



THE VILLAGE OF
N A K U S P

REQUEST FOR PROPOSALS
2026-RFP-03

Nakusp Water Treatment Plant

UV Disinfection Equipment

Date Issued: July 21, 2026

This Request for Proposals is an invitation by the Village of Nakusp (the “Village”) to prospective Respondents to submit Proposals for the supply of Ultraviolet (UV) System Reactors (the “Project”), as further described herein. The UV equipment must conform to the specifications provided in Appendix A.

Original and one (1) complete copy of a Proposal in an envelope plainly marked "2026-RFP-03" may be hand delivered, couriered, or mailed. Alternatively, submissions may be made through BC Bid. All submissions must be received prior to the Closing Date and Time. **Email submissions will be rejected.**

RFP Closing Time: 3:00 p.m. local time

RFP Closing Date: August 18, 2026

Delivered to: Village of Nakusp
PO Box 280
91 1st Street NW Nakusp, BC V0G 1R0
Attention: Mark Tennant, Director of Finance

Submission Enquiries: Cavan Gates
E-mail: operations@nakusp.com
Phone: (250) 265-3689

NOTE: Questions may not be accepted or answered after the questions deadline.

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1. Interpretation

1.1. Definitions

“Best Value” means the value placed upon quality, service, past performance and price.

“Contract” means an agreement between the Village and the Successful Proponent.

“Village” means The Corporation of the Village of Nakusp.

“Village Representative” means the representative or appointee engaged by the Village to supervise the work.

“Must,” “mandatory” or “required” means a requirement that must be met in order for a Proposal to receive consideration.

“Premises” means building(s) or part of a building with its appurtenances.

“Proposal” means the Proponent's submission to the RFP. **“Proponent”** means a party submitting a Proposal to this RFP. **“RFP”** means the “Request for Proposal”.

“Should” or “desirable” means a requirement having a significant degree of importance to the objectives of the Request for RFP.

“Special Conditions” means the special conditions, which are included in the RFP. **“Specifications”** means the specifications which are included in the RFP.

“Subcontractor” includes, inter alia, a person, firm or corporation having a contract with the Successful Proponent for the execution of a part or parts, or furnishing to the Successful Proponent materials and/or equipment called for in the RFP.

“Successful Proponent” means the Proponent submitting the most advantageous RFP as determined by the Village of Nakusp.

“Work” means any labour, duty and/or efforts to accomplish the purpose of this Work.

2. Introduction

1.1 Invitation to Respondents

This Request for Proposals ("RFP") is an invitation by the Village of Nakusp (the "Village") to prospective Respondents to submit Proposals for the supply of Ultraviolet (UV) System Reactors (the "Project"), as further described in Section 3 – Scope of Work.

1.2 Village of Nakusp

Situated on the east shore of Arrow Lake in the BC Southern Interior, the Village is a municipality of approximately 1,600 residents with a rural and rugged climate.

The Village of Nakusp is an authorized user of the Province of British Columbia's Corporate Supply Arrangements and is a member of several buying groups/group purchasing organizations including Canoe Procurement. The Village may be eligible for discounted pricing through cooperative purchasing agreements arranged by these organizations. If a Respondent is able to offer discounted pricing through any of the aforementioned programs, that pricing should be made available to the Village.

Further details on the Village can be found at: <http://nakusp.com>

1.3 Background on WTP Ultraviolet (UV) System Upgrade

The Village owns and operates the Nakusp Water Treatment Plant, located at 170 Upper Brouse Rd, just off of Highway 6 in Nakusp. The plant utilizes source water from Brouse Creek. Primary disinfection at the WTP is provided by UV light with secondary disinfection through sodium hypochlorite.

The existing UV system at the WTP is a dual-reactor Severn Trent MicroDynamics system with two reactors that can be operated remotely and independently of flow variations. To achieve effluent disinfection requirement, the UV reactors run as required to achieve 3 log inactivation of cryptosporidium.

Refer to Appendix A for reactor specifications, additional information, and photos of the current UV disinfection system.

3. Scope of Work

The overall objective of this project is to upgrade the existing UV disinfection system at the Village of Nakusp Water Treatment Plant (WTP).

MANDATORY SCOPE OF WORK

The mandatory scope of work, includes, but is not limited to the equipment detailed in Appendix A or equivalent including:

- Supply of two new UV disinfection reactors to replace the existing units.
- Work includes supply and delivery of the two UV reactors.
- Configuration of equipment based on design peak hour flow rate as listed in this document;
- Supply new control panel(s);
- Supply of new intensity monitoring devices;
- Provision of experience references of recent comparable installations;
- Guaranteed supply date for UV reactors;
- Supply of Spare parts as listed;
- Preparation of application to Interior Health as needed;
- Provision of Technical support during installation and commissioning.

OPTIONAL SCOPE OF WORK

The optional scope of work for which pricing is requested includes:

- Installation of UV System by qualified, experienced installers;
- Optional quote includes removal, disposal of existing UV reactor and electrical panel utilizing environmentally safe procedures in conformance with WorkSafe practices and requirements for disposal;
- Work must be performed on one process train at a time, one train of the WTP UV disinfection process must remain operational at all times;
- Must maintain regulatory compliance with no disruption to UV treatment;
- Work to be performed during staff work hours of 7am to 3:30pm;
- Operation of all UV systems must be confirmed at time of installation; and
- Provision of installation date for UV reactors.

Respondents will not be disqualified if they only provide the mandatory scope of work.

4. Content of Proposal

Proponents must fill in and submit every page with a numbered heading beginning with 4 i.e. 4.1, 4.2, etc. AND the submittal requirements in Appendix A.

START

(FILL IN EVERYTHING UNTIL THE LABEL “END”)

4.1. Proponent Information and Certification

RFP Project Title:	Nakusp Water Treatment Plant - UV Disinfection Equipment
RFP Reference Number:	2026-RFP-03
Legal Name of Proponent:	
Contact Person and Title:	
GST Number:	
WorkSafe Number:	
Business Address:	
Telephone:	
Email Address:	

To the Village of Nakusp

I/We, the undersigned duly authorized representative of the Proponent, having received and carefully reviewed all of the Proposal documents, including the RFP and any issued addenda posted on the BC Bid Website (or having received directly), and having full knowledge of the Site, and having fully informed ourselves as to the intent, difficulties, facilities and local conditions attendant to performing the Services, submit this Proposal in response to the RFP.

I/We confirm that the following parts are attached to and form a part of this Proposal:

- Part 1 - Proponent Information;
- Part 2 - Alternate Proposal;
- Part 3 - Exceptions and Departures;
- Part 4 - Questionnaire;
- Part 5 - Pricing Proposal

I/We confirm that this proposal is accurate and true to best of my/our knowledge.

I/We confirm that, if I/we am/are awarded the Agreement, I/we will at all times be the “prime contractor” as provided by the Worker's Compensation Act (British Columbia) with respect to the Services. I/we further confirm that if I/we become aware that another contractor at the place(s) of the Services has been designated as the “prime contractor”, I/we will notify the Village of Nakusp

immediately, and I/we will indemnify and hold the Village of Nakusp harmless against any claims, demands, losses, damages, costs, liabilities or expenses suffered by the Village of Nakusp in connection with any failure to so notify the Village of Nakusp.

I/We confirm that by submitting a proposal and signing below, the undersigned declares that the owners and officers of the Proponent have no relationship with any employee, elected official, or committee member of the Village of Nakusp, or any other relationship or circumstance which could be perceived to be a conflict of interest, unless such relationship or circumstance is fully disclosed and attached to this form.

This Proposal is submitted this _day of __, 20__.

I/We have the authority to sign on behalf of the Proponent.

(Name of Proponent)

(Signature of Authorized Signatory)

(Signature of Authorized Signatory)

(Print Name and Position)

(Print Name and Position)

4.2. Alternate Proposal

I/We intend to submit an alternate proposal.

YES

NO

Circle one of the above

Alternate proposals must be submitted in a way that clearly identifies how it will meet the owner's objectives.

Proponents submitting an alternate proposal do not need to fill in Part 4.3 but must fill in all other parts.

Proponent initial: _____

4.3. Exceptions and Departures

If the Proponent is NOT submitting an alternate proposal and proposes an exception to any of the requirements, terms or conditions contained in the RFP Documents please identify all such exceptions here. Please add additional lines to the table below if required.

Reference should be made in each case to the relevant provision(s) of the RFP Documents to which the exception applies and, to the extent possible, Proponent should submit the wording it would propose.

Note: Exceptions not identified and submitted below may not be considered at a later date.

