



REGIONAL DISTRICT OF NORTH OKANAGAN

DUTEAU CREEK WATER TREATMENT PLANT ULTRAVIOLET DISINFECTION UPGRADES REQUEST FOR PROPOSALS

RFP #2017-E372.09.2

**SUPPLY, DELIVERY AND COMMISSIONING OF ULTRAVIOLET (UV)
DISINFECTION SYSTEM FOR DRINKING WATER APPLICATION**

MARCH 2017

**OPUS INTERNATIONAL CONSULTANT (CANADA) LTD
#206 – 2365 GORDON DRIVE
KELOWNA, B.C.
V1W 3C2**

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RFP #2017-E372.09.2
SUPPLY AND DELIVERY OF ULTRAVIOLET (UV) DISINFECTION
SYSTEM FOR DRINKING WATER APPLICATION

Request for Proposal

The Regional District of North Okanagan - Greater Vernon Water (RDNO-GVW) hereinafter referred to as the "OWNER", invites proposals for the Supply, Delivery, Startup and Testing of the Ultraviolet (UV) Disinfection System.

The OWNER is in the process of designing and constructing a UV Disinfection Facility at the site of the Duteau Creek WTP. The OWNER intends to purchase UV equipment prior to completing the facility design so that the design can efficiently integrate the UV equipment into the building. The OWNER will directly purchase the UV equipment and provide them as "OWNER Supplied" materials to the future building contractor.

SCOPE:

This Request for Proposal (RFP) is for the supply of a validated reactor, delivery, startup, and testing of the **Ultraviolet (UV) Disinfection System for Drinking Water**.

Proposal documents are being sent from the offices of Opus International Consultants (Canada) Ltd., #206 - 2365 Gordon Drive, Kelowna, BC V1W 3C2, being issued as a digital copy to each proponent.

Sealed proposals in a clearly marked envelope labeled with the Proposal title, and Proposal number, will be received at the following specified physical location, not later than **2:00 p.m. local time on Thursday, March 23, 2017** (the "Proposal Closing"):

Regional District of North Okanagan
9848 Aberdeen Road
Coldstream, B.C. V1B 2K9
att: Sandy Edwards

For technical information please contact: **Stephen Horsman, P.Eng., Opus International Consultants (Canada) Ltd. at (250) 868-4925 ext. 201, or stephen.horsman@opusinternational.ca, with required cc to:**

- **Megan Wood, Assistant Project Engineer, megan.wood@opusinternational.ca**
- **Sandy Edwards, Project Manager of the RDNO, at sandy.edwards@rdno.ca**



PART 1 INVITATION

1.1 INVITATION TO PROPOSAL

The Regional District of North Okanagan (the “OWNER”) invites Proposals for Supply, Delivery, and Commissioning of Ultraviolet (UV) Disinfection System for Drinking Water Application

1.2 INTENTION TO SUBMIT BID

Proponents shall inform OWNER in writing within seven (7) calendar days of electronic receipt that they intend to submit a bid to be sent via email.

1.3 SCOPE OF WORK

1.3.1 The work includes the supply, delivery and commissioning of the complete Ultraviolet (UV) Disinfection System to the Delivery Site.

1.3.2 The initial purpose of this Request for Proposals (RFP) is to permit the Engineer to complete the detailed design for the Duteau Creek Water Treatment Plant UV Disinfection Building, including the establishment of key equipment purchases to be supplied to a General Contractor for installation. The Work to be covered by this Request for Proposal is for the supply (and all specified support services) of the UV Equipment for the new Duteau Creek Water Treatment Plant UV Disinfection Facility. If Proponents wish to participate in this process, they are requested to respond to this RFP and must do so in accordance with the specified requirements in the RFP.

1.3.3 Once the Stage 1 portion of the contract has been completed to the satisfaction of the Engineer and the OWNER, the Proponent will, at the OWNER's sole discretion, and pending the legal availability of funds related to the project grant application, be sent a Notice to Manufacture and Deliver. Upon receipt of the Notice to Manufacture and Deliver, the Proponent shall supply all equipment and remaining services defined in the RFP, provided for in the Proponent's proposal and established in the Contract and as outlined in Section 01010.

1.3.4 All relevant technical and commercial information provided by the Proponent, in conjunction with the completion of the initial portion of the Contract, will be incorporated into the tender and contract documents that the Engineer prepares for the Construction Contract.



- 1.3.5 The OWNER shall provide the UV Equipment to the General Contractor as OWNER Supplied Equipment.
- 1.36 The equipment to be manufactured or assembled, as the case may require, will be shipped to the project site in adequate time to be incorporated into the Construction Contract. The equipment will be stored by the manufacturer at their cost until such time as delivery is acceptable. The time of manufacture and shipping to site will be coordinated with the General Contractor.
- 1.3.7 The SUPPLIER shall deliver all equipment F.O.B. to the **Duteau Creek Water Treatment Plant, 1014 Whitevale Road, Vernon, BC, V1B 3E7 or other storage facility in Vernon, BC** designated by the General Contractor, including freight, duty, insurance, and all covering charges on the delivery scheduled within the period entered in the Request for Proposal.
- 1.3.8 The Work includes providing the specified equipment and all labour and materials in order to meet the requirements of the Request for Proposal documents and the attached specifications.
- 1.3.9 The Work is subject to grant funding through the Provincial/Federal Clean Water and Wastewater Fund. A Letter of Intent will be issued to the successful Proponent, at the OWNER's sole discretion, to enter into an agreement for the Stage 1 portion of the contract, as set out in Schedule 1 of Section 00300. Award of all other work not included in the Stage 1, is subject to funds being legally available through the Provincial/Federal Clean Water and Wastewater Fund.
- 1.3.10 The fee specified for the supply of Stage 1 - Submittal Package #1 in Section 00300 fully and completely covers the cost of all work not associated with the second portion of the Contract.
- 1.4 PROPOSAL SUBMISSION
- 1.4.1 Proposals shall be submitted in accordance with Section 00100, Part 11.
- 1.4.2 Proposals will be received at the Regional District of North Okanagan no later than **2:00 p.m.** local time on **Thursday, March 23, 2017** (the "Proposal Closing"):

Regional District of North Okanagan
9848 Aberdeen Road
Coldstream B.C., V1B 2K9



- 1.4.3 Proposals received after the Proposal Closing at the specific physical location referred to in Section 00100, Part 9.1 will not be considered and will be returned to the Proponent.
- 1.4.4 The submission of a Proposal constitutes the agreement of the Proponent to be solely responsible for any and all costs and expenses incurred by it in preparing and submitting its Proposal, including any costs incurred by the Proponent after the Proposal Closing.

1.5 SCHEDULE

Proposals to be submitted by:	Thursday March 23, 2017
Number of calendar days after receipt of Letter of Intent for SUPPLIER Submittal Package No. 1 in accordance with Section 11287 :	30 calendar days
Number of calendar days after receipt of shop drawings for Engineer to return reviewed shop drawings:	14 calendar days
Number of calendar days after receipt of Approval of Submittal Package No. 1 the SUPPLIER shall submit Submittal Package No. 2	30 calendar days
Number of calendar days prior to shipment Submittal Package No. 3 shall be submitted	30 calendar days
Delivery of equipment on site between the following dates:	November 1, 2017 – January 13, 2018
Commissioning of plant anticipated to be completed by:	March 10, 2018
Submittal Package No. 4 shall be submitted prior to Final Completion	March 31, 2018

The schedule shown above is for information only. The award of the general contract for the Duteau Creek WTP construction is scheduled for June 2017 and an updated schedule will be provided to the selected UV SUPPLIER at this time.



PART 2 PROPOSAL DOCUMENTS

- 2.1 Documents may be obtained digitally from Stephen Horsman, with cc to Megan Wood at Opus International Consultants (Canada) Ltd., at stephen.horsman@opusinternational.ca, and megan.wood@opusinternational.ca
- 2.2 Notification of Addenda will be posted on the RDNO website <http://www.rdno.ca/index.php/about/tenders> and can be obtained digitally from Stephen Horsman with cc to Megan Wood.
- 2.3 All persons who obtain a set of Proposal Documents shall ensure that the person provides their correct name, address, telephone number and facsimile number to Opus International Consultants (Canada) Ltd. at the time the person obtains a set of Proposal Documents.
- 2.4 The OWNER's language in its procurement documents shall be English.

PART 3 ENQUIRIES AND ADDENDA

- 3.1 Enquiries should be addressed to:

Mr. Stephen Horsman, P.Eng.
Opus International Consultants (Canada) Ltd.
#206 - 2365 Gordon Drive,
Kelowna, BC, V1W 3C2
Telephone: (250) 868-4925 ext. 201
Fax: (250) 868-4923
Email: stephen.horsman@opusinternational.ca
cc: megan.wood@opusinternational.ca and sandy.edwards@RDNO.ca
(Regional District of North Okanagan)

- 3.2 Any requests for explanations, interpretations, or clarifications made by Proponents must be submitted in writing to Opus International Consultants (Canada) Ltd. on behalf of the OWNER no later than seven (7) calendar days prior to the Proposal Closing.
- 3.3 Explanations, interpretations, or clarifications may be made in the form of Addenda. Addenda may be issued by Opus International Consultants (Canada) Ltd. on behalf of the OWNER during the Proposal period and will be distributed by Opus International Consultants (Canada) Ltd. to all persons known by Opus International Consultants (Canada) Ltd. to have obtained a set of the Proposal Documents.
- 3.4 All Addenda issued by Opus International Consultants (Canada) Ltd. on behalf of the OWNER shall be incorporated into and become part of the Proposal Documents. Addenda will be issued by Opus International Consultants (Canada) Ltd. on behalf of the OWNER to all qualified persons of record receiving Proposal Documents.



- 3.5 If a Proponent finds any errors, omissions or discrepancies in the Proposal Documents, it shall immediately notify Opus International Consultants (Canada) Ltd. on behalf of the OWNER in writing.
- 3.6 No oral explanation, interpretation or clarification of the Proposal Documents by any person whatsoever shall bind the OWNER in the interpretation of the Proposal Documents.

PART 4 COMPLETION OF PROPOSAL DOCUMENTS

- 4.1 The Proponent shall complete the Bid Form in ink or in type.
- 4.2 The quantities stated herein are estimates only and are given for the purpose of providing a uniform basis for the comparison of Proposals. Payment will be based on actual quantities.
- 4.3 Unit prices shall be in Canadian currency, and shall be shown for each unit specified and shall include all necessary costs including but not limited to supply, fabrication and finishing, conveyance and delivery to the Delivery Site, packing, crating, freight, cartage, shipping charges, unloading, installation, drafting charges, overhead, profit, commissioning and all tariffs, duties and taxes.

PART 5 INFORMATION TO ACCOMPANY PROPOSALS

- 5.1 Each Proposal shall be accompanied with information covering the equipment offered in sufficient detail to show that the equipment will conform to the requirements of the contract documents.
- 5.2 To facilitate the assessment and comparison of Bids, Proponents are required to provide the information required under Section 00400 SUPPLIER Qualifications Questionnaire.
- 5.3 Drawings and other material as requested in Section 00400 SUPPLIER Qualifications Questionnaire should be enclosed with the Proposal. Material relating to an alternative Proposal should be clearly marked as such.

PART 6 BID RIGGING

- 6.1 The Proponent's attention is directed to the Competition Act which provides that bid-rigging as defined in the Act is an indictable offence punishable upon conviction by a fine or imprisonment or both.

PART 7 SOLICITATION

- 7.1 If any director, officer, employee, agent or other representative of a Proponent makes any representation or solicitation to any director, officer or employee of the OWNER with



respect to the Proposal, whether before or after the submission of the Proposal, the OWNER shall be entitled to reject or not accept the Proposal.

PART 8 SUBMISSION OF PROPOSAL

8.1 The Proponent shall submit to the OWNER the following completed and executed documentation:

- (1) Proposal Form Section 00300 SUPPLIER Proposal form.
- (2) Section 00400 SUPPLIER Qualification Questionnaire.
- (3) Acknowledgement of Receipt of Addenda.
- (4) Consent of Surety or Letter of Credit (See Appendix A to Section 00100)

in a sealed envelope or package, on the exterior of which shall be indicated the Proposal Number, Title and the name of the Proponent. The Proposal shall be submitted no later than the Proposal Closing at the following specific location:

Regional District of North Okanagan
9848 Aberdeen Road
Coldstream, B.C. V1B 2K9

8.2 No oral or electronically transmitted Proposals or amendments to Proposals will be considered.

8.3 It is solely the responsibility of the Proponent to ensure that it has obtained, prior to the Proposal Closing, all Addenda issued by Opus International Consultants (Canada) Ltd. on behalf of the OWNER.

8.4 Opus International Consultants (Canada) Ltd. on behalf of the OWNER will not accept an amendment to a previously submitted Proposal unless:

- (1) it is in writing;
- (2) it is received at the specific physical location set out in Section 00100, Part 8.1, prior to the Proposal Closing in a sealed envelope or package on the exterior of which shall be indicated the Proposal Number and the name of the Proponent;
- (3) it indicates a change to a Proposal already submitted; and
- (4) it is signed by the person or persons who signed the original Proposal.



- 8.5 It is solely the responsibility of the Proponent to ensure that its Proposal and any amendments are received at the specific physical location set out in Section 00100, Part 8.1 by the Proposal Closing.
- 8.6 Tenderers shall be solely responsible for the completion and delivery of Proposals and any amendments in the manner and time specified by Section 00100, Part 1 and Part 8. No extension of the Proposal Closing will be given to accommodate Tenderers or amendments to Proposals that do not comply with the requirements of Section 00100, Part 8.

PART 9 VARIATION TO SPECIFICATIONS

- 9.1 The Proposal shall be in accordance with the terms and conditions contained in the Proposal Documents. Any Proposal that materially changes these terms and conditions by, for example, including vendors "Standard Terms of Sale", may be subject to disqualification at the sole discretion of the OWNER.
- 9.2 If the Proponent wishes to submit a Proposal based on specifications or terms that differ from the specifications or Proposal Documents, it shall show in detail where and how it has varied the specifications or Proposal Documents. The acceptability of any such variations will be at the OWNER's sole discretion.
- 9.3 Alternate SUPPLIERS will be considered as long as they meet the requirements as stipulated in section 11287 and provide the information set out in Section 00300 and Section 00400.
- 9.4 Unless otherwise expressly stated in the Proposal, the Proponent agrees to accept without reservation or amendment, the whole of the specifications and Proposal Documents.
- 9.5 If the OWNER stipulates a completion date herein, and the Proponent is unable to commit to this date, the Proponent may submit a Proposal stating the Proponent's best possible completion date. The suitability of such completion date will be solely at the OWNER's discretion and may be justification for rejecting the Proposal.
- 9.6 Proposals shall be based on the use of materials specified in the Proposal Documents. Equivalent alternatives to materials specified may be considered by the OWNER but only if full and complete descriptive data (including a clear statement as to the change in the Proposal Price if the proposed alternative is accepted) is submitted to the OWNER in accordance with the requirements set out in Part 9.3.

PART 10 IRREVOCABILITY OF OFFER

- 10.1 The Proposal submitted by the Proponent shall be irrevocable and remain open for acceptance by the OWNER for a period of 60 days from the Proposal Closing, whether another Proposal has been accepted or not. If at any time after 60 days from the Proposal



Closing, the Proponent has not revoked its Proposal in writing, the OWNER may accept the Proposal.

- 10.2 If a Proponent, for any reason whatsoever purports to revoke its Proposal within 60 days from the Proposal Closing, the OWNER, without limiting any other remedy it may have under the Proposal Documents or otherwise, shall be entitled to:
- (1) require the Proponent to pay to the OWNER an amount equal to the difference between the Proposal price of its Proposal and any other Proposal which is accepted by the OWNER, if such other Proposal is for a greater price, plus the total of all costs, expenses and damages, including legal fees on a solicitor and own client basis, incurred by the OWNER as a result of or related to such revocation or failure by the Proponent.

PART 11 PROPOSAL OPENING

- 11.1 Proposals received by the OWNER at the specified place prior to the Proposal Closing will be opened in public, 15 minutes following the closing of the RFP, after the Proposal Closing. Information made public at the Proposal opening will be done so as to ensure the integrity of the tendering process and shall not be construed as an indication of the acceptability of any Proposal nor should such information be used for comparative evaluation. All Proposals properly received and opened are subject to review and evaluation by the OWNER.

PART 12 ACCEPTANCE AND REJECTION OF PROPOSALS

- 12.1 Notwithstanding any other provision in the Proposal Documents, any practice or custom in the construction industry, or the procedures and guidelines recommended for use on publicly funded construction projects, the OWNER, in its sole discretion, shall have the unfettered right to:
- (1) accept any Proposal;
 - (2) reject any Proposal;
 - (3) reject all Proposals;
 - (4) accept a Proposal which is not the lowest Proposal;
 - (5) reject a Proposal even if it is the only Proposal received by the OWNER;
 - (6) accept all or any part of a Proposal; and
 - (7) award all or a portion of the Work to any Proponent.



- 12.2 Awards shall be made on Proposals that in the OWNER's sole discretion give the greatest value based on quality, service and price. In considering what constitutes greatest value, the OWNER may take into account the OWNER's previous experience with a Proponent.
- 12.3 The OWNER will notify the successful Proponent in writing that its Proposal has been accepted. The successful Proponent will be required to sign an 'Agreement' in the form attached (Section 00400).
- 12.4 The OWNER may accept the Proposal by purchase order, the form of which will be determined by the OWNER.

PART 13 COMPARISON OF PROPOSALS

- 13.1 In comparing Proposals, the OWNER will, in addition to confirming compliance with the specifications and the proposed initial price of the equipment, take into account the following:
- (1) total lifecycle (capital, operating and maintenance) costs, related facility cost, and ease of installation;
 - (2) ease and cost of maintenance and availability of replacement parts;
 - (3) ultraviolet (UV) system sizing and performance criteria;
 - (4) anticipated delivery date of the equipment.

Proponents are invited to make as many proposals as they feel worthy of consideration in fulfilling the specifications herein.

PART 14 SUCCESSFUL PROPONENT REQUIREMENTS

- 14.1 Unless otherwise waived in writing by the OWNER, the successful Proponent shall submit to the OWNER the following original documentation (facsimile or photocopy copies not acceptable) within seven (7) working days of the notification of the successful Proposal under Section 00100, Part 13.3:
- (1) An original certificate of insurance in a form acceptable to the OWNER.
- 14.2 The successful Proponent shall not commence the Work until it has received a Notice to Proceed issued by the OWNER.



PART 15 CONFIDENTIALITY AND SECURITY

15.1 The following conditions apply:

- (1) the Proposal Documents, or any portion thereof, may not be used for any purpose other than submission of Proposals; and
- (2) the successful Proponent must agree not to divulge or release any information that has been given to it or acquired by it on a confidential basis during the course of carrying out the Work or performing its services;
- (3) it is the OWNER's policy to maintain confidentiality with respect to all confidential information related to the Proposal, but the OWNER is subject to the Freedom of Information and Privacy Act. If the Proponent considers that any of its information is confidential, the Proponent shall identify that confidential information and advise the OWNER in its Proposal.

PART 16 DISCLAIMERS/LIMITATIONS OF LIABILITY

- 16.1 Neither acceptance of a Proposal nor execution of an Agreement shall constitute approval of any activity or development contemplated in any Proposal that requires any approval, permit or license pursuant to any federal, provincial, regional district or municipal statute, regulation or bylaw.
- 16.2 The OWNER, its directors, officers, servants, employees, agents and consultants expressly disclaim any and all liability for representations, warranties, express or implied or contained in, or for omissions from this Proposal or any written or oral information transmitted or made available at any time to a Proponent by or on behalf of the OWNER. Nothing in this Proposal is intended to relieve a Proponent from forming their own opinions and conclusions in respect of this Request for Proposal.
- 16.3 The Proponent, by submitting a Proposal, agrees that it will not make a claim against the OWNER, for whatever reason, relating to the Proposal, the Proposal Documents or the competitive Proposal process, in excess of an amount equivalent to the reasonable costs actually incurred by the Proponent in preparing its Proposal and the Proponent, by submitting a Proposal, waives any claim or recovery for loss of profits or any prospective damages whatsoever if no Agreement is entered into with the Proponent.

PART 17 NON-RESIDENT WITHHOLDING TAX

- 17.1 Regulation 105(1) of the Canadian Income Tax Act requires that payments to non-residents for any services performed in Canada are subject to a Non-Resident Withholding Tax of 15%. Exemptions from this withholding tax are available in some circumstances, but you must apply directly with Canada Customs and Revenue Agency



(CCRA), at least 30 days before commencing work. Please call the CCRA at (604) 587-2215 if you have any questions or to receive a copy of the application form.

PART 18 QUALIFICATIONS AND COMPETENCY

- 18.1 The OWNER reserves the right to reject Proposals from Proponents who are unable to provide evidence that they are capable of providing the necessary labour, materials, equipment and adequate financial arrangements for satisfactory performance of the Work and the provisions of this Proposal as herein specified.
- 18.2 To be eligible for consideration for a Contract, the Proponent must be able to demonstrate successful performance in comparable work during the previous three years and must include with their Proposal submission satisfactory references for the OWNER's consideration.

PART 19 PROPOSED PRICES

- 19.1 The total proposed price or prices quoted in the Form of Proposal shall include the furnishing of all materials, supplies, equipment and provision of all labour, construction tools and equipment, utility and transportation services necessary to perform, complete delivery and commissioning of the specified equipment and systems required under the Proposal, including all miscellaneous work, whether specifically included in the Proposal documents or not. It is the intention of the specifications to provide furnished equipment and systems. Any items omitted there from which are clearly necessary for the completion of the equipment and systems or its appurtenances shall be considered a portion of the work though not directly specified and/or shown or called for on the drawings or specifications.
- 19.2 Without limiting more specific requirements contained in the Specifications for equipment the Proponent shall include with his Proposal, descriptive literature, adequate engineering data, power requirements, efficiencies and Outline Drawings showing principal dimensions and weights of the equipment offered. The Proposal as submitted shall be essentially complete as to permit the OWNER to make a full analysis of the equipment offered without the need for additional information.
- 19.3 The Proponent shall give the total Proposal price both in words and in figures, and shall fill in all blank spaces for unit prices, item prices, lump sums and other information in the Form of Proposal.

END OF SECTION 00100

APPENDIX A - Section 00100
Example Consent of Surety or Letter of Credit

Date:

Submitted By: (Legal Name of Bank or Surety)
(Address of Bank or Surety)
Fax: (Fax Number), Telephone: (Telephone Number)

Regional District of North Okanagan
9848 Aberdeen Road
Coldstream, B.C. V1B 2K9

Project: D-15043.00 – Ultraviolet (UV) Disinfection System for Drinking Water Application
Supply of Ultraviolet (UV) Disinfection Equipment for Drinking Water

To Whom it May Concern:

Should the Regional District of North Okanagan [hereinafter referred to as the "OWNER"] accept the Proposal and execute an Agreement with _____, [hereinafter referred to as the Supply Contractor], we, the undersigned Surety Company, do hereby consent and agree to become bound to the OWNER as Surety for the Supply Contractor in any of the following Bonds, on the standard format of the Canadian Construction Association.

1. Performance Bond for the amount equal to the total contract value,
2. Warranty Bond for an amount 10% of contract value.
3. Maintenance Bond consisting of a Letter of Credit in the amount of 10% of the Total Proposal Price valid for one year following the date of Substantial Performance.

We, the undersigned Surety Company, agree to furnish the OWNER with the Performance and Warranty Bonds within 10 days after written notification that the OWNER has requested the said Bond or Bonds. We hereby further declare that our Company is legally entitled to do business in the Province of British Columbia.

Yours truly,

(Name of Surety Company)

(Address)

(SEAL)

Note: This Agreement must be executed on behalf of the Surety Company by its authorized Officers under the Company's corporate seal.



MATERIAL SUPPLY AGREEMENT TO: **Regional District of North Okanagan**

1.01 PRICING AGREEMENT

- A. SUPPLIER shall commence to proceed actively with the Stage 1 Submittals Package #1 portion work of the Contract promptly following receipt of the Letter of Intent, and to complete the remainder of the Work under the Contract upon receipt of the Notice to Manufacture and Deliver as per the Schedule of Supply and Delivery, subject to the legal availability of funds from the Federal\Provincial Canadian Water and Wastewater Fund and provisions for the extension of Contract Time stipulated in the General Conditions.
- B. Upon receipt of the Notice to Manufacture and Deliver, the undersigned SUPPLIER will fabricate, manufacture, test, and deliver equipment (the WORK) to the OWNER and perform the SERVICES for the OWNER, as specified or indicated in these Documents for the prices stated in the Pricing Schedules.
- C. Installation of the equipment will be by a CONTRACTOR under a separate and independent agreement with the OWNER. The CONTRACTOR will be selected and named at a later date upon completion of design by the OWNER based on the SUPPLIER's equipment. Design of the UV facility will be completed by May 2017. Project construction is anticipated to begin June 2017 and will continue for approximately 8 months. Delivery to the Delivery Point is to be no later than January 13th, 2018 for UV reactors and electrical panels.
- D. SUPPLIER accepts all of the terms and conditions of the Agreement. All SUPPLIER's proposed Pricing Agreements shall remain subject to acceptance for 90 days after Proposal opening during which time the OWNER will select a SUPPLIER, or for such longer period of time that SUPPLIER may agree to in writing upon request of OWNER.
- E. In submitting the Proposal, SUPPLIER represents that:
 - 1. SUPPLIER has examined and carefully studied the Documents, the other related data identified in the Documents, and the following Addenda, receipt of which is hereby acknowledged.

ADDENDA

No. _____ Dated _____

No. _____ Dated _____

- 2. SUPPLIER does not consider that any further examinations, investigations, tests, studies, or data are necessary for the determination of this Proposal for performance of the WORK at the price and guaranteed replacement and operating costs stated and within the times and in accordance with the other terms and conditions of the Documents.
- 3. SUPPLIER is aware of the general nature of work to be performed by CONTRACTOR and others that relates to supplying the specified UV equipment as indicated in the Documents.
- 4. SUPPLIER has given ENGINEER written notice of all conflicts, errors, ambiguities, or discrepancies that SUPPLIER has discovered in the Documents, and the written resolution thereof by ENGINEER is acceptable to SUPPLIER.



