

**Invitation to Tender No. 19-009
Ravensong Aquatic Centre Mechanical Upgrade**

Issue Date: February 5, 2019

The Regional District of Nanaimo invites Tenders from qualified and experienced Contractors for the Ravensong Aquatic Centre Mechanical Upgrade.

SCOPE: Provide new, complete, operational and tested mechanical systems for heating, ventilation, air conditioning, controls, and plumbing systems as described herein during the facility shutdown is expected to be from August 3, 2019 to August 31, 2019.

Tender documents may be downloaded directly from the Regional District of Nanaimo website at www.rdn.bc.ca or the BC Bid website at www.bcbid.gov.bc.ca

Tenders must be in a sealed envelope bearing the name of the firm bidding, to the specific physical location on or before **3:00:00 p.m. local time on the 5th day of March, 2019** (the “Tender Closing”):

Regional District of Nanaimo
6300 Hammond Bay Road
2nd Floor, Main Reception
Nanaimo, BC V9T 6N2

There will be an optional pre-tender meeting on **February 12, 2019, at 12:00 p.m., at Ravensong Aquatic Centre, 737 Jones St, Qualicum Beach BC V9K 1S4**. All persons in attendance must bring their own personal protection equipment (i.e., steel toe footwear, high visibility vest, etc.).

All inquiries related to this Tender are to be directed to **Aaron Mullaley, Rocky Point Engineering at 250.585.0222 or aaron.mullaley@rpeng.ca**.

Tenders will not be opened in public.

The Regional District's language in its procurement documents shall be English.
This procurement is subject to Chapter 5 of the Canadian Free Trade Agreement.



PART 1.1 - INSTRUCTIONS TO BIDDERS

CLAUSE 1 - DOCUMENTS

1.1 DOCUMENTS

- .1 Carefully examine the following information. Failure to follow these instructions may result in bid disqualification.
- .2 Project information:
 - .1 Project / Contract No.: 19-009
 - .2 Project / Contract: Ravensong Aquatic Centre - Mechanical Upgrade

1.2 Bid Documents

- (a) Advertisement - Invitation to Bid;
- (b) BCDC 2 - 2016, Part 1.1 Instructions to Bidders;
- (c) BCDC 2 - 2016, Part 1.2 Bid Form;
- (d) CCDC 2 - 2008, Articles of Agreement;
- (e) CCDC 2 - 2008, General Conditions;
- (f) BCDC 2 - 2016, Part 1.3 Supplementary Conditions;
- (g) BCDC 2 - 2016, Part 1.4 Project Specific Amendments, if any;
- (h) General Requirements;
- (i) Drawings and Specifications;
- (j) Addenda and Appendices, if any.

1.3 CONTRACT DOCUMENTS

- .1 Upon award of contract the Contract Documents consist only of (b) to (j) above.

CLAUSE 2 - PRE-BID INQUIRIES

- 2.1 Direct inquiries relating to Bid Documents, only to the Consultant/Owner at:

Aaron Mullaley, Eng.L. ASCT, PTECH, LEED AP
Principal, Senior Project Manager
Rocky Point Engineering
102-3721 Shenton Road Nanaimo BC V9T 2H1
Tel: (250) 585-0222
aaron.mullaley@rpeng.ca

CLAUSE 3 - PARTICULARS AFFECTING BID PRICE

3.1 MATERIALS

- .1 Establish the Bid Price based on the use of materials specified in Drawings and Specifications.
- .2 Proposed alternatives to materials specified will be considered during the bidding period only if full descriptive data are submitted in writing to the Consultant/Owner at least
 - 5 Working Days before the bid closing date.



- .3 Approved alternatives will be incorporated in the Drawings and Specifications by issuance of an Addendum.
- 3.2 CONDITIONS RELATED TO THE WORK
 - .1 Become familiar with the site and existing conditions prior to submitting a bid and make allowances for conditions related to the *Work*.
 - .2 Claims for an increase in Contract Price or Contract Time arising from observable conditions will be rejected by the *Owner*.
- 3.3 TAXES
 - .1 The Bid Price includes all applicable taxes in force at the time of bidding and related to the progress of the *Work* except Value Added Tax (As defined by CCDC 2).
 - .2 The successful bidder agrees to:
 - .1 Pay applicable taxes in force during and related to progress of the *Work*.

CLAUSE 4 - COMPLETION OF BID FORM

- 4.1 COMPLETION OF BID FORM
 - 1. Complete the bid on the Bid Form included with the Bid Documents in a non-erasable medium and execute in accordance with provisions of Clause 5 of the Instructions to Bidders, - EXECUTION OF THE BID.
 - 2. If required, state the number of weeks within which the bidder will Substantially Perform the *Work*.
 - 3. Initial erasures or corrections to entries on the Bid Form.
 - 4. Indicate receipt of Addenda.
 - 5. The Owner may reject the bid if the Bid Form has alterations, qualifications or omissions.

CLAUSE 5 – EXECUTION OF THE BID

- 5.1 EXECUTION OF THE BID
 - 1. Execute the Bid Form in one of the following ways:
 - .1 Limited Company: Include the company's full name and the name(s) and status of the authorized signing officer(s) in the spaces provided for that purpose. Affix the signature(s) of authorized officer(s) and date the Form; or
 - .2 Partnership: Print the partnership name and the name(s) of the person(s) signing in the spaces provided. Affix the signature of one or more of the authorized partners, who shall sign in the presence of a witness who shall also sign and date the Form; or
 - .3 Sole Proprietor: Print the business name and the name of the sole proprietor in the spaces provided. The sole proprietor shall sign and date the Form in the presence of a witness who shall also sign and date the Form.

CLAUSE 6 - DELIVERY OF THE BID

- 6.1 DELIVERY OF THE BID
 - 1. Enclose the properly completed and executed Bid Form in a properly addressed envelope.
 - 2. Ensure the name and address of the bidder, the project name, (and project number where provided by the *Owner*) appear on the envelope face.



3. Seal the envelope and deliver it to the submission location stated in the Invitation to Bid prior to the time and date specified for the closing of bids.
4. The Owner will immediately record the date and time on envelopes containing bids and on bid revisions received by fax and this information will take precedence over machine-initiated date and time information transmitted through a fax machine.
5. Bids and other related documents received after the stated time and date of closing will not be considered by the *Owner*.
6. The *Owner* is neither liable nor responsible for costs incurred by bidders in the preparation, submission, or presentation of the bid. Bid documents become the property of the *Owner*.

CLAUSE 7 – REVISION OF THE BID

7.1 REVISION OF THE BID

1. A Bid Form already delivered to the Owner may only be revised in the manner described in paragraph 7.2 of this Clause, and to qualify, the revision(s) shall be received by the Owner at the submission location stated in the Invitation to Bid prior to the time and date specified there for the closing of bids. Ensure revision(s) plainly refers to a particular bidder.
2. Revisions will be accepted by either: signed letter delivered to the address stated in the Invitation to Bid, or, faxed to the number designated in the Invitation to Bid.
3. Only the bidder's entries on the delivered Bid Form may be revised; the revision shall state only the amount by which a bid figure is to be increased or decreased (except itemized, alternative or unit prices as described in 7.4), or specific directions as to the exclusion or inclusion of particular words.
4. Where itemized, alternative, or unit prices are being revised, submit a new price that replaces the previously submitted price.
5. Ensure faxed revisions to the original bid are clearly legible. State monetary revisions to the bid amount numerically and in writing.
6. For faxed revisions, the clock used for the official bid closing time shall govern.
7. Bidders are warned that faxed revisions are submitted solely at their risk and will not be considered received until they have been received and printed at the designated fax number, and date and time of the revision has been recorded by hand by the Owner prior to bid closing. The Owner's hand written date and time or time stamp from the clock used for the official bid closing shall take precedence over facsimile machine generated time and date.

CLAUSE 8 - SECURITY REQUIREMENTS

8.1 BID BONDS

- .1 Ensure the Bid Form is accompanied by a bid bond in the amount of ten percent (10%) of the Bid Price. Certified cheques and guaranteed letters of credit will not be accepted.
- .2 Ensure the bid bond is issued on a CCDC 220 Bid Bond form or other form approved by the Surety Association of Canada and issued by a Surety acceptable to the *Owner*.
- .3 If a successful bidder declines to enter a Contract within the period set out in the Bid Form, or a further agreed period of time, the principal and surety will be required to pay to the *Owner* a sum equivalent to the difference between the principal's bid and the accepted bid or ten percent (10%) of the principal's bid, whichever is the lesser.



8.2 PERFORMANCE BONDS AND LABOUR AND MATERIAL PAYMENT BONDS

- .1 The successful bidder agrees to:
 - .1 Provide a Performance Bond and a Labour and Material Payment Bond each in the amount of fifty percent (50%) of the Contract Price.
 - .2 Provide these bonds within ten (10) Working Days of contract award. Maintain bonds in good standing until Contract fulfillment. Ensure requirements of GC 1 2.3 – WARRANTY are met and payment obligations arising under the Contract are made while bonds are still in place.
 - .3 Ensure the Performance Bond is issued on CCDC-221 Performance Bond form, and Labour and Material Performance Bond is issued on CCDC-222 Labour and Material Performance Bond form or other forms approved by the Surety Association of Canada and issued by a Surety acceptable to the *Owner*.
 - .4 Include bonding costs in the Bid Price.
 - .5 Ensure the obligee on the bonds is the *Owner*.

CLAUSE 9 - ACCEPTANCE OF THE BID

9.1 ACCEPTANCE OF THE BID

- .1 The lowest or any bid will not necessarily be accepted.
- .2 The *Owner*, at its sole discretion, may accept or reject any or all of the Alternative Prices submitted in the Bid Documents. Alternative Prices will not be considered in determining the successful bidder.
- .3 Alternative Prices listed in the Bid Documents shall remain open for acceptance by the *Owner* for the period stated in the Bid Documents, from the time and date specified for closing of bids.
- .4 Bids which contain qualifying conditions or otherwise fail to conform to these Instructions to Bidders may, at the sole discretion of the *Owner*, be disqualified or rejected.
- .5 The *Owner* retains the separate right to waive irregularities in the Bid Form if, at the *Owner's* discretion, such irregularities are of a minor or technical nature and have not provided the bidder with a competitive advantage. Errors of a clerical or technical nature are not grounds for a bidder to revoke a bid. Bidding irregularities will be reviewed generally in accordance with 2.3 Guideline for Administering Bidding Irregularities of the British Columbia Documents Committee (BCDC) in effect at the time of bid closing.
- .6 In the event a single bid is received, the *Owner* may open the bid privately without reference to the bidder. If the bid is opened and it is in excess of the *Owner's* budget, the *Owner* reserves the right to re-issue the Bid Documents for new public re-bid without revisions being made to the Bid Documents and without disclosing the single Bid Price. The *Owner* reserves the right to accept or reject a single bid.
- .7 The *Owner* has the right to enter into over-budget negotiations with the lowest compliant bidder or a single bidder, without cancellation of all bids or consideration to other bidders, and to require that bidder to negotiate with Subcontractors named on their Bid Form.

CLAUSE 10 – OWNER PROVIDED INSURANCE

- .1 Refer to GC 11.1 - INSURANCE, GC 12.1 - INDEMNIFICATION and Supplementary Condition(s).



CLAUSE 11 – CONTRACTOR PROVIDED INSURANCE

- .1 Refer to GC 11.1 - Insurance, GC 12.1 - Indemnification and Supplementary Condition(s).

CLAUSE 12 – SUBCONTRACTOR BIDDING

- .1 Subcontractors listed below shall submit their bids through the specified method as defined in the Invitation to Bid at the time and on the date stated in the Invitation to Bid.

(a) **BONDED AS PER THE RULES OF PROCEDURE**

The current Rules of Procedure for the submission of trade contractor bids including bonding and amendments listed in paragraphs 12.2, .3 and .4 of this Clause shall apply to the following subcontractors:

(Use of the BCCA Bid Depository is not applicable to this project. Bidders are advised to bid not sub-trades through the bid depository)

(b) **SUBCONTRACTORS BIDS, NOT BONDED**

The current Rules of Procedure for the submission of subcontractor bids except bonding, and amendments listed in paragraphs 12.2, .3 and .4 of this Clause shall apply to the following subcontractors:

(Use of the BCCA Bid Depository is not applicable to this project. Bidders are advised to bid not sub-trades through the bid depository)

- .2 Notwithstanding the requirements for exclusion of work contained in the Rules of Procedure, ensure all Work described in the Bid Documents is included in the Bid Price.
- .3 When a bid is over budget and the lowest compliant bidder has received a single bid through the Rules of Procedure for subcontractor bidding the Owner has the right to negotiate with the lowest compliant bidder and the lowest compliant bidder, in turn, has the right to negotiate with the single subcontractor bidder and the named Subcontractor(s). Should such negotiations not be successful, that portion of the Work may be re-bid by the lowest compliant bidder in cooperation with the Owner. The Owner has the right to apply other actions or remedies that may also be appropriate under the law.
- .4 Bidders receiving no bids through the process specified for submission of bids shall none the less list the name of a Subcontractor on the Bid Form in the place provided.
- .5 When requested to do so the bidder agrees to provide the Owner with proof of Subcontractor bonds within ten (10) Working Days of contract award.

CLAUSE 13 – WORKSAFE BC LETTER

- .1 After bid closing, upon request, the lowest compliant bidder agrees to provide a WORKSAFE BC Letter of Good Standing within forty-eight (48) hours.



PART 1.2 - STIPULATED PRICE BID FORM

Project/Contract: Ravensong Aquatic Centre - Mechanical Upgrade

Project/Contract No.: 19-009

From (Bidder):

company name

street address or postal box number

city/town, province and postal code

Bidders Ph. _____ **Bidders Fax.** _____

To (Owner):

We, the undersigned, having examined the Bid Documents for the above named project/contract, including Addendum Number(s) _____, and being familiar with the site and existing conditions, hereby offer to perform the Work in accordance with the Bid Documents, for the stipulated bid price of:

\$ _____
amount in writing

_____ in Canadian dollars, excluding Value Added Taxes.

\$ _____
amount in figures

We, the undersigned, declare that:

- (a) We agree to attain Substantial Performance of the Work within (*Contractor to fill in*) _____ weeks after receiving notice of contract award and the contract time noted herein WILL NOT be taken into account by the Owner in awarding the contract. The date of contract award shall be the date the letter of award is sent to the bidder.
- We agree to attain Substantial Performance of the Work within (*Contractor to fill in*) _____ weeks, taking into account the milestones and/or schedule noted in Division 01 of these Project Specifications, and after receiving notice of contract award. The contract time noted herein MAY BE considered by the Owner in evaluating the bid and determining contract award. The date of contract award shall be the date the letter of award is sent to the bidder.
- We agree to attain Substantial Performance or the work within (*Owner to fill in*) [not applicable] weeks after receiving notice of contract award. This contract time is identified by the Owner based on the rational included in Part 1.4 Project Specific Amendments. The date of contract award shall be the date the letter of award is sent to the bidder.



- (b) we have arrived at this bid without collusion with any competitor,
- (c) this bid is open to acceptance by the Owner for a period 30 days from the date of bid closing, and
- (d) all bid form supplements called for by the Bid Documents form an integral part of this bid.

Signatures:

Signed and submitted by:

company name

name and title of authorized signing officer

signature of authorized signing officer

name of witness

signature of witness

name and title of authorized signing officer

signature of authorized signing officer

name of witness

signature of witness

Dated this _____ day of _____, 20_____



Appendix 'A' – LIST OF SUBCONTRACTORS

Project/Contract: Ravensong Aquatic Centre - Mechanical Upgrade
Project/Contract No.: 19-009
From (Bidder): _____
company name

We, the above named bidder, propose to use for the above named project/contract Subcontractors named below:

Item of Work

Name of Subcontractor

Subcontractor Bidders Bids Received as per Instructions to Bidders Clause 12

Subcontractors and Suppliers Not Bid as per Instructions to Bidders Clause 12

Bidders are required to name major sub-trades listed below at the time of bid submittal.

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If named sub-trades are different companies than the bidder the Owner reserves the right to request follow-up information and references on the sub-trade companies, as to competency and ability to adhere to project schedule, and that such information may be used as a reason not to accept any particular bid

REQUIRED TRADES TO BE NAMED:

- SHEET METAL
- PLUMBING
- INSULATION
- ELECTRICAL
- ROOFING



Appendix 'B' – ALTERNATIVE PRICES

Project/Contract: Ravensong Aquatic Centre - Mechanical Upgrade

Project/Contract No.: 19-009

From (Bidder): _____
company name

We, the above named bidder, offer the alternative prices requested below. The amount to be added to, or deducted from, our bid price (as entered in the Bid Form) is entered for each alternative requested. These prices do **NOT** include Value Added Taxes. If there is no change to the bid price for an alternative, we have so indicated. It is understood that:

- (a) the Owner may accept any of the alternatives and corresponding alternative prices in any order or combination, including all or none,
- (b) alternatives and alternative prices are open for acceptance by the Owner for the same period of time as the bid price, notwithstanding the award of the Contract.
- (c) the Work of the Contract and the Contract Price will reflect the alternatives and alternative prices, if any, accepted by the Owner at the time of contract award, and
- (d) acceptance of any alternatives will not affect the bid price contract completion time, unless we have specifically indicated an increase or decrease in time, in number of days, on account of a particular alternative.

<u>Description of Alternative</u>	<u>Effect on Bid Price</u>	
	<u>Add</u>	<u>Deduct</u>
Alternative Price No. 1		
Alterations and re-commissioning of the solar hot water heating system as shown on the drawings and specifications. Including Cash Allowance No. 3 Cash Allowance No. 4 and all associated electrical work.	\$ _____	\$ _____
	+	
Time (in Days)	_____	_____
Alternative Price No. 2		
Supply and install of ceiling propeller fans PF-1, 2, 3 and 4 including associated electrical and DDC controls. Mechanical contractor to coordinate with controls contractor (ESC).	\$ _____	\$ _____
Time (in Days)	_____	_____



Appendix 'C' – ITEMIZED PRICES

(To be submitted within forty eight [48] hours of bid closing, upon request)

Project/Contract: Ravensong Aquatic Centre - Mechanical Upgrade

Project/Contract No.: 19-009

From (Bidder): _____

company name

We, the above named bidder, provide the breakdown of items of Work included in our bid price (as entered in the Stipulated Price Bid Form) as requested below. It is understood that these itemized prices are provided for information purposes only and will not be used to modify the scope of the Work or adjust our bid price. These prices do **NOT** include Value Added Taxes.

Item of Work

Itemized Price

(NOT APPLICABLE)



Appendix 'D' – LIST OF UNIT PRICES

Project/Contract: Ravensong Aquatic Centre - Mechanical Upgrade

Project/Contract No.: 19-009

From (Bidder): _____
company name

The following are our Unit Prices for the units of work listed hereunder. The Unit Prices listed apply to performing the units of work only during the Contract Time. These prices do **NOT** include Value Added Taxes.

<u>Unit of Work</u>	<u>Unit Price (\$)</u>	
	<u>Add</u>	<u>Deduct</u>
(NOT APPLICABLE)		



Appendix 'E' – LIST OF CASH ALLOWANCES

Project/Contract: Ravensong Aquatic Centre - Mechanical Upgrade
Project/Contract No.: 19-009
From (Bidder): _____
company name

We, the above named bidder, have provided the Cash Allowance(s) included in our bid price (as entered in the Stipulated Price Bid Form) as requested below. These prices do **NOT** include Value Added Taxes.