As of the date of this proposal, we advise that we have the ability to meet all of the above requirements except as follows (list in order of priority, if any):

Section Reference	Exception Description	Rationale	Proposed Wording

I/We offer the following alternates to improve the Services described in the RFP (list, if any):

Section	Requested Departure(s) / Alternative(s)

The Proponent acknowledges that the departures it has requested will not form part of the Contract unless and until the Village of Nakusp agrees to them in writing by initialing or otherwise specifically consenting in writing to be bound by any of them.

4.4. Questionnaire

Proponents should respond to the questions under each heading clearly and concisely.

Through the information provided in your Proposal, the Village of Nakusp expects to gain an in-depth understanding of a Proponent's experience, capabilities, and capacity to provide the Services.

Supplier Rating

Q1: Describe the background, years of business under the current legal entity, stability and structure of the Proponent. Provide an executive summary describing the Proponent's relevant experience and qualifications in delivering Services similar to those required by the RFP.
A1:

Q2: Describe three (3) specific examples of recent work completed by the Proponent that required the performance of services similar to the Services described in this RFP (to the extent possible).

Project 1

- Project and client name:
- Project actual start and completion dates:
- Scope of services provided;

- Names of key personnel involved in the project who will be available to perform the work in this agreement;

Project 2

- Project and client name:
- Project actual start and completion dates:
- Scope of services provided;

- Names of key personnel involved in the project who will be available to perform the work in this agreement;

Project 3

- [illegible]

Approach

Q3: Provide a narrative that illustrates an understanding of the Village of Nakusp's requirements and Services:

A3:

Q4: Provide a description of the general approach and methodology that the Proponent would take in performing and managing the Services and accomplishing the objectives within the Village of Nakusp's schedule:

A4:

Q5: Proposed Timeline	
RFP Issued	2026-07-21
Questions Deadline	2026-08-10
RFP Closes	2026-08-18
Proposals evaluated	2026-08-31
Proposed start date: (Fill this in) ----->	
Work Finishes	

DID YOU FILL IN THE PROPOSED START DATE?

Proponent initial: _____

4.5. Pricing Proposal

Indicate the Proponent's proposed Fee (excluding GST), and the basis of calculation (use the spaces provided and/or attach additional pages, if necessary) as follows:

Item	Unit Pricing
Stipulated price for core deliverables as described herein:	
Optional services:	
Time based rates (list positions or attach table):	

END

(CHECK THAT YOU SUBMITTED EVERYTHING FROM HERE BACK TO THE LABEL "START")

5. Evaluation Criteria

Proposals will be checked against the mandatory criteria. Proposals not meeting all mandatory criteria will be rejected without further consideration. If all submissions do not meet the Village's mandatory criteria, it shall remain the Village's sole discretion to evaluate submissions and reject all or award to the Proponent with the highest overall ranking.

5.1. Mandatory Criteria

Complete RFP document including all appendices and addenda submitted on time including all signatures.

5.2. Scored Evaluation Criteria

Proposals meeting the mandatory requirements will be further evaluated based on predetermined criteria and weighting as detailed below:

SUBMISSION EVALUATION WEIGHT

SUPPLIER RATING – 20%
• Supplier qualifications & experience • Past performance
APPROACH – 40%
• Approach and Methodology • Timeline
COST – 40%
• Price

5.3. Evaluation Committee

Evaluation of Proposals may be by an Evaluation Committee formed by the Village.

6. Proposal Preparation

6.1. Enquiries

All enquiries related to this RFP are to be directed to the questions contact identified on page 1.

Information obtained from any other source is not official and should not be relied upon. Enquiries and responses will be recorded and may be distributed to all Proponents at the Village's option.

Questions will be answered if time permits.

6.2. Submittal Deadline and Instructions

Delivery of Proposals to the Village office prior to the specified date and time is solely and strictly the responsibility of the Proponent. The Village shall not, under any circumstances, be responsible for delays caused by any private delivery service, or for delays caused by any other occurrence. All Proposals must be manually and duly signed by an authorized Corporate Officer or principal of the organization with the authority to bind said Proponent. Proposals must not be sent by facsimile or e-mail.

Proposals must be received prior to 3:00 p.m. (local time) on the closing date.

Original and one (1) complete copy of a Proposal in an envelope plainly clearly marked with the name and address of the Proponent and the RFP title may be hand delivered, couriered, or mailed to the address on page 1.

Alternatively, submissions may be made through BC Bid.

6.3. Alternative Solutions

If multiple solutions are offered, please submit the information in the same format as a separate Proposal.

6.4. Changes to Proposal Wording

The Proponent will not change the wording of its Proposal after the submission deadline and no words or comments will be added to the Proposal unless requested by the Village for purposes of clarification.

6.5. Pricing

Proposals must be firm for at least 60 days after the final date. Prices will be firm for the entire contract period.

6.6. CURRENCY AND TAXES

Prices Quoted are to be:

- in Canadian dollars;
- inclusive of duty, where applicable;
- FOB destination, delivery charges included where applicable; and
- Taxes extra.

7. Terms

The following terms will apply to this RFP and to any subsequent Contract. Submission of a Proposal in response to this RFP indicates acceptance of all the following terms.

7.1. General

The law applicable to this RFP shall be the law in effect in the Province of British Columbia. Except for an appeal from a British Columbia Court to the Supreme Court of Canada, no action in respect to this RFP shall be brought or maintained in any court other than in a court of the appropriate jurisdiction of the Province of British Columbia.

In carrying out its obligations hereunder, the Proponent shall familiarize itself and comply with all applicable laws, bylaws, regulations, ordinances, codes, specifications and requirements of all regulatory authorities, and shall obtain all necessary licenses, permits and registrations as may be required by law. Where there are two or more laws, ordinances, rules, regulations or codes applicable to the Works, the more restrictive shall apply.

Applicability of law: All references in the RFP to statutes and regulations thereto and Village bylaws shall be deemed to be the most recent amendments thereto or replacements thereof.

Copyright: All designs, drawings, concept drawings, specifications, digital, hard copies, web pages, internet pages, maps and plans commissioned by the Village of Nakusp, shall remain the property of the Village of Nakusp.

In the case of any inconsistency or conflict between the provisions of the RFP, the provisions of such documents and addenda thereto will take precedence in governing in the following order:

(1) addenda; (2) RFP; (3) Special Conditions; (4) Specifications; (5) Drawings; (6) Executed Form of RFP; (7) all other documents.

Headings are for convenience only: Headings and titles in the RFP are for convenience only and are not explanatory of the clauses with which they appear.

Method of payment is governed by Village policy as well as applicable Federal and Provincial laws. The RFP, accepted submission, and Village Contract represent the entire Agreement between the Village and the Successful Proponent and supersede all prior negotiations, representations or agreements either written or oral. The Contract may be amended only by written instrument agreed and executed by the Successful Proponent and the Village.

7.2. Ownership Of Documents

All documents and materials submitted in response to this RFP become the property of the Village.

7.3. Request For Proposal Process

7.3.1. NOT A TENDER CALL

This RFP is not a tender call, and the submission of any response to this RFP does not create a tender process. This RFP is not an invitation for an offer to contract, and it is not an offer to contract made by the Village.

7.3.2. NO OBLIGATION TO PROCEED

Though the Village fully intends at this time to proceed through the RFP, in order to select the 20 of 57

Works, the Village is under no obligation to proceed with the Work, or any other stage. The receipt by the Village of any information (including any submissions, ideas, plans, drawings, models or other materials communicated or exhibited by any intended Proponent, or on its behalf) shall not impose any obligations on the Village. There is no guarantee by the Village, its officers, employees or Managers, that the process initiated by the issuance of this RFP will continue, or that this RFP process or any RFP process will result in a contract with the Village for the purchase of the equipment, service, or Work.

7.3.3. LATE PROPOSALS

Proposals received after the Closing Date and time for receipt of Proposals will be considered as “late Proposals.” Late Proposals will not be accepted and will be returned unopened to the sender.

7.4. Pre-RFP Information

7.4.1. COST OF PREPARATION

Any cost incurred by the Proponent in the preparation of this Proposal will be borne solely by the Proponent.

7.4.2. INTENTION OF THE VILLAGE

The Proponent that submits to the Village the most advantageous Proposal and which represents the interests of the Village, best overall, may be awarded the contract. The Village reserves the right to accept or reject all or part of the RFP, however, the Village is not precluded from negotiating with the Successful Proponent to modify its Proposal to best suit the needs of the Village.

7.4.3. REJECTION OF PROPOSALS

The Village reserves the right to reject, at the Village’s sole discretion, any or all Proposals, without limiting the foregoing, any Proposal which either:

- is incomplete, obscure, irregular or unrealistic;
- has non-authorized (not initialed) erasures or corrections in the Proposal or any schedule thereto;
- omits or fails to include any one or more items in the Proposal for which a price is required by the RFP;
- fails to complete the information required by the RFP to be furnished with a Proposal; and/or
- fails to complete the information required whether the same purports to be completed or not.