- 5. The Documents are generally sufficient to indicate and convey understanding of all terms and conditions for the performance of the WORK for which this Proposal is submitted.
 - 6. SUPPLIER has familiarized itself with the nature and extent of the Agreement, WORK and SERVICES, project site, locality where the WORK and SERVICES are to be delivered, the legal requirements (federal, provincial and local laws, ordinances, rules, and regulations), and the conditions affecting cost, progress or performance of the Agreement and has made such independent investigations as SUPPLIER deems necessary.
 - 7. The Agreement Price shall be for Equipment and materials delivered to the OWNER's physical location, including all insurance, deliverables, services, freight, applicable duties and taxes.
- F. No implied contract of any kind whatsoever, by or on behalf of the Owner, shall arise or be implied from anything contained in this Contract or from any position or situation of the parties at any time, it being understood and agreed that the express contracts, covenants, and agreements contained herein and made by the parties hereto are and shall be the only contracts, covenants, and agreements on which any rights against the Owner may be founded.
- G. To all the foregoing, and including all Agreement Forms and O&M present worth evaluation information contained in this Proposal, said SUPPLIER further agrees to complete the WORK required herein for the prices stated herein and to guarantee replacement and operating costs as stated in the proposal documents and questionnaire of Section 00400.

SUPPLIER: _____ (SEAL)

Province / State of Incorporation: _____

By: _____
(Signature – attach evidence of authority to sign)

Date: _____

Name (typed or printed): _____

Title: _____

Attest: _____
(Signature of Corporation Secretary, Acting Secretary of other officer)

Business address: _____

Phone Number: _____ FAX Number: _____

Date of Qualification to do business is _____



1.02 PRICING SCHEDULE – UV DISINFECTION SYSTEM

A. The Pricing Schedule for furnishing the UV Disinfection System for the Duteau Creek WTP is provided below. The Agreement between the OWNER and SUPPLIER for the scope of WORK and SERVICES, as defined in the Documents, will be for the total amount shown in Schedule 1 below.

Schedule 1 - Capital Cost and Pricing

Item	Description	Price
1	Complete all work associated with Stage 1 – Submittal Package #1 as described in Section 11287. Payment for this item shall be made upon Owner’s approval of Submittal Package #1.	\$25,000
2	Complete all work associated with Stage 2 – Submittal Package #2 as described in Section 11287. This line item shall not exceed 20% of the Total Schedule 1 Price. Payment for this item shall be made upon Owner’s approval of Submittal Package #2.	\$
3	Supply a complete Ultraviolet Disinfection System including UV reactors, control panels and all other associated equipment specified or otherwise, including delivery to the Delivery Point and as described in Section 11287. This line item shall not exceed 70% of the Total Schedule 1 Price. <u>Note:</u> 50% of the payment for this item shall be made upon acceptance of UV reactors by the Owner at the Delivery Point and 50% of payment for this item shall be made upon acceptance of the control panels and all other associated equipment and materials by Owner at the Delivery Point.	\$
4	All work associated with Submittal Package #3 as described in Section 11287. Payment shall be made upon Owner’s approval of Submittal Package #3.	\$
5	All installation, testing, training, and support services as described in Section 11287. Payment for this item shall be made following completion of installation, testing and training.	\$
6	All work associated with Submittal Package #4 as described in Section 11287. Payment shall be made upon Owner’s approval of Submittal Package #4.	\$
7	Final Payment. Payment of this item shall be made following successful completion of the Owner’s Acceptance Testing Period and OWNER issuing UV Final Acceptance Notification.	\$50,000
Total Schedule 1 Price (Sum of Items 1 through 7).		\$

B. Exceptions. Any exceptions taken by the SUPPLIER to the WORK and SERVICES specified herein shall be explicitly stated and shall accompany this signature page and shall be signed by all signers of this document. If no exceptions are attached, SUPPLIER shall be responsible for meeting the full requirements of these Documents. OWNER reserves the right to not accept proposals based on any exceptions taken.



1.03 GUARANTEED O&M COST DATA

A. The SUPPLIER shall provide all cost information required to complete Schedule 2 – Guaranteed O&M Cost to enable calculation of annual operations and maintenance cost and present worth analysis based on seasonal flow rates, UV transmittance (UVT) and operations conditions listed in the table by quarter of year.

1. The following formulas are to be used to calculate the values entered into rows 45 through 58:

Row 45 =	Value in Row 9 (i.e. R9) x 730 (hours/month)
Row 46 =	R45 x R6 x EC
Row 47 =	(R6/12) x (R35+R36) x (R11 x 8760/R21)
Row 48 =	(R6/12) x R37 x (R12 / R23)
Row 49 =	(R6/12) x R38 x (R13 / R24)
Row 50 =	(R6/12) x R39 x (R14 / R26)
Row 51 =	(R6/12) x R30 x (R14)
Row 52 =	Sum of R46 for each operating period
Row 53 =	Sum of R47 for each operating period
Row 54 =	Sum of R48 for each operating period
Row 55 =	Sum of R49 for each operating period
Row 56 =	Sum of R50 for each operating period
Row 57 =	Sum of R51 for each operating period
Row 58 =	Sum of R52 through R57
Row 59 =	R58 x PWF

B. SUPPLIER shall state maximum replacement costs and power usage values herein that are guaranteed for the analysis period as identified in Paragraph C below. Signature of SUPPLIER in the Supplier Tender Form indicates SUPPLIER's acceptance to guarantee maximum replacement power usage costs stated herein for the warranty period.

C. The following economic factors shall be used to determine the present worth of annual O&M cost.

1. Analysis Period (N): 20 years.
2. Effective Annual Interest Rate (I): 5 percent.
3. Present Worth Factor (PWF: For "N" years at "I" percent): 12.462.
4. Unit Energy Cost (EC): \$0.10 per kW-hour.
5. Labor Cost (LC): \$50 per hour.



Schedule 2 - Guaranteed O&M Cost

ROW / DESCRIPTION	UNITS	OPERATING CONDITIONS		
		Winter	Shoulder	Summer
TREATMENT REQUIREMENTS				
1 Flow Rate	ML/day	6	30	90
2 UVT	%/cm	86	86	86
3 Target Pathogen		<i>Cryptosporidium</i>		
4 Target Log Inactivation		3.0		
5 Target Dose, D _{VAL}	mJ/cm ²	15.6		
6 No. of Months Per Year		6	2	4
POWER, INSTALLED & OPERATING QUANTITIES				
7 Number of Installed Reactors (duty + standby)				
8 Number of Operating Reactors				
9 Guaranteed Total Power at Target Dose (S/S _o limited to CAF) ⁽¹⁾ kW				
10 Total No. of Lamps Installed				
11 Total No. of Lamps in Service				
12 Total No. of Sleeves Installed				
13 Total No. of Ballasts Installed				
14 Total No. of Sensors Installed				
15 Total No. of Reference Sensors				
UV REACTOR OPERATING REQUIREMENTS				
16 CAF (lamp aging factor x fouling factor)				
17 Operating Relative Lamp Output, S/S _o ⁽²⁾				
18 Reduction Equivalent Dose, RED	mJ/cm ²			
19 Validation Factor, VF	%			
20 Validated Dose, D _{VAL}	mJ/cm ²			
EQUIPMENT LIFETIME & MAINTENANCE FREQUENCY				
21 Guaranteed Lamp Life ⁽⁴⁾	hours			
22 Lamp Prorated Start Period	hours			
23 Guaranteed Sleeve Life ⁽⁵⁾	years			
24 Guaranteed Ballast Life ⁽⁶⁾	years			
25 Ballast Prorated Start Period	years			
26 Guaranteed Sensor Life ⁽⁷⁾	years			
27 Guaranteed Reference UV Sensor Life	years			
28 On-Site Duty Sensor Calibration Check ⁽⁸⁾	# /			
29 Off-Site Duty Sensor Recalibration by Supplier	years			
30 Off-Site Reference Sensor Factory Calibration ⁽⁹⁾	years			
31 Guaranteed Wiper Life	Months			
32 On-Site UVT Monitor Calibration Check ⁽¹⁰⁾	# / week			
33 On-line mechanical wiper cleaning sol (if appl.)	L/year			
34 Off-Line Chemical Cleaning (if applicable)	# / year			



Schedule 2 - Guaranteed O&M Cost (continued)

ROW / DESCRIPTION	UNITS	OPERATING CONDITIONS		
		Winter	Shoulder	Summer
GUARANTEED COSTS				
35 Lamp Replacement	\$ / lamp			
36 Lamp Disposal Fee	\$ / lamp			
37 Sleeve Replacement	\$ / sleeve			
38 Ballast Replacement	\$ / ballast			
39 Duty Sensor Replacement	\$ / sensor			
40 Duty Sensor Factory Calibration	\$ / sensor			
41 Reference Sensor Replacement	\$ / sensor			
42 Reference Sensor Factory Calibration	\$ / sensor			
43 Chemical clean solution	\$ / litre			
446 Wiper Replacement Cost	\$ / wiper			
O&M COSTS PER CONDITION (TIME WEIGHT ADJUSTED)				
45 Total Power	kW-hours			
46 Total Annual Energy Cost	\$ / year			
47 Annual Lamp Replacement Cost	\$ / year			
48 Annual Sleeve Replacement Cost	\$ / year			
49 Annual Ballast Replacement Cost	\$ / year			
50 Annual Sensor Replacement Cost	\$ / year			
51 Annual Sensor Calibration Cost	\$ / year			
EQUIPMENT LIFETIME & MAINTENANCE FREQUENCY				
52 Total Annual Energy Cost	\$ / year			
53 Annual Lamp Replacement Cost	\$ / year			
54 Annual Sleeve Replacement Cost	\$ / year			
55 Annual Ballast Replacement Cost	\$ / year			
56 Annual Sensor Replacement Cost	\$ / year			
57 Annual Sensor Calibration Costs	\$ / year			
58 TOTAL ANNUAL O&M COSTS	\$ / year			
PRESENT WORTH				
59 PRESENT WORTH COST OF ANNUAL O&M	\$			

Notes:

- (1) Maximum relative lamp output (S/S_o) shall be limited to combined lamp aging and fouling factor (CAF).
- (2) Operating S/S_o is defined as the minimum S/S_o required to maintain the $D_{VAL} \geq D_{REQ}$. This value should be \leq the CAF value used for the design and \geq the minimum S/S_o limit of the validation envelope.
- (3) Not used.
- (4) Lamp life limited to 15,000 hr for LPHO and 10,000 hr for MP lamps.
- (5) Sleeve life limited to 20 yrs.
- (6) Ballast life limited to 10 yrs.
- (7) Sensor life limited to 10 yrs.
- (8) Minimum frequency of duty sensor checks limited to once per month (UVDGM Section 6.4.1.1).
- (9) Minimum frequency of reference sensor calibration limited to once per year (UVDGM Section 6.3.1).
- (10) Minimum frequency of UVT monitor calibration check limited to once per week (UVDGM Section 6.4.1.2).





1.1. PURPOSE

- .1 This Section lists the minimum qualifications and submittal requirements for the Supplier Qualifications Questionnaire.
- .2 The purpose of the submitted information is to provide OWNER with the necessary information to judge the minimum qualifications of the SUPPLIER for proposing for this project and for ranking and evaluating those SUPPLIERS meeting qualifications and technical requirements of this project.

1.2. MINIMUM QUALIFICATIONS

- .1 The SUPPLIER shall meet the minimum qualifications in order to be considered and evaluated further by the OWNER to provide equipment and services for this project.
- .2 Minimum qualifications as demonstrated by information submitted per Paragraph 1.04, shall be as follows:
 - (1) SUPPLIER shall have manufactured and completed validation per the USEPA UVDGM on UV reactors with flow capacities equal to or greater than 90 ML/day.
 - (2) SUPPLIER shall have three or more installations in USA and/or Canada using UV reactors with individual capacities equal to or greater than 90 ML/day.
- .3 SUPPLIER shall have the capacity to provide a performance bond of equal to the value of the Contract to meet the financial obligations of this project. The performance bond shall be released upon successful completion of the performance tests.
- .4 The SUPPLIER shall provide warranties as described in Section 11287 Paragraph 1.08 and a Warranty Bond of 10% of the total Contract value, which will be released at the end of the 24-month General UV Disinfection System warranty period.

1.3. PROPOSAL SUBMITTAL REQUIREMENTS

- .1 SUPPLIER to submit bound copies of questionnaire and related attachments per this Section.
- .2 Include the following:
 - (1) Identification of SUPPLIER, contact information, name of project, name of OWNER, and date of submittal.
 - (2) Resumes of SUPPLIER's Project Manager and lead Project Engineer who will be providing services.
 - (3) Responses to all questions listed below.
 - (4) Supporting information, calculations, and data as required in response to questions.



- (5) Any other information deemed appropriate by SUPPLIER to assist OWNER in determining SUPPLIER qualifications including company brochures, product data sheets, etc.

1.4. SUPPLIER DESIGN QUESTIONNAIRE

- .1 SUPPLIER shall provide responses to all questions referencing the question number to which the answer pertains. If a question is not applicable to a SUPPLIER's proposed equipment, then an answer of Not Applicable or N/A must be provided.
- .2 SUPPLIER is advised that several responses below are also required to be filled in the appropriate blanks in Table A of this section and pricing schedules and O&M cost data tables of Section 00300. Conflicts in responses will be governed by information provided in Section 00300. All replacement costs shall be quoted in 2017 dollars.

1.5. UV DISINFECTION SYSTEM DESIGN INFORMATION

- .1 Complete Table A by filling in the blanks with requested information that describes the proposed UV equipment for this project. Some of the requested information of Table A may be the same as information requested in Section 00300. SUPPLIER shall identify and resolve conflicting data between the sections.



Table A
Proposed UV Disinfection System Information

UV System Elements	Units	Fill in Blanks
<u>Design Criteria</u>		
Log Inactivation of <i>Cryptosporidium</i>	Log	3
Required Dose	mJ/cm ²	12
Dose Safety Factor	%	30
UVT	%	80
System Flow,		
Maximum (Hydraulic Capacity)	ML/day	179
Design Disinfection Capacity	ML/day	179
Minimum	ML/day	1.5
Power Requirements (nominal 600 VAC, 3 phase, 3 wire + ground or 3 wire with neutral)		
End of Lamp Life Factor (EOLL)	---	
Lamp Fouling Factor	---	
<u>UV Configuration</u>		
UV Reactor Product Name	---	
UV Reactor Model No.	---	
No. of Reactors [Duty + Redundant]	No.	
Design Flow Rate per Reactor	ML/day	
No. of Banks or Rows of Lamps Per Reactor	No.	
No. of Lamps Per Bank or Row	No.	
Total No. of Lamps per Reactor	No.	
Total No. of Lamps	No.	
No. of Ballasts per Reactor	No.	
No. of Lamps Driven by One Ballast	No.	
No. of UV Sensors per Reactor	No.	
<u>UV Reactor Design</u>		
CAF (lamp aging factor x fouling factor)	---	
Operating Relative Lamp Output, S/S _o ⁽¹⁾	---	
Reduction Equivalent Dose, RED (<i>Cryptosporidium</i>)	mJ/cm ²	
Validation Factor, VF		
Minimum Validated UVT	%	
Validated Dose, D _{VAL} (<i>Cryptosporidium</i>)	mJ/cm ²	
<u>Reactor Configuration</u>		
Length (flange to flange)	mm	
Width	mm	
Height (top of reactor to top of supports)	mm	
Inlet/Outlet Flange Fitting Diameter	mm	
Minimum number of upstream pipe diameters to meet validation	No.	
Minimum distance between reactors required for access and maintenance work. (flow centerline to flow centerline)	mm	
Minimum height from floor to centerline of reactor	mm	
Vertical clearance above reactor centerline for maintenance	mm	
Weight, each	kg	
<u>Hydraulics</u>		
Headloss (per reactor) at Design Flow Rate	mm	
Flow Rate at Maximum Allowable Headloss	ML/day	
Maximum Pressure Rating of Reactor	kPa	



**Table A (Cont.)
Proposed UV Disinfection System Information**

UV System Elements	Units	Fill in Blanks
<u>Lamp Characteristics</u>		
Lamp Type (LPHO/MP)	Type	
Nominal 100 % Lamp Power Consumption	Watt/lamp	
Lamp Cool-down Time	Minutes	
Lamp Warm-up Time	Minutes	
Lamp Restart Time	Minutes	
Maximum Start/Stop Cycles Per day	No./24 hours	
Required Clearances for Lamp Removal		
Width	mm	
Lamp Length	mm	
Mercury content per lamp	mg	
<u>Quartz Sleeve Characteristics</u>		
Material (e.g., Type 214)	---	
New Sleeve Transmittance, %	percent	
Final Sleeve Transmittance, %	percent	
<u>Ballast Characteristics</u>		
Power Supply (VAC, phase, hertz, wire)	---	
Operating voltage fluctuation tolerance	± percent	
Nominal 100 % Ballast Power Consumption	Watt/Ballast	
Ballast Type	---	
Maximum Ballast Power Setting per Lamp	% and watts	
Minimum Ballast Power Setting per Lamp	% and watts	
<u>Ballast/Power Supply Cabinet Dimensions</u>		
Length	mm	
Width	mm	
Height	mm	
Weight, each	kg	
Maximum Allowable Lamp Cable Distance (Ballast to Lamp)	mm	
Ambient temperature range	°C	
Ambient humidity range	%	
Ballast Cooling method	----	
<u>UV Sensor</u>		
Manufacturer		
Model		
<u>Cleaning System</u>		
Type (Wipers/Clean-In-Place)	---	
Space Requirements (L x W x H)	mm x mm x mm	
Power Requirements	kW	
<u>Other</u>		
No. of Temperature Sensors per Reactor	No.	
No. of Temperature Sensors per Ballast Cabinet	No.	
No. Lamp Quartz Sleeve Seals Per Reactor	No.	
Lamp Quartz Sleeve Seal Replacement Interval	Months	
No. Wiper Seals Per Reactor	No.	
Wiper Seal Replacement Interval	Months	

NOTE TO SUPPLIER: Proposal design and hydraulic criteria specified in Section 11287.



UV DISINFECTION SYSTEM – COMPONENT QUESTIONS

.1 REACTOR

- (1) Provide schedule of materials for all wetted parts the materials used for construction of the wetted parts (seals, optional wipers, optional wiper mechanisms, etc.).

.2 LAMPS

- (1) Describe the lamp guarantee including lamp life, replacement costs, and the application of pro rata. What criterion defines a failed lamp? How is compliance to that criteria quantified?
- (2) Can other lamps remain operating during lamp replacement?
- (3) What is the minimum flow required by the UV reactors to protect lamps and prevent over heating?
- (4) State the operating combinations of lamps with a given reactor that are supported by validation.

.3 BALLASTS

- (1) Describe the ballast guarantee including lamp life, replacement costs, and the application of pro rata.
- (2) List the range of power settings for the ballast. Are the ballast setting discrete or continuous. If discrete, what is the interval between settings?

.4 SLEEVES

- (1) State the sleeve guarantee including sleeve life and replacement costs? What criteria are used to define a sleeve failure (e.g. sleeve break, sleeve UV transmittance at 254 nm)?
- (2) What flow rate do the sleeves experience resonant vibration?

.5 UV SENSORS

- (1) State the UV sensor guarantee including UV sensor life and replacement costs?
- (2) Provide details on how duty and reference UV sensors are calibrated, including the use of primary and transfer standards. Describe all primary and transfer standards and instrumentation used. Explain how the calibration accounts for the wavelength response, angular response, and linearity of the UV sensor and transfer standards. Provide details on how UV sensor calibration is traceable to a National Standard. State the measurement uncertainty of the standards and the calibration steps.



- (3) What is the turn-around time for UV sensor recalibration?

.6 SEALS

- (1) Describe and quantify all the seals used by the reactors. State the recommended replacement intervals and costs.

.7 POWER SUPPLY AND CONTROL CABINETS

- (1) State the Arcflash hazard rating for the electrical cabinets.
- (2) What is the maximum power at design conditions (at minimum ballast power and S/So to achieve required dose) per reactor and total UV system?
- (3) What is the maximum power (with lamps set to 100% ballast power setting) per reactor and total UV system?
- (4) Are transformers required? If yes, provide dimensions and weight.

.8 OTHER

- (1) Provide overall dimensions of each reactor, required piping to confirm UVDGM, space requirements needed to access reactors and cabinets for maintenance, connections to other work, and interconnections and interface requirements.
- (2) Provide overall dimensions for all electrical and control panels, transformers, etc.

1.6. SUPPLIER EVALUATION QUESTIONNAIRE

.1 UV SYSTEM OPERATION

- (1) Provide the relation between ballast power consumption in kW and kVA and ballast power setting.
- (2) Provide the UV sensor equation that predicts UV sensor readings as a function of UVT, ballast power setting, and lamp operating status
- (3) Provide the UV dose monitoring equation that predicts test microbe log inactivation as a function of UVT, flow rate, relative lamp output, lamp status, and if used microbe UV sensitivity.
- (4) Does the UV dose monitoring equation use instantaneous values of the measured parameters or time averaged values? If time averaged, provide details on the averaging algorithm.



.2 DISINFECTION CAPACITY

- (1) What is the maximum flow capacity at the design UVT and 3.0-log inactivation of *Cryptosporidium*?
- (2) What is the minimum flow capacity at the design UVT and 3.0-log inactivation of *Cryptosporidium*?
- (3) What is the validated range of flow, UVT, relative lamp output (S/So), and log inactivation or RED for the UV reactor?

.3 SLEEVE CLEANING SYSTEM AND MAINTENANCE

- (1) What type of cleaning system is proposed (automatic or clean-in-place)?
- (2) If automatic,
 - a What mechanism is used to wipe the lamp quartz sleeves and UV sensor windows?
 - b What method is used to drive the wiper?
 - c What is the recommended wiping frequency based on design fouling factor? What is the minimum recommended wiping frequency to exercise the wiper mechanism?
 - d Are chemicals used in the wiping process? If yes, what chemicals are used? What is the typical recommended replacement interval? How much volume should be maintained on-site? What is the expected annual consumption (gallons/year)? How much labor is required per UV reactor to replace cleaning chemicals per reactor?
 - e Is manual chemical cleaning recommended or required? If yes, what is the recommended cleaning interval based in design fouling factor? What chemicals are used? What components are cleaned? How much labor is required per UV reactor?
- (3) Provide drawings of the cleaning system showing all major components and space requirements.

.4 SERVICE AND SUPPORT AND SPARE PARTS

- (1) For all spare parts including lamps, sleeves, ballasts, UV sensors, and seals, provide the following information:
 - a Name and address of parts supplier
 - b Location where parts are manufactured.
 - c Location of warehouse where parts are stocked and shipped from
 - d Range of response time for parts orders from order to shipment
 - e How long (in years) will consumable parts be stocked for the supplied system?



- (2) Provide a description of the field service organization and facility locations, including the following:
 - a Closest service person and availability for all major equipment.
 - b Description of major service depot that can provide service and replacement parts for the Work.
 - c Brief history of nearest facility, including the amount of time servicing similar equipment for manufacturer named in this Proposal.

.5 EXPERIENCE AND QUALIFICATIONS

- (1) List five (5) UV Disinfection Systems supplied in the last five years for drinking water applications. Three (3) of these references must meet the minimum qualification requirements specified in this Section.
- (2) Provide description of each system including size of reactors, design dosage, flow through reactors, number of reactors, type of reactors, number of lamps, size of reactors, cleaning method, method of control, and other information that would assist OWNER in evaluating the installation.
- (3) Provide name, title, address, and telephone number of installation's contact representative for three (3) installations.
- (4) List project experience with UV installations that use a UVDGM (2006) compliant calculated dose monitoring and control strategy.

.6 QUALITY ASSURANCE AND PRODUCT DURABILITY

- (1) Is your organization certified per ISO quality standards? State those standards and how they are applied with the Supplied equipment.
- (2) Provide a description of how the Equipment is tested and the testing standards used. Indicate which tests are performed on all Equipment versus type tests. Indicate the location of the testing facility.

.7 MANUFACTURER'S FACILITIES

- (1) List the location and provide a description of the manufacturing facilities which would serve this project.
- (2) Provide a list of possible subcontractors' names, locations, and facilities for the work. Indicate which work/materials would be subcontracted.
- (3) Provide information describing the engineering, technical support, and manufacturing staff of the SUPPLIER or manufacturer and where they are located.

END OF SECTION 00400



PART 1 GENERAL

1.1 DEFINITIONS

The following words and terms, unless the context otherwise requires, in all Contract Documents, shall have the meanings set out below. Words using the male gender include the female gender and either includes the neuter and vice versa and words using the singular number includes the plural number and vice versa.

"Accepted Proposal" means the Supplier's proposal which has been accepted by the Owner and forms part of the Contract Documents;

"Agreement" means the agreement set out in Section 00300 Form of Proposal;

"Consequential Damages" has the meaning set out in Section 00500 Clause 7.1.3;

"Construction Contract" means the agreement between the Owner and the General Contractor who will install the Goods supplied by the Supplier under the Contract;

"Contract" means the agreement formed between the Owner and the Supplier for the supply of the Goods in accordance with the Contract Documents;

"Contractor" means general contractor.