<u>Description of Cash Allowance</u>	<u>Amount</u>
CASH ALLOWANCE No. 1 - For the cost of the Direct Digital Controls (DDC) system, the Contractor is to INCLUDE in the submitted tender a Cash Allowance amount of:	\$60,000.00
CASH ALLOWANCE No. 2 - For AutoCad Drafting of Record Drawings, the Contractor is to INCLUDE in the submitted tender a Cash Allowance amount of:	\$1,000.00
CASH ALLOWANCE No. 3 (Alternative Price No. 1) - For the cost of the Direct Digital Controls (DDC) associated with the alternations and re-commissioning of the solar hot water heating system, the Contractor is to INCLUDE in the submitted tender a Cash Allowance amount of:	\$12,000.00
CASH ALLOWANCE No. 4 (Alternative Price No. 1) - For testing, repair, replacement, required component shipping and commissioning of existing 1500 gallon storage tank and tank accessories, the Contractor is to INCLUDE in the submitted tender a Cash Allowance amount of:	\$10,000.00

Ravensong Aquatic Centre - Mechanical Upgrade
737 Jones St., Qualicum Beach, BC V9K 1S4
Regional District of Nanaimo

February 1, 2019

Section 00020



Appendix F - FAXED BID AMENDMENT

(To be used where required)

TO (OWNER): Regional District of Nanaimo
FAX NUMBER: (250) 390-4163 DATE: _____
PROJECT: Ravensong Aquatic Centre - Mechanical Upgrade

WE HEREBY AMEND OUR BID PRICE AS FOLLOWS:

	TO PREVIOUSLY SUBMITTED BID PRICE ADD	FROM PREVIOUSLY SUBMITTED BID PRICE SUBTRACT
AMENDMENT TO BID PRICE (in figures)	\$ _____	\$ _____
AMENDMENT TO BID PRICE (in writing)	ADD / SUBTRACT	\$ _____

AMENDMENT TO TIME: We agree to attain Substantial Performance within _____ weeks.

Amend our Required Alternative, Itemized or Unit Prices to read as follows:

Note: These prices are completely new prices as per Clause 7.4 of the Instructions To Bidders. These changes in price or in time are not a subtraction from or addition to already submitted Alternative, Itemized or Unit Prices.

These prices do **NOT** include Value Added Taxes.

	(Add to Bid Price)	(Subtract from Bid Price)
_____	\$ _____	\$ _____
_____	\$ _____	\$ _____

Other amendments including issued addendum numbers are (or reference and include by attachment):

NAME OF BIDDER: _____

ADDRESS: _____ TELEPHONE: _____

_____ FAX: _____

AUTHORIZED SIGNING OFFICER:

Name and Title: _____ (Signature)



PART 1.3 - SUPPLEMENTARY CONDITIONS

GENERAL CONDITIONS OF THE STIPULATED PRICE CONTRACT

PART 2 ADMINISTRATION OF THE CONTRACT

GC 2.3 REVIEW AND INSPECTION OF THE WORK

2.3.2 Add, in the first sentence "review," before the word "tests".

2.3.4 In the first sentence replace "special" with "review," and add "review," before the third instance of "inspections".

Add:

2.3.8 Should the *Consultant* be required to make more than one review of rejected work or should the *Consultant* perform additional reviews due to failure of the Work to comply with the application for status of completion made by the *Contractor*, the *Contractor* is required to compensate the *Owner* for such additional *Consultant* services including expenses incurred. Adjustment for such compensation should be made as outlined under PART 6 CHANGES IN THE WORK.

PART 3 EXECUTION OF THE WORK

GC 3.2 CONSTRUCTION BY OWNER OR OTHER CONTRACTORS

Delete:

3.2.2.2 Delete this clause in its entirety.

Add:

3.2.3.4 as it applies to the applicable health and construction safety legislation at the *Place of the Work* the *Contractor* shall assume overall responsibility and be designated as the "Prime Contractor."

GC 3.6 SUPERVISION

3.6.1 Add after the last sentence:

"The appointed *Contractor* representative shall not be changed except for valid reason. The appointed *Contractor* representative shall not be changed without consultation with and written acceptance of the *Owner*. This acceptance shall not be unreasonably withheld."

GC 3.7 SUBCONTRACTORS AND SUPPLIERS

3.7.4 Add at the end of the sentence ", as outlined in GC 6.3 – CHANGE DIRECTIVE."

PART 4 ALLOWANCES

GC 4.1 CASH ALLOWANCES

4.1.2 Add, after the first sentence "Unless noted otherwise, none of the work included in the drawings and specifications is intended to be paid for by the cash allowances. The cash allowances are for the *Owner's* use, at the *Owner's* sole discretion. "



PART 5 PAYMENT

GC 5.2 APPLICATIONS FOR PROGRESS PAYMENT

5.2.4 Add, after the first sentence:
"A second schedule, stating the anticipated monthly progress payments, is to be submitted upon request."

Add:

5.2.8 An application for payment shall be deemed received only if submitted complete with required supporting documentation as determined by the *Consultant*.

Add:

5.2.9 The *Contractor* shall with each and every application for payment subsequent to the first, submit a current CCDC 9A Statutory Declaration of Progress Payment Distribution by Contractor, which shall be completed and sworn before a Notary Public or a Commissioner for Oaths for the Province of British Columbia.

GC 5.3 PROGRESS PAYMENT

5.3.1.2 Add,

"If, after a certificate of payment has been issued to the *Owner* (and prior to payment by the *Owner*), the *Consultant* determines on the basis of new information that the amount certified for payment is inappropriately high or low relative to the value of the work performed, then the *Consultant* shall issue a revised certificate of payment,"

5.3.1.3 Delete in its entirety and replace with,

"The *Owner* shall make payment to the *Contractor*, on account, in the amount certified by the *Consultant* as provided in Article A-5 of the Agreement – PAYMENT, on or before the later of:

- twenty calendar days after receipt by the *Consultant* of the application for payment, or
- twenty-eight calendar days after the last day of the payment period for which the *Contractor's* application for payment is made."

GC 5.4 SUBSTANTIAL PERFORMANCE OF THE WORK

Add:

5.4.4 Subject to the requirements of the Builders Lien Act relative to the date of issuance by the *Consultant* of the certificate of completion pursuant to paragraph 5.4.2:

- .1 The *Consultant* shall issue to the *Owner* and copy to the *Contractor* a certificate of payment for an amount equal to the *Contract Price* less:
 - .1 twice the value of any deficiencies shown on the comprehensive list of items to be completed or corrected as in GC 5.4.1, as determined by the *Consultant*;
 - .2 the value of incomplete work as determined by the *Consultant*; and
 - .3 the amounts of all previous certificates of payment.



- .2 The *Owner* shall make payment to the *Contractor* in accordance with the provisions of GC 5.3.1.3.

Add:

- 5.4.5 The *Owner* reserves the right to take possession of and use completed or partially completed portion of the *Work*, in addition to occupancy conditions included in the Contract, providing:
- .1 the portion of the *Work* is ready to be used for the purpose intended, to the satisfaction of the *Consultant* and authorities having jurisdiction; and
 - .2 the *Owner's* possession and use do not interfere with the *Contractor's Work*; and
 - .3 the *Consultant* conducts a review prior to possession by the *Owner*; and
 - .4 any extra costs are borne by the *Owner*, subject to the provisions of GC 6.5 Delays.

Add:

- 5.4.6 An application for *Substantial Performance of the Work* shall be deemed complete only if submitted with required supporting documentation, including those requirements in GC 5.2.8, as determined by the *Consultant*.

GC 5.5 PAYMENT OF HOLDBACK UPON SUBSTANTIAL PERFORMANCE OF THE WORK

Add:

- 5.5.1.3 When applying for release of holdback, the *Contractor* shall submit a current CCDC 9B Statutory Declaration of Progress Payment Distribution by *Subcontractor* from each of the *Subcontractors* and a Worker's Compensation Board Letter of Good Standing.

GC 5.6 PROGRESSIVE RELEASE OF HOLDBACK

Add:

- 5.6.4 An application for progressive release of holdback will not be considered complete until all related documentation required for the *Consultant's* review is received, including those requirements in GC 5.2.8.

GC 5.7 FINAL PAYMENT

- 5.7.4 Delete'
"no later than 5 calendar days after the issuance of a final certificate for payment,"

Add:

- 5.7.5 Partial payment may not be made for the completion or correction of any deficiencies shown on the comprehensive list of items to be completed or corrected prior to the date of the issuance of the final certificate of payment.

PART 6 CHANGES IN THE WORK

GC 6.2 CHANGE ORDER

Add:

- 6.2.3 The following shall determine *Contractor* markup on *Change Orders* by percentage:
- .1 To the cost of the *Work* performed by the *Contractor* directly, the *Contractor* may add a maximum of 20% markup for overhead and profit combined.



- .2 To the cost of the Work performed by *Subcontractors* for the *Contractor*, before the *Subcontractor's* markup, the *Contractor* may add a maximum of 10% markup for overhead and profit combined.
- .3 On Work deleted from the *Contract*, not covered by unit prices, the credit to the *Owner* shall be the cost of the Work as set out in GC 6.3 – CHANGE DIRECTIVE, article 6.3.7.
- .4 For a detailed list of what the *Contractor* may include in the cost of the work before adding markups, refer to GC 6.3 CHANGE DIRECTIVE, article 6.3.7.

GC 6.5 DELAYS

6.5.3.3 Add the word "local" after the word "adverse".

Add:

6.5.6 The party making the claim shall submit to the Consultant, within 10 Working Days, a detailed account of the Contract Time extension claimed and the grounds upon which the claim is based complete with required supporting documentation as determined by the Consultant.

Add:

6.5.7 Should the *Consultant*, in consultation with the *Contractor*, determine the *Contractor* is delayed in performance of the *Work*, or any part thereof, by the *Contractor's* inaction, or by delay or inaction of anyone employed or engaged by the *Contractor* directly or indirectly, and the *Contract Time* is compromised:

- .1 Then the *Contractor* shall accelerate the *Work* as required to meet the *Contract Time*.
- .2 The *Consultant* will promptly give *Notice in Writing* of such determination to the *Owner* and the *Contractor*.
- .3 The *Contractor* shall then promptly give the *Owner* and the *Consultant Notice in Writing* of specific changes to the construction scheduling and construction processes the *Contractor* will implement to accelerate the *Work*.
- .4 The *Contractor* shall not be entitled to payment for costs to accelerate the *Work* to meet the *Contract Time*.

GC 6.6 CLAIMS FOR A CHANGE IN CONTRACT PRICE

6.6.1 Add "in no case more than 10 Working Days from the event or series of events giving rise to the claim."

PART 7 DEFAULT NOTICE

GC 7.1 OWNER'S RIGHT TO PERFORM THE WORK, STOP THE WORK, OR TERMINATE THE CONTRACT

7.1.5 In the first sentence, after "paragraph 7.1.1," replace "and" with "or".



PART 10 GOVERNING REGULATIONS

GC 10.2 LAWS, NOTICES, PERMITS, AND FEES

Add:

10.2.8 The *Contractor* shall provide to the *Consultant* copies of all inspection reports from the various authorities having jurisdiction within two *Working Days* of their receipt.

GC 10.4 WORKERS' COMPENSATION

Add:

10.4.3 The *Contractor* is formally designated as the "Prime Contractor."

PART 11 INSURANCE AND CONTRACT SECURITY

GC 11.2 CONTRACT SECURITY

Add:

11.2.3 The *Contractor* shall give the *Owner Notice in Writing* of any material change in the surety within 15 days of occurrence.

PART 12 INDEMNIFICATION, WAIVER OF CLAIMS AND WARRANTY

GC 12.3 WARRANTY

12.3.4 Add, "In effecting a correction of defects or deficiencies, the *Contractor* shall also bear all costs involved in removing, replacing, repairing, or restoring aspects of the *Work* that may be affected in the process of making the correction."

Add:

12.3.7 Where a material, product or installation covered by warranty fails, the stipulated warranty and warranty period shall be renewed for the specific work being replaced or repaired, with the exception of warranties referred to in GC 12.3.6.

DIVISION	01	GENERAL CONDITIONS
Division	01000	<u>GENERAL REQUIREMENTS</u>
Section	01050	DESCRIPTION OF THE WORK
Section	01150	SCHEDULING AND COORDINATION
Section	01200	QUALITY CONTROL
Section	01250	SUBMITTAL REQUIREMENTS
Section	01300	CLEANING, SAFETY AND STORAGE REQUIREMENTS
Section	01400	SITE ACCESS AND PARKING
Section	01450	CONTRACT CLOSEOUT
Section	01500	GENERAL TRADES REQUIREMENTS

DIVISION	15	MECHANICAL
Division	15000	<u>MECHANICAL GENERAL REQUIREMENTS</u>
Section	15010	SCOPE OF MECHANICAL WORK
Section	15020	MATERIALS AND EQUIPMENT
Section	15050	PIPE CLEANING AND CHEMICAL TREATMENT
Division	15100	<u>TESTING, ADJUSTING AND BALANCING (TAB)</u>
Section	15120	AIR AND WATER BALANCING
Section	15130	MECHANICAL SYSTEMS VERIFICATION
Division	15200	<u>VIBRATION AND SEISMIC CONTROL</u>
Section	15220	VIBRATION CONTROL
Section	15230	SEISMIC CONTROL
Division	15300	<u>INSULATION AND FIRESTOPPING</u>
Section	15310	PIPE INSULATION
Section	15320	DUCT INSULATION
Section	15330	EQUIPMENT INSULATION
Section	15340	FIRESTOPPING AND SMOKE SEALS
Division	15400	<u>PLUMBING AND DRAINAGE</u>
Section	15410	STORM DRAIN PIPING
Section	15430	DOMESTIC WATER PIPING AND ACCESSORIES
Section	15470	PLUMBING FIXTURES
Section	15490	POOL WATER PIPING
Division	15600	<u>HEATING SYSTEMS AND EQUIPMENT</u>
Section	15620	HEATING WATER PUMPS AND ACCESSORIES
Section	15630	HYDRONIC HEATING PIPE AND ACCESSORIES
Section	15660	HYDRONIC HEAT EXCHANGERS

Division	15700	AIR CONDITIONING SYSTEMS AND EQUIPMENT
Section	15740	CHILLED WATER PIPE, COILS AND ACCESSORIES

Division	15800	VENTILATION SYSTEMS AND EQUIPMENT
Section	15810	CUSTOM AIR HANDLING UNITS
Section	15860	VENTILATION FANS
Section	15880	DUCTWORK, HOODS AND DUCT ACCESSORIES

Division	15900	DIRECT DIGITAL CONTROLS
Section	15910	DDC PRODUCTS AND INSTALLATION
Section	15915	SEQUENCE OF OPERATION

Division	15900	MECHANICAL SCHEDULE
(Refer also to schedules of Mechanical Drawing M-10)		
Section	15998	CONTROL DAMPERS
Section	15999	CONTROL VALVES

**END OF SPECIFICATION
TABLE OF CONTENTS**

1 SCOPE OF WORK

- .1 Provide new, complete, operational and tested mechanical systems for heating, ventilation, air conditioning, controls and plumbing systems, as described herein, indicated on the drawings and in full conformance with applicable codes, standards and ordinances.
- .2 Provide all labour, materials and products as specified, as required to accomplish this work.
- .3 The scope of the mechanical work for this project generally includes:
 - .1 Custom Air Handling Units
 - .2 Ceiling propeller fans (Alternative Price No. 2)
 - .3 Supply, return, outdoor and exhaust air ductwork
 - .4 Internal acoustic duct lining and external duct insulation
 - .5 Balancing and back-draft dampers
 - .6 Hydronic pumps
 - .7 Hydronic (heating and chilled water) piping and pipe insulation
 - .8 Heat exchanger
 - .9 Pre-operational pipe cleaning and Chemical treatment
 - .10 Direct digital controls
 - .11 Air systems balancing
 - .12 Water systems balancing
 - .13 Verification of systems operation and controls
- .4 Plumbing work will include the following:
 - .1 Domestic Water piping
 - .2 Solar Piping systems (Alternative Price No. 1)
- .5 Demolition and builder's work will include the following:
 - .1 Removal of existing equipment and disposal.
 - .2 Other demolition, painting, remediation, etc, as described in the specifications and on the drawings, to accommodate the Work.

- .3 Removal and disposal of existing roof curbs
- .6 Structural work will include the following:
 - .1 Additional rooftop unit support. Refer to structural drawings
 - .2 Non-structural seismic protection
- .7 Electrical work will require the following:
 - .1 Electrical power supply to mechanical equipment. Refer to electrical plans
 - .2 Removal and replacement of miscellaneous electrical devices, including some new equipment
- .8 The mechanical contractor shall act as the Prime Contractor for this project, responsible for the coordination of all trades required to carry out the work as described herein.

2 CASH ALLOWANCES

- .1 Cash Allowances are to be INCLUDED in the Base Amount of Tender for the following items.
 - .1 Cash Allowance No. 1 - For the cost of the Direct Digital Controls (DDC) system, the Contractor is to INCLUDE in the submitted tender a Cash Allowance amount of \$60,000.00.
 - .2 Cash Allowance No. 2 - For AutoCad drafting of Record Drawings, INCLUDE in the submitted tender a Cash Allowance amount of \$1,000.00.
- .2 The Cash Allowance amounts stated do NOT include Contractor's overhead and profit. The Cash Allowances pertain strictly to the work provided specific to the Cash Allowance (ie: commissioning, structural work, etc). The Contractor's overhead and profit for work pertaining to the Cash Allowances are to be included in the Contractors base tender.
- .3 The Cash Allowance amounts stated do NOT include Value added Taxes (GST).
- .4 Refer also to GC 4.1 of the Stipulated Price Construction Contract and Appendix E of the Form of Tender.

3 ALTERNATIVE PRICES

- .1 Provide the following Alternative Prices:
 - .1 Alternative Price No. 1 – Alterations and re-commissioning of the solar hot water heating system as shown on the drawings and specifications, Including Cash Allowances No. 3 & No. 4 below:
 - .1 Cash Allowance No. 3 – For the cost of the Direct Digital Controls (DDC) associated with the alternations and re-commissioning of the solar hot water heating system, the Contractor is to INCLUDE in the submitted tender a Cash Allowance amount of \$12,000.00.
 - .2 Cash Allowance No. 4 – For testing, repair, replacement, required shipping and commissioning of existing 1500 gallon storage tank and tank accessories. INCLUDE in the tender a Cash Allowance amount of \$10,000.00.
 - .2 Alternative Price No. 2 – Supply and install of ceiling propeller fans PF-1, 2, 3 and 4 including associated electrical and DDC controls. Mechanical contractor to coordinate with controls contractor (ESC).
- .2 The Owner may accept any of the alternatives and corresponding alternative prices in any order or combination, including all or none.
- .3 Alternatives and alternative prices are open for acceptance by the Owner for the same period of time as the bid price, notwithstanding the award of the Contract.
- .4 The Work of the Contract and the Contract Price will reflect the alternatives and alternative prices, if any, accepted by the Owner at the time of contract award, and
- .5 Acceptance of any alternatives will not affect the bid price contract completion time, unless specifically indicated as an increase or decrease in time, in number of days, on account of a particular alternative.
- .6 Refer also to GC 4.1 of the Stipulated Price Construction Contract and Appendix B of the Form of Tender.

END OF SECTION 01050

1 SCHEDULING OF THE WORK

- .1 Within seven working days of award of contract provide to the Consultant a detailed schedule describing the sequence and timing of the work.
- .2 All work described in contact documents must be completed during the 4-week facility summer shut-down period. The systems are to be commissioned and operational prior to re-opening of facility. The facility shutdown is expected to be from August 3, 2019 to August 31, 2019.
- .3 Coordination is required with pool operator for drain down of pools in order to facilitate contractors erection of any required scaffolding and temporary construction support.

2 COORDINATION OF THE WORK

- .1 Coordinate all mechanical work with the work of other sections to avoid conflict.
- .2 Locate distribution systems, equipment and materials to eliminate interference, conserve headroom and leave maximum usable space.
- .3 The drawings are approximately to scale. They establish a scope of work only and are not intended as detailed installation instructions. Methods of construction required to attain the scope of work indicated on the drawings, confirmation of site measurements and attaining a level of quality as described in the specification are the responsibility of the Contractor
- .4 Route piping and ductwork in an orderly manner. Generally, follow routes parallel and perpendicular to building structure.
- .5 If interference should occur the Consultant will review relocation of equipment and materials regardless of installation order. No installation shall proceed without complete coordination between all trades.
- .6 Make any necessary minor changes or additions to runs of ducts or pipes, etc., to accommodate structural conditions without additional charge or expense to the Owner.
- .7 Alter location of ducts or pipes at the direction of the Consultant without charge to the Owner, so long as the change is made before installation and does not necessitate additional materials.

3 CONTRACTOR'S RESPONSIBILITIES

- .1 It shall be the General Contractor's responsibility to plan, schedule and perform the work and to coordinate the work of all sub-trades. The General Contractor shall be responsible for any damage caused to the Owner or other Contractors by failure to perform these duties.