Further, a Proposal may be rejected on the basis of the Proponent’s past performance, financial capabilities, completion schedule and compliance with Federal, Provincial, and/or Municipal legislation. As it is the purpose of the Village to obtain a Proposal most suitable to the interests of the Village and what it wishes to accomplish, the Village has the right to waive any irregularity or insufficiency in any Proposal submitted and to accept the Proposal which is deemed most favorable to the interest of the Village.

Upon submitting a Proposal, Proponents agree that the Village may disclose their company name; however, no prices, scores, weights or totals will be provided to any Proponents.

Awards will be made based on the Best Value offered, and the Best Value will be determined by the Village. The quality of the service to be supplied, the conformity with the specifications, the

suitability to requirements, guarantee clauses, and references shall all be taken into consideration.

7.4.4. CONFIDENTIALITY

The Village will endeavor to keep all Proposals confidential. The material contained in the Proposal from the Successful Proponent will be incorporated in a contract and information which is considered sensitive and/or proprietary shall be identified as such by the Proponent. Technical or commercial information included in the Village contract shall not be released if the Finance Department of the Village deems such releases inappropriate, subject to the *Protection of Privacy and Freedom of Information Act*.

7.4.5. CLARIFICATION

The Village reserves the right to seek Proposal clarification with the Proponents to assist in making evaluations.

7.4.6. GIFTS AND DONATIONS

Proponents will not offer entertainment, gifts, gratuities, discounts, or special services, regardless of value, to any employee of the Village. The Successful Proponent shall report to the Finance Department of the Village any attempt by Village employees to obtain such favours.

7.4.7. ACCEPTANCE OF PROPOSAL

The Village shall not be obligated in any manner to any Proponent whatsoever until a written agreement has been duly executed relating to an approved Proposal.

No act of the Village other than a notice in writing signed by the Village's Corporate Officer or Director of Finance shall constitute an acceptance of a Proposal. Such acceptance shall bind the Successful Proponent to execute in a manner satisfactory to the Village.

7.4.8. NEGOTIATION DELAY

If a written Contract cannot be negotiated within 30 days of notification of the Successful Proponent, the Village may, at its sole discretion at any time thereafter, terminate negotiations with that Proponent

and either negotiate a Contract with the next qualified Proponent or choose to terminate the RFP process and not enter into a Contract with any of the Proponents.

7.5. Limitation of Damages

The Proponent, by submitting a Proposal, agrees that it will not claim damages, for whatever reason, relating to the RFP or in respect of the competitive process, in excess of an amount equivalent to the reasonable costs incurred by the Proponent in preparing its Proposal. The Proponent, by submitting a Proposal, waives any claim for loss of profits if no agreement is made with the Proponent.

7.5.1. Sub-Contracting

Using a Sub-contractor (who must be clearly identified in the Proposal) is acceptable. This includes a joint submission by two (2) Proponents having no formal corporate links. However, in this case, one of these Proponents must be prepared to take overall responsibility for successful interconnection of the two (2) product or service lines and this must be defined in the Proposal.

A Sub-contractor individual or firm, whose current or past corporate or other interests may, in the Village's opinion, give rise to a conflict of interest in connection with this Work will not be permitted. This includes, but is not limited to, any firm or individual involved in the preparation of this Proposal.

7.5.2. Liability for Errors

While the Village has used considerable efforts to ensure an accurate representation of information in this RFP, the information contained in this RFP is supplied solely as a guideline for Contractors. The information is not guaranteed or warranted to be accurate by the Village, nor is it necessarily comprehensive or exhaustive. Nothing in this RFP is intended to relieve Contractors from forming their own opinions and conclusions with respect to the matters addressed in this RFP.

7.6. Agreement with Terms

By submitting a Proposal the Contractor agrees to all the terms and conditions of this RFP. Contractors who have obtained the RFP electronically must not alter any portion of the document, with the exception of adding the information requested. To do so will invalidate the Proposal.

7.7. Use of Request for RFP

This document, or any portion thereof, may not be used for any purpose other than the submission of Proposals.

8. Conditions

A qualified Proposal is one which meets the needs and specifications of the Village, the terms and conditions contained in the RFP. The preferred Proposal is a qualified Proposal offering the Best Value, as determined by the Village.

The Village will decide whether a Proposal is qualified by evaluating all of the Proposals based on the needs of the Village, specifications, terms and conditions and price. The Village Director of Finance and/or department head of the Village will examine all Proposals and recommend which Proposal is in the Village's best interest.

A Proposal which is unqualified is one that exceeds the cost expectations of the Village and/or does not meet the terms and conditions contained in the RFP and/or does not meet the needs and specifications of the Village. The Village reserves the right to reject any or all unqualified Proposals.

The Village reserves the right to cancel this RFP at any time.

The Village recognizes that Best Value is the essential part of purchasing a product and/or service and therefore the Village may prefer a Proposal with a higher price, if it offers greater value and better serves the Village's interests, as determined by the Village, over a Proposal with a low price. The Village's decision shall be final.

The Village reserves the right to negotiate with a preferred Proponent, or any Proponent, on any details, including changes to specifications and price. If specifications require significant modification, all Proponents shall have the opportunity to adjust their Proposals or re-submit altogether, as determined by the Village Treasurer and/or department head.

All equipment, goods and workmanship must conform to all Laws and Standards necessary for use in Canada and the Province of British Columbia.

The Successful Proponent, herein named the Contractor, shall guarantee that his Proposal will meet the needs of the Village and that any or all item(s) supplied and/or service(s) rendered shall be correct. If the item(s) supplied by the Contractor and/or the service(s) rendered by it are in any way incorrect or unsuitable, all correction costs shall be borne solely by the Contractor.

All proposed prices shall include delivery F.O.B. Village Public Works yard or other destination point, as specified by the Village, and the Contractor shall bear all risks of loss and/or damage.

Where only one Proposal is received, the Village reserves the right not to make public the amount of the Proposal. The amount of the Proposal will be made public if a contract is awarded. The Village reserves the right to accept or reject a Proposal, where only one Proposal is received.

The Village reserves the right in its sole discretion to accept or reject all or part of any Proposal which is non-compliant with the requirements of this RFP.

The Village shall not be obligated either to accept or reject any non-compliance with the requirements of this RFP.

Cancellation Clause: The Village reserves the right to cancel the Contract Agreement for goods and/or services as outlined in this RFP, at any time, by providing 30 days written notice to the Contractor.

8.1. Registration With WorkSafe BC (WCB)

The Contract may contain a provision that the Contractor and any approved Sub-contractors must be registered with WorkSafe BC (WCB), in which case WorkSafe BC (WCB) coverage must be maintained for the duration of the Contract. Prior to receiving any payment, the Contractor may be required to submit a WorkSafe BC (WCB) Clearance Letter indicating that all WCB assessments have been paid.

The Contractor must ensure compliance on his part with the *Workers' Compensation Act* and any regulations there under, especially provisions of said Act or of regulations under said Act having to do with the prevention of accidents, the prevention of diseases and the provision of safe working conditions, including proper sanitation and ventilation.

In any case where pursuant to the provisions of the *Workers' Compensation Act*, the Workers' Compensation Board orders the Contractor in respect of his operations under this Agreement, to cease operations because of failure to install or adopt safety devices or appliances directed by the order of the said Board, or required under said Act or regulations there under or because said Board is of the opinion that conditions of immediate danger exist that would be likely to result in injury to any person, or because of lack of payment of an account due to the Board, the Village on twenty-four (24) hours written notice to the Contractor, may terminate the Contract.

8.2. Governing Regulations

The Contractor shall apply and pay for all necessary permits or licenses required for the execution of the Work (but this shall include the obtaining of permanent easements or rights of servitude). The Contractor shall give all necessary notices, pay for all fees required by law, and comply with all laws, ordinances, rules and regulations relating to the Work and to the preservation of the public health. The Contractor shall be responsible for the safety of all workmen and equipment on the Work in accordance with all applicable safety legislation passed by Federal, Provincial and local authorities governing safety.

8.3. General Insurance

Before starting the Work, the Contractor must file with the Village, certificates of all insurance policies acceptable to the Village. These certificates shall state that the insurance complies with the requirements of the Contract and that the territory of the policy includes the country in which the Work is to be constructed.

Each insurance policy required under this Article shall contain an endorsement to provide all Additional Insured with prior notice of changes and cancellations. Such endorsement shall be in the following form:

"It is understood and agreed that the coverage provided by this policy will not be changed or amended in any way or cancelled until thirty (30) days after written notice of such change or cancellation shall have been given or sent by registered mail to all Additional Insured."

Should the Contractor fail to make a payment of any premiums or other assessments required by the Contractor's insurers to maintain such policies in force and effect, the Village may in their discretion make payment of such premiums or assessments and deduct the amount thereof from

such monies as may then or later be payable to the Contractor pursuant to the Contract or recover the same from the Contractor as the Village in his discretion may determine.