"Contract Documents" means the documents identified in Section 00100 and includes the following:

1. Proposal Forms and General Conditions
 - 1.1 Section 00100 Instructions to Proponents
 - 1.2 Section 00300 Supplier Proposal Form
 - 1.3 Section 00400 Supplier Qualifications Questionnaire
 - 1.4 Section 00500 General Conditions

2. Technical Specifications
 - 2.1 Section 01010 Summary of Work
 - 2.2 Section 01025 Measurement and Pricing
 - 2.3 Section 01300 Submittals
 - 2.4. Section 11010 Equipment Anchoring
 - 2.5 Section 11287 Ultraviolet (UV) Disinfection System for Drinking Water Application

"Contract Price" has the meaning set out in Section 00300 Schedule 1;

"Day" means calendar day;

"Delivery Date" has the meaning set out in Section 00300;

"Delivery Point" means the location set out in Section 00100;



"Drawings" means that part of the Contract Documents specifically identified as drawings in Section 00100;

"Engineer" means Opus International Consultants (Canada) Ltd. or any other person duly authorized by the Owner to be the Engineer;

"General Contractor" means the person who will install the Goods that the Supplier shall supply under the Contract;

"Goods" means the Goods comprising the subject matter of the Contract and are generally described in Section 11287;

"MSDS" means Material Safety Data Sheets;

"Person" includes an individual, corporation, partnership and joint venturer;

"Site" means the location or locations where the General Contractor will install the Goods;

"Specifications" means that part of the Contract Documents specifically identified as specifications in Section 00100;

"Submittals" means the information which shall be submitted to the Owner in accordance with the Specifications;

"Supplier" means the person that has executed the Agreement as the Supplier;

"Supply Contactor" means the Supplier;

"Supplier's Plant and Equipment" means the equipment, material, supplies and all other items (except labour) brought onto the Delivery Point by the Supplier, but not to be incorporated in the Goods;

"Supplier's Representative" means the person appointed under Section 00500 Clause 2.2.2;

"Letter of Intent" means the notification from the Owner to the successful proponent of the Owner's selection of the proponent's proposal or modified proposal, including negotiated adjusts to that proposal, if any. At this point, the successful proponent becomes the Supplier;

"Owner" has the meaning ascribed to it in Section 00400 and the Owner shall include Regional District of North Okanagan (RDNO) with respect to any rights, indemnities, releases and other provisions benefiting the Owner under this Contract;

"WHMIS" means Workplace Hazardous Materials Information System.

1.2 JOINT VENTURES



If the Supplier is a joint venture of two or more entities, the grants, covenants, provisos and claims, rights, powers, privileges and liabilities of the Supplier shall be joint and several.



1.3 CONTRACT REQUIREMENTS

.1 Successors' Obligations

The Contract shall ensure to the benefit of and be binding upon not only the parties hereto but also their respective successors and permitted assigns.

.2 Assignment of Contract

The Supplier shall not assign the Contract in whole or in part, nor any payments due or to become due under the Contract without the prior written consent of the Owner. No assignment of the Contract shall relieve the Supplier from any obligation under the Contract or impose any liability on the Owner. Involuntary assignment of the Contract as a result of, inter alia, bankruptcy, assignment of the Contract for the benefit of creditors or appointment of a receiver, or insolvency shall be deemed default under the Contract entitling the Owner to terminate the Contract as hereinafter provided.

.3 Waiver of Rights

Except as herein provided, no act or failure to act by the Supplier, the Owner or the Engineer at any time with respect to the exercise of any right or remedies conferred upon them under this Contract shall be deemed to be a waiver on the part of the Supplier, the Owner or the Engineer, as the case may be, of any of their rights or remedies. No waiver shall be effective except in writing. No waiver of one right or remedy shall act as a waiver of any other right or remedy or as a subsequent waiver of the same right or remedy.

.4 Amendment of Contract Documents

The Contract Documents shall not be amended except as specifically agreed in writing signed by both the Owner and the Supplier.

1.4 LAWS, REGULATIONS AND PERMITS

.1 The Contract shall be construed under and according to the laws of the Province of British Columbia and, subject to an agreement to refer a dispute to arbitration under Section 00500, Clause 2.4.7, the parties agree to irrevocably consent to the jurisdiction of the Courts of the Province of British Columbia.

.2 The Supplier shall give all notices required by law and shall comply with all laws, acts, ordinances, rules and regulations relating to or affecting the Goods. If any permits, authorizations, approvals or licences from any government or governmental agencies are necessary or desirable for the prosecution of the work they shall be obtained by the Supplier at its expense, provided that the Supplier shall not make application for any such permit, authorization, approval or licence without first obtaining the written consent of the Owner.

.3 Patents, Royalties and Copyright

(1) The Supply Contractor shall pay all fees, royalties or claims for any patented



invention, article, process or method that may be used upon or in a manner connected with the Goods or with the use of the Goods by the Owner. Before final payment is made on the account of this Contract, the Supplier shall, if requested by the Owner, furnish acceptable proof of a proper release from all such fees or claims.

- (2) If the Supplier, its agent, employee or any of them is prevented from furnishing or using any invention, article, material or Submittals supplied or required to be supplied or used under this Contract, the Supplier either shall promptly pay such royalties and secure the requisite licences or, subject to written approval by the Owner, substitute other articles, materials or appliances in lieu thereof which are of equal efficiency, quality, finish, suitability and market value to those planned or required under the Contract.
- (3) The Supplier shall submit to the Owner descriptive information of any proposed substitutions. Approval by the Owner of any substitutions shall not relieve the Supplier of its responsibility if the substitutions do not function as well as the original specified in the Contract and shall not be deemed an assumption of risk or responsibility by the Owner. Approval shall only mean the Owner has no objection to the substitution being utilized at the Supplier's risk. If the Owner refuses to approve the substitution, the Supplier shall pay such royalties and secure such valid licences as may be requisite for the Owner, the Engineer, their directors, officers, agents and employees or any of them, to use such invention, article, material or appliance without being disturbed or in any way interfered with by any proceeding in law or equity on account thereof.

- .4 All references to money in the Contract Documents shall be interpreted as meaning lawful currency of Canada.

1.5 HEADINGS

- .1 Headings to parts, divisions, sections, clauses and forms are inserted for convenience of reference only and shall not affect the interpretation of the Contract Documents.

PART 2 OWNER-SUPPLIER RELATIONS

2.1 AUTHORITY OF OWNER

.1 Acceptability of Goods

The Owner shall make the final determination of the acceptability of the Goods.

.2 Appointment and Authority of Engineer

- (1) The Owner has appointed an Engineer, who shall both represent the Owner. The Engineer shall have the authority set out in the Contract Documents and such other authority as may be delegated in writing by the Owner, including but not limited to the following:
 - (a) to make decisions regarding the Goods;



- (b) to make decisions regarding the manner of performance and rate of progress of supply of the Goods; and
- (c) to make decisions regarding clarifications and interpretation of the Contract Documents.

2.2 RESPONSIBILITIES OF THE SUPPLIER

.1 Attention to the Goods

The Supplier shall diligently attend to the supply of the Goods so that they are delivered faithfully, expeditiously and in accordance with the Contract Documents.

.2 Authorized Representative

The Supplier shall advise the Owner, and the Engineer in writing of the name of the Supplier's authorized representative.

.3 Off-loading of Goods

The Supplier shall provide all necessary instruction to Delivery Point personnel to ensure satisfactory off-loading, storage, and testing of the Goods.

.4 Shipment

The Supplier shall properly package all Goods for safe shipment to the Delivery Point and a Notice of Shipment shall be sent by the Supplier to the Owner at least 2 weeks before the Goods are shipped. The Notice of Shipment shall state the number of the order, the kind of goods, the Supplier's name and the carrier and route by which the shipment is being made. The Notice of Shipment shall indicate appropriate instructions, considerations or other information regarding the proper storage, handling, transfer, off-loading and installation of the Goods.



.5 Acceptable Delivery

The Supplier will arrange to have the Goods delivered to the Delivery Point between 8:00 a.m. and 3:30 p.m. Monday to Friday, statutory holidays excepted. The Owner shall not be responsible for Goods delivered outside the acceptable time for delivery.

.6 Transportation Costs

If the Contract calls for payment of any transportation cost by the Owner, the Owner shall in no event be liable or accountable in excess of the actual costs of transportation. The Supplier shall be accountable for and pay any excess transportation costs arising from Supplier's failure to make delivery to the Delivery Point or to follow shipping instructions furnished by the Owner.

.7 Employee Safety

The Supplier alone shall at all times be responsible for the safety of its employees, its subcontractors' employees and other persons and equipment lawfully at the Delivery Point in connection with the supply of Goods and shall comply with the standards for the Site, the Workers Compensation Act and regulations thereto and under statutory and common law.

2.3 OWNER - SUPPLIER CO-ORDINATION

- .1 Any notice, order, directive, request or other communication (the "notice") given by the Owner or the Engineer to the Supplier shall be deemed to be given to the Supplier, if left at any office used by the Supplier or delivered to any of its officers or employees, or posted at the Delivery Point, or mailed by mail addressed to the Supplier at the address given in the Contract Documents or mailed to the Supplier's last known place of business. Any notice given to a Supplier that is a joint venture or partnership shall be deemed to be given if delivered or mailed to any one of the joint venturers or partners or any of their officers or employees. Any notice to be given by the Supplier to the Owner shall be deemed to have been given if sent by mail or delivered to the Owner at the address of the Owner set out in Section 00400. Any notice sent by mail shall be deemed to have been given two days after the day of mailing.



- .2 The Supplier shall not have the exclusive right to occupy the Delivery Point and shall permit entry to the Delivery Point by the Owner, the General Contractor or any other contractors that may be performing work on behalf of the Owner. The Supplier shall afford to the Owner, the General Contractor any other contractors and their employees, reasonable facilities and co-operation and shall arrange its work and dispose of its materials in such a manner as to not interfere with the activities of the Owner, the General Contractor or any other contractors at the Delivery Point. The Supplier shall promptly make good and indemnify the Owner from any injury or damage to the Owner, the General Contractor or any other contractors, employees and their agents caused by the Supplier or its employees, subcontractors, suppliers or agents.
- .3 The Engineer, if requested by the Owner, Supplier, General Contractor or any other contractor, shall consider any differences, conflicts or disputes between the Supplier and the General Contractor and any other contractor with regard to the Goods on or near the Delivery Point. The Engineer shall give such directions as it considers desirable to resolve such difference, conflict or dispute and its directions shall be binding on the Supplier and insofar as it may have the authority, on the General Contractor and any other contractor.
- .4 The Delivery Point is open to both union and non-union contractors, and the Owner's own unionized work force. The Supplier and any subcontractors are required to deliver the Goods to the Delivery Point and access the Site regardless of their labour or union affiliation.

2.4 DISPUTE RESOLUTION

.1 Disputes

A dispute occurs between the Owner and the Supplier where there is difference between the parties as to the interpretation, application or administration of the Contract.

.2 Determination by Engineer

Except as otherwise specifically provided, questions regarding interpretation, application or administration of the Contract shall be referred by the Supplier in writing to the Engineer for its decision. The Engineer shall review the matter and respond to the Supplier in writing with the Engineer's decision within 21 days after receipt of written notice from the Supplier.

.3 Dispute of Decision

If the Supplier disputes a decision or instruction of the Owner or the Engineer (the "Disputed Decision") or considers that the Disputed Decision requires extra work, the Supplier shall give a detailed written notice of the dispute to the Owner and the Engineer within 21 days of the date that the Supplier received the Disputed Decision. The written notice must set out the nature of the dispute, the circumstances which gave rise to the dispute, the date on which these circumstances arose and the estimated cost of the work.

The Supplier shall be conclusively deemed to have accepted a decision or instruction of the Owner or the Engineer if the Supplier does not dispute the Disputed Decision by giving the required written notice within the required time and providing the required information.



.4 No Engineer's Review

Notwithstanding Section 00500, Clause 2.4.3, if the Disputed Decision was made by the Owner pursuant to Section 00500, Part 7, the Engineer shall not review the decision and the matter shall be dealt with as provided under Section 00500, Clause 2.4.7.

.5 Instructions Pending Resolution

If the Disputed Decision is not resolved promptly in the sole discretion of the Owner, the Engineer shall give any instructions as may be necessary for the supply of the Goods and to prevent delay in delivery of the Goods pending resolution of the dispute. The Supplier shall comply immediately with the Engineer's instructions. If it is subsequently determined that the instructions were contrary to the Contract Documents, the Owner shall pay the costs incurred by the Supplier in carrying out those instructions beyond what the Contract Documents required.

.6 Notice of Claim

No payment shall be made by the Owner to the Supplier in addition to the Contract Price on account of any extra expense, loss or damage incurred by or sustained by the Supplier for any reason unless the Supplier has given written notice of a claim to the Owner and the Engineer within 30 days of the date the Supplier first became aware of the circumstances which gave rise to the claim. The written notice must set out the date on which these circumstances arose and the estimated amount of the claim.

The Supplier shall be conclusively deemed to have waived any right to make a claim for any amount in addition to the Contract Price, if the Supplier does not give the required written notice within the required time and provide the required information.

.7 Dispute/Claim Resolution

- (1) **All claims, disputes or Disputed Decisions between the Owner and the Supplier that are not resolved shall be decided by arbitration if the parties agree, or failing agreement, in a Court of competent jurisdiction within the Province of British Columbia.**
- (2) **In the event that the parties agree to arbitration, pursuant to Section 00500, Clause 2.4.7(1), the arbitration shall be governed by the rules of the British Columbia International Commercial Arbitration Centre, except that the arbitrator or arbitrators shall be agreed upon by the parties, and failing agreement by the parties, shall be appointed by a Court of competent jurisdiction within the Province of British Columbia.**
- (3) **In the event that the parties agree to arbitration, the arbitration shall take place in Kelowna, British Columbia and be governed by the laws of British Columbia.**

PART 3 SPECIFICATIONS AND DRAWINGS

3.1 INTERPRETATION OF SPECIFICATIONS AND DRAWINGS



.1 General

The Specifications and Drawings are intended to be explanatory of each other. Goods specified on the Drawings and not in the Specifications, or vice versa, shall be executed as if specified in both.

.2 Request for Clarification

If the Supplier requires any clarification concerning the Specifications or Drawings, it shall direct its request in writing for clarification to the Engineer.

3.2 DIVISION OF SPECIFICATIONS AND DRAWINGS

Specifications and Drawings are divided into groups for the convenience of the Owner and the Engineer. These divisions are not for the purpose of apportioning work or responsibility for work among subcontractors, suppliers and manufacturers.

3.3 CONFLICTING PROVISIONS, ERRORS AND OMISSIONS IN CONTRACT DOCUMENTS

.1 Conflicting Provisions

In case of any inconsistency or conflict between the provisions of the Contract Documents, the provisions of such documents and Addenda thereto will take precedence and govern in the following order:

- (1) Agreement
- (2) Accepted Proposal and proposal forms with later documents taking precedence and governing over earlier documents within the Accepted Proposal
- (3) General Conditions
- (4) Specifications
- (5) Drawings
- (6) All other documents identified in Section 00100

.2 Errors and Omissions

If the Supplier discovers that there are any errors or omissions in the Contract Documents, it shall immediately notify the Owner and the Engineer in writing. The Owner and the Engineer will review the matter and if they conclude that there is an error or omission, they shall determine the corrective actions to be taken and the Engineer will advise the Supplier accordingly. If the corrective work associated with an error or omission increases or decreases the amount of work called for in the Contract, the Owner and the Engineer shall issue an appropriate change order. After discovery by the Supplier of an error or omission in the Contract Documents any work thereafter performed by the Supplier shall be done at its risk unless otherwise agreed by the Owner.

- .3 Figured dimensions on a Drawing take precedence over measurements scaled from the Drawing, and large-scale Drawings take precedence over those of a smaller scale. Supplementary Drawings and Specifications supersede their antecedents. In case of conflict



between figured dimensions on a Drawing and the dimensions of a product specified in the Specifications, the dimensions of the product specified in the Specifications will govern.



PART 4 MATERIAL, EQUIPMENT AND WORKMANSHIP

4.1 GENERAL

The Goods shall be new and of the quality specified. All work related to the Contract Documents shall be done with new materials, articles, equipment and workmanship of the best quality and description and by employment of properly skilled workers and in strict conformity with and as required by the Contract Documents. Materials and equipment shall be the product of suppliers or manufacturers of established good reputation, regularly engaged in the supply or manufacture of such materials or equipment.

4.2 DEMONSTRATION OF COMPLIANCE WITH CONTRACT REQUIREMENTS

.1 Inspection

- (1) The Owner or the Engineer or any inspector or agent appointed by either of them shall have access to the Goods and to the places the Goods are being manufactured, assembled, fabricated, stored or transported or where materials, equipment and machinery are being obtained for the Goods. The Supplier at the Supplier's sole cost shall provide to the Engineer or the Owner the assistance necessary for obtaining such access, and shall provide all information necessary or desirable in connection with the inspection of the Goods.
- (2) The Supplier shall at all times give and cause to be given to the Owner or the Engineer or any inspector or agent appointed by either of them, free access to inspect and test the Goods, wherever same is being performed or carried out. Such inspections and testing shall not in any way relieve the Supplier from any of its obligations or responsibilities under the Contract Documents, and shall not in any way prejudice or constitute a waiver of any rights or remedies of the Owner or any guarantees, warranties or covenants in favour of the Owner, and the Owner shall be entitled to rely on the expertise and obligations of the Supplier and its subcontractors and their consultants and engineers to the same extent as if such inspections and testing by the Owner or the Engineer or any inspector or agent had not taken place.
- (3) If the Contract Documents, laws, ordinances, or any public regulatory authority requires parts of the Goods to be specially inspected, tested or approved, the Supplier agrees that the Goods shall comply.
- (4) The Goods are subject to inspection and acceptance by the Owner, and the Engineer within a reasonable time after receipt. The Engineer will notify the Supplier in writing of the rejection of any of the Goods, which are not in accordance with the Contract Documents, and the Goods will be held subject to disposition by the Supplier at the Supply Contractor's risk and subject to all charges accruing as a result of such rejection.
- (5) Notwithstanding any prior payment therefore, all Goods are subject to inspection and testing by the Owner at the Delivery Point or the Site and if the Goods are to be incorporated into an operating facility, the Owner's inspection and testing of the Goods may be made under operating conditions after the Goods have been installed.



.2 Certification

Where compliance of Goods, materials or equipment with the Contract Documents is not readily determinable through inspection and tests, the Owner or the Engineer may require that the Supplier provide, at the Supplier's expense, properly authenticated documents, certificates or other satisfactory proof of compliance. These documents, certificates or other proof shall include performance characteristics, materials of construction and the physical or chemical characteristics of materials.

.3 Expenses

Unless otherwise specified in the Contract Documents, the travel, subsistence and labour expenses incurred by the Owner or the Engineer for inspection and testing shall be paid by the Owner. If the Supplier requests the Owner or the Engineer to inspect and test the Goods, materials or equipment at the point of manufacture, then the additional costs to the Owner for travel, subsistence and labour expenses shall be paid by the Supplier and may be deducted by the Owner from any payment due to the Supplier under the Contract. After an inspection by the Owner or the Engineer, if the Goods, materials or equipment require further inspection by the Owner or the Engineer, then the additional costs to the Owner for travel, subsistence, and labour expenses shall be paid by the Supplier and may be deducted from any payment due to the Supplier under the Contract.

4.3 DEFECTIVE OR IMPROPER GOODS

.1 Correction of Defective Goods

If upon inspection, testing or otherwise the Goods or any portion thereof are found to be non-conforming, unsatisfactory, defective, or inferior quality or workmanship, or fail to meet any guarantee of operating or other Specifications contained herein, or any other requirements of the Contract Documents, then without prejudice to any other rights or remedies, the Owner or the Engineer may give notice of its dissatisfaction to the Supplier either verbally or in writing and the Supplier shall immediately upon receipt of such notice do all things that are required to satisfy the Owner or the Engineer. Any such verbal notice may be confirmed in writing by the Owner or the Engineer if requested by the Supplier within one working day of the verbal notice. If the Supplier refuses or neglects to do all things that are required to satisfy the Owner or the Engineer within one week from the receipt of notice, the Owner may employ some other person to do so and all expenses and costs consequent thereon or incidental thereto shall be charged to the Supplier. The employment of such other person or the doing of the said work by the Owner itself shall not affect the Supplier's duties and liabilities hereunder or relieve the Supplier from the performance and fulfilment of any or all of the Supplier's warranties, covenants, undertakings, obligations and duties under the Contract.

.2 If upon inspection, testing or otherwise the Goods or any portion thereof are found to be non-conforming, unsatisfactory, defective, or inferior quality or workmanship, or fail to meet any guarantee of operating or other Specifications contained herein, or any other requirements of the Contract Documents, then without prejudice to any other rights or remedies, the Owner may return the Goods or any part thereof to the Supplier at the Supplier's sole cost and all amounts theretofore paid by the Owner to the Supplier on account of the Contract Price of



such returned Goods, shall be repaid to the Owner by the Supplier. The Supplier shall advise the Owner in writing, where to return the Goods, and failing such advice from the Supplier, the Supplier agrees to accept the returned Goods at the Supplier's registered office. Neither the inspection nor failure to make inspection, nor acceptance of Goods shall release the Supplier from any warranties or other provisions of this Contract nor impair the Owner's right to reject non-conforming Goods. The Owner reserves the right even after it has paid for and accepted Goods to make a claim against the Supplier on account of any Goods which do not prove to be satisfactory or are defective irrespective of the Owner's failure to notify the Supplier of a rejection of non-conforming Goods or revocation of acceptance thereof, or to specify with particularity any defect in non-conforming Goods after rejection or acceptance thereof.

.3 Retention of Defective Goods

If in the opinion of the Owner or the Engineer any portion of the Goods supplied under the Contract is defective or not in accordance with the Contract Documents and if the defect or imperfection in the same is not of sufficient magnitude or importance to make the Goods dangerous or undesirable, or if the removal of such Goods is impracticable, or will create conditions which are dangerous or undesirable, the Owner shall have the right and authority to retain such Goods instead of requiring the defective or imperfect Goods to be removed and reconstructed, but the Owner shall be entitled to make such deductions from the payments due or to become due to the Supplier as are just and reasonable.

.4 No Implied Approval

The fact that the Owner or the Engineer has not disapproved of or rejected any part of the Goods shall not be deemed or be construed to be an acceptance of any such part of the Goods or any such materials.

4.4 WARRANTY AND GUARANTEE

- .1 The Supplier agrees that the Goods manufacturer's standard warranty will be to the benefit of the Owner and that the Goods are free from all defects arising from faulty construction, manufacturing, materials, equipment or workmanship for the period of the Goods manufacturer's standard warranty period.
- .2 The Supplier warrants and guarantees that the Goods are free from all defects arising from faulty construction, manufacturing, installation, materials, equipment or workmanship in any part of the Goods for a period of one year commencing from the date of acceptance by the Owner. During the warranty period, the Supplier, upon the receipt of notice in writing from the Owner or the Engineer, shall promptly make all repairs arising out of the defects referred to in this Clause 4.4.2. The Owner shall be entitled to make such repairs, if 5 days after the giving of such notice to the Supplier, the Supplier has failed to make or undertake with due diligence the repairs. In case of an emergency, where, in the opinion of the Owner or the Engineer, delay could cause serious loss or damage, or inconvenience to the public, repairs may be made without notice being sent to the Supplier. The costs of any repair made by the Owner in connection with this Clause 4.4.2 shall be charged to the Supplier and the Supplier shall



reimburse the Owner for such costs. All covenants and agreements shall continue to be binding on the Supplier until they have been fulfilled.

- .3 The Owner is relying on Supplier's skill and judgment in selecting and providing the proper Goods and any applicable services for the Owner's particular use. The Supplier warrants to the Owner and its successors in interest that the Goods and any services covered hereby will correspond with the description of the same in the Contract Documents, will conform to all applicable Specifications, will be new and of the best quality and, unless otherwise specified, will be fit for the purpose for which they are to be used and will conform in all aspects, both in the manufacture and use thereof, with all applicable safety orders or regulations of the Province of British Columbia. The Supplier also warrants that the Goods are free and clear of all liens and encumbrances whatsoever and that the Supplier has a good and marketable title to the same.
- .4 The Supplier warrants and guarantees that the Goods are free from all defects arising at any time from faulty design in any part of the Goods.

PART 5 INDEMNIFICATION AND INSURANCE

5.1 INDEMNIFICATION AND RELEASE

.1 Indemnification

The Supplier shall save harmless and indemnify the Owner, and the Engineer and their directors, officers, servants, employees and agents (the "Indemnified Parties") from and against all actions, claims, demands, proceedings, suits, losses, damages, costs and expenses of whatsoever kind or nature (including but not limiting the generality of the foregoing, in respect of death, injury, loss or damage to any person or property) arising in any way out of or connected with the Goods under this Contract, including but not limited to their supply, delivery and any related services, except to the proportionate extent that such actions, claims, demands, proceedings, suits, losses, damages, costs and expenses were caused by the Indemnified Parties or any of them.

.2 Release

The Supplier shall release and discharge the Owner and the Engineer and their directors, officers, servants, employees and agents (the "Released Parties") from and against all actions, claims, demands, proceedings, suits, losses, damages, costs and expenses of whatsoever kind or nature (including but not limiting the generality of the foregoing, in respect of death, injury, loss or damage to any person or property) which the Supplier or its servants or employees might have in any manner arising in any way out of or connected with the Goods under this Contract, including but not limited to their supply, delivery and any related services, except to the proportionate extent that such actions, claims, demands, proceedings, suits, losses, damages, costs and expenses were caused by the Released Parties or any of them.



5.2 INSURANCE

.1 General

The Supplier shall itself obtain and maintain, at its own expense, the insurance set out below until all conditions of the Contract have been fully complied with.

.2 Comprehensive General Liability Insurance

(a) Comprehensive Public Liability Insurance and Property Damage Insurance providing coverage up to \$5,000,000.00 dollars inclusive against liability for bodily injury or death on an occurrence basis and/or damage to property on an accident basis.

(b) Automobile Insurance for public liability and property damage providing coverage up to \$3,000,000.00 dollars inclusive on owned, non owned or hired vehicles.

(c) Completed Operations coverage up to \$5,000,000.00 dollars inclusive against liability for bodily injury, death and/or damage to property of others arising out of the existence of any condition in the completed work or any installation or repair operations during the period of one year next ensuing after acceptance of the completed work by the Corporation.

.3 Evidence of Coverage

The Contractor shall file with the Owner prior to the commencement of work a certificate of insurance covering all policies and endorsements. The Supplier shall also file with the Owner evidence of the renewal of each policy at least fifteen (15) days prior to the expiry date of the policy.

.4 Indemnity Not Restricted By Insurance

The provisions for insurance shown above shall not in any way limit the indemnity granted by the Supplier to the Indemnified Parties elsewhere in Section 00500.

5.3 PATENT, TRADEMARK OR COPYRIGHT

.1 The Supplier represents that it has fully investigated all documents and Specifications, including any furnished by the Owner, in connection with the Goods and based on such investigation and its past experience and superior knowledge with respect to such Goods has determined that the production and supply thereof will not infringe any patent, trademark or copyright.