- .2 Protect work performed and areas of the existing building from damage caused by carrying out of work. Pay particular attention to protection of building vapour barriers, waterproof membranes and existing interior and exterior surfaces. Where necessary to protect building surfaces using tarpaulins, plastic sheet, drop-cloths, etc. Repair any damage caused by the work to the satisfaction of the Owner and the Consultant.
- .3 Be responsible for the condition of all materials and equipment supplied to the site.
- .4 Obtain copies of the following Owner's policies and procedures, and ensure adherence to the requirements of these by all employees of the Contractor and sub-Contractors working on the site.
 - .1 Harassment
 - .2 Smoking
 - .3 Parking
 - .4 Security
 - .5 Safety
- .5 Be responsible for security of the property and equipment within the building, where that property or equipment can be impacted by the contractor's negligence or failure to secure the building.
- .6 Coordinate with the Owner any requirement to shut down mechanical systems or utility services to accommodate service connections. Do not shut down any such services without written consent from the Owner.
- .7 Any work that will generate excessive noise, odour or dust, or that may set off building fire detection equipment or alarms must also be scheduled with The Owner to ensure minimal impact to all ongoing facility activities.

4 SEQUENCING OF THE WORK

- .1 The required sequence of changeover from existing to new mechanical equipment is as follows:
 - .1 Complete demolition of all systems as noted on plans
 - .2 Install all new mechanical equipment, ductwork, piping, etc. During this phase of the work none of the new equipment will be operational.
 - .3 Perform system start-up, balancing and commissioning.
 - .4 Remove all redundant equipment, piping and ductwork.

- .5 Where existing materials are required to be removed earlier in the described sequence, to allow installation of new materials and equipment, contact the consultant to discuss a strategy for removal from service of existing equipment.

END OF SECTION 01150

1 CODES, STANDARDS AND PERMITS

- .1 Obtain and pay for any permits required for the work to be carried out.
- .2 The work shall be in performed in accordance with the regulations of the following authorities:
 - .1 2018 British Columbia Building Code
 - .2 Canadian Standards Association
 - .3 Technical Safety BC
 - .4 Worksafe BC (WCB)
- .3 Ventilation systems and equipment shall be installed and conform to the followings standards.
 - .1 ASHRAE
 - .2 SMACNA
 - .3 Equipment manufacturers and suppliers recommendations.
- .4 Installation and equipment shall conform to the requirements of the plans and specifications.

2 INSTALLATION REQUIREMENTS

- .1 Installation and equipment shall conform to the requirements of the plans and specifications.
- .2 Install equipment in locations shown with minimum interference with other services or free space.
- .3 All HVAC equipment shall be located with full service access and height. Remove and replace improperly installed equipment to satisfaction of the consultant at no extra cost.
- .4 Piping and ductwork shall be installed in such a way as to conserve head room and interfere as little as possible with the free use of space through which they pass. Service lines shall run parallel or perpendicular to building lines. All duct and pipes at ceiling level shall be kept as tight as possible to beams or other limiting structural members. All pipes and ducts shall be coordinated in elevation to ensure that they are concealed in the ceiling space.
- .5 Provide seismic restraints for all equipment, piping and ductwork when required by code.

- .6 The Mechanical Contractor shall coordinate with the General Contractor locations of pipe trenches, roof openings and wall openings to accommodate ducts and pipes, cutting and patching of beams, walls, floor slabs and masonry work necessary for hanger rods, brackets and sleeves.
- .7 Relocate improperly located holes and sleeves.
- .8 Drill for expansion bolts, hanger rods, brackets, and supports.
- .9 Repair building where damaged from equipment installation, improperly located holes etc. by this section of the work. This repair work shall be carried out by the specialist trade at the expense of this section of work. Use matching materials as specified in the respective sections.
- .10 HVAC and plumbing systems shall be of institutional quality

3 INSPECTIONS OF THE WORK

- .1 Do not conceal any installation prior to review by the consultant or the appropriate inspection authority. Ensure 72 hours written notice is provided to each of these parties prior to requirement for an inspection of the work. This includes any pressure tests of piping, ductwork or safety devices.
- .2 Provide certificates and inspection reports received from applicable authorities with jurisdiction, verifying that work installed conforms to necessary codes and standards.

4 GUARANTEE-WARRANTY

- .1 The Contractor shall furnish a written warranty stating that all work executed will be free from defects of material and workmanship for a period of one year from the date of total performance.
- .2 The warranty shall include any part of equipment, units or structures furnished hereunder that show defects in the works under normal operating conditions and/or for the purpose of which they were intended.
- .3 The Contractor further agrees that they will, at their own expense, promptly investigate any mechanical or control malfunction, and repair or replace all such defective work, and all other damages thereby which becomes defective during the time of the guarantee-warranty.

5 TRADE QUALIFICATIONS

- .1 Installation must be carried out by skilled tradesman holding a valid TQ license, or apprentices working under the supervision of a licensed tradesman. When apprentices are working, the licensed tradesman for each discipline must be on the site. These requirements apply to the installation of the following components of the project:
 - .1 Pipefitting for plumbing, solar water and pool water systems

- .2 Pipefitting for hydronic heating and chilled water systems
 - .3 Sheet Metal
 - .4 Structural
 - .5 Roofing
 - .6 Electrical
-
- .2 Should the Contractor opt to use apprentices on the project a minimum level of supervision of one Journeyman for each two Apprentices must be maintained.
 - .3 The Journeyman must be on site at all times. The Apprentices must not work without the direct supervision of a Journeyman.
 - .4 The Contractor shall submit names and qualifications of all personal (including sub-trades) intended for this project within twenty one (21) days of contract award. The Owner reserves the right to accept or reject any individual proposed for the project, on the basis of qualifications.

END OF SECTION 01200

1 SHOP DRAWINGS

- .1 Provide PDF copies of shop drawings for the equipment listed below, in accordance with MCA-BC standards.
- .2 Shop drawings shall indicate all aspects of the construction and operating performance of the product proposed.
- .2 Identify materials and equipment by manufacturer trade name and model number. Include copies of applicable brochure or catalog material.
- .3 Clearly mark submittal material using arrows, underlining or circling to show specific model numbers if equipment sheets are generic, differences from specified products, ratings, capabilities and options being proposed. Cross out non-applicable materials.
- .4 Specifically note on the submittal specified features such as special tank linings, pumps, seals, material, or painting.
- .5 Include dimensional and technical data sufficient to check if equipment meets requirements. Include wiring, piping, and service connection data and motor sizes.
- .6 Shop drawings shall be endorsed by the General Contractor and Mechanical Sub-contractor indicating that the shop drawings have been reviewed and submitted without qualifications.
- .7 Provide for:
 - .1 Custom Air Handling Units
 - .2 Hydronic Pumps
 - .3 Propeller fans
 - .4 Grilles, Diffusers and Dampers
 - .5 Heat Exchanger
 - .6 Expansion Tanks
 - .7 Water systems chemical treatment
 - .8 Glycol
 - .9 Thermostatic Mixing Valve
 - .10 Controls

2 OPERATING AND MAINTENANCE MANUALS

2.1 CONTRACTUAL RELATIONSHIP

- .1 The work of this section will be performed by a Testing, Adjusting and Balancing (TAB) Agency retained by the contractor.
- .2 The Contractor's obligation for manuals is to provide the following documentation to the TAB agency:
 - .1 TWO clean paper, and PDF copies of
 - .1 A copy of all Shop Drawings. Version included is to be the version given "Reviewed" status by the Consultant.
 - .2 "Record" controls shop drawings
 - .3 Manufacturer representatives' equipment start-up reports for:
 - .1 Custom Air Handling Units
 - .2 A digital copy in Microsoft Word format of
 - .1 Controls end-to-end check verification lists provided by Controls Contractor
 - .2 Hydrostatic tests performed on new;
 - .1 Domestic water piping
 - .2 Heating and Chilled water piping
 - .3 Inspection certificates for
 - .1 Domestic water piping
 - .4 Certificate of Guarantee
 - .5 List of equipment manufacturers and suppliers and sub-contractors used on the project.
 - .6 A valve schedule. Refer also to Section 15020.

2.2 REQUIRED CONTENT OF OPERATION AND MAINTENANCE MANUALS

- .1 The Operating and Maintenance manuals are to be submitted in hard cover three ring binders) The front cover and spine of the binders are to be labeled with the text
***"MECHANICAL SYSTEMS OPERATING AND MAINTENANCE MANUAL –
RAVENSONG AQUATIC CENTRE – MECHANICAL UPGRADE - 2019"***

- .2 The TAB Agency is to provide two hard copies and two digital (CD-ROM) copies in PDF format of then Operating and Maintenance Manual for the completed installation.
- .3 Organize the manuals into sections as described below, with each section labeled with celluloid covered tabs. For shop drawings organize into sub-sections mirroring numbering of the mechanical specification. Indicate the appropriate specification section in the main index and put the shop drawings into the manuals in this order.

Part 1 – Description of Systems:

- .1 Title page indicating project title and the names, addresses, telephone and fax numbers of the Owner, Mechanical Engineer, General Contractor, Mechanical Contractor and the agency preparing the manuals.
- .2 Description of systems, including description of system operation and components comprising the system. Describe systems operation and sequence of control operation, including start-up, shutdown and intended response of system components to controlling devices.

Part 2 – Maintenance and Test Information

- .1 Maintenance procedures and lubrication requirements, including preventative maintenance procedures, lubrication schedules and a belt schedule.
- .2 List of equipment manufacturers and suppliers and sub-contractors used on the project.
- .3 Copies of hydrostatic tests performed on new;
 - .1 Domestic water piping
 - .2 Heating and Chilled water piping
- .4 Inspection certificates for
 - .1 Domestic water piping
- .5 Balancing reports for air and water systems
- .6 Equipment verification checklists. Checklists are to be provided for:
 - .1 Custom Air Handling Units
 - .2 Hydronic Pumps
 - .3 Propeller fans
 - .4 Controls
- .7 Controls end-to-end check verification lists provided by Controls Contractor
- .8 Equipment start-up reports.

- .9 Contractor's Certificate of Guarantee

Part 3 - Shop Drawings

- .1 Include a copy of all Mechanical Shop Drawings. Version included is to be the version given "Reviewed" status by the Consultant.
- .2 Control shop drawings to be "As-Built" version, and include all system schematics, points lists and sequence of operations

3 RECORD DRAWINGS

- .1 Maintain a set of record drawings at the site. Record drawings shall be neatly maintained on a set of prints provided to the Contractor by the Mechanical Consultant.
- .2 Drawings are to be maintained in an up to date condition at all times, recording all changes and deviations to the installation from those indicated on the construction issue drawings. The "record drawings shall include, but not be limited to, the following changes and shall be recorded daily.
- .1 Size, location, arrangement, route and extent of ductwork, piping, conduit, terminal units, equipment, fixtures, cleanouts, valves, rough-in, etc., Above and below grade inside the building, including locations of buried piping.
- .2 Include all revision drawings, supplementary drawings, change orders, addenda and site revisions, etc. on the as-built drawings.
- .3 At the time of Substantial Completion the Contractor shall engage and pay for services of either a competent drafting service or the Consultant to transfer the changes from the site record drawings to electronic drawing files. The Consultant will provide electronic files of the construction issue drawings to the alternate drafting service if required.
- .4 When the electronic drawing files are revised with the changes previously recorded on site by the Contractor, the Contractor will have a set "ARCH D" prints of the electronic drawings plotted, add the notation "Certified Record Drawings", and date and sign the drawings. Alternatively, the contractor may "digitally sign" the PDF copy of the Record drawings in lieu of providing hard copy signed drawings. The hard copy set (ARCH D) and the electronic drawing files in both AutoCAD DWG format and ADOBE PDF format are to be submitted for the Consultants review before turning over to the Owner.

END OF SECTION 01250

1 EQUIPMENT STORAGE AND PROTECTION

- .1 The Owner will designate storage areas for tools and equipment. The Contractor shall assign and coordinate storage facilities for sub-Contractors within these designated areas.
- .2 Prevent damage of material and equipment during delivery, handling, storage and after installation, until final acceptance. Leave factory covers in place. Take special precautions to prevent entry of foreign material into working parts of piping and duct systems.
- .3 All mechanical materials and equipment stored on site shall be kept in a dry storage area and stored in accordance with supplier's instructions.
- .4 Operate, drain and flush out bearings and refill with new change of oil, before final acceptance.
- .5 Thoroughly clean piping, ducts and equipment of dirt, cuttings, and other foreign material.
- .6 Protect bearings and shafts during installation. Grease shafts and sheaves to prevent corrosion. Supply and install necessary extended nipples for lubrication purposes.
- .7 Provide temporary filters on all return air grilles and in all ventilation systems if the units must be run before the building is in a clean, operating condition.
- .8 Prior to the owners demonstration, provide written certification that all ductwork is clean and that all temporary filters have been replaced with new filters.
- .9 Touch-up damaged factory finished surfaces using primer or enamel to match original. Do not paint over nameplates under any circumstances.

2 PROJECT CLEANLINESS

- .1 Maintain Work in tidy condition, free from accumulation of waste products and debris, including other than that caused by Owner or other Contractors.
- .2 Remove waste materials from site at daily regularly scheduled times dispose of as directed by RDN. Do not burn waste materials on site.
- .3 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.
- .4 Provide on-site containers for collection of waste materials and debris.
- .5 Provide and use marked separate bins for recycling.
- .6 Dispose of waste materials and debris off site.

- .7 Clean interior areas prior to start of finishing work, and maintain areas free of dust and other contaminants during finishing operations.
- .8 Store volatile waste in covered metal containers and remove from premises at end of each working day.
- .9 Provide adequate ventilation during use of volatile or noxious substances. Use of building ventilation systems is not permitted for this purpose.
- .10 Use only cleaning materials recommended by manufacturer of surface to be cleaned, and as recommended by cleaning material manufacturer.
- .11 Schedule cleaning operations so that resulting dust, debris and other contaminants will not fall on wet, newly painted surface nor contaminate building systems.
- .12 All work described in contract documents must be performed in a manner which allows the building to function without interruption.
- .13 If in the opinion of the Owner or the Consultant adequate clean up is not maintained, cleaning will be performed by Owner's forces and the Contractor will be back charged at a rate of \$50.00 per hour plus supplies and equipment for all such cleaning required.

3 FINAL CLEANING

- .1 When work is substantially performed remove surplus products, tools, construction machinery and equipment not required for performance of remaining work.
- .2 Remove waste products and debris other than that caused by others, and leave Work clean and suitable for occupancy.
- .3 Prior to final review remove surplus products, tools, construction machinery and equipment.
- .4 Remove waste products and debris other than that caused by owner or other contractors.
- .5 Remove waste materials from site at regularly scheduled times, do not burn waste materials on site.
- .6 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.
- .7 Clean and polish glass, mirrors, hardware, wall tile, stainless steel, chrome, porcelain enamel, baked enamel, plastic laminate and mechanical and electrical fixtures. Replace broken, scratched or disfigured glass.
- .8 Remove stains, spots, marks and dirt from decorative work, electrical and mechanical fixtures, furniture fittings, walls and floors.

- .9 Clean lighting reflectors, lenses and other lighting fixtures impacted by this project
- .10 Vacuum clean and dust building interiors, behind grilles, louvers and screens.
- .11 Inspect finishes fitments and equipment and ensure specified workmanship and operation.
- .12 Broom clean and power wash exterior walks, steps and surfaces; rake clean other surfaces of grounds as impacted by this project.
- .13 Remove dirt and other disfiguration from exterior surfaces.
- .14 Sweep and power wash paved areas.
- .15 Clean equipment and fixtures to sanitary condition; replace filters of mechanical equipment.
- .16 Remove debris and surplus materials from crawl area and other accessible concealed spaces.

4 SITE SAFETY

- .1 All work shall be carried out in a safe and orderly manner, consistent with applicable Worksafe BC (WCB) safety regulations.
- .2 Provide any required scaffolds, hoists and ladders require to safely carry out the work.
- .3 The Contractor shall provide and keep up to date a Fire Safety Plan in accordance with Part 8 of British Columbia Building Code, Worksafe BC and to satisfy the requirements of the local Authorities.
- .5 Provide first aid facilities to the requirements of the Workers Compensation Board for all employees and authorized visitors to the construction site.

5 REDUNDANT EQUIPMENT

- .1 The Owner retains right of first refusal for any old equipment indicated as being removed.
- .2 The materials and equipment are to be formally turned over to the Owner's designated site representative. The Contractor is to prepare a letter for countersigning by the Owner's representative that the equipment has been turned over in a condition acceptable to the Owner.
- .3 All other redundant materials and equipment are to be removed from the site and disposed of in a manner conforming to Worksafe BC and any applicable environmental codes and standards.

END OF SECTION 01300

1 CONTRACTOR'S ACCESS TO BUILDINGS

- .1 Access to the building shall be co-ordinated through Mike Chestnut, the Superintendent of Aquatic Services. (Telephone (250) 752-5014).
- .2 Keys are available to be signed out for inside access only. Master outdoor keys will not be issued.
- .3 Any keys which are given and registered by the Contractor must be returned at completion of the project. Lost keys will require the facility be re-keyed at the Contractors expense.
- .4 All work described in contact documents must be performed in a manner which allows the building to function without interruption.
- .5 All Contractors are required to wear photo ID, bearing the logo of the employer and the employees name and photograph.

2 CONTRACTOR'S USE OF THE BUILDING

- .1 Sanitary Facilities: The washrooms within the buildings may be used by the Contractor but must be maintained in a clean and orderly manner. If the Owner deems that maintenance of the washrooms is unacceptable, the Contractor will be required to provide temporary washroom facilities for the duration of the project. Be responsible for all damages thereto.
- .2 Water Supply: The water supply may be used by the Contractor provided damage to piping or valves does not occur. Be responsible for all damages thereto.
- .3 Temporary Power and Light: The permanent power and lighting system of the building or portions thereof may be used subject to approval of the Owner and the Consultant. Be responsible for all damages thereto.
- .4 Telephone, Fax and Internet: The Contractor shall make provision for his own hook-ups for any required telephone, fax, or internet service required for the duration of the contract. Permanent telephone, fax, and internet equipment in the building are for occupant use only.
- .5 Noise Control
 - .1 Conform to Municipal Noise Control Bylaws including hours of work.
 - .2 Workers shall refrain from use of loud and vulgar language. Non-compliance to this policy will result in the specific worker(s) involved being required to immediately leave the site and to be permanently removed from any subsequent involvement on this project by the Contractor.
 - .3 Use of loud radios shall be prohibited.

- .6 Smoking Policy
 - .1 The Owner has a no-smoking policy anywhere on the property, including in service and mechanical rooms, attics, crawlspaces, basements and the fields.
 - .2 All construction personnel will be required to conform to this policy.
 - .3 The Contractor shall be responsible for enforcement of this requirement.

END OF SECTION 01400

1 SUBMITTALS

- .1 Operation and Maintenance Manuals
 - .1 Operation and Maintenance Manuals will be supplied by the TAB Agency retained by the Contractor
 - .2 Final O+M manuals, including final commissioning reports, letters of warranty and all required inspection certificates are to be submitted at or before the time of Total Completion. Total Completion will not be granted without this requirement being met.
 - .3 Refer to section 01250 for further details
- .2 Record Drawings
 - .1 Provide marked-up copies of record drawings for the Consultant's review at the time Substantial Completion is requested. Substantial Completion will not be granted without this requirement being met.
 - .2 Provide digital copies of record drawings and a hardcopy set authorized by the Contractor as "Record" at the time Total Completion is requested. Total Completion will not be granted without this requirement being met.
 - .3 Refer to section 01250 for further details

2 SUBSTANTIAL PERFORMANCE INSPECTION

- .1 Prior to requesting an inspection for Substantial Performance, the Contractor shall verify in writing that all the following items have been provided and that beneficial use of the building is available to the Owner.
 - .1 All systems shall be certified in writing as complete and fully operational.
 - .2 A complete list of items that are not finished or are deficient shall be provided. If, in the opinion of the Consultant, this list indicates the project is excessively incomplete, a substantial completion inspection will not be performed.
 - .3 The Contractor shall be fully responsible to accumulate all necessary data from this Sub-trades and suppliers and present it in the specified format for the approval by the Consultant.
- .2 If the Contractor requests an inspection for Substantial Completion and it is deemed by the Owner and/or Consultant that items not identified on the Contractor supplied list are not complete, the Contractor shall bear the Consultant's cost for subsequent site inspections.