Whenever the word The Village is to appear in the insurance policies, the legal name shall be inserted.

8.4. Protection of Work, Property And Public:

The Contractor shall comply with all applicable laws, ordinances, rules, regulations and lawful orders of any public authority having jurisdiction for the safety of persons or property or to protect them from damage, injury or loss.

The Contractor shall protect the property adjacent to the Work areas from damage as the result of operations under the Contract. The Contractor shall protect the Work and the Village's property from damage and shall make good at their own expense any damage which may arise as the result of the Contractor's operations under the Contract.

8.5. Contractor's Insurance:

Public Liability & Property Damage Insurance. The Contractor shall save and hold harmless the Village, its officers, Managers, servants and employees, from and against any and all suits or claims alleging damage or injury (including death) to any person or property that may occur or that may be alleged to have occurred, in the course of the performance of this Contract, whether such claim shall be made by an employee of the Contractor, or by a third person and whether or not it shall be claimed that the alleged damage or injury (including death) was caused through a willful or negligent act or omission of the Contractor, its officers, servants, managers or employees, or a willful negligent act or omission of any of its sub-contractors or any of their officers, servants, managers or employees; and at its own expense, the Contractor shall defend any and all such actions and pay all legal charges, costs and other expenses arising there from.

The Contractor shall maintain and keep in force during the term of the Contract and until the date of the completion certificate, Five Million Dollars (\$5,000,000) inclusive limits for public liability and property damage, against liabilities or damages in respect of injuries to persons (including injuries resulting in death) and in respect of damage to property arising out of the performance of work.

The Contractor shall, at the time the Contract is signed, submit to the Village two copies of the insurance policies required under this Article and shall also provide to the Village from time-to-time, as may be required, satisfactory proof that such policies are still in full force and effect.

The Village shall be an additional insured on the policy. The policies shall preclude subrogation claims by the insurer against anyone insured thereunder. In addition, such insurance policy shall include the following "Cross Liability" clause:

"The insurance afforded by this policy shall apply in the same manner, as though separate policies were issued, to any action brought against any of the additional insured by or on behalf of any other additional insured."

8.6. Indemnity

The Contractor shall be liable for all loss, costs, damages, and expenses whatsoever incurred or suffered by the Village, its elected officials, officers, employees and Managers (collectively)

including but not limited to damage to or loss of property and loss of use thereof, and injury to or death of a person or persons resulting from or in connection with the performance, purported performance, or non- performance of this contract, excepting only where such loss, costs, damages and expenses are as a result of the sole negligence of the Indemnities.

The Contractor shall defend, indemnify and hold harmless the Indemnities from and against all claims, demands, actions, proceedings, and liabilities whatsoever and all costs and expenses incurred in connection therewith and resulting from the performance, purported performance, or non-performance of this contract, excepting only where such claim, demand, action, proceeding or liability is based on the sole negligence of the Indemnities.

8.7. Village Representative

A Village Representative will be assigned by the Village to oversee the compliance of the Proposal awarded to the Contractor. In addition, the Contractor will be expected to name a counterpart Work Manager. The Contractor's Work Manager will be responsible for providing scheduled status reports to the Village Representative.

8.8. Software

It is the Contractor's responsibility to ensure that the Village has all licenses required to use any software that may be supplied by the Contractor pursuant to the Contract.

8.9. Arbitration

All disputes arising out of or in connection with the Contract must, unless the parties otherwise agree, be referred to and finally resolved by arbitration pursuant to the *Commercial Arbitration Act*.

APPENDIX A – SPECIFICATIONS

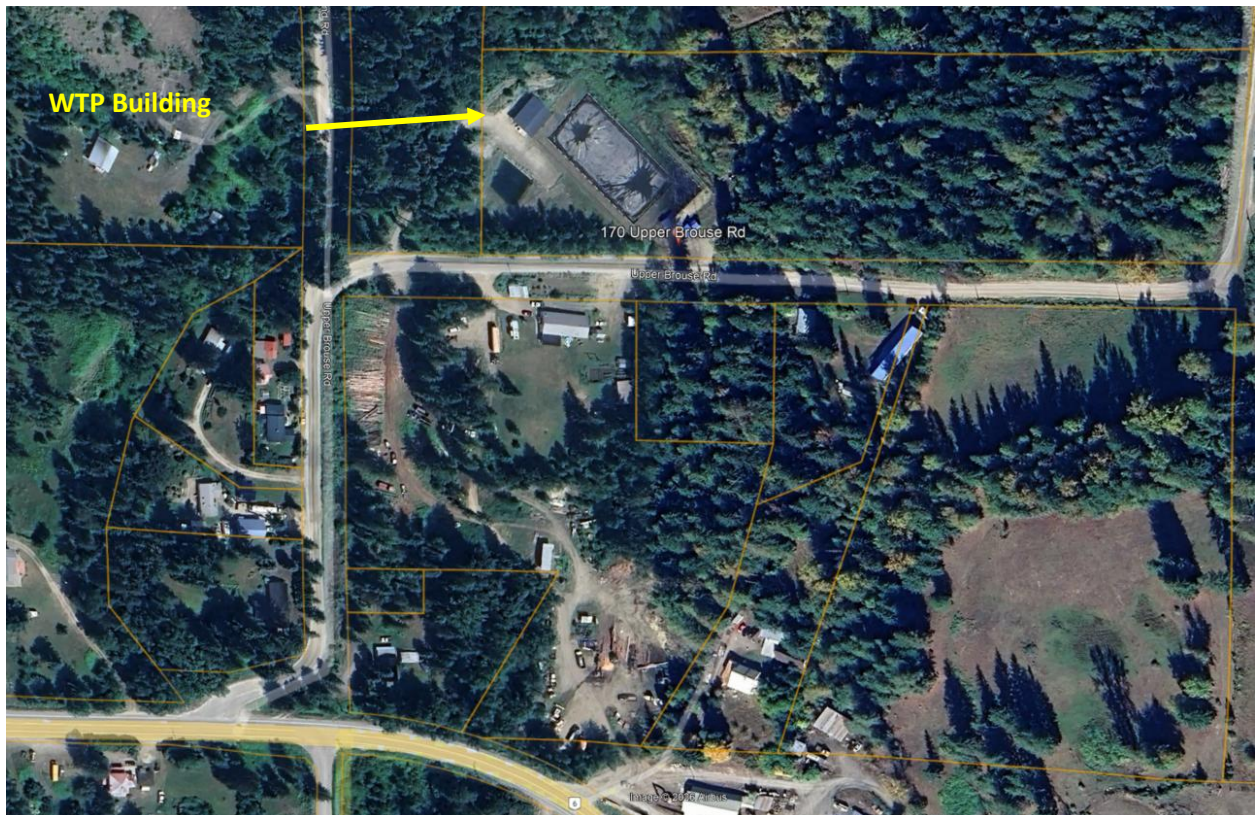
GENERAL

1.1 Introduction

The intent of this Specification and Proposal request is to obtain a formal offer to: supply; to provide installation and commissioning support for two UV reactors for the Village of Nakusp. The reactors are to be installed at the Nakusp Water Treatment Plant (WTP). The new UV reactors will replace the two existing reactors that are currently in place. It is intended that the UV reactor installation be conducted by Nakusp Water Utility personnel. Installation support and quality control from the UV reactor SUPPLIER is required as per the contents of this specification. Sections 1 & 2 of APPENDIX A generally refer to the materials supply requirements.

An optional price has been requested for installation services. Section 3 of APPENDIX A generally refers to the optional installation services requirements. The installation services will be awarded only if the installer is affiliated with the UV supplier. Figure 1.1 provides the location of the Nakusp WTP at 170 Upper Brouse Rd.

Figure 1.1 – Nakusp WTP – Aerial Site Plan – 170 Upper Brouse Rd.



The Village of Nakusp relies on groundwater wells and surface water from Brouse Creek to meet its' water demand requirements. The surface water from Brouse Creek is treated by means of a package Ultra-Filtration Plant, then disinfected and distributed to the Village.