.2 Supplier warrants to the Owner and its successors in interest that the manufacture, sale or use of the Goods and any services covered by this Contract, whether manufactured in accordance with the Specifications or otherwise, do not and will not infringe upon any patent, trademark or copyright. The Supplier shall save harmless and indemnify the Indemnified Parties from and against all actions, claims, demands, proceedings, suits, losses, damages, costs and expenses of whatsoever kind or nature arising in any way from liability of any nature or kind



for or on account of any copyrighted or uncopyrighted composition, secret or other process, patented or unpatented invention, articles or appliances manufactured or used in connection with the Goods, and used or to be used by the Owner unless otherwise stipulated in this Contract, and if the Supplier shall fail to save harmless and indemnify in manner aforesaid, any money collected from the Indemnified Parties shall be charged to the Supplier.

PART 6 SHIPMENT OF GOODS/DAMAGE TO GOODS

6.1 SHIPMENT OF GOODS

.1 Delivery of Goods

The Supplier shall deliver the Goods to the Delivery Point. Delivery of the Goods to a carrier for transmission to the Delivery Site does not constitute delivery of the Goods to the Owner. Any such carrier is deemed to be the Supplier's agent and not the Owner's agent.

.2 Delivery Costs

The Supplier is responsible for all costs and expenses whatsoever in relation to the supply and delivery of the Goods to the Delivery Point, including without limitations, all shipping, carrier, transportation, freight, insurance, storage and handling costs, as well as any customs or excise charges or duties.

.3 Supplier to Bear Risk

The Supplier shall bear all risks and shall assume all responsibility for the Goods, including, without limitation, any loss or damage to the Goods from any cause whatsoever, up to and including the delivery of the Goods at the Delivery Point.

.4 Loss or Damage

If loss or damage to the Goods occurs for which the Supplier is responsible, the Supplier shall immediately effect repairs or replace any property as necessary in order to make good any such loss or damage. If the Supplier refuses or neglects to do so, the Owner may make good any such loss or damage, either by itself or by employing some other person, and the expense of doing so shall be charged to the Supplier. If any repair or replacement of property is performed on the Goods as a result of loss or damage to the Goods for which the Supplier is responsible the Supplier represents and warrants that the warranty provided in Section 00500 Clause 4.4 shall not be affected or changed to any manner or respect whatsoever.

.5 Acceptance of Goods by Owner

The Owner's acceptance or deemed acceptance of the Goods shall not prejudice any rights or remedies the Owner may have hereunder relating to Goods that are found to be non-conforming, unsatisfactory, defective, of inferior quality or workmanship, or which fail to meet any Specifications or requirements of the Contract Documents.



PART 7 PROGRESS AND COMPLETION

7.1 CONTRACT TIME

.1 Performance by the Supplier

Time shall be of the essence. The Supplier shall supply the Goods in accordance with the Contract Documents. The Supplier acknowledges that the schedule for supply of the Goods as set out in the Contract Documents is reasonable.

.2 Schedule

The Supplier shall provide a schedule and reports for scheduling and coordinating the supply of Goods within the prescribed time. Contract time extensions, if any, shall be incorporated into updated schedules. The failure of the Supplier to comply with this requirement shall entitle the Owner to terminate the Supplier's right to continue with the supply of Goods or to delay progress payments.

.3 Consequential Damages

The Owner and the Engineer shall not be liable to the Supplier for, and the Supplier hereby waives recovery from them of, loss of profits or anticipated profits, loss of production, impact costs, overhead, claims of the Supplier's customers, suppliers or contractors, or other indirect or consequential damages arising at any time from any cause whatsoever, whether arising under tort, implied or statutory warranties, strict liability or breach of contract ("Consequential Damages") notwithstanding any right or remedy available to the Supplier at law or in equity to Consequential Damages.

7.2 TERMINATION

.1 Termination for Default

The Owner may terminate the Contract if the Supplier at any time becomes bankrupt, makes an assignment of his property for the benefit of his creditors, or if a receiver or liquidator should be appointed. Such termination shall be effective upon the Owner giving notice thereof.

- (1) If at any time the Owner forms the opinion that the Supplier is in default under this Contract because the Supplier:
 - (a) has breached a fundamental term of the Contract or is in substantial breach of the terms of the Contract;
 - (b) has failed to supply the Goods, within the time specified in the Contract Documents;
 - (c) has failed or is failing to furnish or to maintain a detailed schedule;
 - (d) has become in any way unable to supply the Goods or any part thereof; or



- (e) has repeatedly failed to make prompt payments to subcontractors, suppliers or others for labour, materials or equipment;

then the Owner may give notice in writing to the Supplier of such opinion and require that such default or defaults be remedied forthwith. If, within five days of such notice, such default or defaults are not remedied to the satisfaction of the Owner, the Owner may terminate the Contract. Such termination shall be effective immediately.

- (2) Upon termination pursuant to Section 00500 Clause 7.2.1(1), the Owner may take all Goods out of the Supplier's hands and employ such means as the Owner may see fit. In such case:
 - (a) the Supplier shall have no claim for any further payment in respect of the Goods;
 - (b) no objection or claim shall be raised or made by the Supplier by reason of or on account of the ultimate cost of the Goods so taken over for any reason proving greater than, in the opinion of the Supplier, it should have been;
 - (c) notwithstanding Part 8, all materials and all rights, proprietary or otherwise, licences, powers and privileges, whether relating to or affecting real or personal property, acquired, possessed, or provided by the Supplier for the purposes of supply of the Goods will become or remain and be the property of the Owner for all purposes incidental to the completion of supply of the Goods and may be used, exercised, and enjoyed by the Owner as fully to all intents and purposes connected with supply of the Goods as they might theretofore have been used, exercised, and enjoyed by the Supplier; and
 - (d) the Owner may assign all rights and privileges granted to the Owner in this Clause to another Supplier retained by the Owner to continue with the supply of the Goods.
- (3) If the Supplier's right to supply the Goods is terminated in accordance with the provisions of this Clause 7.2.1, the Supplier shall not be entitled to receive any further payment until the supply of Goods is completed.

.2 Termination for Convenience

The Owner may terminate the Supplier's performance of the Contract for its convenience in accordance with this Clause in whole or from time to time in part whenever the Owner shall elect. Such termination shall be effective upon the Owner giving notice thereof specifying the extent to which performance under the Agreement is terminated, and the date upon which such termination becomes effective.

- (1) Upon receipt of any such notice, the Supplier shall, unless the notice requires otherwise:
 - (a) immediately discontinue work on the date and to the extent specified in the notice;
 - (b) place no further orders for materials other than as may be necessarily required for completion of any portion of the Goods that is not terminated;



- (c) promptly make every reasonable effort to either obtain cancellation on terms satisfactory to the Owner of all orders to subcontractors or assign those orders to the Owner; and
 - (d) assist the Owner upon request in the maintenance, protection, and disposition of property acquired by the Owner under this Contract.
- (2) If requested in writing within 30 days after notice of termination, the Owner will pay to the Supplier as full compensation:
- (a) all amounts due and not previously paid to the Supplier for the Goods completed in accordance with this Contract prior to such notice, and for work thereafter completed as specified in such notice;
 - (b) a reasonable amount for any Goods then in production; provided that no such adjustment shall be made in favour of the Supplier with respect to any Goods which are the Supplier's standard stock;
 - (c) reasonable costs of settling and paying claims arising out of the cancelled orders; and
 - (d) a reasonable profit for costs incurred in the performance of the work terminated; provided, however, that if it appears that the Supplier would have sustained a loss on the entire Contract had it been completed, no profit shall be included.
- (3) The total sum to be paid to the Supplier under this Clause shall not exceed the total Contract Price as reduced by the amount of payments otherwise made and as further reduced by the Contract Price of work not terminated, and will not include any consideration for loss of anticipated profits on the terminated work, all claims for which the Supplier agrees to waive.
- (4) Except as herein before provided, the Supplier shall have no claim against the Owner for any reason whatsoever by reason of the termination of the Contract.

PART 8 PAYMENT

8.1 PAYMENTS TO SUPPLIER

- .1 Payments to the Supplier will be made on the basis of the Schedule 1 of the Section 00300 of the Accepted Proposal.
 - (1) The equipment will be paid for at the price set out in the tender. The price tendered shall include the cost of all material, labour and workmanship necessary for supplying and delivering the equipment specified in this contract.
 - (2) The Supplier will be paid according as outlined in Section 00300. Payments will be made within 30 days of receipt of invoice, after the completed milestones specified in Section 00300.



- (3) Should any work be required which in the opinion of the Corporation is due to defective material or equipment, the Supplier will be notified and requested to complete the necessary repairs. The Corporation will proceed to complete the repairs of the said work either after the expiration of 10 days following notification to the Contractor or immediately, if it is considered that the said work requires immediate attention. The cost of any repair work completed by the Corporation and attributed to defective material, equipment or installation will be charged to the Contractor.
- .2 Notwithstanding Clause 8.1.1 the Owner may withhold from payment:
 - (1) Any deduction the Owner may be entitled to under the Contract;
 - (2) Such reasonable amount as the Owner determines appropriate with respect to any part of the goods otherwise not in compliance with the Contract Documents.
- .3 Payments may be withheld until the relevant operating manuals and all operating and maintenance materials together with all warranties have been delivered to the Engineer.
- .4 In addition to any other remedy the Owner may have in the Contract or law, the Owner may refuse to make payment because of subsequently discovered evidence or test results, and shall be compensated for any payment previously made to the Supplier to such extent as may be necessary to protect the Owner from loss as a result of:
 - (1) Defective or damaged Goods;
 - (2) A deductive change order;
 - (3) Failure of the Supplier to supply the Goods in accordance with the Contract Documents, including failure to maintain the supply of the Goods in accordance with the schedule;
 - (4) Disregard by the Supplier of the authority of the Engineer or the laws of any public body having jurisdiction.

The Owner may refuse to make payment of the full amount because of claims made against the Owner on account of the Supplier's performance or supply of Goods. In such case, the Owner shall give the Supplier prompt written notice stating the reasons for each action.

- .5 The Owner may withhold from payment to the Supplier:
 - (1) Any set-off the Owner may be entitled to under the Contract; and
 - (2) The amount of any bona fide builders lien claim asserted against the Owner or which the Owner acting reasonably anticipates will be made against the Owner.
 - (3) Prior to payment to the Supplier, if requested by the Owner, the Supplier shall deliver to the Owner a statutory declaration in form satisfactory to the Owner declaring that all subcontractors, labour and accounts for material and equipment have been paid and that no persons, firms or any other entities have any lien against the lands comprising



the Delivery Point or the Site together with such other documentation as the Owner, acting reasonably, determines is necessary or desirable.

.6 Builders Liens

- (1) The Supplier shall, at its own cost and expense, cause any and all builders liens and other liens for labour, services or materials alleged to have been furnished in connection with the supply of the Goods to the lands comprising the Delivery Point or the Site which may be registered against or otherwise affect the said lands or the supply of Goods, except liens properly filed by the Supplier on its own behalf, to be paid, satisfied, released or vacated forthwith after the Owner has sent to the Supplier written notice of any claim for any such lien.
- (2) In the event of a bona fide dispute of the validity or correctness of any claim for any such lien, the Supplier shall be entitled to defend against the claim for such lien in any proceedings brought in respect thereof after first paying into court the amount claimed or sufficient security therefore and such costs as the court may direct and registering all such documents as may be necessary to cancel such lien, or providing such other reasonable security in respect of such claim as the Owner may in writing approve. Upon receiving satisfactory security for its costs and an indemnity in writing, the Owner will authorize the Supplier to apply to the court in the name of the Owner to have any lien removed upon payment into court or deposit in court of satisfactory security therefore.

PART 9 WHMIS

- 9.1 The Supplier shall comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage and disposal of hazardous materials; and regarding labelling and provision of material safety data sheets acceptable to the Labour Code, Canada Health.
- 9.2 The Supplier shall deliver copies of MSDS data sheets to the Owner on or before delivery of the Goods to the Delivery Point.

END OF SECTION 00500



PART 1 – GENERAL

1.1 DOCUMENTS

- .1 This Section of the Specifications forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

1.2 DESCRIPTION OF SCOPE OF SUPPLY

- .1 The scope of supply shall consist of the design, supply, fabrication and delivery to the Delivery Point of the Goods, which consist of UV reactors; including but not limited to all parts, components, accessories, shop drawings, installation instructions and supervision, operation and maintenance manuals, other Submittals, factory testing, Site acceptance testing, commissioning, training and other services. The Goods will be installed by the General Contractor as part of the Duteau Creek WTP UV Upgrades. The Supplier shall furnish all labour, materials and equipment to design, supply, fabricate and deliver the Goods.
- .2 All obligations that are described in all of the Specifications are obligations of the Supplier unless specified otherwise.
- .3 The Delivery Point is at the Duteau Creek WTP, Coldstream, British Columbia.

1.3 RELATIONSHIP OF SUPPLIER AND GENERAL CONTRACTOR

- .1 The Supplier will be duly notified by the Owner upon award of the Construction Contract.
- .2 The Supplier shall coordinate its delivery of all Goods to the Delivery Point with the General Contractor to ensure a timely delivery to match the General Contractor's work schedule.
- .3 The date of delivery of the Goods to the Delivery Point pursuant to Clause 1.4.1 defines the anticipated time frame when the General Contractor will commence installation of the Goods. The General Contractor, with the approval of the Owner, may make minor changes to the delivery schedule to best suit the General Contractor's installation program and the Supplier shall adjust its delivery schedule for the Goods accordingly at no additional cost to the Owner, as long as the requests from the General Contractor are reasonable and they are approved by the Owner and the Engineer in advance.
- .4 If required by the General Contractor to suit the construction schedule, delivery of the Goods shall be made in multiple deliveries over time, as necessary, during this time frame to minimize the time that work are stored on-Site prior to installation.
- .5 The Supplier will assume full responsibility for protection and safekeeping of all Goods supplied under this Contract until such time as they are delivered to the Delivery Point, at



which time the General Contractor will assume full responsibility for protection and safekeeping of the Goods.

- .6 The Supplier will be responsible to properly and sufficiently identify and tag all Goods supplied under this Contract to assure proper installation and to prevent loss.
- .7 The Owner and the Engineer will jointly inspect the Goods upon delivery to the Delivery Point, and the Supplier will be notified promptly of any damage prior to off-loading. The General Contractor will be responsible for off-loading, handling, and storage of the Goods at the Delivery Point, and any re-handling prior to installation.

1.4 WORK SCHEDULE

- .1 Refer to Section 00300.

1.5 DOCUMENTS REQUIRED

- .1 Refer to Section 01300 - Submittals.

- .2 **Stage 1 Submittal Package 1**– Submittals Following Stage 1 Review

Provide all Submittals as generally described in Section 01300 – Submittals and more specifically described in Section 11287 within 30 days of Letter of Intent.

- .3 **Submittal Package 2** - Submittals Following Stage 1 Review

Submit Package 2 within thirty (30) days following review and acceptance of all Submittal Package 1.

Provide all Submittals as generally described in Section 01300 – Submittals and more specifically described in Section 11287

- .4 **Submittal Package 3** - Submittals Prior to Delivery

Submit Package 3 for review at least thirty (30) days prior to delivery of the Goods:

Provide all Submittals as generally described in Section 01300 – Submittals and more specifically described in Section 11287

- .5 **Submittal Package 4** - Submittals After Installation

Submit Package 4 for review prior to final completion.

Provide all Submittals as generally described in Section 01300 – Submittals and more specifically described in Section 11287



1.6 SITE LOCATION

- .1 The Site for installation of the Goods by the General Contractor is the same as the Delivery Point, the DCWTP 1014 Whitevale, Vernon BC.

1.7 FIELD SERVICES

- .1 Services that are required at the Site as part of the Contract include installation supervision, start-up, commissioning, training and field acceptance testing.
- .2 Additional on-Site services shall be provided, if required, at the per diem rates as described within Schedule 3 – Additional Field Services, of the Accepted Proposal.

PART 2 – PRODUCTS

Not Applicable

PART 3 – EXECUTION

Not Applicable

END OF SECTION 01010



PART 1 – GENERAL

1.1 DOCUMENTS

- .1 This Section of the Specifications forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

1.2 MEASUREMENT AND PAYMENT

- .1 The Goods will be paid for in accordance with the prices set out in the Accepted Proposal.

1.3 PROGRESS CLAIMS

- .1 Submit to the OWNER invoices for payment based on the prices set out in Schedule 1 – Capital Costs and Pricing of the Accepted Proposal stating Goods done and percentage amount claimed.

- .2 Progress payments will be made on the basis of the following:

- (1) For Submittals, payment will be made thirty (30) days after receipt and acceptance by the Engineer of all the submittals as required by each item and receipt of an invoice, whichever is later, less any amount the OWNER is entitled to withhold pursuant to the Contract Documents.
- (2) For Products, thirty (30) days after delivery of the item of Goods at the Delivery Point and receipt of an invoice, whichever is later, the SUPPLIER will be paid for the item, less any amount the OWNER is entitled to withhold pursuant to the Contract Documents.

Thirty (30) days after completion to the satisfaction of the OWNER of satisfactory commissioning and acceptance testing, including testing of the UV equipment at the maximum daily demand, of the item of Goods and receipt of an invoice, whichever is later, the SUPPLIER will be paid, less any amount the OWNER is entitled to withhold pursuant to the Contract Documents.

- (3) For Services, payment will be made thirty (30) days after performance of the service to the satisfaction of the Engineer or receipt of an invoice, whichever is later, less any amount the OWNER is entitled to withhold pursuant to the Contract Documents.
- (4) For all approved and accepted optional prices, payment will be made thirty (30) days after delivery of the optional Goods to the Delivery Point or completion of the optional service at the Site, and receipt of an invoice, whichever is later, less any amount the OWNER is entitled to withhold pursuant to the Contract Documents.



- .3 The Engineer shall review the SUPPLIER's claim for Progress Payment, prepare Progress Payment Certificate and if acceptable, submit to the OWNER for processing within seven (7) days following receipt of SUPPLIER's claim.
- .4 The Engineer's estimate of percentage of goods completed under each category will govern calculation of payment on all Progress Payment Certificates.

1.4 CHANGE ORDERS, SUPPLIER'S RESPONSIBILITIES

- .1 Complete and promptly return all change order price requests issued by the OWNER. Include appropriate supporting documentation to verify prices.
- .2 Do not proceed with goods affected by a change order price request until authorized to do so by Change Order.
- .3 Make no change in the supply of Goods unless a Change Order is issued. Change Orders are only valid when signed by the OWNER.

PART 2 - PRODUCTS

Not Applicable

PART 3 - EXECUTION

Not Applicable

END OF SECTION 01025



PART 1 – GENERAL

1.1 CATEGORIES OF SUBMITTALS

- .1 General requirements and detailed Specifications require various submissions to demonstrate that materials, equipment, methods, and work comply with the provisions and intent of the Contract Documents. Shop drawings are a primary component of submittals. Submittals fall into two general categories:
 - (1) Submittals for review.
 - (2) Submittals for information only.
- .2 Provide submittals in accordance with this section.
- .3 The Engineer may require additional submittals from the Supplier when, in the opinion of the Engineer, such additional submittals are warranted.

1.2 ADMINISTRATIVE

- .1 Submittals covered by these requirements include manufacturers' information and data sheets, descriptive data, certificates, product data, shop drawings, test procedures, test results, samples, requests for substitutions, all mechanical, electrical and electronic equipment and systems, fabricated items, piping and miscellaneous work-related submittals.
- .2 Adjustments made on shop drawings or other submittals by the Engineer are not intended to change the Contract Price. If adjustments affect the value of work, state such in writing to the Engineer prior to proceeding with the work.
- .3 Provide to Engineer for review the submittals specified. Submit all information promptly and in an orderly sequence so as to not cause delay in the Work. Failure to submit in ample time is not considered sufficient reason for an extension of Contract time and no claim for extension by reason of such default will be allowed.
- .4 Do not proceed with work affected by any submittal until review is complete. Submittals and Substitutions for review and comment will be returned to the Supplier within 10 days and 15 days respectively, exclusive of time awaiting clarification or further information; however, the time for returns will necessarily vary and may exceed 10/15 days depending upon the complexity of the submittal, the number of submittals, and the express needs of the Supplier.



- .5 Review submittals prior to submission to the Engineer. This review represents that necessary requirements have been determined and verified, or will be, and that each submittal has been checked and coordinated with the requirements of the Work and the Contract Documents. Submittals not stamped, signed, dated and identified by the Supplier will be returned without being examined and will be considered rejected.
- .6 Clearly edit submittal documents to indicate only those items, models, or series of equipment, which are being submitted for review. Cross out or otherwise obliterate all extraneous materials.
- .7 Ensure that there is no conflict with other submittals.
- .8 Coordinate submittals among sub-Suppliers.
- .9 Coordinate submittals with the Work so that work will not be delayed and schedule different categories of submittals, so that one will not be delayed for lack of coordination with another.
- .10 The Supplier is responsible for the accuracy and completeness of information submitted. Notify Engineer in writing of materials, equipment or methods of work which deviate from the Contract Documents. Notification in writing, to accompany submittal transmittal and noted under deviations.
- .11 The Supplier's responsibility for errors, omissions and deviations in submission is not relieved by the Engineer's review of submittals.
- .12 Keep one reviewed copy of each submission on site.
- .13 Detail all shop drawings and data sheets using the metric system. Prepare to a drafting standard equivalent to the Contract Drawings.
- .14 Shop drawings and data sheets indicating modified design requirements or design requirements not included in the Contract Documents require the seal of a qualified Professional Engineer, registered in the Province of British Columbia.

1.3 TRANSMITTAL PROCEDURE

- .1 Accompany all submittals with a transmittal form.
- .2 Use a separate form for each specific item, class of material, equipment, and items specified in separate, discrete sections, for which the submittal is required. Identify Contract Document, equipment numbers, equipment descriptors, drawing numbers, and Specification Sections for each submittal and item in each submittal.



- .3 Identify submittal documents common to more than one piece of equipment with all the appropriate equipment numbers.
- .4 Use a single form for submittals for various items when the items taken together constitute a manufacturer's package or are so functionally related that expediency indicates checking or review of the group or package as a whole.
- .5 Note a unique number, sequentially assigned, on the transmittal form accompanying each item submitted. Submittals will be classified according to categories agreed to by the Supplier and Engineer. Use the following format by category for submittal numbers: "XXX", where "XXX" is the sequential number assigned by the Supplier. Resubmittals will have the following format: "XXX-Y", where "XXX" is the originally assigned submittal number and "Y" is a sequential letter assigned for resubmittals, i.e., A, B, or C being the 1st, 2nd, and 3rd resubmittals, respectively. Submittal 25B, for example, is the second resubmittal of submittal 25.

1.4 SUBMITTALS FOR REVIEW

- .1 All submittals, except where specified to be submitted for information only, to be submitted by the Supplier to the Engineer for review. Provide submittals for review for all equipment and material substitutions, alternatives or deviations from that specified.
- .2 Submittals, which do not have all the information required to be submitted, including notation of all deviations from the Contract requirements, are not acceptable and will be returned without review.
- .3 Review by the Engineer is for the sole purpose of ascertaining conformance with the general design concept in accordance with the Specifications. This review does not mean that the Engineer approves the detail design inherent in the submittals, shop drawings and data sheets, responsibility for which remains with the Supplier, and such review does not relieve the Supplier of responsibility for errors or omissions in the shop drawings and data sheets or of responsibility for meeting all requirements of the Contract Documents. The Supplier is responsible for dimensions to be confirmed and correlated at the job-site, for information that pertains solely to fabrication processes or to techniques of construction and installation and for coordination of the work of all sub-trades.
- .4 Indicate materials, methods of construction and attachment or anchorage, erection diagrams, connections, explanatory notes and other information necessary for completion of work. Where articles or equipment attach or connect to other articles or equipment, indicate that such items have been coordinated, regardless of



the section under which the adjacent items will be supplied and installed. Indicate cross references to Contract Drawings and Specifications.

- .5 Submit one (1) electronic copy of the submittals, except where other quantities are specified, including shop drawings for each requirement requested in Specification sections and as the Engineer may reasonably request. One (1) marked up electronic copy will be returned. Electronic copies are expected to be .pdf format though .dwg may be requested and must then be provided.
- .6 Submittals for review will be returned to the Supplier with one of the four following notations:
 - (1) If the review indicates that the material, or equipment complies with the Contract Documents, submittal copies will be marked "Reviewed". In this event, the Supplier may begin to implement the work method or incorporate the material or equipment covered by the submittal.
 - (2) If the review indicates limited modifications are required, copies will be marked "Reviewed as Modified". The Supplier may begin implementing the work method or incorporating the material and equipment covered by the submittal in accordance with the noted corrections. Where submittal information will be incorporated in operation and maintenance data, provide a corrected copy.
 - (3) If the review reveals that the submittal is insufficient or contains incorrect data, copies will be marked "Revise and Resubmit". Do not undertake work covered by this submittal until it has been revised, resubmitted and returned marked either "Reviewed" or "Reviewed as Modified".
 - (4) If the review indicates that the material, equipment, or work method does not comply with the Contract Documents, copies of the submittal will be marked "Rejected - See Remarks". Submittals with deviations which have not been identified clearly may be rejected. Do not undertake the work covered by such submittals until a new submittal is made and returned marked either "Reviewed" or "Reviewed as Modified".
- .7 After submittals are stamped "Reviewed" or "Reviewed as Modified", no further revisions are permitted unless re-submitted to the Engineer for further review.
- .8 If upon review by the Engineer, no errors or omissions are discovered or if only minor corrections are made, the stamped marked-up review will be returned and fabrication and installation of work may proceed. If shop drawings and data sheets are rejected, resubmission of corrected shop drawings and data sheets, through the



same procedure indicated above, is to be performed before fabrication and installation of work may proceed.

- .9 Village may deduct, from payments due to Supplier, costs of additional Engineer's reviews incurred, if shop drawings and data sheets are not corrected after one (1) review.

1.5 SUBMITTALS FOR INFORMATION ONLY

- .1 Where specified, furnish submittals to the Engineer for information only at least 30 days prior to commencement of the work covered by the submittal. Submittals for information only will be used by the Engineer for general information and filed without comment. The Engineer retains the right to return submittals for information only if the submittal does not comply with the Contract Documents and general design criteria.
- .2 Submittals for information only are not subject to review procedures. They are to be provided as part of the Work under the Contract and their acceptability determined under normal inspection procedures.
- .3 Submit one (1) electronic copy of information only submittals including product data, manufacturer's standard data sheets or brochures for requirements requested in Specification Sections and as the Engineer may reasonably request where shop drawings will not be prepared due to standardized manufacture of product.
- .4 Submit operation and maintenance information in accordance with Section 01831. Obtain from each manufacturer specific equipment record data, performance data and maintenance requirements.
- .5 Where specified, submit engineering calculations sealed by a qualified Professional Engineer, for information only.

