware, cleaning, and lubricating.

Medium voltage

A class of nominal system voltages greater than 1000 volts and less than 100,000 volts.

Ready-to-test condition

Having the equipment which is to be tested isolated, source and load disconnected, the breaker grounded, and control and operating sources identified.

Must

Indicates a mandatory requirement and is used when the testing firm has control over the result.

Should

Indicates that a provision is not mandatory but is recommended as good practice. This term is also used when a value is recommended and there is no practical capability of achieving that value.

System voltage

The root-mean-square (rms) phase-to-phase voltage of a portion of an alternating-current electric system. Each system voltage pertains to a portion of the system that is bounded by transformers or utilization equipment.

Verify

To investigate by observation or by test to determine that a particular condition exists.

Visual inspection

Qualitative observation of physical characteristics, including cleanliness, physical integrity, evidence of overheating, lubrication, etc.

Refer to the attached document on CanadaBuys website

APPENDIX 3 – Equipment Inventory

APPENDIX 4 – Equipment Test Sheets