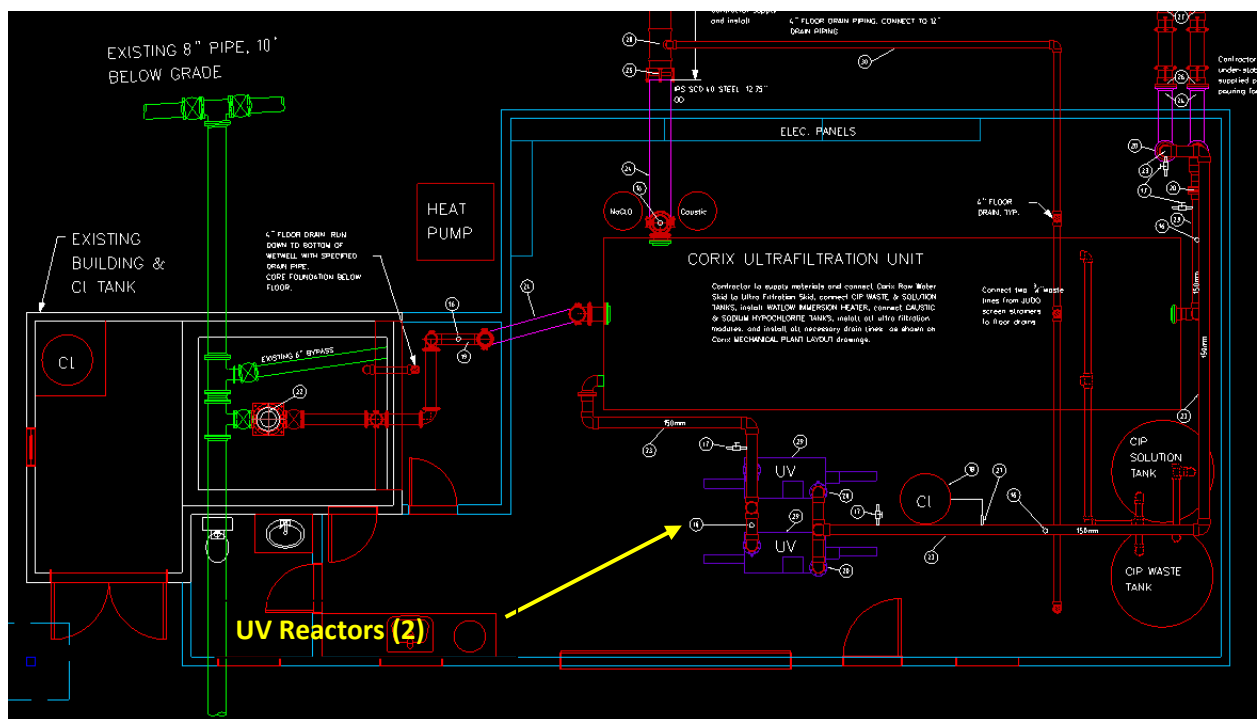
APPENDIX A - SPECIFICATIONS

Each UV reactor shall have the capacity to treat the design flow of 35 L/s for the water parameters described herein. The design conditions are for one on-line reactor and one stand-by redundant UV reactor.

Each reactor shall be identical, having the same design flange sizes, footprint, and number, type and configuration of lamps, sleeves, and UV sensors. The location of the existing reactors within the WTP building is illustrated in Figure 1.2.

The existing reactors are situated on the south side of the building in an accessible area. There are two reactors in place connected to the process piping through 150mm diameter flanges.

Figure 1.2 – Floor Plan – WTP Building



The space available for the two reactors is a pipe-to-pipe length of approximately 1.80 metres.

At the outlet end of the reactors (right side in diagram), there is an available unobstructed area for removal of UV lamps that is 1.72 metres in length.

See photos at the end of Appendix B for the existing UV reactor layout.

1.2 Definitions

OWNER means Village of Nakusp.

ENGINEER means a qualified engineer approved by OWNER to act on behalf of OWNER.

SUPPLIER means the Supply Contractor of the UV Disinfection System.

DELIVERY LOCATION means the Village of Nakusp Water Treatment Plant at 170 Upper Brouse Rd., Nakusp, British Columbia

CONTRACTOR means the entity selected by OWNER to construct the treatment facility and install the UV Disinfection System. The CONTRACTOR may be the OWNER if installation is by Village of Nakusp staff. The CONTRACTOR may also be the SUPPLIER if Nakusp retains the contractor proposed by the SUPPLIER.

1.3 Hydraulic Design Parameters

The UV treatment system must produce water that meets the requirements of Interior Health authority.

1. Provide a UV system complete with two reactors, System Control Center, Power Distribution Center(s), reactor support stands (as required), and monitoring equipment as specified.
2. Maximum peak flow per reactor is 35 L/s. The flow may vary as demands in the system and water level at the Upper Village Reservoir change;
3. Minimum flow rate per reactor is 5.0 L/s;
4. The maximum allowable head loss across the UV reactor for the maximum design flow is 500mm of head;
5. The minimum UV reactor design pressure rating is 50 metres water column (= 490kPa). The minimum required UV reactor test pressure is 1.5x higher than the design pressure rating;
6. The system will be able to continue providing UV treatment with one reactor while replacing UV lamps, quartz sleeves, ballasts and while cleaning the UV lamp sleeves for the unit being serviced.
7. The UV system shall be capable of providing the dosage for the design flows set out in Schedule A, Design Parameter Table, located in APPENDIX B of this document.

1.4 Water Quality

The UV reactor will receive water filtered by means of an ultra-filtration process. The following table provides water quality values to be used for the UV reactor sizing:

Table 1.1 – Treated Water Quality Parameters

Parameter	Value
UVT (%)	80 (min)
Turbidity (NTU)	0.94 (max)
pH	6.6
Water Temperature	1.8°C – 12°C
Hardness (mg/L as CaCO ₃)	46
Alkalinity (mg/L as CaCO ₃)	45
Calcium (mg/L)	17
Magnesium (mg/L)	1.5
Total Iron (mg/L)	0.016

1.5 Disinfection Design Criteria

- .1 Target pathogen inactivation is 3.0-log *Cryptosporidium* inactivation credit as per UVDGM validation requirements. The required minimum UV dose shall be 12 mJ/cm².
- .2 Allow for a 20 percent safety factor when sizing the UV reactor. The minimum UV dose during operation shall be 20 percent greater than the required UV dose. Resulting minimum dose is > 14.4mJ/cm²
- .3 The peak flow through each UV reactor is 35 L/s. The minimum UVT is 85%.
- .4 UV reactor shall be sized using a validated calculated dose algorithm.
- .5 Validation factor shall be calculated using the recommendations of the UVDGM.

Lamp aging factor shall be at most 80%. SUPPLIER shall demonstrate the proposed lamps achieve this minimum lamp aging factor by providing a lamp aging report as per UVDGM or other independent measurement protocol which extends for a time period equal or greater than the guaranteed lamp life proposed for this project.

Fouling factor for UV system with on-line cleaning wipers: 95%
 Fouling factor for UV system with off-line cleaning wipers: 90%

1.6 Dose Control Strategy

The intended operation of the UV Disinfection system is as follows:

APPENDIX A - SPECIFICATIONS

- .1 Using the HMI (Human Machine Interface), the operator will set the water flow that will be treated and delivered to the balancing storage. The flow control valve position will be adjusted accordingly by the PLC once the UV Reactor is ready for treating the objective flow.
- .2 The PLC shall adjust the ballast power to deliver the UV Target Dose for the set flow based on the UV Intensity sensor reading, magnetic flow meter reading and UV Transmissivity reading. Target Dose is to be maintained for changes in the UV Transmissivity and/or flow by adjusting the ballast power or number of operating lamps in the reactor.
- .3 Flow control valve position will be adjusted, reducing the flow if the UV Reactor capacity is maxed out and UV Dose cannot be maintained. A Low Priority Alarm will indicate that objective flow cannot be treated.

1.7 Electrical Criteria

- .1 Room Temperature - max. 30°C
- .2 Ambient Humidity – 0 to 45%
- .3 Supply voltage - 120/208V 3 phase 4 wire or 347/600V 3 phase 4 wire
- .4 Power factor - min. 90%
- .5 Harmonic distortion levels - within the limits listed in IEEE519-1992 Tables 10.1, 10.2, and 10.3.
- .6 Electrical enclosures - CSA Type 1 (dry location) where permitted by code.
- .7 Cable lengths - up to 30m

1.8 Submittals

Submit for review, shop drawings showing the following:

- .1 Complete description in sufficient detail to permit an item comparison with the specification.
- .2 Dimensions and installation requirements.
- .3 Descriptive information including catalogue cuts and manufacturers' specifications for major components.
- .4 Electrical schematics and layouts.
- .5 Hydraulic calculations demonstrating compliance with the required hydraulic characteristics.
- .6 UV treatment performance guarantee.

- .7 Independent bioassay validation and dosage calculations demonstrating compliance with the specified dose requirements.

1.8 Submittals

The selected SUPPLIER shall provide the following submissions in addition to Section 4 in the main Request for Proposal document:

Submittal Package 1

With Section 4 of the main Request for Proposal document.