1.6 REQUEST FOR SUBSTITUTION

- .1 Make requests for substitution by written application accompanied with sufficient information to permit the Engineer to identify the nature and scope of the request.
- .2 Follow submittal procedures and submit one (1) electronic copy of all information for each substitution request.
- .3 Upon receipt of written application for substitution from the Supplier, including the specific information specified, the Engineer will estimate the cost and time requirement of evaluating the request and present the estimates to the Supplier. The Supplier is advised that the estimates are based upon the best information



available to the Engineer at the time; however, the actual cost, based on time and expense, will be documented and applied in the final analysis of the substitution request.

- .4 If the Supplier wishes the Engineer to continue the review of the request, advise the Engineer in writing and submit sufficient additional information as may be requested by the Engineer. No evaluation will take place until such time as the Supplier has agreed to the estimate in writing and has authorized the Engineer to deduct the cost of the evaluation from monthly progress payments due the Supplier.

PART 2 – PRODUCTS

Not Applicable

PART 3 – EXECUTION

Not Applicable

END OF SECTION 01300



PART 1 GENERAL

1.1 SUMMARY

- .1 This Section covers the requirements for anchor bolts supplied with process equipment.

1.2 RELATED DOCUMENTS

- .1 Related Sections:
 - (1) Section 01300 – Submittals
 - (2) Section 11287 Ultraviolet (UV) Disinfection System For Drinking Water Application

1.3 EQUIPMENT ANCHOR BOLTS

- .1 The equipment will be anchored to structural concrete by the CONTRACTOR. SUPPLIER shall size and furnish suitable anchor bolts for each item of equipment anchored to structural concrete.
- .2 Unless otherwise indicated on the Construction Drawings, all anchors and anchor bolts shall be cast-in-place concrete anchor bolts with forged heads or embedded nuts and washers. Unless otherwise specified, anchor bolts shall be at least 19 mm in diameter. Adhesive anchors may be used instead of cast-in-place anchors where allowed by the ENGINEER.
- .3 Unless installed in pipe sleeves, anchor bolts shall be provided with sufficient threads to permit a nut to be installed on the concrete side of the concrete form or the supporting template. Two nuts, a jam nut, and a washer shall be furnished for cast-in-place anchor bolts where indicated on the Construction Drawings to have locknuts; two nuts and a washer shall be furnished for cast-in-place anchor bolts without locknuts.
- .4 When adhesive anchors are indicated on the Construction Drawings or allowed by the ENGINEER, only products tested in accordance with ICC AC308 which have an ICC ESR report in compliance with the International Building Code (2012 or later edition). The anchors shall be approved for use in cracked concrete, and for resisting seismic forces. Unless otherwise required, single nuts and washers shall be furnished for adhesive anchors. Adhesive anchors shall be free of coatings that would weaken the bond with the adhesive.
- .5 Unless otherwise indicated or specified, anchor bolts for items of equipment mounted on baseplates shall be long enough to permit 36 mm of non-shrink, non-metallic grout beneath the baseplate and to provide adequate anchorage into structural concrete. Non-shrink grout shall be as specified later in this section.



1.4 SUBMITTALS

.1 General

- (1) Submittals shall be in accordance with the requirements of Section 01300, Submittal Procedures, and the submittal schedule according to Section 11287.

PART 2 PRODUCTS

2.1 EQUIPMENT ANCHOR BOLT MATERIALS

- .1 Anchor bolts shall be 316 stainless steel, ASTM F593 and nuts shall be 316 stainless steel ASTM F594. Flat washers shall be 316 stainless steel ANSI B 18.22.1.
- .2 For adhesive anchors, threaded rods and nuts shall be as recommended by the adhesive manufacturer; adhesive shall be Hilti "HIT-RE 500-SD" or "HIT-HY 150 MAX-SD", Powers Fasteners "PEIOOO+", or Simpson "Set-XP".

2.2 GROUT

- .1 Non-Shrink Grout will be provided by others and shall be precision cementitious grout with demonstrated non-shrinking properties; L&M "Crystex", Master Builders "Masterflow 713" or "Set Grout", Sauereisen "F-100 Level Fill Grout", Sonneborn "SonogROUT I OK", Hilti "CG 200 PC", or Five Star Products "Five Star Grout".
- .2 Cementitious Grout will be provided by others and shall be shall be furnished factory premixed so that only water is added at the jobsite.
- .3 Epoxy grout will be provided by others and shall be used in lieu of cementitious grout when required by the equipment manufacturer for performance or warranty requirements. Epoxy grout products and installation procedures shall be submitted to Engineer for approval.

PART 3 – EXECUTION

Not Applicable

END OF SECTION 11010



GENERAL

1.1 SUMMARY

- .1 This Section includes requirements to provide all equipment, appurtenances, materials, and services for a UV disinfection system for the disinfection of potable water.

1.2 RELATED DOCUMENTS

- .1 Related Sections:

- (1) Section 00100 – Instructions to Proponents
- (2) Section 00300 – Supplier Tender Form
- (3) Section 00400 – Supplier Questionnaire
- (4) Section 01010 – Summary of Work
- (5) Section 01300 – Submittals
- (6) Section 11010 – Equipment Anchoring

1.3 REFERENCES, CODES, AND STANDARDS

- .1 Without limiting the generality of other requirements of the specifications, all WORK specified herein shall conform to or exceed the applicable requirements of the following documents to the extent that provisions of such documents are not in conflict with the requirements of this Section.

- (1) National Sanitation Foundation (NSF)
 - a NSF/ANSI Standard 60: Drinking Water Treatment Chemicals - Health Effects
 - b NSF/ANSI Standard 61: Drinking Water System Components – Health Effects
- (2) USEPA Long Term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR)
- (3) USEPA UV Disinfection Guidance Manual (UVDGM) published November 2006.
- (4) DVGW – W294 Parts 1-3 (2003): Requirements and Testing for UV Disinfection Devices for Drinking Water, German Gas and Water Management Union
- (5) ONORM M5873-2 (2003): Requirements for Testing UV Disinfection Systems for Drinking Water, Austrian Standard
- (6) International Conference of Building Officials (ICBO).
 - a International Building Code (IBC) 2012.
- (7) American Society of Mechanical Engineers (ASME)
 - a ASME Boiler and Pressure Vessel Code, Section VIII, Division 1
 - b AWWA C207, Steel Pipe Flanges for Waterworks Service
 - c ASME Large Diameter Steel Flanges, NPS 26 through NPS 60, B16.47
- (8) NEMA 250: Enclosures for Electrical Equipment
- (9) Institute for Electrical and Electronics Engineers, Inc. (IEEE)



- d. IEEE 519-1992 - Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems
- e. IEEE 1100-1992 - Recommended Practice for Power and Grounding Electronic Equipment
- f. IEEE 1184-2006 – Guide for Batteries for Uninterruptible Power Supply Systems
- (10) Underwriter’s Laboratory and Underwriter’s Laboratories of Canada (UL and ULC) - UL 508
- (11) Canadian Standards Association (CSA)
- (12) American National Standards Institute (ANSI)
- (13) American Iron and Steel Manufacturer’s Association (AISI)
- (14) National Electric Code (NEC)
- (15) National Building Code of Canada.
- (16) ISA, International Society for Measurement and Control
 - a. ISA/ANSI S5.4 – Instrument Loop Diagram Standards

1.4 DEFINITIONS

- .1 UV Disinfection System: All equipment associated with the complete UV Disinfection System including the following:
 - (1) Factory assembled UV reactors
 - (2) Electrical cabinets, controls, operator interface/HMI, cables and accessories
 - (3) Offline chemical cleaning system or on-line automatic mechanical wiper cleaning system.

- .2 UV Reactor: A prefabricated in-line pipe mounted assembly ready for installation that includes:
 - (1) One closed vessel, irradiation chamber designed with flanged inlet and outlet connections and drain connections.
 - (2) Low-pressure high-output (LPHO) or medium-pressure (MP) UV lamps to provide disinfection, number as required to meet criteria specified herein.
 - (3) High purity lamp quartz sleeves (one sleeve per lamp) to house and protect lamps from direct contact with water flowing through reactor.
 - (4) UV sensors to provide continuous measurement of UV intensity within the reactor. One UV sensor will continuously measure the UV intensity from each medium pressure lamp or from each bank or row of low-pressure high-output or amalgam lamps.
 - (5) UV sensor ports with high purity quartz sleeves or quartz windows to house and protect the UV sensors from direct contact with water flowing through reactor.
 - (6) Mechanism to detect quartz sleeve breakage.
 - (7) Temperature sensor to protect the chamber against heat build-up under no flow or drained chamber conditions.
 - (8) If applicable, automatic on-line mechanical wiper cleaning system for periodic cleaning of the lamp quartz sleeves and UV sensor port windows



- (9) If applicable, quick-coupling connection ports for chemical cleaning system for off-line cleaning of the UV reactor's internal wetted surfaces.
 - (10) Factory assembled interconnection cabling between the UV lamps, sensors, cleaning mechanism, and any reactor mounted junction boxes.
- .3 Low-Pressure High-Output (LPHO) Lamp: a mercury vapor lamp that operates at an internal pressure of 0.001 to 0.01 torr (0.13 to 1.3 Pascal) and an electrical input on the order of 0.5 watts per centimeter, and produces a monochromatic germicidal UV output at 254 nm.
- .4 Medium Pressure (MP) Lamp: a mercury vapor lamp that operates at an internal pressure of 100 to 10,000 torr (14 to 1400 kPa) and electrical input of 50 to 150 W/cm, and produces a polychromatic germicidal UV output from 200 to 300 nm.
- .5 Offline Chemical Cleaning System: A prefabricated assembly that includes all tanks, piping, valves, spray nozzles, hoses, quick-coupling connections, pumps, mixers, instrumentation, electric controls, pneumatic controls, ancillary equipment, all appurtenance and support systems as necessary to allow chemical cleaning of the lamp quartz sleeves, UV sensor port windows, and the inside walls of the irradiation chamber. System assembly should also incorporate neutralization and disposal of waste chemical cleaning agent.
- .6 UV Transmittance (UVT): The percent of UV light at a wavelength of 254 nm transmitted over a 1.0 cm path length through the water. UVT of the water passing through the UV reactor may be measured with an on-line UVT monitor or a calibrated bench top UV spectrophotometer.
- .7 UV Intensity: UV light power per area measured by the UV sensor and displayed on the UV reactor human machine interface (HMI) in units of mW/cm^2 or W/m^2 .
- .8 UV Dose: The UV energy per unit area incident on a surface, typically reported in units of mJ/cm^2 or J/m^2 .
- (1) Required UV Dose (D_{REQ}): The UV dose, in units of mJ/cm^2 , needed to achieve the UV system target log inactivation for the target pathogen, as specified in the LT2ESWTR.
 - (2) Validated Dose (D_{VAL}): This is the RED measured with a given reactor corrected for the bias and uncertainty associated with the validation testing for that reactor and challenge organism. Validated dose is equal to RED/VF , where VF is the validation factor. The validated dose is compared to the Required UV dose to determine the pathogen log inactivation achieved by the UV reactor.
 - (3) Reduction Equivalent Dose (RED): The calculated UV dose actually delivered by the UV reactor that is based on the UV dose monitoring algorithm developed through UV validation testing.
 - (4) Target Dose: A dose value utilized in the Calculated Dose Monitoring Strategy that the UV system attempts to maintain during normal operating conditions. The target dose is higher than the required dose as a safety factor should any



rapid changes in operating conditions occur to which the UV system is unable to immediately respond.

- .9 UV Reactor Validation: A process by which a UV reactor's disinfection performance is evaluated via biosimetry testing as a function of the system operating parameters that can be monitored. Validation provides performance curves for UV dose delivery and monitoring as a function of flow rate, UVT, and lamp output and status.
- .10 Validation Factor (VF): An uncertainty term that accounts for the bias and uncertainty associated with the validation testing for a given UV reactor.
- .11 Dose Control Strategy: The technique whereby the UV system turns on and off lamps and/or adjust lamp power to control the UV dose delivered by the UV reactor.
- .12 Calculated Dose Approach: An approach for UV system monitoring and control of the UV dose delivered by the UV reactor that uses an equation which related RED to the measured operating conditions of flow rate, UVT, UV intensity, lamp status and if applicable, UV sensitivity. The dose equation is generated from the UV reactor Validation.
- .13 Lamp Burn-in: Operation of a new lamp over a period of time to stabilize and benchmark the UV output. Typically, 100 hours is assumed to be sufficient for lamp burn-in.
- .14 Lamp-Aging Factor: The relative reduction in measured UV intensity caused by aging of a UV lamp. UV systems are sized to deliver the required UV dose at a lamp-aging factor that occurs at the end of the UV lamp's working life.
- .15 Fouling Factor: The relative reduction in measured UV intensity caused by fouling and aging of the lamp quartz sleeve and UV sensor port window during operation of the UV system. UV systems are sized to deliver the required UV dose at a fouling factor that occurs immediately prior to activating a cleaning sequence.
- .16 Combined Aging and Fouling Factor (CAF): The combined impact of lamp aging and fouling, calculated as the ratio of UV intensity measured from operating lamps to that measured with a calibrated UV sensor in a new, clean UV sensor port window, monitoring a new, burnt-in UV lamp, located in a new, clean lamp quartz sleeve, as benchmarked during validation testing.

1.5 UV SYSTEM DESIGN CRITERIA

.1 General

- (1) Raw water is from Duteau Creek. Regional District of North Okanagan (RDNO) diverts water from Duteau Creek and provides treatment consisting of coagulation, flocculation and dissolved air floatation.



- .2 Treated water is stored in a two-cell reservoir, which provide a total of 10 ML of storage. These reservoirs are operated near their high water level to maximize the settling time for particles passing through the reservoirs. Chlorine is fed at the inlet of the reservoir. Water then flows by gravity from a top water level of 649.95 meters to the distribution system. The new UV Facility will be located next to the reservoir, treating the reservoir effluent.
 - (1) These design requirements apply to UV Systems using MP and LPHO lamps, unless otherwise noted.

- .3 UV Facility Layout
 - (1) Flow at the UV facility will enter a common inlet manifold, where it will be distributed to UV reactors configured in parallel. Flow from the UV reactors will be collected into a common outlet manifold, where water will flow to the system. A minimum of two or a maximum of four duty reactors shall treat the total combined system flow under design conditions with one additional, redundant UV reactor acting as standby. Each reactor shall have the same design in terms of flange size, footprint, and number, type and configuration of lamps, sleeves, and UV sensors.
 - (2) Between the inlet manifold and the outlet manifold, the piping with each reactor includes, in order, an inlet isolation butterfly valve, straight pipe with length equal to five or more pipe diameters, a flow meter, the UV reactor, one or more pipe diameters of straight pipe, and an outlet isolation valve. Flow to each reactor train is controlled by the outlet valves. The length of straight pipe on the reactor inlet and outlet shall be selected to provide UV dose delivery equal to or greater than indicated by the validated UV dose monitoring algorithm and meet Option 1 of Section 3.6.2 of the UVDGM.
 - (3) The UV system will be contained indoors within a dedicated building.
 - (4) SUPPLIER shall state in their proposal how many pipe diameters of straight pipe are required upstream and downstream of the reactor to comply with Option 1 of Section 3.6.2 of the UVDGM, given the piping used with validation.

- .4 Water Quality
 - (1) Source water. The UV system shall treat unfiltered , DAF clarifier subnatant water.
 - (2) The following table provides annual water quality data on the water that will be treated by the UV reactor.



	MINIMUM	AVERAGE	MAXIMUM
TURBIDITY (NTU)	0.2	0.3	1.0
FREE CHLORINE (PPM)	1	2	3
TOTAL ORGANIC CARBON (PPM)	2	5	20
TOTAL ALUMINUM (PPM)	0.2	0.3	0.6
DISSOLVED ALUMINUM (PPM)	0.07	0.10	0.14
ALKALINITY RAW WATER AS CaCO₃ (PPM)	10	20	40
PH	6	7	8

.5 Hydraulic Design Criteria.

- (1) Maximum design flow rate for the system is 179 ML/day. Flow rate will vary depending on system demand.
- (2) Maximum allowable UV reactor headloss with all duty reactors in service, based on the maximum flow rate: 200 mm
- (3) Minimum UV reactor pressure ratings:
 - a. Design pressure: 10 meters water column (98 kPa)
 - b. Test pressure: 1.5 times design.

.6 Disinfection Design Criteria.

- (1) UV system sizing shall be sized using a validated calculated dose algorithm.
- (2) Target pathogen inactivation: 3.0-log Crypto inactivation credit per UVDGM validation requirements. The required UV dose shall be 12 mJ/cm².
- (3) Validation factor shall be calculated using the recommendations of the UVDGM.
- (4) The UV system sizing shall include a 30 percent safety factor to account for a target UV dose during operation that is 30 percent greater than the required UV dose.
- (5) Design flow rate and UVT conditions.
 - a. The UV Disinfection System for the common header option shall meet the target UV dose at all operating conditions presented as follows:

Design Flow Rate (ML/day)	Design UVT (percent)
179	80

- (6) Lamp aging factor.
 - a. The lamp aging factor shall be at most 80 percent.
 - b. SUPPLIER shall demonstrate the proposed lamps achieve this minimum lamp aging factor by providing a lamp aging report using a UVDGM or NWRI compliant measurement protocol which extends for a time period equal to or greater than the guaranteed lamp life proposed for this project.



- (7) Fouling factor
 - a. UV systems with on-line cleaning wipers: 95%
 - b. UV systems with off-line cleaning wipers: 90%

.7 Electrical Criteria

- (1) Ambient Room Temperature: 55 to 90 degrees Fahrenheit.
- (2) Ambient humidity: 0 to 45 percent relative humidity.
- (3) Supply Voltage: Nominal 600 VAC, 3 phase, 3 wire with ground, or 3 wire with neutral.
- (4) Supply Voltage Range: 90 to 110 percent of nominal
- (5) Power factor shall be between 0.9 and 1.0 lagging, and not leading at any operating point.
- (6) Harmonic distortion level: To comply with IEEE519-1992 Tables 10.1, 10.2, 10.3 as measured at the electrical control panel which houses the ballasts.
- (7) The electrical enclosures shall be designed to accommodate the future expansion of the UV system.
- (8) Lamp cable length between each UV reactor and its associated ballast connection points: Approximately 30 meters.

.8 Structural Design:

- (1) Design support system, connections, and related details for seismic design criteria as specified herein including selecting anchor bolt size, material, and embedment depth.
- (2) Do not use friction to resist sliding due to seismic forces.
- (3) Do not use more than 60 percent of the weight of the mechanical and electrical equipment for designing anchors for resisting overturning due to seismic forces.
- (4) Bolt Holes in Equipment Support Frames: Do not exceed bolt diameter by more than 25 percent, up to limiting maximum diameter oversize of 6 mm.

1.6 SUBMITTALS

.1 General

- (1) Submittals shall be in accordance with the requirements of Section 01300.
- (2) All submittals shall be submitted directly from the SUPPLIER to the OWNER, and information will be used to complete the design of the project.
- (3) Submit number of copies as specified in Section 01300.

.2 Submittal Schedule

- (1) The SUPPLIER shall provide the submittals in accordance with the schedule as described in Section 00100.

.3 **Submittal Package 1 Submittals for Stage 1 Review** shall include the following information:

- (1) Submittal shall provide information in sufficient detail to permit an item-by-item comparison with the specification.



- (2) Submittal shall be divided into sections that correspond to the headings used in this submittal description.
- (3) UV System Sizing
 - a. State design criteria used to size the UV system including lamp aging and fouling factors.
 - b. Provide headloss at peak flows specified.
 - c. Provide pressure rating of UV reactor.
 - d. Report summarizing the third party validation report including conditions covered in the test matrix, challenge organisms used, third party conducting the validation, test conditions reactor conditions, dose control algorithm, and power consumption summary.
- (4) General
 - a. Provide equipment drawings that include outline drawings, cut-away drawings, parts lists, material specification lists, and other information required to substantiate that proposed equipment complies with specified requirements. Provide an AutoCAD block of the UV and control panel.
 - b. Shop drawings showing support dimensions, anchor bolt sizes and locations, and other furnished components.
 - c. Clearly mark submittal information to show specific items, materials and accessories or options being furnished.
 - d. For each item of Equipment:
 - 1 Design features and design capacities.
 - 2 Material designations by UNS alloy number or ASTM Specification and Grade.
 - 3 Data needed to verify compliance with these Specifications.
 - 4 Dimensions, weights, and clearances for maintenance and operation.
 - 5 Detailed interface and interconnection drawings indicating interlock signals and terminal connections.
 - 6 Electrical one-line diagrams depicting sizes of wiring and conduits and rating and dimensions of electrical equipment.
 - 7 Catalog data, nameplate data, or descriptive information including catalog cuts and manufacturers' specifications for all reactor components.
- (5) UV System Parts Lists and Spare Parts
 - a. Provide parts lists with pricing for the following:
 - 1 UV reactor including UV lamps, lamp quartz sleeves, third-party calibrated duty and reference UV sensors, UV sensors ports, UV sensor windows, temperature sensors, wipers and wiper drive mechanisms if applicable, and motors.
 - 2 Local control panel including number of ballasts, PLCs, temperature sensors, fans, air conditioners, and GFIs and HMIs, and any other electrical enclosures.
 - 3 List separately and individually the following PLC spare parts:
 - a HMI
 - b PLC CPU
 - c PLC I/O Rack



- d PLC I/O Rack power supply.
- e PLC I/O Module of each type.
- f Ethernet Switch
- 4 Off-line cleaning system or on-line automatic mechanical wiper cleaning system, whichever is applicable. .
- b. Recommended list of spare parts, covering the following at a minimum (showing frequency of probable replacement):
 - 1 Spare parts required in the first 6 months of operation, 12 months operation and 36 months of operation.
 - 2 UV lamps.
 - 3 UV ballasts.
 - 4 Quarts sleeves.
 - 5 Duty Sensors.
 - 6 UV sensor port windows and seals.
 - 7 Wiper rings (if applicable).
 - 8 Wiper mechanism and seals (as applicable).
 - 9 Control panel cooling exhaust fans.
 - 10 Cleaning solution.
 - 11 Controls Equipment including:
 - a HMI.
 - b PLC processor, rack and power supplies.
 - c I/O module of each type.
 - d Ethernet communication parts of each type.
- (6) UV Irradiation chamber
 - a. List materials in direct contact with the water, exposed to UV light, and in direct contact with chemical cleaning agents, if applicable.
 - b Provide evidence of NSF 61 certification for materials in contact with water.
 - c Provide sectional drawings (top, side, and front views) for the chamber giving all wetted dimensions.
- (7) UV Lamps
 - a. Shop drawings for the UV lamp including part number, manufacturer, mercury content, operating voltage, and nominal electrical current and power rating, and germicidal output at 100 hour burn-in.
 - b Tabulated lamp aging test data giving lamp output versus lamp operating hours. Details of the test shall be provided including number of lamps tested, lamp part number and manufacturer, ballast part number and manufacturer, and lamp sleeve dimensions.
 - c Data on the magnitude and duration of voltage sags and cycle losses that cause the lamp to extinguish.
 - d Data on the required lamp warm-up times with a cold start and data on the required lamp cool-down and warm-up following voltage sags and cycle losses that extinguish the lamps.
 - e Instrumentation and method for detecting lamp breakage.
- (8) Lamp Ballasts
 - a. Shop drawings for the lamp ballasts including part number, manufacturer, electrical schematic showing connections, description of all electrical inputs and outputs, part list, power supply (voltage,



- current, frequency), output (voltage, current, frequency), power settings, power consumption at those settings, and electrical efficiency.
- (9) Lamp quartz sleeves
 - a. Shop drawings for the lamp quartz sleeve including part number, manufacturer, sleeve dimensions including inside and outside diameters, material, and spectral UV transmittance from 200 to 300 nm for a zero degree incident angle and air-quartz interfaces.
 - b. Confirmation that lamp quartz sleeves are fully annealed by the manufacturer to relieve internal stresses.
 - c. Quartz sleeve material type, hardness, critical bending stress and vibration calculations, measurements, and documentation for the range of flow rates specified in Article 1.05 of this Section.
 - d. Drawings showing details of seal between sleeve and reactor.
 - e. Instrumentation and method for detecting lamp quartz sleeve breakage.
 - (10) Cleaning System
 - a. Shop drawings for the cleaning system.
 - b. Details on the cleaning system operation and maintenance.
 - c. Specification for all cleaning chemicals stating chemical composition and volume requirements.
 - d. Evidence of NSF 60 certification for cleaning chemicals.
 - e. MSDS sheets and safety and disposal instructions for cleaning chemicals including response procedures for clean-up in the event of a leak/spill.
 - (11) Duty and Reference UV Sensors
 - a. Shop drawings giving part number, manufacturer, and dimensions.
 - (12) UV Sensor Port
 - a. Shop drawings giving sensor port dimensions and components including quartz windows and seals
 - b. Drawing showing relative placement of the UV sensor, UV sensor port, and lamp sleeve with dimensions
 - c. Specification for the sensor port windows stating material, hardness, thickness, and UVT from 200 to 300 nm
 - (13) Electrical
 - a. Overall system block diagram complete with all wiring, cabling, and conduits between electrical panel(s) and irradiation chamber.
 - b. General electrical schematics and layout drawings including but not limited to:
 - i. Interior panel layout drawings.
 - c. Cut Sheets For Each Electrical Power And Control Device.
 - d. Recommended wire sizes and insulation types for system electrical interconnections.
 - e. Total connected loads and power requirements and completed motor datasheets.