3 PERFORMANCE VERIFICATION OF INSTALLED EQUIPMENT

- .1 Installed mechanical equipment whose performance is questioned by the Consultant, may be subject to performance verification as specified herein.
- .2 When performance verification is requested, equipment shall be tested to determine compliance with specified performance requirements.
- .3 The Consultant will determine by whom testing shall be carried out. When requested, the contractor shall arrange for services of an independent testing agency.
- .4 Testing procedures shall be approved by the Consultant.
- .5 Maintain building comfort conditions when equipment is removed from service for testing purposes.
- .6 Promptly provide the Consultant with all test reports.
- .7 Should test results reveal that equipment does not meet specified performance requirements, equipment will be rejected and the following shall apply:
 - .1 Remove rejected equipment. Replace with equipment which meets requirements of Contract Documents including specified performance requirements.
 - .2 Replacement equipment will be subject to performance verification as well, using same testing procedures on originally installed equipment.
 - .3 Contractor shall pay all costs resulting from performance verification procedure.

4 INSTRUCTION OF OPERATING STAFF

- .1 The TAB Agency will coordinate and run a training and instruction session for facility operating and maintenance personnel. Training time to be a minimum of four hours and include instruction on complete start-up sequence of all systems and equipment and review of all modes of operation, as indicated in the control sequence of operations.
- .2 Instruction to be during regular work hours.
- .3 The following sub-Contractors are required to participate and assist with the demonstration and training session
 - .1 Controls
 - .2 Balancing
 - .3 Manufacturers representative custom air handling units
- .4 The Contractor shall submit to the Consultant a document signed by Owner or his representative, stating:

- .1 The Owner has received satisfactory instruction in operation and maintenance of all equipment and systems.
- .2 Operation and maintenance manuals have been reviewed with Owner.
- .3 Specified spare parts of components, keys, removable handles and the like, have been turned over to the Owner.

5 TURNOVER OF EQUIPMENT

- .1 The Owner retains right of first refusal for any old equipment indicated as being removed.
- .2 The materials and equipment are to be formally turned over to the Owner's designated site representative. The Contractor is to prepare a letter for countersigning by the Owner's representative that the equipment has been turned over in a condition acceptable to the Owner.
- .3 All other redundant materials and equipment are to be removed from the site and disposed of in a manner conforming to Worksafe BC and any applicable environmental codes and standards.

6 KEYS AND SECURITY ITEMS

- .1 Return all keys to the Owner

END OF SECTION 01450

1 QUALITY ASSURANCE

- .1 The general trades work described below is to be performed by skilled tradesmen holding valid TQ licenses, or apprentices working under the supervision of a licensed tradesman.
- .2 When apprentices are working, the licensed tradesman for each discipline must be on the site.

2 PAINTING

- .1 All painting work shall conform to the standards of the Master Painters and Decorators Association. (MPDA).
- .2 Solvents to be odour free.
- .3 Paint materials shall meet the flame spread and smoke developed ratings indicated in Part 3 of the British Columbia Building Code, latest edition.
- .4 Paint products shall comply with CGSB standards.
- .5 Touch-up damaged finished equipment surfaces.
- .6 Surfaces shall be prepared as recommended in Chapter 2 and Chapter 3 of the Architectural Standards Manual of the MPDA.
- .7 Exterior ductwork shall be painted with weatherproof coating as described in Section 15320, Clause 5.
- .8 Natural gas piping shall be painted where exposed with solvent based primer and finish coat.
 - .1 Colour to be yellow, to CGSB 505-101
 - .2 Exposed natural gas pipe installed on the roof, in attics, crawl spaces and within ceiling plenums does not require painting, but is to be clearly identified with markers and banding, every 25 metres maximum spacing and in accordance with clause 14.1 above

3 ROOFING

- .1 Installation of new roof mounted air handling units is required by this project. The roofs are not under warranty. A roofing contractor who is a member of the Roofing Contractor's Association of British Columbia must be retained to perform roofing work related to the installation of these mechanical units.
- .2 Smoking shall be prohibited on the roof and in the immediate vicinity of propane tanks, glues and solvents.

- .3 The Contractor must have adequate fire extinguishing equipment on hand. A minimum of five 20 lb. multipurpose dry chemical extinguishers is required. There must be at least one fire extinguisher within 20 ft. horizontal travel distance of any torch applied roofing equipment. For larger roof areas, additional protections such as charged hose lines or additional extinguisher(s) may be required. The Contractor should be made aware of the location of fire hoses if they are available as well as the location of outside faucets from domestic water supply.
- .4 The Contractor or any supervisor on the job site must carry a phone and be aware of the location of the nearest accessible phone.
- .5 Any fires, even if extinguished, must be reported to both Facilities Services and the local Fire Department.
- .6 A minimum one-hour fire watch must be provided after completion of all hot work. All roof areas shall be checked for hot spots and signs of smoldering. The inside of the building immediately adjacent to the work shall also be checked for signs of fire or smoke.
- .7 Caution will be exercised when working around openings, penetrations or flashings. Extreme caution shall be exercised when working around exhaust vents, which may have grease or lint accumulations. Such accumulations shall be cleaned before roofing work is started.
- .8 Torches shall be used according to manufacturer's instructions. Torch stands should be used to direct flame upward when momentarily not in use. Torches should not be used where flame impingement cannot be fully viewed. Open flames should not be left unattended. Torches should not be used near gas lines, electrical wires or flammable liquids. All equipment should be inspected regularly and kept in good working order
- .9 Where practical, tar kettles and other heating appliances should be operated on grade rather than on the roof.
- .10 Unfinished work shall be fully covered by tarpaulins or plastic sheeting which is properly secured.
- .11 Roofing materials shall not be left unsecured at the job site where they may be dislodged by wind.
- .12 Drainage systems shall be cleared of construction debris or excess tar when work is complete.

4 REMOVAL AND REPLACEMENT OF CEILINGS

- .1 In most areas new piping and ductwork is intended to run exposed to minimize disruption to ceilings. Some removal of ceilings of GWB will be required, as indicated on the drawings.

- .2 Replacement of drywall ceilings to include 16-mm (5/8-inch) gypsum wallboard, mudding, taping, sanding and painting to the Owner's and the Consultants satisfaction.
- .3 Painting to match existing, surrounding building finishes.

6 FIRESTOPPING

- .1 Refer to Section 15340

END OF SECTION 01500

1 SCOPE OF WORK

- .1 Provide new, complete, operational and tested mechanical systems for heating, ventilation, air conditioning, controls, plumbing and fire protection systems, as described herein, indicated on the drawings and in full conformance with applicable codes, standards and ordinances.
- .2 Provide all labour, materials and products as specified and as required to accomplish this work.
- .3 The following general Divisions of the specification comprise the mechanical work of this project. The mechanical systems shall meet the performance guidelines of the following specifications.
 - .1 15000 Mechanical General Requirements
 - .2 15100 Testing, Adjusting and Balancing
 - .3 15200 Vibration and Seismic Control
 - .4 15300 Insulation
 - .5 15400 Plumbing Systems and Equipment
 - .6 15600 Heating Systems and Equipment
 - .7 15700 Air Conditioning Systems and Equipment
 - .8 15800 Air Distribution Systems and Equipment
 - .9 15900 Controls
- .2 Refer to the Table of Contents, Section 15001, for reference to specific specification sections included under each of the general Divisions noted above.

2 SUBMITTAL REQUIREMENTS

2.1 Shop Drawings

- .1 Refer to Division 01 for requirements of shop drawing submission.

2.2 Operating and Maintenance Manuals

- .1 Refer to Division 01 for requirements of operating and maintenance manuals submission.

2.3 Record Drawings

- .1 Refer to Division 01 for requirements of record drawings.

3 FALL RESTRAINT FOR ROOF MOUNTED MECHANICAL EQUIPMENT

- .1 Where possible locate any roof mounted mechanical equipment or access hatches at least two metres from the edge of any roof three metres or higher above surrounding grade.
- .2 Where equipment or hatches are located within two metres of the edge of a roof three metres or higher above surrounding grade, provide anchors (at least two per piece of equipment) to which fall restraint equipment can be secured by maintenance workers. Refer also to Part 11 of the Worksafe BC Occupational Health and Safety Regulation.
- .3 The anchors must be capable of withstanding a load of 800 lbs in any direction. The Mechanical Contractor is to retain the services of a Professional Engineer, registered in the Province of British Columbia to ascertain that all fall restraint anchors installed under this contract are of adequately capacity.
- .4 At the completion of the project obtain a letter bearing the seal of the Engineer stating that the fall restraint anchors are of adequate capacity and correctly installed.

4 ALTERATION WORKS

- .1 Where utilities are removed, relocated, or abandoned, cap, valve, plug or by-pass to make complete and working installation.
- .2 "Making good" is defined as providing new surfaces identical to the ones removed or disturbed and matching adjacent surfaces with no visible difference between new and existing. Where re-painting of a surface is required, paint to the entire surface between the nearest adjacent corners, ie: the entire plane of the surface containing the disturbed area.
- .3 Where concealed conditions differ from those indicated on the drawings the Contractor shall immediately inform the Consultant.

5 INSTRUCTION OF OWNER'S OPERATING STAFF

- .1 Refer to Division 01 for requirements of record drawings.

6 LAWS, NOTICES, PERMITS AND FEES

- .1 Give all necessary notices, obtain all necessary permits and pay all fees in order that the work specified may be carried out.
- .2 Furnish any certificates necessary as evidence that the work installed conforms with the law and regulations of all authorities having jurisdiction.

7 CASH ALLOWANCES

- .1 Cash Allowances are to be INCLUDED in the Base Amount of Tender for the following items.
 - .1 Cash Allowance No. 1 - For the cost of the Direct Digital Controls (DDC) system, the Contractor is to INCLUDE in the submitted tender a Cash Allowance amount of \$60,000.00.
 - .2 Cash Allowance No. 2 – For the cost of the Direct Digital Controls (DDC) associated with the alternations and re-commissioning of the solar hot water heating system, the Contractor is to INCLUDE in the submitted tender a Cash Allowance amount of \$12,000.00.
 - .2 Cash Allowance No. 3 - For AutoCad drafting of Record Drawings, INCLUDE in the submitted tender a Cash Allowance amount of \$1,000.00.
 - .3 Cash Allowance No. 4 – For testing, repair, replacement, required shipping and commissioning of existing 1500 gallon storage tank and tank accessories. INCLUDE in the tender a Cash Allowance amount of \$10,000.00.
- .2 The Cash Allowance amounts stated do NOT include Contractor's overhead and profit. The Cash Allowances pertain strictly to the work provided specific to the Cash Allowance (ie: commissioning, structural work, etc). The Contractor's overhead and profit for work pertaining to the Cash Allowances are to be included in the Contractors base tender.
- .3 The Cash Allowance amounts stated do NOT include Value added Taxes (GST).
- .4 Refer also to GC 4.1 of the Stipulated Price Construction Contract and Appendix E of the Form of Tender.

8 ALTERNATIVE PRICES

- .1 Provide the following Alternative Prices:
 - .1 Alternative Price No. 1 – Alterations and re-commissioning of the solar hot water heating system as shown on the drawings and specifications. Including Cash Allowance No.3, Cash Allowance No. 4 and all associated electrical and structural work.
 - .2 Alternative Price No. 2 – Factory testing of the custom air handling units AHU-1 and AHU-2.
- .2 The Owner may accept any of the alternatives and corresponding alternative prices in any order or combination, including all or none.
- .3 Alternatives and alternative prices are open for acceptance by the Owner for the same period of time as the bid price, notwithstanding the award of the Contract.

- .4 The Work of the Contract and the Contract Price will reflect the alternatives and alternative prices, if any, accepted by the Owner at the time of contract award, and
- .5 Acceptance of any alternatives will not affect the bid price contract completion time, unless specifically indicated as an increase or decrease in time, in number of days, on account of a particular alternative.
- .6 Refer also to GC 4.1 of the Stipulated Price Construction Contract and Appendix B of the Form of Tender.

END OF SECTION 15010

1 PRODUCTS – CONDITIONS FOR ACCEPTANCE

- .1 Base Bid means an item is specified by manufacturer and model number meets the specifications in all respects regarding performance, quality of material and workmanship and is acceptable to the Consultant without qualification. Base Bid equipment is as listed in the Specification and Mechanical Equipment Schedules and on the Drawings.
- .2 Approved Equal means the Consultant has deemed the manufacturer capable of producing material, fixture or equipment of comparable quality. Products supplied by an approved equal must match the specified product in performance, approximate dimensions, quality of material and quality of workmanship. If in the opinion of the Consultant material submitted for review does not meet these criteria, satisfactory material from the equal manufacturer shall be provided, or the Contractor will revert to the Base Bid product.
- .3 Alternate means the Consultant may deem a manufacturer capable of producing substitute material, fixture, or equipment which will fulfill project requirements but may differ in material, quality, performance, characteristics, methods of construction or mode of operation. Alternate equipment suggested by bidders will be indicated as a separate item, with applicable cost differences from the specified product(s). The bidders tender will include a product supplied by a manufacturer indicated in the approved equals list as a part of the bidders base tender price.
- .4 The use of an equal or alternate products shall in no way relieve Division 15 from the responsibility of furnishing all work that may be required by reason of different space, weight or electrical requirements from that of the specified manufacturer. If, in the opinion of the Consultant, such work is necessary and is not carried out in a manner, which will ensure satisfactory operation and performance of the equipment, then the specified manufacturer shall be used.
- .5 Request for review from manufacturers of materials, fixtures and equipment who are not listed as equal and wish to be accorded "equal" status, shall be made at least seven (7) days prior to close of tender. Such material, fixtures, and equipment shall meet the requirements for an equal as described in the Standard of Acceptance. All information required by the Consultant to evaluate proposed manufacturer shall furnish the proposal at the time of the request.
- .6 Mechanical systems have been designed based on equipment from the Base Bid manufacturer. The onus shall be on the Mechanical Contractor in conjunction with the equal or alternate supplier(s) to ensure that their equipment will meet the required performance characteristics, electrical characteristics, as well as fit properly into allotted space including allowing for the required access and service spaces. Any additional costs incurred as a result of modifications to the system or room layout, or modifications required by other trades shall be borne by the Mechanical Contractor.
- .7 Provide within 24 hours a list of equipment and manufacturers to be used on this project. This list shall not be deviated from unless delivery, performance, or dimension issues require a change to be reviewed by the Consultant.

- .8 If shop drawings of any product submitted are rejected on technical reasons after three submissions, the Contractor at no additional expense to the Owner shall revert the specified product and manufacturer for this project.

2 PRODUCTS – BASE BID AND APPROVED EQUAL MANUFACTURERS

Access Doors	Acudor, E.H. Price, Maxam, Mifab
Air and Dirt Separators	Armstrong, Bell & Gossett, Amtrol, Caleffi
Air Handling Unit - Custom	Haakon, Scott Springfield
Automatic Air Vent	Hoffman, Braukman, Sarco, Armstrong
Chemical Water Treatment	Pace, Suez
Control Dampers - Low Leakage	Tamco, Ruskin
Controls - DDC	ESC Automation
Dampers – Fire	Maxam, Ruskin, Tamco
Duct Cleaning	Enviro-vac, Ace Mobile, Power Suction Services
Ductwork – Flexible	Thermafex, Wiremold, Flexmaster, Canaflex
Ductwork – Round and Oval Spiral	Spiro-Lock, Ecco
Ductwork – Canvas Flexible Connectors	Durodyne, Ventlan
Expansion Tanks	Amtrol, Wessels, Elbi
Fans – Ceiling Mounted Propeller	Big Ass Fans
Filters	Farr, Continental, Cambridge, AAF
Firestopping and Smoke Seals	3M, Tremco, Hilti
Flow and Pressure Switches	Potter, System Sensor
Grilles, Registers and Diffusers	Titus, E.H. Price, Krueger, Tuttle & Bailey
Heat Exchangers – Plate	Alpha-Laval, Mueller, Armstrong, Bell & Gossett, Sondex
Identification – Pipe and Duct	3M, SMS, Duramark, Bradley

Insulation – Piping and Duct	3M, Dow, Fibrex, Knauf, Johns-Manville, Owens Corning, Pittsburgh Corning, Manson, Roxul, Fibreglass Canada, Certainteed
Insulation Jacketing	Childers, Fiberglas, Johns-Manville
Pipe Couplings - Grooved	Victaulic, Grinnell, Shur Joint
Pipe Couplings - Di-Electric	Watts, AG Specialties
Pipe Couplings - Flexible	Mason, Victaulic
Pipe Fittings and Flanges	Crane, Grinnell, Jenkins
Pipe Supports and Hangers	Crane, Unistrut, Myatt, Grinnell, Sarco, Hunt, Taylor
Pressure Gauges	Weiss, Ashcroft, Terrice, Marsh, Winter, Miljoco
Pressure Reducing Valves	Watts, Singer
Pressure Relief Valves	Watts, Singer, Braukmann, Conbraco, Sarco
Plumbing Fixtures	Refer to Section 15470
Pumps - In-Line Circulators	Grundfos, Taco, Armstrong, Bell & Gossett, WILO
Slack Cable Restraints	Square M, Vibra Sonic, VMC-Korfund
Strainers	Red & White, Sarco, Armstrong, Mueller, Watts, Conbraco
Testing, Adjusting and Balancing Agencies	Flotech, Perfectionaire
Thermometers	Weiss, Ashcroft, Terrice, Marsh, Winter, Miljoco
Valves (Ball, Gate, Globe, Check)	Red & White/Toyo, Grinnell, Watts, Kitz, Crane, Milwaukee, Conbraco
Valves (Butterfly)	Red & White/Toyo, Grinnell, Kitz, Crane
Valves (Balancing)	Armstrong, Grinnell

Valves (Circuit Balancing)	Tour & Anderson, Bell & Gossett, Armstrong
Valves (Drain)	Red & White/Toyo, Watts, Kitz, Conbraco
Vibration Isolation	Mason, Vibron, VMC-Korfund, Mason, LoRez

2 TEMPORARY USE OF EQUIPMENT

- .1 Permanent systems and equipment are not to be used during construction period without prior written consent from the Owner.
- .2 Heating systems may be used for temporary heating within the limitations specified below.
- .3 Equipment used during the construction period is to be thoroughly cleaned and overhauled. Replace worn or damaged parts so equipment is in perfect condition, to the satisfaction of the Owner and the Consultant.
- .4 Provide proper care, attention and maintenance for equipment while in temporary operation. If in the opinion of the Consultant sufficient care and maintenance is not being given to equipment and systems, the Consultant reserves right to forbid further use.
- .5 Temporary use of systems and equipment shall in no way affect the guarantee-warranty period on all mechanical systems installed, which comes into effect from the date of Substantial Performance.
- .6 Replace all filters in air systems and seals in pumps used during temporary operation just prior to turnover to the Owner.

3 ELECTRIC WIRING AND MOTORS

- .1 All electrical equipment supplied by the Mechanical contractor shall bear CSA label. Obtain special inspection labels required by Provincial Authority having jurisdiction for equipment that does not have a CSA label and/or a ULC label.
- .2 All electrical equipment and wiring shall conform to requirements of Canadian Electrical Code, the Provincial Electrical Inspector and specified standards.
- .3 All electrical motors shall conform to CEMA and CSA standards for hard, continuous service, designed to limit temperature rise to 40 deg C for open housing and 50 deg C for drip proof housing, and operate 1200 or 1800 RPM unless otherwise specified. Do not use air over ratings.
- .4 Motors shall have ball or roller type bearings with grease lubrication fittings.
- .5 All belt-driven motors shall be mounted on adjustable bases with adjusting screws

so that proper belt tension can be obtained.

- .6 Motors of 15 KW and greater shall have capacitor and thermistor over heat protection.
- .7 Motor noise criteria shall not exceed NC-60.
- .8 Motors shall meet or exceed BC Hydro Power Smart High Efficiency standards.
- .9 All motors shall meet or exceed requirement necessary for variable frequency drive applications when this technology is used.
- .10 It shall be the responsibility of Division 15 to supply high efficiency motors with proper voltage characteristics to suit electrical distribution systems and suitable construction such as explosion-proof, dust-proof, part wind starting, etc., as required to suit operating conditions. Division 15 is responsible of complete working installation and must coordinate all electrical and control work.
- .11 Division 16 will provide and install all power wiring and connection of such to motor driven mechanical equipment.
- .12 Division 16 will provide and install motor starters for electric motors except where equipment is furnished with integral starters.
- .13 Division 15 shall provide and install all control wiring required to operate the mechanical systems, whether line or low voltage.