- a. Provide detailed information to permit item by item comparison with the requirements of this document;
- b. UV system sizing, including design criteria used for system sizing. Include lamp aging and fouling factors;
- c. Provide head-loss at peak design flow;
- d. Provide UV reactor pressure rating;
- e. Provide documentation summarizing the third-party validation. Disclosure requirements may be included with the documentation;
- f. Provide *Equipment Drawings* complete with outline drawings, cut-away drawings, parts lists, material specifications lists, and other information required to substantiate that the proposed reactor complies with the requirements outlined in this document;
- g. Clearly mark accessories or options being furnished;
- h. Provide *UV System Parts List and Spare Parts*, including UV lamps, quartz sleeves, UV sensors, UV sensor ports, temperature sensors, cleaning mechanism parts if applicable;
- i. Electrical Submission consisting of Single Line Diagram, Panel Schedule(s) and Floor Plans showing locations of distribution equipment, details of relocation of existing equipment and devices (if applicable), branch circuit information and connection details for new UV equipment.
- j. The SUPPLIER is to provide what range of harmonics can be handled by the UV equipment. The submission by the SUPPLIER will provide sufficient information for the OWNER to determine if harmonic filters are required to protect the equipment.
- k. Control and Instrumentation including detailed information about the PLC and modules, HMI, power supplies for control and instrumentation equipment, and connection details for all connections to and from the control panel.
- l. List separately and individually the following PLC parts:
 - HMI
 - PLC CPU
 - PLC I/O Rack

PLC I/O Rack power supply

PLC I/O Module of each type

Ethernet switch

- m. Recommended list of spare parts showing frequency of probable replacement.
- n. Reference and duty UV Intensity Sensor shop drawings, electrical specifications describing all electrical connections, stability over time, statement of measurement uncertainty, standard calibration procedures used by SUPPLIER or manufacturer, instructions for using the sensor, recommended intervals for reference sensor checks, acceptance criteria for reference sensor checks, procedures for using the reference sensor to field calibrate the duty UV sensor.
- o. Shop drawings showing support requirements.
- p. Installation and checkout instructions and initial startup procedures.
- q. Control instrumentation.
Complete block diagrams with inter equipment wiring requirements;
Detailed schematic drawings for all control equipment;
- r. Shop drawings for UVT analyzer.
- s. UV System Control Philosophy.

Submittal Package 2

15 days prior to UV system shipment.

- a. SUPPLIER's delivery instructions including loading and unloading requirements;
- b. Written startup, testing and training plan. The training plan shall include the outline of the course.
- c. List of recommended safety equipment for operators.
- d. Qualifications of SUPPLIER's field representative including who will be conducting startup and training procedures and training.
- e. Operation and Maintenance Manuals (O&M Manuals). Provide 3 hard copies in 3-ring binders with rigid covers with tabs for each section. Include a soft copy in a CD-ROM in PDF format.

Submittal Package 3 (commissioning support)

Prior to Final Completion.

- a. Certificate of Proper Installation as per enclosed;
- b. Test reports completed;
- c. Additions/modifications to the O&M Manuals, approval of O&M Manuals incorporating Submittal Package 3 items;

APPENDIX A - SPECIFICATIONS

- d. Record documentation for all electrical schematics, wiring, diagrams, loop drawings, ladder logic, loop descriptions and interconnection diagrams;
- e. As-installed and tested PLC application software program in both printed and electronic format (CD-ROM). Programs shall not be password protected such that OWNER can access the program and re-load the program into the PLCs if needed. Non-disclosure agreement as required by the SUPPLIER will be signed by the OWNER if applicable. (coordination with installer required).

1.9 Spare Parts

- 1.1 Total number of UV lamps required for one reactor.
 - 1.2 Total number of Ballasts required for one reactor.
 - 1.3 One year of supply of cleaning solution if applicable.
 - 1.4 One complete set of replacement seals.
- .2 Any spare part components consumed during startup and commissioning of the UV system shall be replaced by the SUPPLIER with new components.

1.10 Guarantees and Warranties

The selected SUPPLIER shall submit to the OWNER an equipment warranty for the UV disinfection system and all its components for a period of one (1) year after acceptance of the Performance Test.

Warranty shall be applied if the OWNER operates and maintains the UV disinfection system as per SUPPLIER instructions. The SUPPLIER shall include those instructions and records to be kept by the OWNER that demonstrate compliance with those instructions in the O&M Manuals.

1.11 Site Photographs

Existing MicroSiemen UV Reactors and Pipe works





PRODUCTS

2.1 Scope

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.

Supply suitable UVT Analyzer with all hardware required for its installation.

2.2 General Product Requirement

- .1 The UV reactors installed at the WTP facility shall be equivalent to the validated reactors in terms of dose delivery and dose monitoring.
- .2 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.
- .3 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.
- .4 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.
- .5 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.
- .6 The installed UV reactor shall use the same dose-monitoring algorithm as determined by validation. The dose monitoring algorithm defines the relation between the Reduction Equivalent Dose (RED) and measured flow, UV intensity, lamp status, and if used, UVT.

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, and frames 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: Neoprene, nonmetallic separators or washers, or other materials.

2.4 UV Reactor Chamber

- .1 The chamber shall be designed and built 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 certified by the SUPPLIER to meet the design pressure 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 by the SUPPLIER if the inside elevation of reactor is higher than inlet and outlet piping.
- .8 UV systems are 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 Provide and install baffle plates within the reactor if 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 4°C and 26°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.

APPENDIX A - SPECIFICATIONS

- .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 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 a sleeve 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 critical bending stress point of the lamp sleeve shall be greater than the maximum stress incident on the sleeve at the maximum flow rate.
- .5 SUPPLIER shall confirm that resonant vibration does not occur over the flow range specified.

2.7 Cleaning System

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 could include using an automatic wiper cleaning system or an off-line acid rinse cleaning system.

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 be fixed and not 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.

APPENDIX A - SPECIFICATIONS

- .6 The UV sensor shall have a germicidal spectral response. The spectral response shall be focused 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 age 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 UV Reactors shall be equipped with sensors to detect UV lamp or lamp quartz sleeve breakage.

2.10 Electrical

- .1 Power supply may be either 120/240v single phase or 575v three phase.
- .2 All materials supplied shall be new and of the quality indicated in the Specifications and shall conform to the standards of the CSA and the ULC and approved by these agencies where applicable. In the event that a material specified does not bear CSA and ULC approval, obtain the approval of the local inspection authority, pay all charges levied by the inspection authority and make any modifications required, at no additional expense to the OWNER.

.3 Wiring and Cables:

All wiring shall be copper unless indicated otherwise. SUPPLIER is responsible for supplying all cables and wires required for communications/controls and power between the UV Reactors and the Control Panels.

- .4 Branch circuit wiring shall be min. 12 AWG 90 C rated in EMT or PVC/DB2 below grade. AC 90 may be used for concealed wiring where permitted by Code. Provide liquid tight flexible connections to equipment.
- .5 Feeders shall be 90C rated wire in EMT or PVC/DB2 below grade. Teck 90 and ACWU 90 cables may be used where permitted by Code.
- .6 Standard branch circuit wire is rated at 90C. Where equipment is marked with a maximum conductor termination temperature then wire size shall be revised as per CEC 4-006.
- .7 SUPPLIER shall provide cable identification as per OWNER requirements.
- .8 SUPPLIER shall identify the interconnection electrical service requirements, control wiring requirements, and other accessories (disconnect switches, etc.) that need to be provided by the OWNER for a complete installation.
- .9 Lamp Ballasts: Shall comply with ANSI C62.41 Class A for Transient Protection.
- .10 .11 Sufficient airflow shall be provided to have effective cooling of the ballast.
- .11 LCP or ballasts shall be equipped with temperature sensor to indicate overheating.
- .12 LCP or ballasts shall be equipped with lamp GFIs.
- .13 LCP or ballasts shall be equipped with circuitry for monitoring lamp current and indicating lamp operation status.
- .14 Ballast shall not initiate lamp re-strike independent of PLC
- .15 Cabinets shall be CSA Type 1 (dry location) where permitted by code, lockable, with concealed front bolts and hinges. Provide CSA Type 4 enclosures if located where subject to splashing or hose-directed water.