- f. Provide transformer voltage and kVA ratings. Indicate the number of transformers provided for the UV system.
- g. Provide heat load from electrical cabinets, UV lamps, and equipment for HVAC sizing.
- h. Submit electrical harmonic analysis demonstrating that the UV units shall not exceed the THD limitations for voltage and current at the point of common coupling as specified herein and as defined in IEEE 519 Tables 10.1, 10.2 (Special Applications), and 10.3.
 - (1) State all assumptions made for the analysis.
 - (2) Provide a system impedance diagram based on the Electrical single line diagrams included in the Drawings.
 - (3) Provide analysis for UV system operation from utility and stand-by generator.
 - (4) Control and Instrumentation
 - (5) Overall system architecture diagram complete with all wiring and communication between equipment by SUPPLIER and equipment by others.
 - (6) Parts list to denote PLC model numbers, PLC programming software for programming, HMI model, and HMI programming software.

.4 Submittal Package No.2 Submittals Following Stage 1 Review shall include the following information:

- a. Submittal shall provide information in sufficient detail to permit an item-by-item comparison with the specification.
- b. Supply and Delivery Instructions
 - 1. SUPPLIER's delivery instructions, including loading and unloading requirements.
 - 2. SUPPLIER's installation instructions, including leveling and alignment tolerances and grouting.
- c. UV Intensity Sensors
 - (1) Shop drawings giving part number, manufacturer, and external dimensions for both the duty sensors and the reference sensor(s).
 - a. Electrical specification describing all electrical connections.
 - b. Data on properties including:
 - a. Spectral response from 200 to 400 nm.
 - b. Temperature response from 0 to 40°C.
 - c. UV intensity working range in W/m² or mW/cm²



- (2) Stability over time.
 - (3) Statement of measurement uncertainty.
 - (4) Standard procedures used by SUPPLIER or manufacturer for calibration including:
 - a. Organization conducting calibration.
 - b. Instrumentation used to conduct calibration.
 - c. Description of calibration standards.
 - d. Calibration procedure.
 - e. QA/QC.
 - (5) Statement of measurement uncertainty.
 - (6) Time interval between calibrations by SUPPLIER.
 - (7) Standard procedures used by SUPPLIER for verifying UV sensors sent for recalibration meet specifications for spectral response, angular response, linearity response and temperature response.
 - (8) Instructions for using the reference sensor including:
 - a. Recommended intervals for reference sensor checks.
 - b. Acceptance criteria for reference sensor checks.
 - c. Procedures for using the reference sensor to field calibrate the duty UV sensor.
- d. Structural
- (1) Installation and checkout instructions including leveling and alignment tolerances, grouting, chemical cleaning requirements, and initial startup procedures.
 - (2) Calculations and other information to substantiate base plates, supports, and anchor bolts meet minimum design strength requirements and seismic design criteria specified herein.
 - (3) Calculations for connection details demonstrating compliance with specified structural design requirements.
 - (4) Require Professional Engineer registered in the Province of British Columbia to stamp and sign calculations.
 - (5) Installation instructions.
 - (6) For equipment with operating weight of 400 pounds or more (including control panels) provide calculations for:
 - a. Determination of operating weight and centroid of equipment.
 - a. Operating weight of the reactor is to be weight of unit plus weight of water normally contained in unit during operation.
 - b. Determination of seismic forces and overturning moments.
 - c. Determination of shear and tension forces in connections.
 - d. Design of connection details based on calculated shear and tension forces.
- e. Electrical, Control, and Instrumentation
- (1) Hardware Submittal
 - a. Bill of Materials.



- b. ISA S20 data sheets for all instruments provided.
- c. Catalog cuts for all process control and instrumentation equipment.
- d. Detailed control panel drawings including assembly/layout drawings and heating/cooling calculations.
- e. Instrument installation, mounting, and anchoring details
- (2) Complete system block diagrams with inter-equipment wiring and conduit requirements
- (3) Detailed schematic drawings for all control equipment.
- (4) Detailed loop drawings per ISA S5.4. Submittal of generic diagrams shall not be acceptable. Loop drawings shall contain all of the minimum and optional content required by Articles 5.2 and 5.3 of the standard.
- (5) Point-to-point interconnection wiring diagrams indicating field instrumentation and control panel connections.
- (6) Grounding layout
- (7) Panel wiring, conduit diagrams, and I/O module layout.
- (8) English-language loop descriptions.
- (9) Instrument index with ranges and set points.
- (10) Fully documented function block PLC program listing including the I/O list and rack configuration for each PLC.
- (11) Each function block must be associated with a complete English language narrative describing the function and operation of function block.
- (12) Color copies of all proposed operator interface screens.
- (13) Detailed factory testing procedure.
- (14) Flash drive with software copies of the source code and configuration data in a format that is suitable for revision and reloading into the PLC, where conditions of the warranties are voided in changes are made without written permission of the SUPPLIER.
 - 1. Statement that OWNER has right to modify, monitor, and troubleshoot PLC programming with written permission of SUPPLIER.
- f. Dose Monitoring Algorithm
 - (1) Mathematical equations for the dose monitoring algorithm programmed into the PLC including:
 - a. Calculation of delivered dose, selection of the number of rows, etc.
 - b. How the UV intensity value used in algorithm is determined from measured UV intensity.
 - c. Signal update rate for measured flow, UVT, and UV intensity
 - d. How the algorithm responds when flow, UVT, or lamp status, S/So, DL (if applicable), or predicted RED (log inactivation) are outside the validated range.
 - e. Example calculations.
 - (2) Definition and calculation of off-spec performance.
- g. UV System Control Philosophy



- (1) Description of UV system operating modes and communication with the plant control system, including:
 - a. List of all displayed, entered, and controlled parameters at the HMI and through the SCADA. Parameter listing shall include: engineering units, range, data type (e.g., read/write, binary/integer/floating), alarm limits, and Profibus address.
 - b. Description of all alarms and UV system response to those alarms
 - c. Description of UV system startup and shutdown sequences
 - d. Description of dose pacing algorithm
 - e. UV system response to off-spec performance
 - f. Description of cleaning system operation

- h. Operating and Maintenance Costs
 - (1) Provide a full list of UV system consumables with part numbers.
 - a. Guaranteed maximum replacement costs for UV lamps, lamp quartz sleeve, ballasts, wiper mechanism, and all seals as per Section 00300.

- i. Schedule and Plan
 - (1) The SUPPLIER shall submit a schedule and plan for startup, testing, and training with Submittal No. 2. Startup shall be scheduled to commence no less than 60 days after the submittal is approved by OWNER and ENGINEER.
 - (2) The schedule shall include submission of final O&M manuals.
 - (3) The plan shall include:
 - a. List of OWNER and CONTRACTOR-furnished supplies, electrical test equipment, and water quality testing.
 - b. Testing procedures.
 - c. Checklists and data forms
 - d. Coordination with the OWNER's staff.
 - e. Approaches required to ensure safety of personnel involved in startup and testing
 - (4) The SUPPLIER shall revise the Plan as necessary based on review comments. The SUPPLIER shall submit written requests at least two weeks in advance if interruption of process flows or operation of other systems at the Duteau Creek WTP UV facility is necessary to start up, test, or modify the UV Disinfection System. OWNER alone will approve such requests.



(9) Submittal Package No.3 - Submittals Prior to Delivery

a. Shall include the following information:

- (1) Operation and Maintenance (O&M) Manuals
- (2) Provide O&M Manuals in hard and soft formats. Hard copy format shall be 3-ring binders with rigid covers, using tab sheets to organize information. Soft copy format shall be provided on flashdrive in searchable Adobe Acrobat PDF format such that the OWNER can supplement the information provided.
- (3) Provide on flashdrive, training videos for operation and maintenance of UV system including:
 - a. Inspection, calibration, and troubleshooting.
 - b. Replacements of components including lamps, sleeves, UV sensors, wipers, and ballasts.
 - c. UV system cleaning.
 - d. Preventative maintenance.
- (4) Organization
 - a. Cover Page. List equipment name and tag number, project name, OWNER's name, and release date.
 - b. Table of Contents. General description of information provided within each tab section.
 - c. Control Diagrams. Internal and connection wiring, including logic diagrams, wiring diagrams for control panels, ladder logic for computer based systems, and connections between existing systems and new additions, and adjustments such as calibrations and set points for relays, and control or alarm contact settings.
 - d. Startup Procedures. Instructions for installation, adjustment, calibration, and troubleshooting.
 - e. Operating Procedures. Step-by-step procedures for starting, operating, and stopping equipment under specified modes of operation. Should include safety precautions and emergency operating shutdown instructions.
 - f. QA/QC. Procedures and criteria for using reference UV sensors to check the duty sensors, using bench-scale measurements of UVT to check UVT measured by the on-line UVT monitor (by others) if applicable, checking S/So meets design criteria, checking variability in UV output from lamp-to-lamp for UV systems that use fewer UV sensors than lamps, checking calculated RED displayed by the UV system, and checking alarm responses.
 - g. Preventative Maintenance Procedures. Recommended steps and schedules for maintaining equipment.
 - h. Overhaul Instructions. Directions for disassembly, inspection, repair, and reassembly of the equipment; safety precautions; and recommended tolerances, critical bolt torques, and special tools that are required.
 - i. Parts List. Generic title and identification number of each component



- j. Spare Parts List. Recommended number of parts to be stored at the site and special storage precautions.
- k. Provide electrical and instrumentation schematic record drawings.
- (5) Written startup, testing, and training plan meeting all elements of Part 3. The training plan shall include a general outline of the course covering class room and field “hands-on” training.
- (6) List of recommended recommend safety equipment for operators
- (7) Qualifications of SUPPLIER’s field representative for UV Disinfection System including who will be conducting startup, testing, and training.

(10) Submittal Package No.4 Submittals After Installation

- a. Shall include the following information:
 - (1) Manufacturer’s Guarantee: Submit warranty bond, which will expire at the end of the warranty period
 - (2) Manufacturer’s Warranty: Submit UV equipment warranty.
 - (3) Certificate of Proper Installation.
 - (4) End of Warranty Report.
 - (5) Inspection, Functional Test, Operational Test, and Field Test reports.
 - (6) Approved O&M Manuals which incorporate submittal review comments of Submittal Package No. 3.
 - (7) Record Documentation for all as built electrical schematics, wiring, diagrams, loop drawings, ladder logic, loop descriptions, and interconnection diagrams.
 - (8) As-installed and tested PLC application software program in both printed and electronic format. Program shall not be password protected such that OWNER can access the program and re-load the program into the PLCs if needed. OWNER will sign non-disclosure agreement as required by the SUPPLIER, if applicable. Electronic format shall be CD-ROM.

1.7 SPARE PARTS

- .1 The SUPPLIER shall furnish the following spare parts:
 - (1) Five (5) percent of total installed UV lamps.
 - (2) Five (5) percent of total installed UV Ballasts.
 - (3) One (1) sleeve.
 - (4) One (1) year supply of cleaning solution.
 - (5) One (1) complete set of replacement seals
 - (6) UV face shield.
- .2 Any spare part components consumed during the startup and commissioning of the UV system shall be replaced by the SUPPLIER with new components.
- .3 Provide lists with pricing for spare parts as required in Submittal Package 1.



1.8 GUARANTEES AND WARRANTIES

- .1 The SUPPLIER shall submit to the OWNER, a performance guarantee, equipment replacement cost guarantee, and an equipment warranty for the UV disinfection system as specified herein.
 - (1) The guarantees and warranties shall include signature by two persons with signing authority or power of attorney the SUPPLIER.
 - (2) Performance guarantee shall include a Performance Bond equal to 100% of the contract price, which will be released upon successful completion of the Owner's Acceptance Testing described herein. If the performance testing is delayed past the project durations stated herein, OWNER will pay the costs of extending the bond date.
 - (3) Seal and signature of Notary Public.

- .2 Dates for application of guarantees and warranties shall be as follows:
 - (1) UV System Final Acceptance date shall be defined as the date of completion of the Owner Acceptance Testing and written notification of UV System Final Acceptance.
 - (2) Final Completion shall be defined as the final completion of all outstanding payable work by the CONTRACTOR for the entire UV facility.

- .3 UV System Performance Guarantee
 - (1) The SUPPLIER shall provide a performance guarantee.
 - (2) The performance guarantee shall state the following:
 - a. The UV system installed and used at the Duteau Creek WTP UV facility matches the UV system that underwent validation as specified.
 - b. The UV system is capable of delivering a validated UV dose that is equal to or greater than the required UV dose at the design conditions specified herein.
 - c. The UV system is capable of delivering a validated UV dose that is equal to or greater than the required UV dose at the operating conditions indicated in Section 00300 without exceeding the guaranteed energy cost as stated by the SUPPLIER in Section 00300.
 - (3) The guaranteed energy cost as stated by the SUPPLIER in Section 00300 will be confirmed by Power Performance Test as specified herein.
 - (4) The SUPPLIER shall pay a penalty equal to the 20 year present worth cost of the excess power consumption as calculated in Section 00300. Payment of penalty shall be by method agreed to with OWNER such as deduction from final payment.

- .4 Equipment Replacement Cost Guarantee
 - (1) For a period of five (5) years after the UV system final acceptance date, the SUPPLIER shall provide to the OWNER a guaranteed fixed-cost price for replacement of the following components not covered under warranty. Every year, the fixed cost shall be adjusted according to the Machinery and Equipment Price Index (Total) as published by Statistics Canada.



- a. Lamps including disposal of used lamps returned to the SUPPLIER
 - b. Lamp ballasts
 - c. Lamp quartz sleeves
 - d. Duty and Reference UV sensors
 - e. UV sensor port windows for sleeves
 - f. Factory calibration costs for Duty and reference UV sensors
- (2) The SUPPLIER's Guaranteed Equipment Replacement Costs must be provided as required in the Pricing Agreement and included in Section 00300.
- (3) OWNER shall pay the lower of market price at the time of replacement or the guaranteed replacement cost for all replacement items.

.5 Lamp Life Guarantee and UV Lamp Warranty

- (1) The guaranteed lamp life as stated by the SUPPLIER in Section 00300 shall apply for a period of five (5) years after the UV system Final Acceptance Date.
- (2) The SUPPLIER shall replace, at no cost to OWNER, any UV lamps not meeting the UV Lamp Warranty during the guaranteed lamp life period up to the lamp prorated start period stated in Section 00400. After the prorated start period, the SUPPLIER shall replace any failed UV lamp on a "pro-rata" cost basis. SUPPLIER shall pay shipping costs and disposal costs of used lamps associated with any lamp replacement during the guaranteed lamp life period.
- (3) UV Lamp Warranty
 - a. The SUPPLIER shall provide a warranty valid for a the guaranteed lamp life period that new UV lamps after 100-hour burn-in have a relative lamp output no less than 90 percent of the relative lamp output expected based on the UV sensor equation either determined through validation or on-site testing.
 - b. The SUPPLIER shall provide a warranty that UV lamp output shall be above the lamp-aging factor used to size the UV system over the lamp life specified in Section 00300.
 - c. Failure to meet with warranty shall occur when the lamp operating hours are less than the lamp life specified in Section 00300 and the lamp either fails to ignite or has a relative lamp output below the lamp age factor used to size the UV system
 - d. Verification of such a failed condition, if required, shall be made when the reactor is operating at 100 percent power, immediately after thorough cleaning of the lamp quartz sleeves and the sensor port windows, and after the duty UV sensors accuracy has been verified against calibrated reference UV sensors. This warranty shall not apply if the number of lamp ON/OFF cycles per day averaged over any one-week period exceeds criteria specified by the SUPPLIER. Lamp operating hours shall be defined as accumulated time when the lamps are ON.

.6 UV Disinfection System Warranties

- (1) Unless otherwise specified, warranties shall begin upon UV System Final Acceptance.



- (2) Warranties shall be applied if the OWNER operates and maintains the UV systems as per SUPPLIER instructions. The SUPPLIER shall clearly define those instructions and records kept by the OWNER that demonstrate compliance to those instructions.
- (3) General UV Disinfection System Warranty
 - a. The SUPPLIER shall provide a twenty-four (24) month warranty that the installed UV Disinfection System is free of defects in materials and workmanship, including damage that may occur during shipping, storage, installation, and testing.
 - b. The SUPPLIER shall provide a Warranty Bond in the amount of 10% of the contract value, which will be released at the end of the warranty period.
- (4) UV Ballasts Warranty
 - a. The SUPPLIER shall provide a five (5) year warranty for ballast failure. SUPPLIER shall replace any failed ballasts within the warranty period at no additional costs to the OWNER, including shipping, up to the ballast prorated start period stated in Section 00300. The SUPPLIER shall replace or recalibrate any failed ballast on a “pro-rata” basis for after the ballast prorated start period.
- (5) Lamp Quartz Sleeve and UV Sensor Port Window Warranty
 - a. The SUPPLIER shall provide a twenty-four (24) month warranty that the lamp quartz sleeves and the UV sensor port windows after recommended cleaning shall maintain a UVT above specified values over the lifetime specified in Section 00300. The SUPPLIER shall replace, at no cost to OWNER, any failed lamp quartz sleeve or UV sensor port window during the warranty period including shipping.
 - b. Failure to meet this warranty shall occur if the UVT measured at 254 nm using methods recommended by the SUPPLIER is less than the specified value.
- (6) UV Sensor Warranty
 - a. The SUPPLIER shall provide a twenty-four (24) month warranty that the UV sensors shall perform within specification over the vendor specified calibration period stated in Section 00300. The SUPPLIER shall replace, or recalibrate at no cost to OWNER, any failed UV sensor during the warranty period, including shipping.
 - b. Failure to meet this warranty shall occur if the UV sensor does not meet specifications, occurring when the difference between the reference sensor and the duty sensor measurements fails to meet criteria defined by the SUPPLIER in Section 00400.

PART 2 PRODUCTS

2.1 SCOPE OF SUPPLIES

- .1 Furnish all tools, supplies, materials, and equipment for the UV Disinfection System including design, fabrication, and delivery of all equipment, appurtenances and instrumentation, an integrated control system with hardware and software, installation



oversight, equipment checkout, commissioning and startup, performance testing, and training.

2.2 GENERAL PRODUCT REQUIREMENTS

- .1 The UV reactors installed at the Duteau Creek WTP UV facility shall be equivalent to the validated reactors in terms of dose delivery and dose monitoring.
 - (1) The installed UV reactor shall have the same wetted dimensions as used during validation in terms of chamber dimensions, baffle dimensions, location and orientation, and lamp quartz sleeve location.
 - (2) The installed UV reactor shall have the same UV lamps as used during validation in terms of lamp type (LP, LPHO, or amalgam versus MP lamps), mounting location within the lamp quartz sleeves, arc-length, and germicidal UV output at 100 hour burn-in.
 - (3) The installed UV reactor shall be equipped with the same lamp quartz sleeves as used during validation in terms of dimensions, quartz material, and UV transmittance.
 - (4) The installed UV reactor shall be equipped with the same UV sensors as used during validation in terms of mounting location on the UV reactor, water layer between the UV sensor port window and the lamp quartz sleeves, spectral response, absolute calibration, and part number.
 - (5) The installed UV reactor shall use the same dose-monitoring algorithm as determined by validation. The dose monitoring algorithm defines the relation between RED and measured flow, UV intensity, lamp status, and if used, UVT.
- .2 Provide UV reactors and electrical enclosures with lifting lugs or eyes to allow removal with hoist or other lifting device.

2.3 MATERIALS

- .1 All materials in contact with the water shall be resistant to chlorine.
- .2 All metal components in contact with water or chemical cleaning agents shall be 316L stainless steel.
- .3 All material exposed to UV light shall be either Type 316L stainless steel, quartz, viton, or teflon.
- .4 Bolts and nuts shall be Type 316L stainless steel and shall be installed with anti-gall compound.
- .5 All material used for structural legs, supports, frame shall be 316L stainless steel. Design shall prevent any risk of electrolytic corrosion between any supports or frame and irradiation chamber for dissimilar metals.
- .6 All materials in contact with drinking water shall be NSF 61 certified.



- .7 Dielectric materials shall be used for separation of dissimilar metals:
 - (1) Neoprene, nonmetallic separators or washers, or other materials.

- .8 Anchors Bolts shall be Type 316L stainless steel with a minimum 12 mm diameter.

2.4 UV REACTOR CHAMBER

- .1 The chamber shall be designed to ASME Section VIII, Div. 1, 2007 edition. Flange connections shall conform to ANSI/AWWA C207 Class D.
- .2 The chamber shall be designed to prevent operator exposure to UV light.
- .3 The chamber shall be designed for complete immersion of the quartz sleeves housing the UV lamps.
- .4 The chamber shall be designed with the same internal finish as validated. The UV reactor shall be cleaned, pickled, and passivated in accordance with ASTM A380.
- .5 The chamber shall be designed to maintain structural integrity with the working and transient pressures specified in these documents. The reactor shall be pressure tested at 1.5 times the design pressure by the SUPPLIER at the factory prior to shipment.
- .6 An access hatch or hand holes shall be provided on the chamber to allow easy, simple access for visual lamp/sleeve inspection and/or removal of foreign debris from the chamber. Access hatch dimensions shall be adequately sized for intended purpose.
- .7 Air relief valves shall be provided if the inside elevation of reactor is higher than inlet and outlet piping.
- .8 UV systems equipped with MP lamps to provide temperature sensors mounted on the outside of the reactor to prevent external surface temperatures from exceeding 60 °C.
- .9 The chamber may be equipped with baffle plates:
 - (1) Baffles shall be constructed of 316 L stainless steel and no less than 8 mm thick.
 - (2) Baffles shall be integral to the vessel and require no maintenance.
 - (3) Baffles shall be designed to limit deflection at the center of the plate to no more than 3 mm at maximum design flow.
 - (4) All baffle plates provided with the reactor must have been used during validation



2.5 UV LAMPS

- .1 Lamps shall be cooled by heat transfer to the water flowing through the reactor.
- .2 The lamp output shall not fluctuate by more than 3% as a result of variations in water temperature between 5°C and 38°C.
- .3 Lamps shall be operator accessible and removable from one end or one side of the irradiation chamber without draining the unit or removing the lamp quartz sleeves from the flow.
- .4 Supports and fittings used to hold the lamps within the quartz sleeves must be resistant to UV light and any high temperatures and ozone caused by lamp operation. Materials must be selected not to outgas and foul the internal surfaces of the lamp sleeve.
- .5 All wires connecting the lamp to the power distribution module shall be enclosed inside a module or junction box and not exposed to the water. The conduits should be sealed to prevent the passage of water if a lamp sleeve breaks.
- .6 The lamp assembly design shall allow the removal of the lamp power cable, the lamp power cable and UV lamp, or the lamp power cable and entire lamp assembly (including lamp) independent of all other associated equipment.
- .7 The number of lamp start/stop cycle per 24-hour period shall be as stated in Section 00300.
- .8 Lamps shall be operated by electronic or electromagnetic ballasts capable of multiple or continuous power settings.

2.6 LAMP QUARTZ SLEEVES

- .1 The sleeves shall be fully annealed clear quartz circular tubing. No Teflon coating shall be allowed. The UV transmittance at 254 nm of the quartz sleeve at the start of its life shall be 88 percent or greater, as measured with air-quartz interfaces.
- .2 UV system shall be designed to be able to detect lamp quartz sleeve breakage. The UV system shall be designed such that the reactor does not release water should the sleeves break.
- .3 Sleeve seals shall be designed to prevent fracture of the lamp sleeve. Seals shall not involve metal to quartz contact. The SUPPLIER shall specify maximum torques for all bolts used to mount the sleeve within the reactor.
- .4 The design of the reactor and sleeve assembly shall ensure lamp replacement can be conducted by plant operators within the time period specified in Section 00300.
- .5 The critical bending stress point of the lamp sleeve shall be greater than the maximum stress incident on the sleeve at the maximum flow rate.



- .6 SUPPLIER shall confirm that resonant vibration does not occur over the flow range specified.

2.7 CLEANING SYSTEM

- .1 Provide a cleaning system to clean the sleeves.
- .2 In the O&M manual, the SUPPLIER shall specify the approach for keeping the lamp quartz sleeves and UV sensor port windows free from foulant. Approaches include using automatic wiper cleaning systems and off-line acid rinse cleaning systems.
- .3 Automatic Wiper Cleaning Systems:
 - (1) The cleaning system shall consist of wipers that move along the length of the lamp sleeve and remove foulant that accumulates on the sleeve surface.
 - (2) The wipers shall be fully operational without requiring either lamps or reactor to be placed out of service.
 - (3) The wipers shall be driven by mechanical or pneumatic means. Ancillary equipment (i.e., air compressor) for operation of the wiper system shall be provided by the UV System Supplier.
 - (4) Cleaning cycle intervals shall be field adjustable within the range of once/hour to once/month. Local cleaning system control shall be available through the HMI
 - (5) Sensors shall be used to signal the control system to stop the actuator when the wiper mechanism reaches the end of the chamber.
 - (6) Wiper material shall be chlorine resistant and UV compatible.
 - (7) The hardness of the wiper material in physical contact with the lamp quartz sleeves and UV sensor port windows shall be less than the hardness of the lamp quartz sleeve and UV sensor port window material.
- .4 Offline Acid Rinse Cleaning System
 - (1) The UV reactor shall be cleaned by spraying phosphoric acid or an acceptable alternative onto internal surfaces of the reactor that include lamp quartz sleeves and UV sensor port windows.
 - (2) The chemical cleaning system shall allow safe, quick, and user-friendly chemical cleaning of the reactor. The cleaning system shall be designed to work with a stationary storage tank and header system (by others).
 - (3) Each reactor shall be provided with drains to drain the vessel during cleaning. Provide with service water connections to flush acid solution out of reactor.
 - (4) Manual operations shall be limited to spray nozzles connections to the reactor, open/close service water valve, open/close drain and vent valves, charging the tank with chemical cleaning agent, turning on motor(s). Chemical agent must be NSF 60 approved for use in drinking water applications.
 - (5) Interlocks shall be provided to prevent any use of the chemical cleaning system when the UV reactor is not off-line and not isolated from influent line and effluent line.



- (6) Instruments and/or procedures shall be implemented to ensure that the reactor can be safely turned back on production after chemical cleaning and rinsing.
- (7) Interlocks shall be provided to prevent returning the reactor on-line unless both the service water valve is closed and the drain and vent valves are closed.
- (8) The SUPPLIER shall provide a procedure for neutralization and safe disposal of the waste chemical agent. This procedure shall be demonstrated during operator training.