4 IDENTIFICATION

4.1 Piping

- .1 Identify fluids in piping with markers showing name, pipe size and service, including temperature and pressure where relevant, and with arrows to indicate flow direction.
- .2 Use ANSI/ASME A13.1 – 2007 standard for identification of pipes with respect to colour coding and pipe marker size.
- .3 Standard of Acceptance: WH Brady identification tapes, bands, and markers.
- .4 For retrofit projects match existing identification system present in building.

4.2 Ductwork

- .1 On ductwork use black 50 mm high stenciled letters to indicate duct size, duct function (ie: "Supply", "Exhaust") and air handling unit or fan (ie: AHU-1, EF-1, SF-1) to which the duct is connected. Use arrow to indicate air flow direction.
- .2 Identify duct runs at least once in every room and maximum 50 ft. between markings.
- .3 The nomenclature for identification of equipment shall be consistent with the

designations in the plans and specifications.

4.3 Valves and Controllers

- .1 Provide all valves with brass or plastic WH Bradey or equivalent, minimum 40mm (1-1/2") diameter with 10mm (3/8") stamped numbers filled with black paint secure by brass chains; or 5" hooks to the valve handle. Valves adjacent to plumbing fixtures, convectors, unit heaters and entrance heaters need not be tagged. Prepare an approved list detailing the valve location, tag numbers and purpose its serves; also indicated on the As-Built drawings.
- .2 Provide for all operable valves on all piping systems.
- .3 Provide a valve list showing the tag number, the location of the valve and its use, for inclusion in the Operation and Maintenance Manuals.

4.4 Ceiling Access Panel Identification

- .1 The location of terminal units, valves, etc. above ceiling panels shall have their location identified by means of a data dot. In the case of T-bar ceilings, the data dot shall be placed on the metal T-bar rail, not on the ceiling tile.

4.5 Equipment

- .1 Provide factory supplied and installed nameplate on each piece of equipment.
- .2 Provide registration/approval nameplates (ie. CSA, ULC, ASME) in accordance with the requirements of authorities having jurisdiction.
- .3 Identify all mechanical equipment with lamacoid plastic plates 100mm x 35mm x 2.5mm (4" x 1-1/4" x 1/8") thick, with beveled edges having engraved white letters onblack background giving the nature of equipment service and its number (ie., "Washroom Exhaust EF-1", "Pump P1"). Provide plates with 12mm (1/2") lettering for motor starters and automatic controls and 25 mm (1") lettering for equipment and terminal units. Mechanically fixed to the equipment in a conspicuous location.

5 START UP OF MECHANICAL SYSTEMS AND EQUIPMENT

- .1 Give the Consultant 72 hours written notice of date of start-up or commissioning of equipment or systems.
- .2 From the time of equipment or systems commissioning there shall be a three week stabilization period during which the Contractor shall ensure that all systems are functioning as intended. After the three week stabilization period, provide written confirmation that systems are fully compliant with requirements of the contract documents. This will be a requirement of Substantial Performance of the work.

6 ACCESS DOORS

- .1 All installed equipment must be fully accessible for service to the Owner's and WorkSafe BC standards. Any equipment which is not reasonably accessible for service will be relocated at no cost to the Owner.
- .2 For adjustment and maintenance of valves, dampers, coils and terminal units, or for inspection of safety devices, provide access doors in ducts and for installation by General Contractor in walls and ceilings.
- .3 Where any access doors are to be installed in a fire separation, the door provided shall meet the fire rating so as to maintain the integrity of the separation.
- .4 Minimum size of access doors for hand access to be 225-mm x 225-mm (9-inch x 9-inch).
- .5 Minimum size of access doors for man access to be 450-mm x 450-mm (18-inch x 18-inch) except where duct width is insufficient.

END OF SECTION 15020

1 CONTRACTUAL RELATIONSHIP

- .1 The Chemical Treatment Specialist will be retained and paid by the Mechanical Contractor but must be the agency the Owner typically deals with.
- .2 The Contractor is to obtain and include a price for Chemical Treatment work provided PACE Chemicals Ltd. or Suez Water Technologies & Solutions.

2 SCOPE OF CHEMICAL TREATMENT WORK

2.1 Quality Assurance

- .1 At completion of the heating water installation thoroughly flush the system and retain a water treatment specialist to chemically treat the system. The chemical treatment sub-trade will supply for installation by the mechanical contractor a chemical pot-feeder and all chemicals and coupons required for the operation of the system until the expiry of the one-year warranty from the time of Substantial Completion.
- .2 During the one-year warranty period, at 6 months and 12 months from the date of Substantial Completion, the chemical treatment sub-trade will monitor the levels of chemical treatment in the heating system and add chemicals as required to maintain the required levels of treatment necessary for control of nitrates and chromates and to provide adequate corrosion protection.
- .3 The water treatment chemicals and treatment process shall be supplied and performed by the Contractor. This work shall be supervised by the Water Treatment Specialist who, upon completion shall certify that the process is satisfactory and submit a report outlining the cleaning operation and the treatment process for inclusion in the Operations and Maintenance manual.
- .4 Notify Consultant 72 hours prior to chemical cleaning so that work may be verified and inspected.

2.2 Submittals

- .1 Submit shop drawings including proposed chemicals, quantities, calculations, procedures and equipment to be supplied. Provide written operating instructions and system schematics.
- .2 Provide written report containing log and procedure of system cleaning, giving times, dates, problems encountered and condition of water.
- .3 Submit written report containing test results and list of chemicals added from the time of commissioning to Substantial Completion and at the 6-month and 12-month system reviews during the one-year warranty period following Substantial Completion.

3 EXECUTION

3.1 Pre-Operational Cleaning and Chemical Treatment

- .1 All systems must be chemically cleaned and flushed before water treatment is added. This includes partial or complete filling for pressure testing.

- .2 Flush each section of the heating and chilled water systems independently. Flush all 3-way control valves fully open in each position. Flush all reheat coils and terminal devices independently of the remainder of the system. Where duty and standby pump are provided, run both pumps in parallel for increased flow during the flushing period. The system and all components shall be flushed a minimum of 72 hours prior to chemical treatment.
- .3 Provide drain connections to drain system in one hour.
- .4 All drains for chemical treatment shall be piped to the sanitary sewer.
- .5 Install totalizing water meter(s) and record capacity in each system.
- .6 After all components of the piping system have been pressure tested and proven to be in full operational condition and leak free, flush entire system with fresh, clean make-up water to remove loose mill scale, sediment and construction debris.
- .7 After initial flushing has been completed, clean all strainer screens. **DO NOT FLUSH SYSTEMS THROUGH THE BOILERS OR HEAT PUMPS.**
- .8 System pumps may be used for cleaning, provided that pumps are dismantled and inspected, worn parts repaired with new gaskets and seals installed. Submit used seals.
- .9 Add cleaner to closed systems at concentration levels recommended by the Water Treatment Specialist.
- .10 For hot water heating systems, apply heat while circulating, raise temperature slowly to 70°C and maintain at 70°C for minimum of 12 hours. Remove heat and circulate at 40°C or less. After cleaning, drain system as rapidly as possible. Flush system by opening drain valves and opening bypass valve on water make-up to system. Continue flushing until test show pH, Iron, TDS and Chloride levels of water leaving system are the same as entering system. Install corrosion coupons, refill system and immediately add water treatment to proper level.
- .11 Use neutralizing agents upon recommendation of the Water Treatment Specialist and as approved by Consultant.
- .14 Inspect, remove sludge and flush low points with clean water after cleaning process is completed. Include disassembly of components as required.

3.2 Cleaning and Chlorination of Potable Water Piping

- .1 All domestic and solar water piping shall be thoroughly flushed so that it is free from scale, sediment, construction debris etc.
- .2 Retain an independent inspection firm to supervise and inspect the chlorination and flushing procedures and perform chemical tests as required.

- .3 On completion of installation and testing of the potable water systems, pre-flush, chlorinate with Sodium Hypochlorite to AWWA C-601 specifications and let stand for 24 hours. Thoroughly flush again until flush water meets AWWA standards.
- .4 Remove two samples of water 24 hours after chlorinating and provide test lab results of samples.
- .5 Both sample tests must indicate less than 10 PPM residual chlorine and less than 1 PPM total coliform. If not, repeat the chlorination and testing procedure until satisfactory results are obtained.
- .6 Include documentation from the testing laboratory in the Operation and Maintenance Manual, indicating water test results obtained.
- .7 Acceptable Firms: PACE Chemicals Ltd., Suez Water Technologies & Solutions.

4 PRODUCTS

4.1 Materials

- .1 System Cleaner: Use a Sodium Metasilicate, Sodium Nitrite and a wetting agent compound which in solution removes grease and petroleum products. Concentration level to be determined by Water Treatment Specialist. (PACE Chemicals Ltd. – PURGEX L-24 or approved equal)
- .2 Closed System Treatment (Hot Water, Chilled Water): Use all-organic based corrosion inhibitor. Maintain levels at 60 to 100 ppm. (PACE Chemicals Ltd. – BAR COR CWS-105 or approved equal.) *Note: The use of Nitrite only, Molybdate only or Sulphite only will not be accepted.*
- .3 Provide sufficient chemicals to treat the system from the time of commissioning to acceptance of the building. In addition, provide a stock of chemicals, filters and corrosion coupons suitable for twelve (12) months normal operation.
- .4 Materials which may contact finished areas must be colourless.

4.2 Equipment

- .1 Closed System Heating and Chilled Water Loops
 - .1 Bypass Pot Feeder: existing to remain.
 - .2 Sidestream Filter: All closed hot water and chilled water systems shall have a sidestream filter housing of steel construction using 250 mm x 30 micron filter cartridge, with a minimum flow rate of 0.6 L/s per minute (9 USGPM). A Flow Indicator shall be installed in conjunction with the sidestream filter. Connections shall be 20 mm MxFNPT and all isolating valves shall be installed as per manufacturer's instructions. Include filter cartridges.
 - .3 Totalizing Make-up Water Meter: existing to remain.
 - .4 Chemical Feed Piping: Schedule 40 black steel

- .5 Corrosion Coupon and Holder Assembly:
 - .1 Mild steel corrosion coupon.
 - .2 Holder, 20 mm or 25 mm NPT male connection.
 - .3 Provide malleable or cast iron cross, 20 mm or 25 mm NPT female connection.
- .2 Refer to drawings for piping assembly and hook-up.

5 GLYCOL SYSTEM

- .1 Label all drain valves with "GLYCOL – DO NOT DRAIN".
- .2 Pre-mix solution in mixing tank, demonstrate specific gravity of solution to Owner and charge system using feed pump. After system has been filled, check specific gravity of solution in each system. Leave mixing tank with specified glycol solution. Secure cover lid.

5.1 Glycol Feed System

- .1 Automatic feed system:
 - .1 Use Existing Glycol Fill tank
- .2 Supply and install propylene glycol, complete with corrosion inhibitors, to the following concentrations:
 - .1 Solar Hot Water System: for all piping, provide a sufficient glycol to achieve a solution with 25% concentration of propylene glycol (by weight).

6 TEST KITS

- .1 Provide test kits to determine proper systems treatment, including but not limited to the following:

6.1 Glycol System Specific Gravity Test Kit

- .1 To determine freezing point of glycol systems. To contain a suitable hydrometer cylinder, a 300 mm specific gravity hydrometer equivalent to Kessler Model 8350 with scale range of 1.000 – 1.110 at .001 specific gravity increments and a 305 mm brass armoured, mercury-filled thermometer equivalent to Kessler Model 2048/3252 with scale range of -35°C to +50°C. Provide a chart showing the specific gravity of the specified solution by volume, at a specified temperature. (PACE Chemicals Test Kit #127 or approved equal.)

END OF SECTION 15050

1 CONTRACTUAL RELATIONSHIP

- .1 The TAB Agency will be retained and paid by the Mechanical Contractor.

2 SCOPE OF BALANCING WORK

- .1 Balancing of supply air systems
- .2 Balancing of return air systems.
- .3 Balancing of exhaust air systems
- .4 Balancing of building relief air systems.
- .5 Balancing of heating water systems
- .6 Balancing of chilled water systems
- .7 Balancing of solar hot water heating system
- .8 Submission of air and water balance report
- .9 Cooperation with the building verification agency if different than this balancing agency. Refer to Section 15130.

3 REFERENCE STANDARDS AND QUALITY ASSURANCE

- .1 Air and water systems balancing will be performed by an agency that has demonstrated experience in balancing mechanical systems of this scope. Refer to Section 15020 for listing of agencies approved to perform this work.
- .2 Air systems balancing shall be in general accordance with the AABC "National Standards for Field Measurement and Instrumentation" and ASHRAE standards.
- .3 All measuring instruments utilized by the balancing agency shall be accurate, with recent documented calibration test results. Supply such test results if requested by the Consultant.
- .4 The balancing agency shall include for two eight-hour days of time on site following occupancy of the building to perform spot checks and make adjustments requested by the Owner or Consultant.

4 SUBMITTAL REQUIREMENTS

- .1 The TAB agent will provide a report, in both hard copy and PDF digital format, for inclusion in the Operating and Maintenance Manuals, describing the final balanced operating conditions of the mechanical systems outlined below.

- .2 A preliminary copy of the report is to be submitted for the Consultant's review two weeks prior to Substantial Performance, and the final version submitted at the time of Substantial Performance. Submission of the final report will be a requirement of declaration of Substantial Performance.

5 WATER SYSTEMS BALANCING

5.1 Heating Water System

- .1 Systems Requiring Balancing
 - .2 Secondary distribution heating circuits affected by scope of work. Pumps are located in the mechanical room.
 - .3 Flow through all AHU heating coils.
- .2 Indicate in the balance report:
 - .1 Operating performance (design vs actual) for all secondary circuit pumps.
 - .2 Temperature and pressure drops in the secondary loops.
 - .3 Flow through all AHU heating coils.
 - .4 Temperature drops in all AHU heating coils.
 - .5 Motor HP draw, lock rotor amperage, running load amperage and motor RPM of each pump.
- .3 Procedures
 - .1 Use a portable differential pressure meter in conjunction with circuit balancing valves to determine flow rates and pressure drop characteristics of required water systems.
 - .2 Balance water flow rates to between 100% and 105% of design requirements
 - .3 Use the following sequence to adjust water volumes to design amounts in individual systems
 - .1 Where pump delivery substantially exceeds system requirements, and manufacturer's pump curves indicate a reduction in impeller size will accomplish required flow, trim impellers to match pump performance to system characteristics. The cost of doing so will be considered as an extra cost to the contract.
 - .2 Set balance valves.
 - .3 Do not use service or shut-off valves for balancing water systems.

- .4 Mark the final balance position of heating water balancing valves.

5.2 Chilled Water System

- .1 Systems Requiring Balancing
 - .2 Secondary distribution cooling circuits. Pumps are located in the mechanical room
 - .3 Flow through all AHU cooling coils.
- .2 Indicate in the balance report:
 - .1 Operating performance (design vs actual) for chilled water pumps.
 - .2 Temperature and pressure drops in the heat pump and distribution loops.
 - .3 Temperature and pressure drops in all AHU cooling coils
 - .4 Motor HP draw, lock rotor amperage, running load amperage and motor RPM of each pump.
- .3 Procedures
 - .1 Use a portable differential pressure meter to determine flow rates and pressure drop characteristics of required water systems.
 - .2 Balance water flow rates to between 100% and 105% of design requirements
 - .3 Use the following sequence to adjust water volumes to design amounts in individual systems
 - .1 Where pump delivery substantially exceeds system requirements, and manufacturers pump curves indicate a reduction in impeller size will accomplish required flow, trim impellers to match pump performance to system characteristics. The cost of doing so will be considered as an extra cost to the contract.
 - .2 Set balance valves.
 - .3 Do not use service or shut-off valves for balancing water systems.
 - .4 Mark the final balance position of cooling water balancing valves.

5.3 Solar Hot Water Heating System

- .1 Systems Requiring Balancing
 - .1 Secondary distribution heating circuits. Pumps are located in the mechanical room.

- .2 Flow through solar water heater and solar water heat exchanger.
- .2 Indicate in the balance report:
 - .1 Operating performance (design vs actual) for all primary and secondary circuit pumps.
 - .2 Temperature and pressure drops in the primary and secondary loops.
 - .3 Flow through all solar water heaters and solar water heat exchanger.
 - .4 Temperature drops in all solar water heaters and solar water heat exchanger.
 - .5 Motor HP draw, lock rotor amperage, running load amperage and motor RPM of each pump.
- .3 Procedures
 - .1 Use a portable differential pressure meter in conjunction with circuit balancing valves to determine flow rates and pressure drop characteristics of required water systems.
 - .2 Balance water flow rates to between 100% and 105% of design requirements
 - .3 Use the following sequence to adjust water volumes to design amounts in individual systems
 - .1 Where pump delivery substantially exceeds system requirements, and manufacturer's pump curves indicate a reduction in impeller size will accomplish required flow, trim impellers to match pump performance to system characteristics. The cost of doing so will be considered as an extra cost to the contract.
 - .2 Set balance valves.
 - .3 Do not use service or shut-off valves for balancing water systems.
 - .4 Mark the final balance position of heating water balancing valves.

6 AIR SYSTEMS BALANCING

- .1 Systems Requiring Air Balancing
 - .1 Natatorium AHU-1, AHU-2
 - .2 Existing AHU-3X, AHU-4X
 - .3 Existing RF-3X, RF-4X

- .2 Indicate in the balance report:
 - .1 Operating performance (design vs actual) of all fans and air systems.
 - .2 Air flow from each overall fan system and individual supply and exhaust outlets.
 - .3 Outdoor air flow from each air handling unit, with outdoor air damper at minimum position.
 - .4 Inlet and outlet pressure of each air handling unit and exhaust fan. (Total system pressure drop)
 - .5 Motor HP draw, lock rotor amperage, running load amperage and fan and motor RPM of each air handling unit.
 - .6 Airflow through individual supply and exhaust grilles
- .3 Procedures
 - .1 Measure air flow in ducts by velocity traverse of entire cross section of duct.
 - .2 Ensure all test holes are properly sealed after use with rubber grommet type plugs.
 - .3 Balance air quantities to between 100% and 105% of design requirements
 - .4 Use the following sequence to adjust air volumes to design amounts in individual systems
 - .1 Adjust fan speed or blade angle where possible as the first step towards balancing. When the design target is outside the range of the sheave provided install a replacement sheave of the required size.
 - .2 Second, provide major volume control in main and branch ducts only by use of duct balancing dampers, not by throttling of terminal grilles, registers or diffusers.
 - .3 Finally provide minor adjustment at terminal inlet and outlets may be by throttling of individual dampers or grille blades.
 - .5 Adjust discharge pattern controllers on diffusers and registers to attain draft-free air distribution.
 - .6 Permanently mark the positions of balancing dampers.

7 PROPELLER FANS SYSTEM BALANCING

- .1 Systems Requiring Air Balancing
 - .1 Propeller Fans PF-1 to PF-4
- .2 Indicate in the balance report:
 - .1 Operating performance (design vs actual) of all fans and air systems.
 - .2 Air flow from each overall fan system and individual fans.
 - .3 Motor HP draw, lock rotor amperage, running load amperage and fan and motor RPM of each fan.
- .3 Procedures
 - .1 Confirm the minimum speed setting of the fans with the fan manufacturer.
 - .2 Fans to be set at the minimum speed setting. 14% or 10Hz (Maximum speed is 60Hz).
 - .3 Measure the air speed at the finished floor/water level halfway between two fans and directly below one of the fans (or as close to these locations as possible)
 - .4 Report the air speeds measured above.
 - .5 Further reduction in fan speed may be required in order to meet the target air speed of 30-40 FPM at the water surface.
 - .6 Follow manufacturers instructions to modify VFD settings in the field to further reduce the speed of the fans if required. Repeat steps 3 through 6 as required).