Table 2.1 - Electrical Load Table – Existing WTP

EQUIPMENT SCHEDULE									
NO.	MECH. REF.	DESCRIPTION	LOAD	VOLT	Ø	CCT. NO.	BKR. SIZE	FEEDER	NOTE
1	P-101	UF1 INLET PUMP	7.5HP	600	3			3#12	1
2	P-201	UF2 INLET PUMP	7.5HP	600	3			3#12	1
3	P-301	BACKWASH PUMP	20HP	600	3			3#10	2
4	P-401	CLEAN-IN PLACE PUMP	7.5HP	600	3			3#12	1
5	H-417	TANK HEATER	25KW	600	3			3#10	2
6		UV REACTOR	3.25KW	240	1	A13,15	2P-20	2#12	
7		UV REACTOR	3.25KW	240	1	A17,19	2P-20	2#12	
8		AIR COMPRESSOR	2@0.6HP	240	1			2#12	1
9		CHLORINE PUMPS	FHP	120	1	A21	1P-15	2#12	3
10									
M1	FC-1	FAN COIL UNIT	1/3HP & 9.6KW	240	1	A2,4	2P-60	2#6	
M2	HP-1	HEAT PUMP	8.0A	240	1	A6,8	2P-15	2#12	4
M3	DWH-1	WATER HEATER	3.0KW	240	1	A10,12	2P-20	2#12	
M4	EF-1	EXHAUST FAN	FHP	120	1	A3	1P-15	2#12	
M5	EF-2	EXHAUST FAN	FHP	120	1	B2	1P-15	2#12	5

2.11 Controls

- .1 Programmable controller shall be by a widely recognized manufacturer, with readily accessible replacement parts.
- .2 All control equipment shall be CSA or cUL certification.
- .3 PLC monitoring the following signals:
 - a. Ballast signals include 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 lamp breakage detectors.
 - c. UVT Analyzer signal.
 - d. Flow meter (Supplied and installed by OWNER) measurement and status per each reactor.
 - e. Automatic cleaning system status if applicable.
- .4 PLC shall provide the following functions:
 - a. Power UV intensity sensors.
 - b. Control starting and shutdown sequences.

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- c. Adjust flow control valve position to limit flow to value set by the operator. Reduce flows if UV Reactor capacity has maxed out, preventing water treatment to be out of specification.
 - d. Calculate and report dose delivery by the reactor.
 - e. Calculate and report accumulated off-spec performance by time and volume.
 - f. Turn on and off lamps and adjust lamp ballast power settings to provide efficient dose pacing.
 - g. Initiate and control automatic cleaning systems with operator adjustable timers.
 - h. Monitor lamp hours, lamp starts, bank/row hours, and UV sensor hours with operator re-settable timers.
 - i. Generate high and low priority alarms.
 - j. Communicate all monitored parameters to the OWNER'S SCADA including all alarms.
- .5 PLC shall communicate with the following devices:
- a. Flow control valve (by Others). Flow control valve will require analog signal for modulating flow.
 - b. Flow meters (by Others) using 4-20mA.
 - c. UVT analyzer (by Others) using 4-20mA
- .6 Human Machine Interface (HMI)
- a. HMI to be rated for the environmental conditions at the installation site.
 - b. NEMA Rating: 4X when mounted correctly.
 - c. HMI shall be mounted on the front panel of each enclosure between 1200 to 1600mm above the floor elevation.
 - d. HMI shall use visual graphics and minimal written instructions in easy to interpret screens.
- .7 Other Controls at the LCP
- a. Power ON light
 - b. Three position HAND-OFF-AUTO switch.
 - c. High Priority Alarm visual indicator.
 - d. Low Priority Alarm visual indicator.

2.12 Control Interface Requirements

- .1 Alarms and status signals from the UV System are to be dry contact relay outputs, rated for up to 230VAC. Analog monitoring signals from the UV System (Dose Delivered) are to be 4-20mA isolated signals.

APPENDIX A - SPECIFICATIONS

- .2 Analog control signals to the UV System (flow, UVT) will be 4-20mA. Discrete signals to the UV System (run call and standby) will be dry contact outputs.
- .3 HMI shall display the following parameters:
 - a. HAND/AUTO/OFF Indication for UV system.
 - b. Lamp ON/OFF status (each lamp).
 - c. Reactor ON/OFF status.
 - d. UVT Analyzer measurement.
 - e. Measured flow rate L/s.
 - f. Accumulated off-spec performance by volume based on a sliding 30-day period.
 - g. Measured UV intensity of each UV sensor in mW/cm^2 or W/m^2 and mA.
 - h. Values of all parameters used in the control algorithm equations. Units to be as per SI.
 - i. Calculated UV Dose.
 - j. Combined Aging and Fouling (CAF) Factor for each UV sensor.
 - k. Flow control valves position.
 - l. Lamp operating hours for each lamp.
 - m. Cumulative number of lamp ON/OFF cycles for each lamp.
 - n. Ballast power setting for each lamp in W, kW or percent.
 - o. Ballast operating hours.
 - p. Automatic cleaning system status (if applicable).
 - q. Any other parameters or information recommended by the SUPPLIER.
- .4 The HMI shall allow for the following adjustable set-points:
 - a. Objective water flow to be treated.
 - b. Resetting Ballast operating hours.
 - c. End of lamp life hours used for alarm.
 - d. Maximum lamp ON/OFF cycles allowed.
 - e. Factors used to convert mA to values of flow and UV Intensity.
 - f. Validation and monitoring factor used to calculate validated dose and pathogen inactivation level achieved from calculated challenge microbe RED.
 - g. High and low priority alarm reset.
- .5 As a minimum the following High Priority Alarms shall be available for each reactor:
 - h. Calculated RED below Minimum RED or UV Dose.

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- i. Off specification performance (as defined by Control Algorithm) including indication of reason for alarm.
 - j. Ground Fault Interrupt.
 - k. Wiper jammed.
 - l. High reactor or control cabinet temperature.
 - m. Lamp quartz sleeve breakage.
 - n. UV Lamp breakage.
 - o. Low water level.
- .6 As a minimum the following Low Priority Alarms shall be available for each reactor:
- a. Calculated RED below Target RED or UV Dose
 - b. Lamp hours exceeds set point.
 - c. ON/OFF cycles exceeds set point.
 - d. Flow being treated below objective flow.
- .7 HMI shall display 5-day minimum alarm history.
- .8 Interface with SCADA will be Modbus TCP, so monitoring signals should be available via Modbus TCP interface (in addition to hardwired signals)
- .9 Modbus TCP is the supported Ethernet protocol, for communications to the UV System

2.13 Control Algorithm

- .1 SUPPLIER shall provide the RED calculation equation with explanation and units for all the parameters used. The control algorithm based on the RED equation shall be programmed into the PLC.
- .2 The RED equation shall be submitted with the validation report. Equation shall be validated.
- .3 RED shall be calculated using a minimum relative lamp output from operating lamps as opposed to the average relative lamp output.
- .4 Off specification performance
 - a. The UV system shall monitor whether or not the UV system is operating as off-specification every 10 seconds.
 - b. The UV system shall calculate and report off-specification performance by volume for a sliding 30-day period.
- .5 Off specification performance is defined as:
 - a. Flow rate greater than the maximum validated flow rate.
 - b. UVT is 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/S_o) less than the lower bound of the validated S/S_o .
- 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

PART 3 - SERVICES

3.1 Services

The SUPPLIER's services shall include the following items described in Section 3:

- .1 Planning and Schedules
- .2 Factory Testing
- .3 Special Services to be provided to the OWNER's representative
- .4 Delivery, storage, and handling of the reactor
- .5 Installation
- .6 Inspection
- .7 Startup Testing
- .8 Functional Testing
- .9 Operational Testing
- .10 Performance Testing
- .11 Training
- .12 OWNER Acceptance Testing
- .13 End of Warranty Inspection

3.2 Planning and Schedules

- .1 The SUPPLIER shall submit startup, testing and training plans as per Section 1.7 of this document.
- .2 The plans shall include testing procedures, checklists and data forms, coordination with the OWNER staff, and required procedures to ensure safety of personnel present during testing.

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- .3 The SUPPLIER shall revise the plans as required by reviewing comments from the OWNER or its representative. The SUPPLIER shall submit written requests at least two weeks in advance if interruption of process flows or operation of other systems at the Big White Rhonda Lake WTP facility is necessary to start up, test, or modify the UV Disinfection System. OWNER alone will approve such requests.
- .4 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:
 - e. Service records for each mechanical and electrical equipment item
 - f. Hours of daily operation for each mechanical and electrical equipment item
 - g. Logs of electrical measurements and tests
 - h. Instrumentation calibration and testing logs
 - i. Testing and validation of SCADA inputs, outputs, logic functions, status indications, and alarms
 - j. Factory and field equipment settings
 - k. Log of problems encountered and adjustments made
 - l. Other relevant records, logs, and checklists.

3.3 Factory Testing

- .1 The SUPPLIER shall provide written notification of successful factory testing prior to shipment.
- .2 Factory testing shall include inspection report detailing that the shipped reactor matches the reactor described in the *Validation Report* and described in this document, hydrostatic pressure tests and functional tests of the control and electrical systems associated with the UV reactor operation.

3.4 Special Services

- .1 The 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 digital copy.
- .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 two (2) full days (16 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 Provide service on request by OWNER at any time during the warranty period for defective work covered under warranty.
- .4 SUPPLIER shall return to site for one additional day (at least half-day at site) six months after final acceptance to review UV system performance and operations. Coordinate with OWNER two weeks before scheduling site inspection.
- .5 SUPPLIER shall provide all safety equipment, protective guards and shields as necessary for startup, testing, and training.