2.8 UV SENSORS

- .1 UV reactors using low-pressure, low-pressure high-output, or amalgam UV lamps shall be equipped with a minimum of one UV sensor per row or bank of UV lamps. UV reactors equipped with medium-pressure UV lamps shall be equipped with a minimum of one UV sensor per lamp.
- .2 The UV sensors shall be removable from the irradiation chamber without draining the UV reactor.
- .3 Each sensor shall continuously monitor the UV intensity and transmit a 4-20 mA signal proportional to the measured UV intensity.
- .4 The physical calibration of the UV sensor shall not be field adjustable. Rather, duty UV sensors will be compared to the reference UV sensor measurements, and correction factors applied at the UV control panel.
- .5 The UV sensors signals shall be properly shielded to avoid interference from electromagnetic fields.
- .6 The UV sensor shall have a germicidal spectral response. The spectral response shall peak between 250 and 270 nm and the measurement of UV light above 300 nm shall be less than 5 percent of the total measurement.
- .7 For UV systems using medium-pressure lamps, the UV sensors shall be located to give a Polychromatic Bias of one. This requirement shall be verified during UV validation testing as per the approach described in the UVDGM.
- .8 UV sensors shall be located to monitor a location along the length and around the circumference of the lamp that ensures dose delivered by the UV reactor is equal or greater than the dose indicated by the dose monitoring system as the UV lamps aged and the UV system fouls.
- .9 The operating temperature range of the sensor shall be 0 to 50 °C.
- .10 A minimum of two (2) reference UV sensors shall be provided for checking measurements made by the duty sensor. The reference sensors shall be handheld device, with a handheld local operator interface (LOI), that provides measurement of UV intensity in W/m² independent of the UV reactor and its control system. The SUPPLIER shall state the recommended interval for reference sensor checks in the



O&M manual. SUPPLIER recommendations must meet the relevant regulatory agency requirements.

- .11 The SUPPLIER shall state the measurement uncertainty of the duty and reference UV sensors, based on third party calibration, and the associated criteria for reference sensor checks. The criteria used must match the criteria used to define the Validation Factor stated in the validation report of the UV system.
- .12 The SUPPLIER shall specify the time period over which the duty UV sensor shall stay within calibration as defined by reference sensor checks.
- .13 Reference sensors shall be regularly sent by the OWNER to the SUPPLIER for absolute calibration by a qualified third party laboratory. Calibration shall confirm that spectral response, angular response, linearity response and temperature sensitivity is within manufacturer specifications. The SUPPLIER shall specify the time period between absolute calibration, not to exceed 1 year. The SUPPLIER shall provide records on the results of absolute calibration to the OWNER.

2.9 OTHER SENSORS

- .1 Sensors shall be used to detect either UV lamp or lamp quartz sleeve breakage, either per lamp or sleeve or per group of lamps and sleeves.
- .2 Each UV reactor shall be equipped with water level sensors.

2.10 ELECTRICAL

.1 Power Supply

- (1) The electrical supply to the UV system shall be 600 VAC, 3 phases, 3-wire, 60 hertz Delta-Wye configuration. The SUPPLIER shall provide K-rated transformer(s) as required for step down purposes and trapping of the triplen harmonics. Transformer(s) windings shall be copper.
- (2) The UV system will receive electrical supply by OTHERS which will distribute power to the Local Control Panels (LCP) at each UV reactor which house the ballasts, and other components of the UV system.
- (3) Harmonic filtering equipment shall be provided that meets the requirements of IEEE 519-1992 table 10.1,10.2, and 10.3 with the Point of Common Coupling (PCC) defined as the input to the LCP with a maximum short circuit current rating equal to 125% of the UV disinfection systems power requirement.
- (4) Each LCP shall be provided with dedicated individual UPS to supply uninterrupted power in case of a power loss. The UPS shall be Liebert GXT4-1000 make.
- (5) The electrical supply to the UV system will include overload protection, short circuit protection, ground fault protection, surge protection, and transient protection.



- (6) The electrical supply to the UV system will be equipped with a power meter (by others) that measures true and apparent power consumption and harmonics by each UV reactor and its control system.
 - (7) Power consumption by the UV system shall be no greater than the kW values stated by the SUPPLIER in Section 00300.
 - (8) Provide a voltage regulating line isolation transformer with 120 V secondary and a separate redundant 24 V DC regulated power supply; isolate all low voltage variable power signals entering the LCP.
 - (9) Each 120 VAC loop shall be powered through an individual circuit breaker.
 - (10) D.C. power supplies shall be fully redundant and their status monitored by the UV System PLC.
 - (11) Provide any starters necessary for the cleaning system or any other ancillary components within the LCP.
 - (12) Provide individual circuit breakers for starters, instrumentation power, duplex GFCI receptacle, operator Interface, air conditioner, and the PLC.
- .2 All electrical equipment including control panels custom manufactured for this project shall bear the label of Underwriter's Laboratories of Canada, Inc. (ULC) or Canadian Standards Association (CSA) that confirms the products meet those safety requirements.
- .3 Panel Enclosures
- (1) Electrical panels shall be 304 stainless steel painted NEMA 4X Enclosures with hinged front doors.
 - (2) Panel face mounted hardware such as indicating lights, push buttons and switches shall be Allen Bradley Series 800 or ENGINEER/OWNER approved equal. Indicating lights shall be LED type.
- .4 Electrical panels shall be complete with ventilation cooling system for the specified ambient conditions, sized to maintain an inside panel temperature of 80 degrees F maximum in an ambient temperature of 110 degrees F. Provide disposable inlet air filter.
- (1) Each cabinet shall be equipped with a cabinet heater to prevent formation of moisture due to humidity.
 - (2) Provide internal fluorescent light in each enclosure.
 - (3) Provide duplex GFCI protected, 120 volt, 60 Hz, 1 phase receptacle in each enclosure.
 - (4) Enclosure nameplates:
 - (5) Type: White lamacoid with black letters.
 - (6) Fastener: Round head stainless steel screws.



.5 Wiring and Cables

- (1) The SUPPLIER shall provide all electrical cables between the UV lamps and ballasts and all power conductors between the ballasts and transformers, as required. The SUPPLIER shall also provide the data cabling for connection between each UV reactor and the LCP. The incoming power supply, conduit, and field terminations shall be the responsibility of the CONTRACTOR.
- (2) The SUPPLIER shall identify the interconnection electrical service requirements (voltage, amperage, etc.) and control wiring requirements, and furnish other accessories (disconnect switches, etc.) that need to be provided by the CONTRACTOR for a complete installation.
- (3) The SUPPLIER shall factory assemble and wire the LCP such that field wiring shall consist only of connections to terminals.
- (4) Wiring and cables shall be grouped together in harnesses and secured to the panel structure.
- (5) Signal interfacing inside and outside the panels shall be through terminal blocks. Loose cable connections are not allowed.
- (6) All field connections shall be made through a field connection terminal strip and an empty panel channel wire-way.
- (7) The LCP cabinet shall use a signal terminal housing enclosure with terminal strips for the ultimate conditions plus 25 percent spare terminations (based on the total terminations in the housing) with no fewer than 2 spare terminations of each size and type. The Class 1, Class 2, and Class 3 control and signals shall be separated per the CEC. Analog signal wire shall be kept separate from digital control/signal wire and the enclosures shall provide separate wire routing for analog signal wire from digital control/signal wire to minimize noise and interference. Other common termination points in the UV system shall also have a minimum of 25 spare terminals. Other common signal wiring pathways in the UV system shall have a minimum spare capacity for 25 percent additional wire/cable.
- (8) Terminal strip mounted fuses shall protect each and every discrete input, discrete output, and analog input. All fused terminal blocks shall be equipped with blown fuse indicators.
- (9) Use CableFast wiring systems, or ENGINEER/OWNER approved equal, between PLC and Field Terminals.
- (10) Use Panduit panel wire-ways, or approved equal, for wire segregation.
- (11) Identify each end of each wire by a unique wire number printed on a heat shrunk sleeve marker.
- (12) Use shrink on wire labels
- (13) Electrical documentation and cable identification labels shall conform as follows:
 - a All External and Internal control and power wires shall be uniquely labeled using machine printed heat shrink labels.



- b The following wire colors shall apply to all conductors.
- | | |
|----------------------|--------|
| L1 (Hot) | Black |
| L2 (Neutral) | White |
| AC control | Red |
| DC circuits | Blue |
| Ground | Green |
| External Interlocked | Yellow |

.6 Lamp Ballasts

- (1) The ballast shall withstand maximum line voltage fluctuation as stated in Section 00400. The ballasts shall comply with ANSI C62.41 Class A for transient protection.
- (2) The ballast case temperature shall not exceed the temperature rating of the internal components given the ambient air conditions specified in Article 1.6. Sufficient airflow shall be provided to provide effective cooling of the ballast.
- (3) LCP or ballasts shall be equipped with a temperature sensor to indicate overheating.
- (4) LCP or ballasts shall be equipped with lamp GFIs.
- (5) LCP or ballasts shall be equipped with circuitry for monitoring lamp current and indicating lamp operating status.
- (6) Ballast shall not initiate lamp re-strike independent of the PLC.

.7 Electrical Cabinets: Prefabricated electrical cabinets include:

- (1) All electrical cabinets shall be sized for all future lamp expansion capabilities of the UV reactors.
- (2) Local Control Panel (LCP) containing all the controls, ballasts, remote I/O, and interfaces to provide power and control of a UV reactor (one ballast enclosure per reactor) including PLC, power suppliers, HMI and communication hardware.
- (3) All UV lamp cables, cabinet interconnecting wiring, lamp cable connectors, and all other accessories for a complete and operable system.

2.11 CONTROLS

- .1 The UV System shall provide one (1) programmable Logic controller and remote IO for each UV LCP lamp ballast enclosure.
- .2 Programmable Logic Controller.
 - (1) PLC shall be Siemens PLC S7-1500 series compatible. The PLC shall have a Profibus TCP Ethernet interface for communication with the SCADA system, HMI, and programming device. The PLC processor shall have battery-backed SRAM to protect the program on loss of power. The battery shall back up the program for up to one year with no power applied to the processor.
 - (2) The PLC shall monitor the following signals.



- a Ballast signals including lamp status, Ground Fault Interrupts (GFIs), and ballast operating temperature
 - b Measurements made by UV intensity sensors, reactor temperature sensors, and if used water level monitors, water leakage, lamp quartz sleeve and/or UV lamp breakage detectors
 - c Flow meter (by Others) measurement and status, as a flow per reactor.
 - d Status of influent, effluent, reactor drainage, and service water valves including FULL OPEN and FULL CLOSED and actual position.
 - e Automatic cleaning system status
- (3) The PLC shall provide the following functions:
- a Provide power for UV intensity sensors
 - b Control starting and shutdown sequences including:
 - 1 Control opening and closing of influent, effluent, and drainage valves
 - 2 Enabling and disabling lamp ballast operation
 - c Calculate and report dose delivery by the reactor.
 - d Calculate and report accumulated off-spec performance by time and volume
 - e Turn on and off lamps and adjust lamp ballast power settings to provide efficient dose pacing
 - f If the calculated RED is less than the Target RED, the PLC increases ballast power, turns on banks/rows of lamps, and turns on UV reactors as required until the calculated RED is equal to or greater than the Target RED.
 - g If the calculated RED is greater than the Target RED, the PLC decreases ballast power, turns off banks/rows of lamps, and turns off UV reactors as required to minimize over dosing.
 - h The PLC shall prevent lamp ON/OFF cycles from exceeding a set-point value specified by the SUPPLIER. Control logic in the PLC shall ensure that the noise in the RED measurement does not trigger ON/OFF cycling of lamps.
 - i Initiate and control automatic cleaning systems with operator adjustable timers
 - j Monitor lamp hours, lamp starts, bank/row hours, and UV sensor hours with operator re-settable timers
 - k Provide necessary interlocks.
 - l Generate high-priority and low-priority alarms, each acknowledgeable through the OWNERS SCADA system without the need to go through the provided HMI.
 - m Provide emergency shutdown functions with high-priority alarms.
 - n Communicate all monitored parameters to the OWNER'S SCADA including all alarms.
 - o Allow full control of the UV system and acknowledgement of all alarms through the OWNER'S SCADA. The Operators shall not be required to interface through the SUPPLIER provided HMI.
 - p High-priority alarms shall require direct Operator interaction through the SUPPLIER provided HMI.



- (4) Measured RED, flow rate, UV intensity, number of lamps or banks/rows of lamps operating, off-spec, and total power shall be updated every 5 seconds and communicated to the OWNER'S SCADA system.
 - (5) The PLC shall communicate with other devices as follows:
 - a. Influent valve and effluent modulating valves (by Others) using Profibus DP.
 - b. Flow meters (by Others) using 4-20 mA.
 - c. UVT analyzer (by Others) using 4-20 mA
 - d. Plant control system using ProfiNet
 - e. Discrete Inputs and Outputs shall be 24 VDC.
 - f. One additional communications port for communication with local (portable) computer or data logger (with or without computer).
 - (6) PLC application software shall be written by the UV system supplier using Step 7 software. Function block programming shall be used to the maximum extent possible.
 - (7) PLC to be mounted in the local control panel for each UV reactor.
- .3 Human Machine Interface (HMI):
- (1) HMI shall be equipped with a Siemens Comfort Panel compatible color monitor with resolution of 800 x 600.
 - (2) Environmental Requirement:
 - a. Operating Temperature: 0 - 55 degrees Celsius
 - b. Humidity: 5 - 95 percent, non-condensing at 0 - 55 degrees Celsius
 - c. Operating Vibration: 0.012 inches peak-peak, 10 to 57 Hg
 - d. Operating Shock: 15g
 - e. NEMA Rating: 4X
 - f. Certification: UL Rated
 - (3) HMI shall be mounted on the front panel of each enclosure between 1200 to 1600 mm above the finished floor elevation.
 - (4) HMI shall use visual graphics and minimal written instructions in easy to interpret screens.
 - (5) HMI shall support Ethernet communication to both PLC and the plant LAN/SCADA
- .4 Other Controls at the Local Control Panel:
- (1) Alarm horn and rotating beacon mounted and energized by high priority alarms.
 - (2) Low Priority Alarm visual indicator.
 - (3) Power ON light
 - (4) Three position HAND-OFF-AUTO switch.
 - (5) Individual UPS for LCP – provide on Liebert GVT4-100 for each PLC panel sized for the PLC power, communication, interior light for minimum 20 minutes.



2.12 CONTROL INTERFACE REQUIREMENTS

.1 HMI shall display the following parameters

- (1) HAND/AUTO/OFF Indication for UV system.
- (2) Lamp ON/OFF status (each lamp).
- (3) Bank or row ON/OFF status.
- (4) Reactor ON/OFF status.
- (5) Measured flow rate ML/day.
- (6) Measured UV intensity of each UV sensor in mW/cm^2 , or W/m^2 , and mA.
- (7) Value of S_o determined for each reactor in mW/cm^2 or W/m^2 .
- (8) Value of S_{Pred} for each UV sensor in mW/cm^2 or W/m^2 , calculated using the validated UV intensity algorithm, with operating flow and UVT as inputs.
- (9) S/S_o with each UV sensor.
- (10) S/S_o value used in the dose calculation for each reactor.
- (11) Calculated UV dose for Cryptosporidium RED (see Equation 1 and Equation 2 herein).
- (12) Combined aging and Fouling (CAF) Factor for each UV sensor: S/S_{Pred} . CAF is defined as the ratio of the measured UV intensity to the UV intensity predicted with the UV intensity equation (defined during validation), at the operating UVT and ballast power. The UV intensity equation is defined using new lamps in new unfouled quartz sleeves monitored by calibrated sensors through new unfouled sensor windows.
- (13) Accumulated off-spec performance by volume based on a sliding 30-day period.
- (14) OPEN/CLOSE status of each valve controlled by the UV system.
- (15) Lamp operating hours for each lamp.
- (16) Cumulative Number of Lamp ON/OFF cycles for each lamp.
- (17) Ballast power setting of each lamp in W, kW, or percent.
- (18) Ballast operating hours.
- (19) Automatic cleaning system status ACTIVE/INACTIVE (if applicable).
- (20) Automatic cleaning cycle interval (if applicable).
- (21) Ground Fault Indication (GFI) status for each lamp.
- (22) Historical and real-time trends of the above parameters.

.2 Either through the HMI or through communication to the SCADA system, the following adjustable set-points shall be available:

- (1) Factors used to converted mA to values of flow-rate and UV intensity.
- (2) End-of-lamp-life hours used for alarm.
- (3) Validation and monitoring factor used to calculate validated dose and pathogen inactivation level achieved from calculated challenge microbe RED.
- (4) Maximum number of lamp ON/OFF cycles allowed.
- (5) Reference UV sensor check period use for alarm.
- (6) Time to next reference UV sensor check for each reactor.
- (7) Off-spec performance alarm level by volume.



- (8) Signal averaging periods for measured UVT, flow, and UV intensity each adjustable from zero to 600 seconds. HMI display shall provide averaged signal.

.3 The following alarms, as a minimum, shall be available for each UV reactor:

- (1) High Priority Alarms:
 - a. Calculated RED below Minimum RED or UV Dose.
 - b. Off-specification performance exceeds alarm set-point (as defined herein under Control Algorithm) including indication of the reason for alarm.
 - c. Ground fault interrupt
 - d. Wiper jammed.
 - e. Specified valve not FULL OPEN
 - f. Specified valve not FULL CLOSED
 - g. High reactor or control cabinet temperature (oF)
 - h. Lamp quartz sleeve breakage
 - i. UV lamp breakage
 - j. Low water level
- (2) Low Priority Alarms:
 - a. Calculated RED below Target RED or UV Dose
 - b. Lamp hours exceeds set-point.
 - c. ON/OFF cycles exceeds set-point.
 - d. Reference UV sensor check required.
 - e. Combined Aging and Fouling (CAF) Factor less than design aging and fouling
- (3) Alarm history (5-day)

.4 The HMI shall facilitate the following control capabilities:

- (1) Switching UV system control from MANUAL to AUTO
- (2) Turning ON and OFF UV system in AUTO mode.
- (3) Turning ON and OFF UV reactors in MANUAL mode
- (4) Turning ON and OFF rows of lamps or individual lamps in MANUAL model and adjusting ballast power setting.
- (5) Resetting of lamp operating hours and lamp ON/OFF cycles either by lamp, by bank or row of lamps, or by reactor
- (6) Ability to set lamp life hours and lamp ON/OFF cycles on an individual lamp to an operator entered value
- (7) Resetting of ballast operating hours by ballast or bank or row of lamps.
- (8) Setting the time period between reference sensor checks in days
- (9) Resetting of reference sensor check days-counter by reactor.
- (10) Manual initiation of automatic cleaning system (for systems with on-line cleaning).
- (11) Setting of automatic cleaning cycle interval with disable feature (for systems with on-line cleaning).
- (12) Setting the End-of-lamp-life-hours alarm set-point level in hours



- (13) Setting the maximum number of lamp ON/OFF cycles
- (14) Setting the off-spec performance alarm set-point level by time or volume
- (15) Ability to change units on displayed parameters (flow rate, UV intensity, PDE power)
- (16) Setting factors used to convert mA to values of flow-rate and UV intensity
- (17) Setting safety factor used in converting measured flow to calculated flow
- (18) Setting reference sensor check days-counter alarm level
- (19) High Priority Alarm reset (resets all audible and visual alarms)
- (20) High priority alarm horn test.
- (21) Low Priority Alarm reset.
- (22) Setting response to the following alarms as either shutdown or operate with all lamps ON at 100 percent power:
 - a. UV system cannot deliver the Minimum RED
 - b. Measured UVT below validated range
 - c. Measured flow above validated range
 - d. UV sensor failure

.5 Interface to Existing SCADA System:

- (1) The OWNER's SCADA system is based on Siemens WinCC V7.3 Update 7 software, without exception.
- (2) The SUPPLIER shall coordinate with the SCADA system to make the UV system's remote operator interface fully functional and integrated with OWNER's SCADA system.
- (3) The SUPPLIER shall provide outputs and addresses for all information to be communicated between the UV system's PLC and the SCADA system or other facility PLCs. Communication protocol between the UV system controls and the SCADA system shall be Profibus TCP Ethernet.

.6 Ethernet Network Switch

- (1) Each UV Control Panel should contain its own Ethernet Switch. A network patch device is to be supplied for connection of the panel network to the facility network.
- (2) Equipment Requirements:
 - a. Ethernet switch. Provide minimum of 8 port, RJ45, 10/100/1000 Base-T Unmanaged Ethernet switch. Model to be Phoenix Contact FL SWITCH SFN 8GT – 2891673 or OWNER approved equal.
 - b. Ethernet Patch Cables. Provide Category 6 cable.
 - c. Network Patch Device. Provide Phoenix Contact Patch Panel FL PF SEC 2TX – 2832687 or OWNER approved equal.

.7 PLC and HMI Software

- (1) Provide a software copy of the PLC and HMI programs after start-up of the UV system. The software files are to be unlocked and not password protected. The files will be the property of Duteau Creek WTP for the sole use at their water treatment.





2.13 CONTROL ALGORITHM

- .1 The dose monitoring algorithm programmed into the PLC shall use an empirical relationship calibrated using validation data that is similar to:

$$RED = 10^A \times UVA^{B \times UVA} \times \left(\frac{S/S_0}{Q} \right)^{C+D \times UVA+E \times UVA^2} \times Banks^F \quad \text{Equation 1}$$

or

$$RED = D_L \times 10^A \times UVA^{B \times UVA} \times \left(\frac{S/S_0}{Q \times D_L} \right)^{C+D \times UVA+E \times UVA^2} \times Banks^F \quad \text{Equation 2}$$

where:

- RED is the challenge microbe Reduction Equivalent Dose delivered by a UV reactor
 - UVA is the UV absorbance of the water passing through the UV reactor calculated from the measured UVT
 - Q is the measured flowrate through the UV reactor
 - Banks is the number of banks/rows of lamps on in the UV reactor
 - D_L is the microbe UV sensitivity
 - S/S_0 is the relative lamp output
 - S is the lowest measured UV intensity value with the UV reactor.
 - S_0 is the UV intensity measured with a new lamp in a new unfouled sleeve monitored by a calibrated sensor through a new unfouled sensor window. S_0 is calculated as a function of UVT, and, if applicable, impact of adjacent operating lamps or banks/rows of lamps, using the UV intensity relationship determined during UV validation and given in the validation report.
 - A through F are constants determined by fitting the equation to the validation data.
- .2 The UV system shall use the minimum relative lamp output from the operating lamps or banks/rows of lamps as opposed to the average relative lamp output to calculate RED.
- .3 Equation 1 shall be capable of using a manually entered UVT based on laboratory measurements as an alternate to the UVT measured by the flow meter.
- .4 Equation 1 shall be capable of using manually entered flow rate as an alternate to the flow rate measured by the flow meter.
- .5 Alternate equations can be used for monitoring if:
- (1) Exact details on the equation are provided in a submitted validation report.
 - (2) Equations are validated.
 - (3) Equations are approved by ENGINEER and OWNER



- .6 Application of Equations 1 and 2 involves the following steps:
- (1) For each operating lamp or bank/row of lamps, the value of S_o is calculated at the measured or entered UVT.
 - (2) For operating lamps or banks/rows of lamps, the ratio of UV sensor reading to S_o , S/S_o , is determined.
 - (3) RED delivered by each reactor is calculated from the measured flow, UVA, and minimum S/S_o , and number of operating banks/rows of lamps. Note;
 - a. Failed lamps or banks/rows of lamps shall not be used in the RED calculation
 - b. Lamps or banks/rows of lamps with UV sensors reading zero or saturated shall be regarded by the PLC as failed and hence not used in the RED calculation
 - (4) The HMI displays the Target and calculated RED values per reactor, and the flow rate per reactor, UVT, lamp and bank/row status, UV sensor reading, and S_o value used in the calculation. This information is also communicated to the plant control system/SCADA.
- .7 The UV system shall have two UV dose set-points:
- (1) Target UV Dose Set-point: User defined operational set-point.
 - (2) Required UV Dose Set-point: User defined compliance set-point.
- .8 The UV system controls shall allow for operator selection of a target pathogen (Cryptosporidium or Giardia) and a target log reduction which will result in automatic calculation by the PLC for the determination of the required dose and associated minimum RED or log inactivation required to achieve the required dose or credited log inactivation. The selectable range for the target log inactivation of the selected pathogen shall not require REDs that are above the validated range of RED.
- .9 The UV system PLC shall have a user adjustable UV sensor scaling factor for converting the electrical output of the UV sensor to a UV intensity value. The scaling factor will be determined by the comparison of duty and reference UV sensor readings.
- .10 Default values for dose monitoring.
- (1) Equations used for dose monitoring shall not be used to extrapolate UV system performance beyond the validated range of flow, UVT, lamp status, relative lamp output (S/S_o), microbial UV sensitivity (D_L) and RED or log inactivation (depending on the monitoring algorithm used by the UV reactor).
 - (2) If the measured flow rate is less than the validated range, the lower limit of flow rate should be used for dose monitoring.
 - (3) If the measured UVT is above the upper limit of the validated range, then the upper limit of UVT should be used for dose monitoring.
 - (4) If the measured relative UV intensity (S/S_o) is above the upper limit of the validated range, then the upper limit of the relative UV intensity should be used for dose monitoring.



- (5) If the UV sensitivity (D_L) used for the prediction of log inactivation is below the lower limit of the validation envelope, then the lower bound of the validation envelope should be used for the prediction of log inactivation.
 - (6) If the calculated log inactivation or RED is greater than the upper bound of the validated range, the PLC should display the upper limit as the delivered log inactivation.
- .11 Off specification performance
- (1) The UV system shall monitor whether or not the UV system is operating as off-specification every 10 seconds.
 - (2) The UV system shall calculate and report off-specification performance by volume for a sliding 30-day period.
 - (3) Off specification performance shall be defined as:
 - a. Flow rate greater than the maximum validated flow rate.
 - b. UVT less than the lower bound of the validated range of UVT.
 - c. If the UV sensitivity (DL) used for the prediction of log inactivation is greater than the upper limit of the validation envelope.
 - d. Relative lamp output (S/ So) less than the lower bound of the validated S/ So .
 - e. Lamp status (i.e. combination of operating lamps or lamp banks) falls outside of the validated conditions.
 - f. Log inactivation/RED less than the lower bound of the validated range log inactivation range or RED.
 - g. Validated UV dose less than the required UV dose.
 - h. Operation with faulty flow meters, UVT analyzers, or UV sensors.
- .12 The UV system shall adjust ballast power and number of lamps or banks/rows of lamps in operation such that the Validated Dose calculated by the PLC is equal to or greater than the Target UV Dose Set-point. The UV system shall turn on and off reactors and turn on and off lamps and/or adjust lamp power settings to meet the Target UV Dose Set-point without excessive over dosing.
- .13 The UV system shall incorporate sufficient turn-down capabilities to minimize over dosing for the full range of flows and UVT indicated in the specified design criteria.
- .14 If the PLC determines high priority dose delivery alarms or off-spec performance, the PLC shall;
- (1) Turn on lamps, banks/rows of lamps and/or UV reactors as needed such that the calculated RED is equal to or greater than the Target RED.
 - (2) Operate with all lamps, banks/rows of lamps and/or UV reactors at maximum power and accumulate off-spec if the calculated RED is less than the Minimum RED.