END OF SECTION 15120

1 CONTRACTUAL RELATIONSHIP

- .1 The TAB Agency will be retained and paid by the Mechanical Contractor.
- .2 The Contractor's responsibility will be to coordinate the timing for the TAB work when it is required, and to cooperate with the TAB processes. This will include assistance with:
 - .1 The Controls Contractor will provide documentation confirming physical end-to-end checks all control points have been performed.
 - .2 When requested the Controls Contractor will assist the TAB agency in verifying software programming language.
 - .3 When requested the Controls Contractor will assist the TAB agency in simulating system operation by opening and closing control valves and dampers and enabling motor driven mechanical equipment
 - .4 Coordinate and supervise the start-up of the various pieces of equipment and systems. Utilize the start-up services of the manufacturer's representatives listed in Section 01250.
 - .5 Ensure that all the equipment is operating in a satisfactory manner.
 - .6 Resolve inter-contractor co-ordination problems. Where problems become apparent during the commissioning process, work at the identification and resolution of these problems.

2 SCOPE OF VERIFICATION WORK

- .1 The TAB agency shall provide the following scope of services to review, inspect and verify all mechanical systems installed under this contract are operating in conformance to the design intent.
 - .1 Review of the drawings and specifications as issued for construction, and confirmation to the Owner and Consultant that the TAB agent understands the intended and design intent and specified sequence of operations. The TAB agent shall allow adequate time to review with the Owner and Consultant the design intent of the project and the intended operation.
 - .2 Verification of condition and operation of installed equipment and reporting on such as indicated below.
 - .3 Review of the air and water balance report, and coordination with the balancing agent to ensure that all systems are functioning as intended.
 - .4 Participating in end-to-end checks on all specified sequence of operations, working in conjunction with the DDC contractor. Initial each device listed on the Control system checkout sheets provided under section 15910 to verify these end to end checks were carried out.

- .5 Co-ordinate and supervise the start-up of equipment and systems as specified below. Utilize the start-up services of the manufacturers representative where specified. Ensure that the equipment is operating in a satisfactory manner.
- .6 Resolve inter-contractor coordination problems. Where problems become apparent during the TAB process, work at the identification and resolution of these problems.
- .2 Organize and conduct the demonstration to the Owner of all mechanical equipment and systems supplied under this contract. The demonstrations shall occur only after the operation and testing has been successfully completed. Equipment suppliers and the balancing agent shall participate in the demonstration as required. The DDC contractor must attend the systems demonstration.
- .3 The TAB agent bears the responsibility to ensure the mechanical installation functions as intended, or to indicate if certain components of the systems cannot operate as intended, why such is the case and what is recommended to rectify the problems.
- .4 The TAB agent will coordinate the work of the mechanical contractor, electrical contractor, balancing agent and controls contractor, including organization and chairing of any meetings required between these parties to resolve and coordinate the TAB process. The co-operation of all trades is essential for an efficient and planned process. A team comprising the above parties is recommended along with an owner's representative.
- .5 The TAB agent will be responsible for verification of the performance and operation of all equipment supplied under the Division 15 contract.
- .6 The TAB agency shall possess computers, cables, and software needed to operate the building control system. This requires the TAB agency to be properly licensed and/or trained to run the Control contractor's software.

3 QUALITY ASSURANCE

- .1 The TAB process shall be consistent with the "Code of Practice for Commissioning Mechanical Systems in Buildings".
- .2 Within seven days of tender closing provide the name, qualifications, and experience of the TAB coordinator to the Owner and Consultant.
- .3 At the time of the schedule submittal, also submit proposed testing recording sheets and procedures for review.
- .4 The TAB Agency shall include for TWO four-hour days of time on site following occupancy of the building to perform checks and recommend adjustments if requested by the Owner or Consultant.

4 DOCUMENTATION

- .1 The TAB agent will provide a report, in both hard copy and PDF digital format, for inclusion in the Operating and Maintenance Manuals, verifying correct operation of all mechanical systems in the building, including trend logs of system operating conditions.
- .2 The report will include a statement that all systems are operational and functioning as intended, checklists indicating tests and control checks carried out on each system, and that control operation of each system is operating as intended. Or if this is not the case, why such is not the case and suggested procedures to rectify the situation.
- .3 A preliminary copy of the report is to be submitted for the Consultant's review two weeks prior to Substantial Performance, and the final version submitted at the time of Substantial Performance. Submission of the final report will be a requirement of declaration of Substantial Performance.
- .4 Submission of the final report will be a requirement of declaration of Substantial Performance.

5 SYSTEMS

5.1 Heating Water System

- .1 General System Requirements
 - .1 Verify the physical completion of the installation.
 - .2 Verify pressure tests are completed and check for any leaks in the installation.
 - .3 Verify installation of all required control equipment, including temperature and pressure sensors, required wells, flow switches, etc.
 - .4 Verify the flushing and chemical cleaning of the system and correct installation and operation of chemical treatment equipment.
 - .5 Verify correct sequencing of all control functions, including coordination of such with the DDC contractor.
- .2 Terminal Units
 - .1 Verify adequate flow through all AHU heating coils.
 - .2 Verify correct operation of control valves serving each of these terminal units, in conjunction with controlling device, DDC and non-DDC.
- .3 Pumps
 - .1 Verify correct direction of rotation of pump impellers.

- .2 Verify alignment of pump impellers.
- .3 Verify pumps are adequately greased and lubricated.
- .4 Verify seals are functioning correctly.

5.2 Chilled Water System

- .1 General System Requirements
 - .1 Verify the physical completion of the installation.
 - .2 Verify pressure tests are completed and check for any leaks in the installation.
 - .3 Verify installation of all required control equipment, including temperature and pressure sensors, required wells, flow switches, etc.
 - .4 Verify the flushing and chemical cleaning of the system and correct installation and operation of chemical treatment equipment.
 - .5 Verify correct sequencing of all control functions, including coordination of such with the DDC contractor.
- .2 Terminal Units
 - .1 Verify adequate flow through all AHU heating coils.
 - .2 Verify correct operation of control valves serving each of these terminal units, in conjunction with controlling device, DDC and non-DDC.
- .3 Pumps
 - .1 Verify correct direction of rotation of pump impellers.
 - .2 Verify alignment of pump impellers.
 - .3 Verify pumps are adequately greased and lubricated.
 - .4 Verify seals are functioning correctly.

5.3 Solar Hot Water Heating System

- .1 General System Requirements
 - .1 Verify the physical completion of the installation.
 - .2 Verify pressure tests are completed and check for any leaks in the installation.

- .3 Verify installation of all required control equipment, including temperature and pressure sensors, required wells, flow switches, etc.
- .4 Verify the flushing and chemical cleaning of the system and correct installation and operation of chemical treatment equipment.
- .5 Verify correct sequencing of all control functions, including coordination of such with the DDC contractor.
- .2 Terminal Units
 - .1 Verify adequate flow through all heat exchangers
 - .2 Verify correct operation of control valves serving each of these terminal units, in conjunction with controlling device, DDC and non-DDC.
- .3 Pumps
 - .1 Verify correct direction of rotation of pump impellers.
 - .2 Verify alignment of pump impellers.
 - .3 Verify pumps are adequately greased and lubricated.
 - .4 Verify seals are functioning correctly.

5.4 Supply Air Systems

- .1 Verify the physical completion of the installation.
- .2 Verify pressure tests are completed and check for any leaks in the installation.
- .3 Verify installation of all required control equipment, including temperature and pressure sensors, required wells, sail switches, etc.
- .4 Verify positioning and marking of correct position of all balance dampers by the balancing agent
- .5 Verify all fire dampers are in the open position and are functional.
- .6 Verify filters are installed and sealed in place.
- .7 Verify correct direction of rotation of all fans.
- .8 Verify all systems are operating quietly.
- .9 Verify alignment of fan drives
- .10 Review the air balance report and verify that adequate airflow is attained throughout each system.

- .11 Verify correct sequencing of all control functions, including coordination of such with the DDC contractor.

5.5 Exhaust Air Systems

- .1 Verify the physical completion of the installation.
- .2 Verify installation of all controls
- .3 Verify positioning and marking of correct position of all balance dampers by the balancing agent
- .4 Verify all fire dampers are in the open position and are functional.
- .5 Verify correct direction of rotation of all fans.
- .6 Verify all systems are operating quietly.
- .7 Verify alignment of fan drives
- .8 Review the air balance report and verify that adequate airflow is attained throughout each system.
- .9 Verify correct sequencing of all control functions, including coordination of such with the DDC contractor.

5.6 Thermostatic Mixing Valve

- .1 Verify correct and stable installation and operation of thermostatic mixing valve.

END OF SECTION 15130

1 SCOPE OF WORK

- .1 Vibration spring isolators for motor driven fans and pumps with electric motors 1/2 HP and greater and on associated piping and ductwork.
- .2 Canvas flexible connections for ductwork
- .3 Braided steel flexible connections for steel piping

2 VIBRATION ISOLATION - GENERAL

- .1 Coordinate with Division 15800 for flexible connections on ductwork connections to fans or plenums.
- .2 Do not bridge isolation elements.
- .3 For isolated equipment provide vibration isolation to withstand without failure or yielding a static load of 2g minimum, acting through the centre of gravity.
- .4 For all equipment mounted on vibration isolators, provide a minimum clearance of 50-mm (2 inches) to other structures, piping, equipment, etc.
- .5 Factory installed isolators for packaged air handling units must comply with the requirements of this section.
- .6 Supply all of the vibration isolation equipment by one approved supplier. The vibration isolation supplier shall provide assistance to the contractor as necessary during the course of installation of isolation equipment
- .7 Vibration isolator housings are considered a safety guard with respect to isolated equipment and any contained compressed springs. Include "Fail Safe" seismic restraint in all vibration isolation designed to hold mechanical equipment and springs in place
- .8 Isolators shall be of the following types, as required, supplied by the manufacturers named, or other acceptable manufacturers listed or approved.

3 HANGERS

- .1 Spring hangers c/w 6 mm (0.25") thick sound pads sized for 25-mm (1-inch) minimum static deflection. Design is based on Vibron Series VH or Mason HD, HS.
- .2 Provide for ceiling hung fans and pumps

4 FLEXIBLE DUCT CONNECTIONS

- .1 Provide flexible duct connectors of Durodyne with Durolon fabric or approved equal.

- .2 Install 75-mm (3-inch) flexible duct connections with a minimum 40-mm (1 ½ inches) metal to metal gap.
- .3 Flexible duct connections shall be installed so that duct size is not reduced by the deflection of the flexible connector.

5 FLEXIBLE PIPE CONNECTIONS

- .1 At the last elbow before piping leaves the mechanical room and where piping passes through building expansion joints provide flexible stainless steel hose with stainless steel braid and carbon steel fittings. Sizes 75-mm (3-inch) and larger shall be flanged. Smaller sizes shall have male nipples,
- .2 Hoses shall be installed on the equipment side of the shut-off valves horizontally and parallel to the equipment shafts wherever possible.
- .3 Design is based on Type SSLFH as manufactured by Mason Industries or approved equal

END OF SECTION 15220

1 SCOPE OF WORK

- .1 Seismic restraint of piping systems
- .2 Seismic restraint of duct systems
- .3 Seismic restraint of motor driven equipment
- .4 Seismic restraint of non-motor driven equipment

2 SEISMIC RESTRAINT - GENERAL

- .1 Provide restraints on all ceiling hung isolated equipment, piping and ductwork in accordance with National Building Code of Canada and SMACNA "Guidelines for Seismic Restraints of Mechanical Systems and Plumbing Piping Systems."
- .2 Retain the services of a Professional Engineer, registered in the Province of British Columbia, and specializing in the design of seismic restraint systems or structural engineering to ascertain that all mechanical equipment installed under this contract are adequately seismically restrained.
- .3 Design seismic restraints to meet the structural requirements of the British Columbia Building Code
- .4 It is the responsibility of the Contractor's Seismic Engineer to ascertain that an appropriate size restraint device is selected for each piece of equipment.
- .5 At the completion of the project obtain a letter bearing the seal of the Engineer, for inclusion in the Operation and Maintenance Manuals, stating that the mechanical installation is seismically restrained in accordance with Building Code and SMACNA requirements.

3 SEISMIC RESTRAINT OF PIPING SYSTEMS

- .1 Provide seismic restraint for all piping systems installed under this contract with the following exceptions:
 - .1 Water piping in mechanical equipment rooms of 32 mm (NPS 1-1/4) diameter and smaller.
 - .2 All other piping of 65 mm (NPS 2-1/2) diameter and smaller.
 - .3 All piping suspended by individual hangers 300 mm (12 inches) or less in length from the top of pipe to the bottom of the support for the hanger.
 - .4 All piping suspended by hangers 300 mm (12 inches) or less in length from the top of the duct to the bottom of the support for the hanger.

4 SEISMIC RESTRAINT OF DUCT SYSTEMS

- .1 Provide seismic restraint for all ductwork systems installed under this contract with the following exceptions:
 - .1 All rectangular air handling ducts less than 0.56 sq. meters (6 sq. ft.) in cross sectional area.
 - .2 All round air handling ducts less than 710 mm (28 inches) in diameter.
 - .3 All ducts suspended by hangers 300 mm (12 inches) or less in length from the top of the duct to the bottom of the support for the hanger.

5 SEISMIC RESTRAINT OF MOTOR DRIVEN EQUIPMENT

- .1 Connect slack cable restraints to ceiling hung or in-line pumps in such a way that the axial projection of the wires passes through the centre of gravity of the equipment. Orient the restraint wires at approximately 90 degrees to each other (in plan), and tie back to the ceiling or structure above at an angle not exceeding 45 degrees.
- .2 Rooftop air handling units AHU-1 and AHU-2 will be supplied with seismically rated roof curbs. The Contractor's Seismic Engineer will determine appropriate methods of seismic attachment of the curbs to the roof structure.

6 SEISMIC RESTRAINT OF NON-ISOLATED EQUIPMENT

- .1 Bolt all non-isolated equipment, to the structure. Design anchors and bolts for 2g applied horizontally through the centre of gravity.
- .2 Applicable to
 - .1 Hydronic system expansion tanks
 - .2 Existing glycol fill tank
 - .3 Heat Exchangers
 - .4 Existing domestic hot water pre-heat tank (PHT-1)
- .3 The use of perforated steel strap hangers to attach tanks to walls is not permitted for this project.

END OF SECTION 15230

1 SCOPE OF WORK

- .1 Domestic hot, cold and hot water recirculation piping
- .2 Heating water piping
- .3 Chilled water piping
- .4 Solar hot water piping
- .5 Storm water piping

2 QUALITY ASSURANCE

- .1 Install insulation to the requirements of the latest edition of the British Columbia Insulation Contractors Association Standards Manual for Mechanical Insulation. Code numbers quoted refer to this specification for installation standards. Code numbers quoted refer to this specification for installation standards.
- .2 Provide materials conforming to British Columbia Building Code requirements for maximum smoke developed rating of 50 and flame spread rating of 25.

3 HEATING WATER PIPE INSULATION (including Solar Hot Water Pipe)

- .1 Provide 38-mm (1.5 inch) thick mineral fibre thermal insulation on all heating water piping smaller than 38-mm (1.5 inch) – not including 38-mm (1.5 inch) pipe.
- .2 Provide 50-mm (2 inch) thick mineral fibre thermal insulation on all heating water piping 38-mm (1.5 inch) and larger.
- .3 All insulation to be type A-2 as defined by BCICA Quality Standards specification 1501-H.
- .4 Where exposed, piping shall be covered with either a continuous white PVC jacket or a canvas covering with white PVC elbows to protect insulation from damage.
 - .1 Exposed pipe is defined as the following:
 - .1 Installed below ceilings
 - .2 Installed below structure or underside of roof where no ceiling is installed
 - .3 In mechanical service rooms
 - .2 Concealed pipe is defined as:
 - .1 Installed above dropped ceilings
 - .2 Installed inside walls

- .3 Installed inside furred vertical or horizontal pipe chases
- .5 Insulate over pipe flanges to provide continuous insulated surface.
- .6 Wherever insulation is not applied to the heating water system, such as on gauge stems, pumps, air separators, unions and valves, apply a coating of non-toxic, liquid thermal insulation such as Robson Thermal Thermalite-SG to prevent potential for burns. Apply to manufacturers recommendations.
- .7 Where exposed on the roof pipe insulation shall be covered with a continuous aluminum jacket.

4 CHILLED WATER PIPE INSULATION

- .1 Provide 38-mm (1-1/2 inch) thick mineral fibre thermal insulation on all chilled water piping.
- .2 All insulation to be type A-2 as defined by BCICA Quality Standards specification 1501-C.
- .3 Where exposed, piping shall be covered with either a continuous white PVC jacket or a canvas covering with white PVC elbows, to protect insulation from damage.
 - .1 Exposed pipe is defined as the following:
 - .1 Installed below ceilings
 - .2 Installed below structure or underside of roof where no ceiling is installed
 - .3 In mechanical service rooms
 - .2 Concealed pipe is defined as:
 - .1 Installed above dropped ceilings
 - .2 Installed inside walls
 - .3 Installed inside furred vertical or horizontal pipe chases
- .4 Provide high density type A3 calcium silicate insulation at locations of pipe hangers and sheet metal insulation shields between insulation and pipe support.
- .5 Insulate over pipe flanges to provide continuous insulated surface. Also insulate over shut-off valves, balance valves, strainers, air separators and chilled water pumps to avoid condensation.
- .6 Where insulation is not applied to the chilled water system, such as on gauge stems, pumps, air separators, unions and valves, apply a non-toxic, no sweat coating, such as Robson Thermal Manufacturing "No-Sweat FX". Apply to manufacturers recommendations.

- .7 Where exposed on the roof pipe insulation shall be covered with a continuous aluminum jacket.

5 DOMESTIC WATER PIPING

- .1 Provide mineral fibre thermal insulation on all domestic, hot, cold and hot water recirculation. All insulation to be type A-2 as defined by BCICA Quality Standards specifications 1501-H and 1501-C.
- .2 Where exposed (not above dropped ceilings or inside walls) piping shall either a continuous white PVC jacket or a canvas covering with white PVC elbows, to protect insulation from damage.
- .3 On cold water pipe hangers provide high density type A3 calcium silicate insulation at locations of pipe hangers and sheet metal insulation shields between insulation and pipe support
- .4 Insulate over pipe flanges to provide continuous insulated surface. Also insulate over shut-off valves, water meter and domestic water booster pumps to avoid condensation.
- .5 Wherever insulation is not applied to the domestic cold water system, such as on gauge stems, pumps, water hammer arrestors, unions and valves, apply a non-toxic, no sweat coating, such as Robson Thermal Manufacturing "No-Sweat FX". Apply to manufacturers recommendations.
- .6 Wherever insulation is not applied to the any domestic hot water system heating intended to operate at 60 deg C (140 deg F) or higher, such as on gauge stems, pumps, water hammer arrestors, unions and valves, apply a coating of non-toxic, liquid thermal insulation such as Robson Thermal Thermalite-SG to prevent potential for burns. Apply to manufacturers recommendations.
- .7 Domestic Cold Water Piping
- .1 All pipe with 25 mm (1 inch) thick insulation
- .8 Domestic Hot Water Piping
- .1 38 mm (1-1/2 inches) and under – 25 mm (1 inch) thick insulation
- .2 50 mm (2 inches) and over – 38 mm (1 ½ inch) thick insulation

6 SOLAR WATER PIPING

- .1 Provide mineral fibre thermal insulation on all new solar water piping. All insulation to be type A-2 as defined by BCICA Quality Standards specifications 1501-H and 1501-C.
- .2 Where exposed (not above dropped ceilings or inside walls) piping shall either a continuous white PVC jacket or a canvas covering with white PVC elbows, to protect insulation from damage.

- .3 Insulate over pipe flanges to provide continuous insulated surface. Also insulate over shut-off valves, water meter and domestic water booster pumps to avoid condensation.
- .4 Wherever insulation is not applied to the any pool water piping system (new sections only) such as on gauge stems, pumps, water hammer arrestors, unions and valves, apply a coating of non-toxic, liquid thermal insulation such as Robson Thermal Thermalite-SG to prevent potential for burns. Apply to manufacturers recommendations.
- .5 Solar Water Piping
 - .1 38 mm (1-1/2 inches) and under – 25 mm (1 inch) thick insulation
 - .2 50 mm (2 inches) and over – 38 mm (1 ½ inch) thick insulation
- .6 Where exposed on the roof pipe insulation shall be covered with a continuous aluminum jacket.