3.5 Delivery, Storage and Handling

- .1 The UV reactor shall be delivered pre-assembled and ready for installation and operations 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 OWNER 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.
- .4 SUPPLIER shall pack equipment in boxes or crates that protect equipment from damage and moisture, weather, dust, or dirt during shipment, handling, and storage.
- .5 SUPPLIER shall obtain All Risk Transit Insurance covering the full value of equipment being transported to the site.
- .6 SUPPLIER shall deliver equipment dry and undamaged. OWNER will unload equipment, inspect the condition with the SUPPLIER and store equipment at the Storage Site Location.
- .7 The OWNER and SUPPLIER shall jointly inspect equipment upon SUPPLIER 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 OWNER or their 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:
 - a. 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.
 - b. Measure lamp quartz sleeve inside and outside diameters
 - c. Record part numbers of UV lamps, duty UV sensors, and reference UV sensors.
 - d. Proper lubrication of all parts
 - e. 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 safety requirements for the site and provide at least seven (7) days' notice to the OWNER 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:
 - 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. If applicable, proper movement of wipers along the lamp quartz sleeve and UV sensor port window.
 - d. If applicable, proper operation of offline acid rinse cleaning system.
 - e. Proper installation of the UVT monitor.
 - 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. Check electrical wiring and connections.
 - j. Confirm operation of circuit breakers, interlocks, GFIs, and other electrical safety features.
 - k. Confirm adequate ventilation in electrical cabinets including operation of cooling fans and air conditioning.
- .3 Supplier shall promptly correct malfunctions and confirm corrected operation of the UV system as required and no added cost to the Owner.

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:
 - a. Flow rate
 - b. UV sensor measurements
 - c. Lamp status
 - d. Cabinet and reactor temperature sensors
 - e. Ground fault interrupts
 - f. Lamp breakage circuit
 - g. Lamp quartz sleeve breakage circuit
 - h. Control Valve FULL OPEN and FULL CLOSE
 - i. Automatic Wiper Parameters (if applicable).
- .3 Confirm all reactor controls implemented through the HMI and SCADA including
 - a. Start up and restart sequences in AUTO and HAND mode.
 - b.
 - c. Shut down sequences in AUTO and HAND mode.
 - d. Timed and manually initiated automatic cleaning cycles.
 - e. Proper response to all high and low priority alarms.
 - f. Timers and counters for lamp hours, ON/OFF cycles, time between cleaning cycles.
 - g. 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.
 - a. Confirm UV system is operating with new lamps, new and clean lamp quartz sleeves, new and clean UV sensor port windows.
 - b. Confirm valid UV sensor readings for all reactors using at least three reference sensors.
 - c. Operate UV system with ballast power set at 100 percent .
 - d. Adjust ballast power from minimum to maximum ballast power setting by 5 percent increments.
 - e. Record measured UV intensity, RED, total power consumption, ballast power consumption, and calculated Lamp Output -So.

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- f. Compare measured UV intensity and total electrical power consumption to relations provided in the *Validation Report*.
 - g. If the number of UV sensors is fewer than the number of lamps, check variability in relative lamp output from lamp-to-lamp. Record and report if lamp variability is greater than 10 %. 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*.
- a. Confirm calculation over the validated range of flow and UVT.
 - b. 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:
- a. Low UVT and high flow, low relative lamp output (S/So) and high target microbe UV sensitivity (DL), if applicable.
 - b. Calculated RED below Target RED.
 - c. Failure of lamp, ballast, UV sensor, on-line UVT monitor, and flow meter.
 - d. 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 SUPPLIER shall promptly correct malfunctions of the UV system as required at no added cost to the OWNER.

3.10 Harmonic Distortion Analysis

- .1 The harmonic distortion analysis of the power supply to the site, indicating total harmonic voltage and current distortion at the defined Point of Common Coupling, will be carried by the OWNER. This analysis shall determine whether the UV Disinfection system can safely operate within the 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 OWNER shall furnish and install all necessary filters to comply with IEEE519-1992.

- .3 UV supplier must provide with Submission Package 1 range of acceptable harmonics for their equipment.

3.11 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:
 - a. Record flow, UV intensity, lamp status, UVT if applicable, calculated RED, and power consumption on an hourly basis
 - b. If applicable, compare on-line UVT measurements with bench-scale measurements twice per day.
 - c. Compare duty and reference UV sensors measurements once per day.
 - d. Record alarms and alarm responses
- .4 At the end of the test period, confirm proper operation of the UV systems as follows:
 - a. Check RED calculations using measured parameters over the seven-day period.
 - b. Confirm proper dose pacing.
 - c. Check timers and counters for lamp life and ON/OFF cycles
 - d. Check calculation of off-specification performance.
 - e. Check reference sensor checks and on-line UVT monitor checks meet criteria in the Validation Report.
 - f. Check Combined Aging and Fouling (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.

3.12 Performance Testing

- .1 Performance Testing shall be conducted and complete during Operational Testing. Power performance testing shall be conducted on-site by the SUPPLIER in the presence of the ENGINEER and OWNER.

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- .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:
 - a. Testing schedule and protocols describing all procedures to be used 14 days before testing.
 - b. Three copies of the performance testing report within 14 days after completion of testing.
- .4 Performance testing shall be conducted on each reactor.
- .5 The performance test shall be conducted to verify the guaranteed energy cost as stated by SUPPLIER in the Equipment Tender Form. Power consumption and UV system operating parameters shall be recorded for the performance tests.
- .6 Performance Testing Requirements
 - a. The UV lamps shall be burned in for a minimum period of 25 hours after which sensor checks shall be conducted.
 - b. The manufacturer shall utilize two 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.
 - c. 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.
 - d. 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.
 - e. The ambient UVT of the water must be within the validation limits of the UV reactor.
- .7 Power Demand Performance Testing Procedure
 - a. 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

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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.

- b. The calculations used to determine the UV reactor operating requirements and guaranteed power demand values provided by the SUPPLIER in Appendix B of the Tender Form 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.
- c. Range of ballast power settings shall be of sufficient operating range to determine the ballast power and associated power demand.
- d. At each ballast power setting, the measured and recorded operating parameters include (but are not limited to) the following:
 - Lamp operating hours
 - Ballast power setting
 - UV intensity
 - Reduction Equivalent Dose (RED) calculated by the PLC
 - Validated dose, DVAL, calculated by the PLC
 - Validation factor (VF) calculated by the PLC
 - Power demand (kW, kVA, pf, V, A).
 - UV transmittance measured by the online UVT monitor.
 - Flow rate.
- e. All data shall be recorded with a data recorder (recording frequency of once per 10 seconds) with supplemental handwritten 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.
- f. 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.
- g. Determine the required ballast power setting for each of the tested UV reactors at the guaranteed conditions stated in the Equipment Tender Section.
 - 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.

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- Use the required S/So 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.
- h. Determine the power demand for each of the guaranteed conditions stated in the Equipment Tender form for the reactors.
 - 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.
 - 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.
 - 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.
- i. Confirm that the RED and DVAL calculated by the PLC are correct for each reactor.
 - Enter the values collected for flow, UVT and intensity into the validated performance equations to determine the RED, VF, and DVAL for each of the ballast power settings evaluated during the performance testing.
 - Compare the RED, VF, and DVAL to the values calculated by the PLC for each reactor during performance testing.
 - 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.
- .8 Submit all results of Performance Tests as a letter-report to OWNER in writing with summary. Successful completion of the Performance Tests is incomplete until the report is delivered.

3.13 Training

- .1 The SUPPLIER shall provide training and demonstration to OWNER personnel before commencing Owner Acceptance Testing. Training shall consist of at least 1-day training (8 hours) and include both an appropriate level of 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:
 - a. Component replacement procedure (lamps, sleeves, sensors, ballasts, fans etc.).
 - b. Emergency shut-down procedures.
 - c. Reference sensor check procedure.

- d. Cleaning system maintenance procedure.
- e. Cleaning system waste chemical agent neutralization and disposal, if applicable.
- f. HMI and SCADA interfaces, and PLC programming.

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:
 - a. Status of equipment and installation for each installed reactor.
 - b. Adherence to SUPPLIER's recommended maintenance and operation of equipment.
 - c. The following checks shall be performed:
 - Check lamp aging
 - Check UV transmittance of lamp quartz sleeves and UV sensor port windows
 - Verify proper operation of cleaning system
 - Check power consumption
 - Check all electrical connections.
 - Check calibration of UV sensors.
 - Verifying operation of alarms.
 - d. Supplier shall make adjustments as necessary to restore equipment within original tolerances.

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.