.15 The PLC shall record the following:

- (1) Accumulated volume operating within specification and off-spec for each day.
- (2) Accumulated volume operating within specification and off-spec over each calendar month.

PART 3 EXECUTION

3.1 SERVICES

.1 Execution by the SUPPLIER shall involve the following:

- (1) Providing Special Services to the OWNER's representative
- (2) Delivery, storage, and handling of the reactor
- (3) Installation
- (4) Inspection
- (5) Startup Testing
- (6) Functional Testing
- (7) Performance Testing and Certification of Proper UV Installation
- (8) Training
- (9) Owner Acceptance Testing and Final Acceptance
- (10) Regulatory Approval Assistance
- (11) End of Warranty Inspection

3.2 PLANNING AND SCHEDULES

(5) The SUPPLIER shall provide at least three (3) copies of the records of Startup and Testing to the ENGINEER prior to acceptance. Records shall include:

- (1) Service records for each mechanical and electrical equipment item
- (2) Hours of daily operation for each mechanical and electrical equipment item
- (3) Logs of electrical measurements and tests
- (4) Instrumentation calibration and testing logs
- (5) Testing and validation of SCADA inputs, outputs, logic functions, status indications, and alarms
- (6) Factory and field equipment settings
- (7) Log of problems encountered and adjustments made
- (8) Other records, logs, and checklists as required by the Pricing Agreement Documents

3.3 SPECIAL SERVICES

.1 Engineering Services:

- (1) SUPPLIER shall provide coordination and matching of the OWNER's PLC and other's software standards, review and approval of PLC ladder logic or function block diagrams and graphic displays. SUPPLIER shall provide one hard copy and one soft copy on flashdrive.



- (2) One or more representatives of the SUPPLIER, who have complete knowledge of the proper operation and maintenance of the equipment, shall be provided to instruct representatives of the OWNER on the proper installation, operation, and maintenance of the UV system.
 - a SUPPLIER shall submit qualifications of representative for review and approval by OWNER.
 - b Installation supervision: As required for proper installation.
 - c Startup, functional, operational, and performance testing: As required to certify UV system meets specification, warranties, and guarantees during the test periods. Minimum of ten (10) full days (80 hours) on site but no less than the number of days until all testing specified herein is complete.
 - d Operator training: One (1) full day (8 hours) and two (2) separate half days (4 hours each) on site.
- (3) Service Scheduling:
 - a. By OWNER on request any time during warranty period for defective work covered under warranty.
 - b. SUPPLIER shall return for one (1) additional day six (6) months after final acceptance to review UV system performance and operations.
- (4) SUPPLIER shall provide all safety equipment, protective guards, and shields as necessary for startup, testing, and.

3.4 FACTORY TESTING

- .1 The SUPPLIER shall provide written notification of successful factory testing prior to shipment.
- .2 Factory testing shall include:
 - (1) Inspection report detailing that the shipped reactor matches the reactor described in the validation report and described in this specification with regards to:
 - a Internal wetted dimensions of the reactor including chamber dimensions, lamp quartz sleeve location, baffle location and dimensions, UV sensor port window location and orientation relative to the lamp quartz sleeves.
 - b Lamp part numbers, arc length, and placement within the lamp quartz sleeve.
 - c Lamp quartz sleeve inside and outside diameters and UV transmittance.
 - d UV sensor port window UV transmittance.
 - (2) Hydrostatic pressure tests.
 - (3) Functional tests of the UV reactor's control and electrical system.
- .3 The SUPPLIER shall provide notice two weeks prior to factory testing to allow the OWNER to witness testing.

3.5 DELIVERY, STORAGE & HANDLING

- .1 The UV reactor shall be delivered pre-assembled and ready for operation with the exception of the installation of UV lamps, lamp quartz sleeves and UV sensors. A factory-trained technician shall install lamps, lamp quartz sleeves, and UV sensors.



- .2 SUPPLIER shall schedule and coordinate delivery with OWNER.
- .3 The CONTRACTOR will store and handle equipment in accordance with the SUPPLIER's written instructions. As a minimum, equipment shall be stored in a climate controlled environment (heated and protected from all weather) prior to installation. Following installation, equipment shall continue to be protected from weather and heated.
- .4 Packing and Shipping:
 - (1) SUPPLIER shall deliver equipment to the Delivery Point in original containers with seals unbroken and labeled with identification and tag number.
 - (2) SUPPLIER shall pack equipment in boxes or crates that protect equipment from damage and moisture, weather, dust, or dirt during shipment, handling, and storage.
 - (3) SUPPLIER shall obtain All Risk Transit Insurance covering the full value of equipment being transported to the site.
- .5 SUPPLIER shall deliver equipment dry and undamaged. OWNER will unload equipment, store equipment out of contact with ground, and cover equipment with weather tight coverings and keep dry.
- .6 OWNER shall jointly inspect equipment with SUPPLIER upon arrival at site and reject or replace, at no added cost to OWNER, damaged or defective items.

3.6 INSTALLATION

- .1 The equipment furnished by the SUPPLIER shall be installed by the CONTRACTOR.
- .2 The SUPPLIER shall submit erection drawings and installation instructions as specified herein and as necessary to ensure proper installation.
- .3 Before startup testing, provide factory trained field service representative to certify that equipment has been installed, aligned and checked in accordance with the SUPPLIER's instructions and specifications.

3.7 INSPECTION

- .1 The SUPPLIER shall inspect the installed UV system to ensure the installed UV system matches the validated UV system as described in the validation report.
- .2 Inspection shall involve:
 - (1) Measurement of internal wetted dimensions of the reactor including chamber dimensions, lamp sleeve location, baffle location and dimensions, and UV sensor port window location and orientation relative to the lamps.
 - (2) Measure lamp quartz sleeve inside and outside diameters
 - (3) Record part numbers of UV lamps, duty UV sensors, and reference UV sensors.
 - (4) Proper lubrication of all parts
 - (5) Preparation and submission of report to OWNER's representative summarizing measured and recorded parameters.
- .3 SUPPLIER shall modify UV system at no cost to owner to ensure installed UV reactor matches the UV reactor described in the validation report.

3.8 START UP TESTING



- .1 SUPPLIER shall comply with OWNER and CONTRACTOR safety requirements for the site and provide at least seven (7) days notice to the CONTRACTOR prior to beginning work.
- .2 Prior to the functional and operational testing, the SUPPLIER shall check that all equipment is installed properly. The installation check shall include but not be limited to:
 - (1) Mechanical systems
 - a. Proper installation and alignment of UV support structure and equipment.
 - b. Proper installation of the lamp quartz sleeves, sensor port windows, UV sensors, and cleaning systems.
 - c. Proper movement of wipers along the lamp quartz sleeve and UV sensor port window, if applicable.
 - d. Proper operation of offline acid rinse cleaning system, if applicable.
 - e. Proper installation of the UVT monitor, if applicable.
 - f. Proper placement of UV lamp within the lamp quartz sleeves per validation report.
 - g. Proper lubrication of all parts.
 - h. Leakage and pressure tests.
 - i. Headloss through the UV system at peak flow.
 - j. Flow distribution to each reactor over the range of flows.
 - (2) Electrical Systems
 - a. Check electrical wiring and connections.
 - b. Confirm operation of circuit breakers, interlocks, GFIs, and other electrical safety features.
 - c. Confirm adequate ventilation in electrical cabinets including operation of cooling fans and air conditions.
- .3 SUPPLIER shall promptly correct malfunctions and confirm correct operation of the UV system as required at no added cost to the SUPPLIER.

3.9 FUNCTIONAL TESTING

- .1 SUPPLIER shall provide ability to test UV system operation with simulated signals for flow and UVT and simulated alarms.
- .2 Check validity of all measurements displayed by the HMI and SCADA including:
 - (1) Flow rate
 - (2) UV sensor measurements
 - (3) Lamp status
 - (4) Cabinet and reactor temperature sensors
 - (5) Ground fault interrupts
 - (6) Lamp breakage
 - (7) Lamp quartz sleeve breakage
 - (8) Valve FULL OPEN and FULL CLOSE
 - (9) Automatic Wiper Parameters
- .3 Confirm all reactor controls implemented through the HMI and SCADA including
 - (1) Start up and restart sequences in AUTO and HAND mode.
 - (2) Shut down sequences in AUTO and HAND mode.



- (3) Timed and manually initiated automatic cleaning cycles.
 - (4) Proper response to all high and low priority alarms.
 - (5) Timers and counters for lamp hours, ON/OFF cycles, time between cleaning cycles.
 - (6) Turning ON/OFF and adjusting ballast power setting with banks/rows of lamps and individual lamps.
- .4 Check UV sensor measurements and ballast power consumption.
- (1) Confirm UV system is operating with new lamps, new and clean lamp quartz sleeves, new and clean UV sensor port windows.
 - (2) Confirm valid UV sensor readings for all reactors using at least three reference sensors.
 - (3) Operate UV system with ballast power set at 100 percent .
 - (4) Adjust ballast power from minimum to maximum ballast power setting by 5 percent increments.
 - (5) Record measured UV intensity, total power consumption, ballast power consumption, and calculated S_o .
 - (6) Compare measured UV intensity and total electrical power consumption to relations provided in the validation report.
 - (7) If the number of UV sensors is fewer than the number of lamps, check variability in relative lamp output from lamp-to-lamp. For 25 percent of the lamps per reactor, minimum of 3 lamps per bank/row, the relative lamp output should be within ten percent of the average. Lamps with the lowest UV output shall be located closest to the UV sensors. Other lamps shall be randomly placed throughout the UV reactors.
- .5 Check accuracy of online UVT monitor measurements. Calibrate as required.
- .6 Confirm that the RED calculated and displayed by UV system matches RED calculated using algorithm given in the validation report.
- (1) Confirm calculation over the validated range of flow and UVT.
 - (2) Confirm calculation uses proper values of flow and UVT when flow is below the validated range and UVT is above the validated range.
- .7 Confirm proper operation of dose pacing by varying flow and UVT.
- .8 Confirm implementation of dose pacing strategy as specified herein.
- .9 Confirm calculation of off-specification performance caused by:
- (1) Low UVT and high flow, low relative lamp output (S/S_o) and high target microbe UV sensitivity (D_L), if applicable.
 - (2) Calculated RED below Target RED.
 - (3) Failure of lamp, ballast, UV sensor, on-line UVT monitor, and flow meter.
 - (4) Operation of banks/rows of lamps outside of validated range.
- .10 Confirmation UV system maintains operation with voltage sags and surges within the specified range.
- .11 Harmonic Distortion Study:
- (1) Supplier shall provide necessary information a technical analysis as required to support the harmonic distortion study by other to investigate. Total harmonic voltage and current distortion is defined at the defined Point of Common



- Coupling. This study shall verify that the UV Disinfection system can meet Total Harmonic Distortion requirements defined in the Documents.
- (2) As part of the electrical acceptance test the OWNER shall provide third party testing of complete harmonic analysis using a harmonic distortion analyzer capable of on-line and real time harmonic analysis from the fundamental through the 30th harmonic. The meter shall be connected to the line side of the power distribution center and shall monitor both voltage and current harmonics. Harmonic distortion levels as measured must be less than those allowed by IEEE519-1992 Tables 10.1, 10.2, and 10.3. If these levels cannot be achieved at the installed site the Supplier shall furnish and install all necessary filters to comply with IEEE519-1992 at no additional cost to the OWNER.

- .12 SUPPLIER shall promptly correct malfunctions of the UV system as required at no added cost to the OWNER.

3.10 OPERATIONAL TESTING

- .1 Operational testing shall commence after successful completion of functional testing.
- .2 Operational testing shall involve operation of the UV system for a consecutive seven-day period in AUTO mode. Upon any upset or fault, the test period shall be reset.
- .3 Testing shall involve the following:
- (1) Record flow, UV intensity, lamp status, UVT if applicable, calculated RED, and power consumption on an hourly basis
 - (2) If applicable, compare on-line UVT measurements with bench-scale measurements twice per day.
 - (3) Compare duty and reference UV sensors measurements once per day.
 - (4) Record alarms and alarm responses
- .4 At the end of the test period, confirm proper operation of the UV systems as follows:
- (1) Check RED calculations using measured parameters over the seven-day period.
 - (2) Confirm proper dose pacing.
 - (3) Check timers and counters for lamp life and ON/OFF cycles
 - (4) Check calculation of off-specification performance.
 - (5) Check reference sensor checks and on-line UVT monitor checks meet criteria in the validation report.
 - (6) Check CAF values for each sensor to confirm values are within design parameters of lamp aging and fouling.
- .5 SUPPLIER shall promptly correct malfunctions of the UV system as required at no added cost to the OWNER.
- .6 Upon successful completion of an Operational Testing period, the SUPPLIER shall submit to the OWNER a report on the startup, functional, and operational testing with a certificate stating the UV disinfection system has been properly installed, is in good condition, is functioning properly, and is in accordance with the Documents. The report shall include the results of tests and description of corrective actions taken.
- .7 Training and Owner Acceptance Testing shall not commence until approval of the report on start-up, functional, and operational testing by the OWNER and ENGINEER, as well as completion of the performance tests.



3.11 PERFORMANCE TESTS

- .1 Power performance testing shall be conducted on-site by the SUPPLIER in the presence of the ENGINEER and OWNER. Testing shall be conducted and complete during Operational Testing.
- .2 The SUPPLIER'S representative performing the test shall have previous satisfactory experience in conducting tests of this type. For each series of tests and, if required, retesting of the UV equipment, qualified SUPPLIER personnel shall operate the UV system, take samples, record the data, prepare and deliver the samples to the laboratory for analysis (if required), and prepare a report on the results.
- .3 The SUPPLIER shall submit the following documentation for review and approval:
 - (1) Testing schedule and protocols describing all procedures to be used 30 days before testing.
 - (2) Calibration data for all instruments 14 days before testing.
 - (3) Five copies of the performance testing report within 14 days after completion of testing.
- .4 Performance testing shall be conducted on one reactors, as selected by the OWNER.
- .5 The performance test shall be conducted to verify the guaranteed maximum head loss at the design flow rate per reactor specified herein, and the guaranteed energy cost as stated by SUPPLIER in Section 00300. Head loss, power consumption and UV system operating parameters shall be recorded for the performance tests.
- .6 Performance Testing Requirements
 - (1) Head Loss Testing.
 - a Headloss measurement shall be conducted with a calibrated differential pressure gauge (with supporting calibration certificates) in which differential pressure is measured as inches of water and the gauge is connected to the ports immediately upstream and downstream of the reactor.
 - (2) Power Demand Testing
 - a The UV lamps shall be burned in for a minimum period of 100 hours after which sensor checks shall be conducted.
 - b A calibrated, bench-top UV spectrophotometer shall be used to measure the UV transmittance of the water throughout the performance testing. Prior to the beginning of the performance testing, the uncertainty of the UV spectrophotometer shall be verified using reference standards.
 - c If an online UVT monitor is used as part of the dose monitoring strategy, then a calibration check of the monitor must be conducted, and the uncertainty of the online UVT monitor shall be verified against



- a bench-top UV spectrophotometer. During the performance testing, UVT measurements made by the online monitor shall not replace those made with the bench-top spectrophotometer, but shall be recorded in addition to UVT measurements made with the spectrophotometer in order to confirm that the online monitor remains within calibration and that no drift occurs throughout the duration of the testing.
- d The manufacturer shall utilize three reference sensors (with calibration documentation) to determine the uncertainty of the duty sensors using the procedure outlined in Section 5.5.4 of the UVDGM. Duty sensor calibration checks should be conducted at the minimum and maximum ballast power setting at the ambient UVT. Duty sensor measurements at each ballast power setting shall be within 10 percent of the average intensity as measured by the reference sensors. Any duty sensors that do not meet this criterion shall be replaced and measurement uncertainty reevaluated.
 - e The measured UV intensity at the ambient UVT and minimum and maximum power settings shall be equivalent (within uncertainty of the validated intensity prediction model) to that demonstrated during validation testing. If the intensity measured during performance testing is not equal to that demonstrated during validation testing, the cause of the difference shall be identified and corrective actions shall be conducted.
 - f Once the intensity has been demonstrated to be equivalent to validation values or a corrective strategy has been approved by the Engineer, power demand performance testing may begin.
 - g The flow rate used for the performance testing shall be constant and at a rate to provide adequate cooling of the UV lamps.
 - h The ambient UVT of the water must be within the validation limits of the UV reactor.

.7 Head Loss Performance Testing Procedure

- (1) Head loss performance testing consists of a series of tests where several flow rates are run through the reactor with the head loss and flow rate measurements are recorded.
- (2) A minimum of four (4) flow rates shall be evaluated, including the minimum and maximum flow rates evaluated during head loss testing conducted during the validation of the reactor. The maximum hydraulic capacity of the reactor for this installation may be used as the maximum flow rate if it is less than the maximum flow rate used the validation.
- (3) At each test condition, the flow rate and pressure drop shall be recorded in ten second intervals for a period of 4 minutes.
- (4) Data collected during the tests shall be used for the development of an equation for head loss as a function of flow rate to be used to calculate the head loss for the design flow rate. The result of this calculation shall be compared to the maximum allowable reactor head loss specified.



.8 Power Demand Performance Testing Procedure

- (1) The performance testing procedure consists of a series of tests where the UV reactor is operated at several ballast power settings during which the operating parameters and power demand of the reactor are measured and recorded. Data collected during the tests will allow for the development of a series of equations that will allow for the determination of the ballast power and associated power demand resulting in the UV intensity required to provide a required dose that is equal to or greater than the validated dose for each of the operating conditions of Section 00300.
- (2) The calculations used to determine the UV reactor operating requirements and guaranteed power demand values provided by the SUPPLIER in Tables 1 and 2 of Section 00300 shall be reviewed and approved by the OWNER and ENGINEER. Spreadsheets must clearly indicate the calculations used to determine the UV system operating requirements to achieve the specified treatment objectives.
- (3) Ballast power settings shall cover the operating range of the ballast power and be divided into increments of ten percent.
- (4) At each ballast power setting, the measured and recorded operating parameters include (but are not limited to) the following:
 - a Lamp operating hours
 - b Ballast power setting
 - c UV intensity
 - d Reduction Equivalent Dose (RED) calculated by the PLC
 - e Validated dose, D_{VAL} , calculated by the PLC
 - f Validation factor (VF) calculated by the PLC
 - g Power demand (kW, kVA, pf, V, A).
 - h UV transmittance measured by bench-top UV spectrophotometer – measured from duplicate samples collected from reactor influent and effluent at the beginning and end of each ballast power setting.
 - i UV transmittance measured by the online UVT monitor.
 - j Flow rate.
- (5) All data, except bench-top UVT measurements, shall be recorded with a data recorder (recording frequency of once per 10 seconds) with supplemental hand written logs. Data shall be recorded for a period of five minutes once intensity readings indicate that the lamp output has stabilized following an adjustment to the ballast power setting.
- (6) During testing, the UVT shall be measured continuously to demonstrate that it is stable during testing. If the UVT varies by more than 0.5% during testing, then the test shall be repeated.
- (7) Determine the required ballast power setting for each of the tested UV reactors at the guaranteed conditions stated in Section 00300.
 - a Create an equation/curve for the relative lamp output $+(S/S_o)$ as a function of ballast power setting (%) for each tested reactor based on the performance testing results. The S_o value shall be calculated from the validated intensity prediction model (at the measured UVT for the



- test condition) and the S value shall be the measured UV intensity for each test condition.
- b Use the required S/ S_o values provided by the SUPPLIER for each guaranteed condition and the lamp output versus ballast power equation to determine the associated ballast power setting for each condition.
- (8) Determine the power demand for each of the guaranteed conditions stated in Section 00300 for each reactor.
- a. Create an equation/curve for the power demand (kW) as a function of ballast power setting (%) for each tested reactor based on the performance testing results.
 - b. Use the required ballast power settings for each guaranteed condition and the power demand versus ballast power setting equations to determine the associated power demand.
 - c. For each of the guaranteed operating conditions, the maximum power demand value, calculated from the results of the two tested reactors, shall be compared to the guaranteed power values.
- (9) Confirm that the RED and D_{VAL} calculated by the PLC are correct for each reactor.
- a Enter the values collected for flow, UVT and intensity into the validated performance equations to determine the RED, VF, and D_{VAL} for each of the ballast power settings evaluated during the performance testing.
 - b Compare the RED, VF, and D_{VAL} to the values calculated by the PLC for each reactor during performance testing.
 - c If the values calculated using the validated performance models do not match those calculated by the PLC, corrective actions shall be required and additional testing conducted to demonstrate the PLC calculation error has been solved.
- .9 Submit all results of Performance Tests as a report to OWNER in writing with summary. Successful completion of the Performance Tests is incomplete until the report is delivered.

3.12 TRAINING

- .1 The SUPPLIER shall provide training and demonstration to OWNER personnel before commencing Owner Acceptance Testing. Training shall consist of at least 2-days training (16 hours) and include both classroom training, and field training.
- .2 Training and demonstration shall cover all aspects of the operation and maintenance of the UV Disinfection System as described in the operations and maintenance manual including:
 - (1) Component replacement procedure (lamps, sleeves, sensors, ballasts, fans etc.).
 - (2) Emergency shut-down procedures.
 - (3) Reference sensor check procedure.
 - (4) Cleaning system maintenance procedure.
 - (5) Cleaning system waste chemical agent neutralization and disposal, if applicable.



- (6) HMI and SCADA interfaces, and PLC programming.
- (7) Daily testing, trouble shooting, routine actives etc.

3.13 OWNER ACCEPTANCE TESTING

- .1 The testing period shall be conducted over a continuous thirty (30) day period by OWNER personnel, as instructed by the SUPPLIER.
- .2 The SUPPLIER shall submit a detailed testing protocol for approval by the OWNER at least 30 days in advance of testing. The protocol shall specify the operational mode of the UV disinfection system, sampling program, method and schedule, equipment and system monitoring data to be collected with each sampling, the daily (manual) log format, and all sampling and analytical procedures. Testing shall commence after the OWNER has approved the protocol.
- .3 Field test data shall be monitored using a data logger. Manual field notes and manual measurements shall supplement and support data recorded in the data logger. Data analysis will use logged data over manual measurements.
- .4 Under the direction and supervision of the SUPPLIER, the OWNER'S representative shall conduct the following:
 - (1) Record flow, UV intensity, lamp status, UVT if applicable, calculated RED, and true and apparent power consumption on an hourly basis.
 - (2) Measure power factor and harmonics on a daily basis.
 - (3) If applicable, compare on-line UVT measurements with bench-scale measurements once per day.
 - (4) Compare duty and reference UV sensors measurements once per week.
 - (5) Record alarms and alarm responses.
 - (6) Collect influent samples two (2) times per day and test for water quality.
 - (7) Once per week, operate the UV reactors in manual mode at 100 percent power and record flow, UV intensity, lamp status, UVT if applicable, calculated RED, and power consumption.
 - (8) Record labor required for operation and maintenance.
- .5 No major changes in equipment or apparatus shall be permitted during this period. However, minor adjustments of equipment that would normally be expected during regular operation of the equipment in plant use may be made.
- .6 At the end of the test period, the OWNER shall confirm proper operation of the UV systems as follows:
 - (1) Check RED calculations using measured parameters.
 - (2) Confirm proper dose pacing.
 - (3) Check timers and counters for lamp life and ON/OFF cycles
 - (4) Check calculation of off-spec performance
 - (5) Check measured power consumption meets warranties.



- (6) Check reference sensor checks and on-line UVT monitor checks meet criteria in the validation report.
 - (7) Check CAF values for each sensor to confirm values are within design parameters of lamp aging and fouling.
 - (8) Check operation of the UV System response to a simulated and real plant power fail test.
- .7 The OWNER shall submit to the SUPPLIER a copy of the test results at the end of the testing period.
- .8 If the UV System does not operate within specification, guaranties, and warranties over the thirty-day test period, the SUPPLIER shall correct malfunctions of the UV system as required at no added cost to the OWNER and the Field Test shall be repeated. Costs for repeated tests shall be borne by the SUPPLIER.
- .9 If the UV System does not meet specification, guaranties, and warranties with the second test, the SUPPLIER shall make any and all modifications to the UV disinfection system including additional equipment and appurtenances including piping, valves, additional lamps, control wiring, electrical system modifications, etc., necessary to enable the system to meet the performance specifications without any additional cost to the OWNER.
- .10 Upon successful completion of the Owner Acceptance Testing, the OWNER and ENGINEER shall issue notification of UV System Final Acceptance.

3.14 END OF WARRANTY INSPECTION

- .1 At 60 days prior to the expiration of the General UV Disinfection System Warranty period, SUPPLIER shall perform a one (1) day inspection to determine and report the following:
- (1) Status of equipment and installation for each installed reactor.
 - (2) Adherence to SUPPLIER's recommended maintenance and operation of equipment.
 - (3) The following checks shall be performed:
 - a. Check lamp aging
 - b. Check UV transmittance of lamp quartz sleeves and UV sensor port windows
 - c. Verify proper operation of cleaning system
 - d. Check power consumption
 - e. Check all electrical connections.
 - f. Check calibration of UV sensors.
 - g. Verifying operation of alarms.
 - (4) Supplier shall make adjustments as necessary to restore equipment within original tolerances.
 - (5) Submit a written letter report to OWNER with copy to ENGINEER covering the inspection items and including recommendations where applicable in which all recorded data and observations are included.



.2 Warranty bond is released after completion of the warranty period.

END OF SECTION 11287