7 POOL WATER PIPING

- .1 Provide mineral fibre thermal insulation on all new pool water piping. All insulation to be type A-2 as defined by BCICA Quality Standards specifications 1501-H and 1501-C.
- .2 Where exposed (not above dropped ceilings or inside walls) piping shall either a continuous white PVC jacket or a canvas covering with white PVC elbows, to protect insulation from damage.
- .3 Insulate over pipe flanges to provide continuous insulated surface. Also insulate over shut-off valves, water meter and domestic water booster pumps to avoid condensation.
- .4 Wherever insulation is not applied to the any pool water piping system (new sections only) such as on gauge stems, pumps, water hammer arrestors, unions and valves, apply a coating of non-toxic, liquid thermal insulation such as Robson Thermal Thermalite-SG to prevent potential for burns. Apply to manufacturers recommendations.
- .4 Pool Water Piping
 - .1 All pipe with 25 mm (1 inch) thick insulation

8 FASTENINGS, ADHESIVES, COATINGS

- .1 Provide all wire insulation fastenings, staples, adhesive tapes, contact adhesives and barrier coatings as required for a complete, neat insulation installation and finish.

- .2 Insulation Fastenings
 - .1 16 gauge galvanized or copper wire
- .3 Jacket Fastenings
 - .1 Thermocanvas: Staples, compatible jacket finishing tape with contact adhesive as recommended by jacket supplier.
 - .2 PVC Covering: Staples and PVC self adhesive tape.
- .4 Adhesives
 - .1 Vapour barrier jacket adhesive: Bakelite 230-39, Childers CP-82 or Foster 85-20.
 - .2 Fabric adhesive: Bakelite 120-18, Childers CP-52 or Robson Thermal White Lag.
- .5 Finish Jackets
 - .1 Thermocanvas jacket: S. Fattal Thermocanvas or Robson Thermal Flamex FR Canvas.
 - .2 All Service jacket: Knauf ASJ, Manson AP or fibreglass ASJ
- .6 Cement
 - .1 Fibrex Supercote or Ryder Thermokote
- .7 Preformed PVC Covers
 - .1 Supplied by S. Fattal, Childers or Knauf

9 EXECUTION

- .1 No insulation is to be applied prior to all hydrostatic testing of pipe installations and confirmation from the Consultant and the Building Inspector that all piping is installed in conformance with code and specification requirements.
- .2 Clean and degrease piping and hanger rods to assure proper adhesion of insulation materials.
- .3 Ensure that insulation is clean and dry during installation and application of all finishes.
- .4 Install insulation with smooth and even surfaces.
- .5 Apply insulation materials, accessories and finishes in accordance with manufacturer's recommendations.

- .6 Protect insulation of exposed pipes passing through floors with 1.3 mm galvanized iron jacket to 300 mm (12 inches) above finished floor.
- .7 Terminate insulation at unions and flanges on low temperature systems, at pipe hangers with insulation cement, to CGSB 51-GP-6, trowelled on and with a smooth bevelled finish.
- .8 Allow for radial expansion of pipe and permit pipe to move longitudinally inside insulation and to expand and contract without opening up joints between sections.

END OF SECTION 15310

1 SCOPE OF WORK

- .1 Flexible internal duct liner in external supply air systems.
- .2 Flexible internal duct liner in supply and return air systems.

2 QUALITY ASSURANCE

- .1 Install insulation to the requirements of the latest edition of the British Columbia Insulation Contractors Association Standards Manual for Mechanical Insulation. Code numbers quoted refer to this specification for installation standards. Code numbers quoted refer to this specification for installation standards.
- .2 Provide materials conforming to British Columbia Building Code requirements for maximum smoke developed rating of 50 and flame spread rating of 25.

3 INTERNAL DUCT INSULATION

3.1 Flexible Acoustic Duct Liner for Exterior Supply Air Systems

- .1 Where acoustic duct liner is indicated on the drawings provide 50-mm (2-inch) thick, closed-cell, moisture resistant, elastomeric acoustic duct liner with washable surface, Nomaco K-Flex Gray Duct Liner, Rubatex Insul-sheet R-1800 FS Elastomeric Insulation, AP Armaflex or approved equal.
- .2 Apply to the following ductwork where indicated on the drawings.
 - .1 Exterior AHU-1 and AHU-2 Supply Air Ductwork
- .3 Application
 - .1 Attach duct liner to pins at 300-mm (12-inches) on centre. Pins to be spot welded to inside surface of duct. Do NOT use pressure sensitive adhesives.
 - .2 In round ductwork, to anchor duct liner material in place provide 38-mm (1.5-inch) wide, 24-gauge steel bands on inside surface of duct liner at each joint of liner material.
- .4 Acoustic duct liner to meet the following standards
 - .1 NFPA 90A For materials used in air distribution systems
 - .2 UL 181 For air erosion (No break-up or delamination of interior surface at air velocities up to 2500 FPM.
 - .3 ASTM C-1071 For fungal and bacterial growth
 - .4 ASTM C-209 For water absorption (Maximum 0.2% by volume)
 - .5 Thermal conductivity $k = 0.277 \text{ BTU / hour-ft-deg F}$

3.2 Flexible Acoustic Duct Liner for Supply and Return Air Systems

- .1 Where acoustic duct liner is indicated on the drawings provide 25-mm (1-inch) thick, closed-cell, moisture resistant, elastomeric acoustic duct liner with washable surface, Nomaco K-Flex Gray Duct Liner, Rubatex Insul-sheet R-1800 FS Elastomeric Insulation, AP Armaflex or approved equal.
- .2 Apply to the following ductwork where indicated on the drawings.
 - .1 AHU-1 and AHU-2 Supply Air
 - .2 AHU-1 and AHU-2 Return Air
- .3 Application
 - .1 Attach duct liner to pins at 300-mm (12-inches) on centre. Pins to be spot welded to inside surface of duct. Do NOT use pressure sensitive adhesives.
 - .2 In round ductwork, to anchor duct liner material in place provide 38-mm (1.5-inch) wide, 24-gauge steel bands on inside surface of duct liner at each joint of liner material.
- .4 Acoustic duct liner to meet the following standards
 - .1 NFPA 90A For materials used in air distribution systems
 - .2 UL 181 For air erosion (No break-up or delamination of interior surface at air velocities up to 2500 FPM.
 - .3 ASTM C-1071 For fungal and bacterial growth
 - .4 ASTM C-209 For water absorption (Maximum 0.2% by volume)
 - .5 Thermal conductivity $k = 0.277 \text{ BTU / hour-ft-deg F}$

4 FASTENINGS, ADHESIVES, COATINGS

4.1 External Ductwork

- .1 Externally coat ductwork exposed on the roof with polyurethane coating to create a waterproof seal on the exterior of the ductwork.
- .2 Apply to dry, clean surfaces.
- .3 Brush on a first coat onto all joints, rivets, bolts, etc. Brush or spray a second coat over the entire surface of exposed ductwork. Take care to protect surrounding roof surfaces from overspray or drips.
- .4 Product: Tremco Vulkem 116.

4.2 Internal Ductwork

- .1 Provide all wire insulation fastenings, staples, adhesive tapes, contact adhesives and barrier coatings as required for a complete, neat insulation installation and finish.

5 EXECUTION

- .1 No insulation is to be applied prior to confirmation from the Consultant and Building Inspector that ductwork is installed in conformance with code and specification requirements.
- .2 Ensure that insulation is clean and dry during installation and application of all finishes.
- .3 Install insulation with smooth and even surfaces.
- .4 Apply insulation materials, accessories and finishes in accordance with manufacturer's recommendations.
- .5 Sagging of duct insulation will not be acceptable.
- .6 Stagger both longitudinal and horizontal joints, on duct insulation of multi-layered construction.

END OF SECTION 15320

1 SCOPE OF WORK

- .1 Heat exchangers

2 QUALITY ASSURANCE

- .1 Install insulation to the requirements of the latest edition of the British Columbia Insulation Contractors Association Standards Manual for Mechanical Insulation. Code numbers quoted refer to this specification for installation standards. Code numbers quoted refer to this specification for installation standards.
- .2 Provide materials conforming to British Columbia Building Code requirements for maximum smoke developed rating of 50 and flame spread rating of 25.

3 PLATE AND FRAME HEAT EXCHANGERS

- .1 Provide mineral fibre thermal insulation, type A-2 as defined by BCICA Quality Standards specification 1501-H, 38-mm (1.5 inches) thick.
- .2 Provide canvas covering to protect insulation from damage.

4 FASTENINGS, ADHESIVES, COATINGS

- .1 Provide all wire insulation fastenings, staples, adhesive tapes, contact adhesives and barrier coatings as required for a complete, neat insulation installation and finish.

5 EXECUTION

- .1 Ensure that insulation is clean and dry during installation and application of all finishes.
- .2 Install insulation with smooth and even surfaces.
- .3 Apply insulation materials, accessories and finishes in accordance with manufacturer's recommendations.

END OF SECTION 15330

1 QUALITY ASSURANCE

- .1 Wherever new piping, ductwork or conduit penetrates fire rated assemblies provide an installation of a firestopping and smoke seal system.
- .2 Materials used are to be asbestos-free and capable of maintaining an effective barrier against flame, smoke and gases in compliance with the requirements of
 - .1 CAN4-S115-M, "Standard Method of Fire Tests of Firestop Systems."
 - .2 British Columbia Building Code Section 3.1.7
- .3 Acceptable Products
 - .1 3M Brand Fire Barrier Penetration Sealing System.
 - .2 Johns Manville Firetemp Products
 - .3 Passive Fire Protection Products
- .4 Install in strict accordance with manufacturers printed specifications, including field quality control after installation.
- .5 Only an approved specialist firm, employing skilled tradesman experienced in firestopping and smoke seals application, shall carry out the work of this section.
- .6 Contractor shall submit to Consultant, suitable document signed by the manufacturer or his representative, stating:
 - .1 The Contractor has received sufficient installation instruction from the manufacturer or his representative
 - .2 Manufacturer or his representative witnessed installation procedures on site.
- .7 Follow manufacturers published installation instructions precisely including field quality control after installation.
- .8 The Contractor shall remove up to four (4) firestopping assemblies for random inspection if requested by the Consultant, and replace at no cost to the Owner.

2 RELATED WORK

- .1 Firestopping and smoke seals at penetration through fire rated wall and floor assemblies, other than mechanical system penetrations: Section 07270.
- .2 Firestopping and smoke seal around electrical service penetrations of fire rated wall and floor assemblies: Division 16 Electrical. Refer to electrical specifications on electrical drawings E-1 through E-6.

3 WORK INCLUDED

- .1 Furnish all labour, material, equipment and services necessary to supply and install firestopping and smoke seals around mechanical service piping, duct penetrations and conduit through fire rated wall and floor assemblies.

4 SHOP DRAWINGS

- .1 Submit shop drawings and product data in accordance with Section 15010.
- .2 Submit shop drawings to show proposed material, reinforcement, anchorage, fastenings, and method of installation. Construction details shall accurately reflect actual job conditions.
- .3 Submit manufacturer's product data for material and prefabricated devices. Provide descriptions sufficient for identification at job site. Include manufacturer's printed instructions for installation.

5 PRODUCT DELIVERY, STORAGE AND HANDLING

- .1 Deliver and store all materials in original wrappings and containers with manufacturer's seals and labels intact and as recommended by the approved manufacturer.
- .2 Protect materials from environmental conditions as required by manufacturer's recommendations.
- .3 Conform to manufacturers recommended temperatures, relative humidity and substrate moisture content for application and curing of firestopping and smoke seal materials.
- .4 Protect works of other trades against soiling and damage arising out of this work.
- .5 At completion replace and repair any defective work and leave perfect.

6 MATERIALS

- .1 Firestopping and Smoke Seal Systems: Asbestos-free materials and systems capable of maintaining an effective barrier against flame, smoke and gases in compliance with requirements of CAN/ULC-S115-M or ULI 1479 and ASTM 814, and not to exceed opening sizes for which they are intended.
- .2 Fire resistance rating of installed firestopping assembly shall not be less than the fire resistance rating of surrounding floor and wall assembly as indicated (as scheduled)
- .3 Primers: To manufacturer's recommendation for specific material, substrate and end use.

- .4 Water (if applicable): Potable, clean and free from injurious amounts deleterious substances.
- .5 Damming and Back-Up Materials, Supports and Anchoring Devices: To manufacturer's recommendations, and in accordance with an assembly being installed as per a listed system by an accredited testing agency.
- .6 Use sealant around single pipes and ducts.
- .7 Use foam for multiple pipe installation through a common opening

7 PREPARATION

- .1 Examine sizes and conditions of voids to be filled to establish correct thicknesses and installation of materials. Ensure that substrates and surfaces are dry and frost free.
- .2 Clean and prepare surfaces in contact with firestopping materials and smoke seals to manufacturer's instructions.
- .3 Maintain insulation around pipes and ducts penetrating fire separation.
- .4 Prime surfaces in accordance with manufacturer's instructions.
- .5 Mask where necessary to avoid spillage and over coating onto adjoining surfaces; remove stains on adjacent surfaces.
- .6 Mix materials in strict accordance with manufacturer's directions.
- .7 Ensure components are mixed thoroughly and that a qualified worker prepares those components.

8 INSTALLATION

- .1 Install firestopping and smoke seal material and components that have been tested by certified testing agencies, ULC, CUL, or Intertek, and manufacturer's instructions to provide a flame rated seal not less than the fire resistance rating of the surrounding wall or floor assembly. Temperature ratings may be required in certain instances and should be specified by the engineering or architectural authority.
- .2 Install to mechanical service through – penetrations to formed, sleeved or cored openings in fire rated wall and floor assemblies.
- .3 Seal holes or voids made by through-penetrations, poke-through termination devices, and unpenetrated openings or joints to ensure continuity and integrity of fire separation are maintained.
- .4 Provide temporary forming as required and remove forming only after materials have gained sufficient strength and after initial curing.

- .5 Prepare all surfaces so they are clean, dry, and frost free, as per manufacturer's published recommendations.
- .6 Tool or trowel exposed surfaces of fire stopping or seals to a neat finish.
- .7 Remove excess compound promptly as work progresses and upon completion.

9 CURING

- .1 Cure materials in accordance with manufacturer's directions.
- .2 Do not cover up materials until proper curing has taken place.

10 INSPECTION

- .1 Remove excess materials and debris and clean adjacent surfaces immediately after application.
- .2 Remove temporary dams after initial set of firestopping and smoke seal materials.
- .3 The Contractor shall remove up to four (4) firestopping assemblies for random inspection if requested by the Consultant, and replace at no extra cost to Owner.
- .4 If this review of installation procedures indicates the work has not been performed in accordance with manufacturer's recommendations the Owner/Consultant reserve the right to have all firestopping assemblies removed and re-installed.

11 SCOPE OF FIRESTOPPING WORK

- .1 Applicable to piping, ductwork and control conduit or wiring penetrating:
 - .1 The walls or ceilings of mechanical rooms

END OF SECTION 15340

1 SCOPE OF WORK

- .1 Condensate drain piping

2 CODES, STANDARDS AND APPROVALS

- .1 The installation shall conform to 2018 British Columbia Building Code.
- .2 Do not conceal any plumbing installation, whether buried or within walls, prior to review by the consultant and the local plumbing inspector. Ensure 72 hours written notice is provided to each of these parties prior to requirement for an inspection of the work.
- .3 Route piping installation in an orderly manner, as indicated on the drawings. Generally follow routes parallel and perpendicular to building structure.

3 BASE BID AND APPROVED EQUAL MANUFACTURERS

- .1 Pipe Cleanouts Jay R. Smith, Ancon, Zurn, Mifab

4 STORM DRAIN PIPING

4.1 Cooling Coil Condensate Drain Pipes above grade

- .1 Type DWV copper.

<u>MATERIAL</u>	<u>CODE REF</u>	<u>CONFORM TO</u>	<u>FITTINGS</u>
Type DWV Copper	BCPC 2.2.7.4	ASTM B306	Wrought copper With 50-50 solder
Type PVC	BCPC 2.2.5.9	ASTM D1784	PVC Schedule 80

5 INSTALLATION OF STORM DRAIN PIPING

5.1 General Requirements

- .1 Grade storm piping as indicated on the drawings.
- .2 Bed buried lines in minimum 150 mm bedding sand above and below pipe. Trenching and backfilling will be provided by the General Contractor.
- .3 Install neoprene pads under all clamps where vertical storm piping rests on floor systems.
- .4 Piping penetrations through drywall (other than fire rated walls) should be ¼ inch oversized and gap caulked with silicone sealant. For fire rated walls refer to the requirements for Firestopping.

5.2 Pipe Hangers

- .1 For non-combustible pipe 3 inch diameter and larger use steel ring and clevis type hangers attached to galvanized steel rods to support all suspended piping.
- .2 The use of perforated band iron is not permitted.
- .3 Hangers for copper pipe shall be copper plated and plastic dipped, or pipe wrapped with Polyken tape at hangers.
- .4 Piping installed below building structural slab to have pipe hangers installed into slab to support piping from above.
- .5 Install hangers for copper pipe with a maximum separation as indicated in table below and where required elsewhere to avoid sag in pipe installation. Provide sheet metal shields to protect insulation from being crushed at hanger locations on cold water installations.

Pipe diameter	Rod diameter	PVC	Copper
Up to 19mm	10mm	1.2m	1.8m
25mm to 32mm	10mm	1.2m	1.8m
38mm to 50mm	10mm	1.2m	2.4m
65mm to 75mm	13mm	1.2m	2.4m
100mm to 130mm	16mm	1.2m	2.4m
150mm	19mm	1.2m	

- .6 Maximum hanger spacing for any size cast iron pipe is 1.5m (5 feet).
- .7 Provide galvanized steel, continuous threaded hanger rods.
- .8 Inserts
 - .1 Insert shall be malleable iron case or galvanized steel shell with expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms.
 - .2 Size inserts to suit threaded hanger rods.
 - .3 Cast-in-place concrete insert shall be galvanized malleable iron or steel Grinnell Fig 281 or Fig 282 or Unistrut.
 - .4 Drilled concrete insert shall be Hilti Model HSL or HVA.
 - .5 All inserts shall be ICBO approved. Use only ICBO design load ratings.

6 CLEANOUTS

6.1 General Requirements

- .1 Provide cleanouts in the following locations for storm drainage systems:
 - .1 At changes of direction of more than 45 degrees.
 - .2 At the end of all horizontal drainage lines.

- .63 Where required by the 2018 National Plumbing Code.
- .2 Cleanouts shall be full size for pipe up to 100mm (4 inch) and not less than 100mm (4 inch) on larger pipe sizes.
- .3 Make cleanouts with Barrett type fitting that has a threaded plug, or a cleanout ferrule that is installed in a "Y" or extended "Y".
- .4 Cleanouts shall be coordinated with existing obstructions and shall be located so as to be easily accessible with sufficient clearance for rodding and cleaning.
- .5 Cleanouts in inside finished areas shall all be same shape (square or round).

7 PIPE SLEEVES & ESCUTCHEONS

- .1 Where gaps between wall sleeves and outside surface of pipes is 13-mm (1/2-inch) or less, caulk gaps.
- .2 Where gaps are greater than 13-mm (1/2 inch) provide chrome escutcheon plates. If the gap is larger than the escutcheon, neatly patch the wall to match the adjacent wall surface.
- .3 For pipe penetrations through concrete walls and floors, or through any walls or floors of any construction that has a fire rating, and through floors in wet areas, provide pipe sleeves.
 - .1 Sleeves to be manufactured of schedule 40 steel pipe.
 - .2 Size sleeves to allow for continuity of insulation. Refer also to requirements for firestopping.
 - .3 Extend sleeves 50mm (2 inches) above floor slabs.

END OF SECTION 15410

1 SCOPE OF WORK

- .1 Domestic cold water piping
- .2 Domestic hot water piping

2 CODES, STANDARDS AND APPROVALS

- .1 The installation shall conform to the 2018 British Columbia Plumbing Code.
- .2 Do not conceal any plumbing installation, whether buried or within walls, prior to review by the Consultant and the local plumbing inspector. Ensure 72 hours written notice is provided to each of these parties prior to requirement for an inspection of the work.
- .3 Route piping installation in an orderly manner, as indicated on the drawings. Generally follow routes parallel and perpendicular to building structure.
- .4 All components of the domestic water system shall be of all bronze construction.

3 BASE BID AND APPROVED EQUAL MANUFACTURERS

3.1 Domestic Water Pipe Specialties

- .1 Water Hammer Arrestors Jay R. Smith, Ancon, Zurn, Watts, Wilkins

4 DOMESTIC WATER PIPE MATERIALS

4.1 Domestic Water Piping Inside Building

<u>MATERIAL</u>	<u>CODE REF</u>	<u>CONFORM TO</u>	<u>FITTINGS</u>
Type L copper	BCPC 2.2.7.4	ASTM B88	Wrought copper With Silvabrite Solder 95.5% Sn, 4% Cu, 0.5% Ag. T-Drill fittings are not approved.
CPVC	BCPC 2.2.5.9	CSA-B137.6-M	

5 DOMESTIC WATER PIPE INSTALLATION

5.1 General Requirements

- .1 Provide eccentric pipe reducers for domestic waterlines to prevent collection of air pockets.
- .2 Provide water hammer arrestors at the top of all domestic cold water risers, on each domestic hot water system and at any quick closing valves.

- .5 Provide written confirmation, for inclusion in Operation and Maintenance Manual, that lead free solder was used on all potable water piping.
- .6 Provide shut-off valves for all fixtures, located in accessible locations.
- .7 Copper pipe, direct connections: UL approval; brazing in accordance with Copper Development Association Copper Tube Handbook.
- .8 Ensure no joints of dissimilar metals are provided. Install dielectrically isolated fittings where dissimilar metallic materials meet.
- .9 Provide unions to all equipment for 65-mm (2.5-inch) pipe and below, and flanged connections for 75-mm (3-inch) and over. Provide isolation valves outside of all unions.

5.2 Pipe Hangers

- .1 For non-combustible pipe 3 inch diameter and larger use steel ring and clevis type hangers attached to galvanized steel rods to support all suspended piping.
- .2 The use of perforated band iron is not permitted on this project.
- .3 Hangers for copper pipe shall be copper plated and plastic dipped, or pipe wrapped with Polyken tape at hangers.
- .4 Install hangers for copper pipe with a maximum separation as indicated in table below and where required elsewhere to avoid sag in pipe installation. Provide sheet metal shields to protect insulation from being crushed at hanger locations on cold water installations.

<u>Pipe diameter</u>	<u>Rod diameter</u>	<u>Steel</u>	<u>Copper</u>
Up to 19mm	10mm	1.8m	1.8m
25mm to 32mm	10mm	2.4m	1.8m
38mm to 50mm	10mm	3.0m	2.4m
65mm to 75mm	13mm	3.6m	2.4m
100mm to 130mm	16mm	3.6m	2.4m

- .5 Provide galvanized steel, continuous threaded hanger rods.
- .6 Inserts
 - .1 Insert shall be malleable iron case or galvanized steel shell with expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms.
 - .2 Size inserts to suit threaded hanger rods.
 - .3 Cast-in-place concrete insert shall be galvanized malleable iron or steel Grinnell Fig 281 or Fig 282 or Unistrut.
 - .4 Drilled concrete insert shall be Hilti Model HSL or HVA.
 - .5 All inserts shall be ICBO approved. Use only ICBO design load ratings.

5.3 Water Hammer Arrestors

- .1 Brass piston type water hammer arrestors in a type 'K' copper casing. Size according to chart below to eliminate water hammer and shock from piping systems.

Fixture Units	Model	Size	
1 – 11	SC - 500	12-mm	½-inch
12 – 32	SC – 750	19-mm	¾-inch
33 – 60	SC – 1000	25mm	1-inch

- .2 Provide Water Hammer Arrestors on hot and cold water supplies to all quick valves, solenoids, and plumbing fixtures, and locate in an upright position between the last two fixtures on a line, or horizontally at the end of line closest to supply source.
- .3 Model: PPP Inc. 'Water Hammer Arrestors' Series 'SC'

5.4 Pipe Sleeves & Escutcheons

- .1 Where gaps between wall sleeves and outside surface of pipes is 13-mm (1/2-inch) or less, caulk gaps.
- .2 Where gaps are greater than 13-mm (1/2 inch) provide chrome escutcheon plates. If the gap is larger than the escutcheon, neatly patch the wall to match the adjacent wall surface.
- .3 For pipe penetrations through concrete walls and floors, or through any walls or floors of any construction that has a fire rating, and through floors in wet areas, provide pipe sleeves.
- .1 Sleeves to be manufactured of schedule 40 steel pipe.
- .2 Size sleeves to allow for continuity of insulation. Refer also to requirements for firestopping.
- .3 Extend sleeves 50mm (2 inches) above floor slabs.

5.5 Domestic Water Valves

- .1 Provide isolation valves on both domestic hot and domestic cold water connections to all plumbing fixtures, and where indicated on the drawings. All required isolation valves may or may not be shown on the mechanical drawings and / or mechanical details. It is the Contractor's responsibility to provide the required isolation valves whether they are shown on the drawings and / or details or not.
- .2 Provide all valves for domestic water service rated for 860 kPa (125 PSIG) service.
- .3 Ball Valves for shut-off service on lines 50-mm (2-inch) and under with screwed connections:
- .1 Watts B-6000
- .2 Apollo-70 series

- .3 Jenkins-1101-T
- .4 Crane 93-TF
- .5 Red & White Fig. 5044A.
- .4 Gate Valves for shut-off service on lines 65 mm (2 ½ inch) and larger with flanged connections:
 - .1 Crane 465-1/2
 - .2 Jenkins 404
 - .3 Lunkenheimer1430C
 - .4 Red & White 421A.

5.6 Pressure Testing

- .1 Pressure Tests on new domestic water systems shall consist of 1030 kPa (150 PSIG) hydraulic test for 8 hours with no loss of pressure

5.7 Disinfection of Potable Water Piping

- .1 All domestic water piping shall be thoroughly flushed so that it is free from scale, sediment, construction debris etc.
- .2 Retain an independent inspection firm to supervise and inspect the chlorination and flushing procedures and perform chemical tests as required.
- .3 On completion of installation and testing of the potable water systems, pre-flush, chlorinate with Sodium Hypochlorite to AWWA C-601 specifications and let stand for 24 hours. Thoroughly flush again until flush water meets AWWA standards.
- .4 Remove two samples of water 24 hours after chlorinating and provide test lab results of samples.
- .5 Both sample tests must indicate less than 10 PPM residual chlorine and less than 1 PPM total coliform. If not, repeat the chlorination and testing procedure until satisfactory results are obtained.
- .6 Include documentation from the testing laboratory in the Operation and Maintenance Manual, indicating water test results obtained.
- .7 Acceptable Firms: PACE Chemicals Ltd., Suez Water Technologies & Solutions.

6 TEMPERATURE & PRESSURE RELIEF VALVES

- .1 Model - Watts ASME rated.
- .2 Pipe T & P valves with a pipe of full outlet size to floor drain and arrange to prevent splash-over.

8 DOMESTIC HOT WATER EXPANSION TANK

- .1 Vertical expansion tank with base, constructed of welded steel to the requirements of ASME Section VIII, Division 1. Factory prime coat painted and with heavy-duty butyl diaphragm. (replaceable butyl bladder). Rated for a working pressure of 861 kPa (125 PSIG) and operating temperature up to 93 deg C (200 deg F).
- .2 Supply with steel support saddle for vertical mounting, lifting ring, charging valve, 13-mm (3/4-inch) system connection and 38-mm (1-1/2-inch) charging tap.
- .3 Provide seismic restraint ring, factory welded to the tank.
- .4 Provide pressure relief valve
- .5 Selection: Refer to Expansion Tank Schedule on mechanical drawing M-10.

END OF SECTION 15430

1 SCOPE OF WORK

- .1 Provision, installation, set-up and testing of all plumbing pipe, fixtures and trim as specified herein.

2 QUALITY ASSURANCE

- .1 Plumbing fixtures shall conform to CSA B45.0-2002.
- .2 Stainless steel fixtures shall be in accordance with CSA B45.4-2002.

3 BASE BID AND APPROVED EQUAL MANUFACTURERS

- .1 Thermostatic Mixing Valves Danfoss, Symmons, Leonard

4 GENERAL REQUIREMENTS

- .1 Fixtures shall be free from flaws or blemishes. Surfaces shall be clear, smooth and bright and have dimensional stability. Visible parts of the fixture supply trim shall be chrome-plated, unless otherwise noted.
- .3 Supply and install all hangers, supports, brackets, reinforcement, 14 gauge steel back-up plates, floor flanges and all accessory piping and fittings, for the proper installation and support of all fixtures and their respective supply fittings.
- .4 All fixtures shall bear stamp indicating CSA approval.
- .5 Where plumbing fixtures come in contact with wall and/or floor, joints shall be sealed with Dow Corning 781 building sealant, made watertight and beaded smooth in a neat and workmanlike manner.

5 FIXTURES – THERMOSTATIC MIXING VALVES

TMV-1

**MASTER THERMOSTATIC
MIXING VALVE**

Symmons Model TempControl 7-1000-P-W- Thermostatic Mixing Valve, thermostatic mixing valve made from lead free metal components, features serviceable integral check stops, wall mounting bracket, polished chrome highlight finish, 3" bimetal dial thermometer (T-425-1000), volume control shut-off valve (BV-1000), water hammer arrestor (WHA-1), durable lead free brass valve casting, lead free bronze and stainless steel internal components, precise temperature control, 3/4" tamper resistant hex bolt , safety lock nut prevents unwanted temperature adjustments, one piece valve cartridge. Integrated turbulator: focuses water on thermal motor to rapidly react to temperature changes, superior temperature control at low flow rates. Thermal motor to quickly respond to changes in inlet temperature. Integrated stainless steel check stops: prevents thermal bleed over, easy water shutoff at valve. Valve shall control temperature from a low flow of 0.5 GPM (0.031 L/s) up to 38 GPM (2.40 L/s) at a pressure drop of 5 PSI (34 kPa). Valve shall provide protection against hot or cold supply line failure and thermostat failure. Unit includes a dial thermometer and shut-off valve on tempered water outlet. Unit is assembled and tested with necessary fittings and nipples. 21.1°C (70°F) to 65.6°C (150°F) temperature control range and 60.0°C (140°F) set point, 38mm (1-1/2") inlets and 50mm (2") outlet. Install as per manufacturers installation instructions and details.

END OF SECTION 15470

1 SCOPE OF WORK

- .1 Pool water piping

2 CODES, STANDARDS AND APPROVALS

- .1 The installation shall conform to the 2018 British Columbia Plumbing Code.
- .2 Do not conceal any plumbing installation, whether buried or within walls, prior to review by the Consultant and the local plumbing inspector. Ensure 72 hours written notice is provided to each of these parties prior to requirement for an inspection of the work.
- .3 Route piping installation in an orderly manner, as indicated on the drawings. Generally follow routes parallel and perpendicular to building structure.
- .4 All components of the domestic water system shall be of all bronze construction.

4 POOL WATER PIPE MATERIALS

4.1 Domestic Water Piping Inside Building

<u>MATERIAL</u>	<u>CODE REF</u>	<u>CONFORM TO</u>	<u>FITTINGS</u>
PVC SCHEDULE 80	BCPC 2.2.5.8	CAN/CSA-B137.6-M	ASTM D 2467

5 POOL WATER PIPE INSTALLATION

5.1 General Requirements

- .1 Provide written confirmation, for inclusion in Operation and Maintenance Manual, that lead free solder was used on all potable water piping.
- .2 Provide unions to all equipment for 65-mm (2.5-inch) pipe and below, and flanged connections for 75-mm (3-inch) and over. Provide isolation valves outside of all unions.
- .3 Install neoprene pads under all clamps where vertical pool water piping rests on floor systems.

5.2 Pipe Hangers

- .1 For non-combustible pipe 3 inch diameter and larger use steel ring and clevis type hangers attached to galvanized steel rods to support all suspended piping.
- .2 The use of perforated band iron is not permitted on this project.
- .4 Install hangers for PVC pipe with a maximum separation as indicated in table below and where required elsewhere to avoid sag in pipe installation. Provide sheet metal shields to protect insulation from being crushed at hanger locations on cold water installations.

<u>Pipe diameter</u>	<u>Rod diameter</u>	<u>PVC</u>
Up to 19mm	10mm	1.2m
25mm to 32mm	10mm	1.2m
38mm to 50mm	10mm	1.2m
65mm to 75mm	13mm	1.2m
100mm to 130mm	16mm	1.2m
150mm	19mm	1.2m

- .5 Provide galvanized steel, continuous threaded hanger rods.
- .6 Inserts
 - .1 Insert shall be malleable iron case or galvanized steel shell with expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms.
 - .2 Size inserts to suit threaded hanger rods.
 - .3 Cast-in-place concrete insert shall be galvanized malleable iron or steel Grinnell Fig 281 or Fig 282 or Unistrut.
 - .4 Drilled concrete insert shall be Hilti Model HSL or HVA.
 - .5 All inserts shall be ICBO approved. Use only ICBO design load ratings.

5.3 Pipe Sleeves & Escutcheons

- .1 Where gaps between wall sleeves and outside surface of pipes is 13-mm (1/2-inch) or less, caulk gaps.
- .2 Where gaps are greater than 13-mm (1/2 inch) provide chrome escutcheon plates. If the gap is larger than the escutcheon, neatly patch the wall to match the adjacent wall surface.
- .3 For pipe penetrations through concrete walls and floors, or through any walls or floors of any construction that has a fire rating, and through floors in wet areas, provide pipe sleeves.
 - .1 Sleeves to be manufactured of schedule 40 steel pipe.
 - .2 Size sleeves to allow for continuity of insulation. Refer also to requirements for firestopping.
 - .3 Extend sleeves 50mm (2 inches) above floor slabs.

5.4 Domestic Water Valves

- .1 Provide isolation valves on both domestic hot and domestic cold water connections to all plumbing fixtures, and where indicated on the drawings. All required isolation valves may or may not be shown on the mechanical drawings and / or mechanical details. It is the Contractor's responsibility to provide the required isolation valves whether they are shown on the drawings and / or details or not.

- .2 Provide all valves for domestic water service rated for 860 kPa (125 PSIG) service.
- .3 Ball Valves for shut-off service on lines 50-mm (2-inch) and under with screwed connections:
 - .1 Watts B-6000
 - .2 Apollo-70 series
 - .3 Jenkins-1101-T
 - .4 Crane 93-TF
 - .5 Red & White Fig. 5044A.
- .4 Gate Valves for shut-off service on lines 65 mm (2 ½ inch) and larger with flanged connections:
 - .1 Crane 465-1/2
 - .2 Jenkins 404
 - .3 Lunkenheimer1430C
 - .4 Red & White 421A.

5.5 Pressure Testing

- .1 Pressure Tests on new pool water systems shall consist of 1030 kPa (150 PSIG) hydraulic test for 8 hours with no loss of pressure

5.6 Disinfection of Pool Water Piping

- .1 All domestic water piping shall be thoroughly flushed so that it is free from scale, sediment, construction debris etc.
- .2 Retain an independent inspection firm to supervise and inspect the chlorination and flushing procedures and perform chemical tests as required.
- .3 On completion of installation and testing of the potable water systems, pre-flush, chlorinate with Sodium Hypochlorite to AWWA C-601 specifications and let stand for 24 hours. Thoroughly flush again until flush water meets AWWA standards.
- .4 Remove two samples of water 24 hours after chlorinating and provide test lab results of samples.
- .5 Both sample tests must indicate less than 10 PPM residual chlorine and less than 1 PPM total coliform. If not, repeat the chlorination and testing procedure until satisfactory results are obtained.
- .6 Include documentation from the testing laboratory in the Operation and Maintenance Manual, indicating water test results obtained.
- .7 Acceptable Firms: PACE Chemicals Ltd., Suez Water Technologies & Solutions.

END OF SECTION 15490

1 IN-LINE AND BASE MOUNTED HEATING PUMPS

- .1 Pumps of standard iron body construction with drip proof, resiliently mounted, and sleeve bearing motor, statically and dynamically balance rotating parts, suitable for handling water at 110°C.
- .2 Pump construction shall permit complete servicing without breaking piping or motor connections.
- .3 Pumps shall operate at 1750 RPM unless specified otherwise.
- .4 The pump shaft shall have an integral thrust collar and shall be supported by two, oil lubricated bronze sleeve bearings. Pump to be equipped with a water-tight long-life mechanical seal
- .5 Pump connections shall be flanged.
- .6 Each pump shall be supplied with a shut-off valve on both inlet and outlet, a strainer on the suction side and a check valve and balancing valve on the discharge side.
- .7 Pumps must be installed to provide free, clear, and unencumbered maintenance access.
- .8 Provide triple duty valves on the suction side of base mounted pumps (Suction guide, strainer and isolation valve). Angle type suction guide fitting with flanged cast iron body, steel or cast iron guide vanes and removable stainless steel strainer.
- .9 Provide combination check and isolation valve on the discharge of base mounted pumps. Angle or straight type with screwed or flanged cast iron body, and bronze disc and seat.
- .10 Performance as indicated in the Pump Schedule on mechanical drawing M-10.

2 INLINE, WET ROTOR 3-SPEED PUMPS

- .1 In-line pipe-mounted pumps shall be Grundfos VersaFlo UPS wet rotor, in-line, 3-speed circulators.
- .2 Pumps and motors shall be designed and built by the same manufacturer.
- .3 Pumps shall be of quiet "Wet Rotor" design. Maximum noise level of the pump and motor shall be 41dB(A).
- .4 The pumps shall be able to operate at maximum 115 deg C (240 deg F) and minimum 15 deg C (60 deg F) water temperature continuously.
- .5 The pumps shall have 3 Operating Speeds with each speed having a distinct Performance Curve. Switching between speeds shall be easy to do without dismantling the pump or making any changes to the pump/motor.

- .6 The head-capacity curve shall have a steady rise in head from maximum to minimum flow within the preferred operating region
- .7 The pump housing shall be Cast Iron, with laser welded stainless steel Impellers and Stainless Steel neck rings to minimize recirculation and maximise pump efficiency. Pumps shall have tungsten carbide sleeve bearings for extended life.
- .8 The pump is to be connected directly to an asynchronous squirrel cage design motor and had to have been tested with the pump as one unit by the same manufacturer
- .9 The motor shall be cooled by the pumped fluid and shall be self ventilating. The stator housing shall have 8 drain holes to enable condensed water to escape
- .10 The terminal box shall be made of black composite material, shall have an Enclosure class of IP44 and shall have fiber optic indicator lights for operation indication and trouble shooting
- .11 The pump shaft shall be installed horizontally per manufacturer's recommendations. The required inlet pressure by the pump shall be available at the pump inlet
- .12 Performance as indicated in the Pump Schedule on mechanical drawing M-10.

3 INLINE, WET ROTOR PUMPS WITH INTEGRATED VFD

- .1 Pump and motor shall be designed and built by the same manufacturer.
- .2 Pumps shall be of quiet "Wet Rotor" design. Maximum noise level of the pump and motor shall be 54dB(A).
- .3 The pumps shall be able to operate at maximum 91 deg C (200 deg F) and minimum 15 deg C (60 deg F) water temperature continuously, and at a maximum of 110 deg C (230 deg F) intermittently.
- .4 The head-capacity curve shall have a steady rise in head from maximum to minimum flow within the preferred operating region
- .5 Pump housings shall be Cast Iron, with laser welded stainless steel Impellers and stainless steel neck rings to minimize recirculation and maximise pump efficiency. Pumps shall have tungsten carbide sleeve bearings for extended life. Pumps for Domestic Hot Water application shall be of Stainless Steel housing.
- .6 Pumps to be connected directly to a single-phase 4- or 8-pole, synchronous, permanent-magnet motor (PM motor) and had to have been tested with the pump as one unit by the same manufacturer.
- .7 Motors shall have a variable frequency drives integrated in the terminal box and a small control panel on the terminal box. The pump speed shall be controlled by the "Integrated Variable Frequency Drive". No additional devices (such as pressure transducer etc.) are to be required for control of the pumps.

- .8 Motors shall be cooled by the pumped fluid and shall be self ventilating. The stator housing shall have 8 drain holes to enable condensed water to escape
- .9 Terminal boxes shall be made of black composite material, shall have an Enclosure class of IP44 and shall have fiber optic indicator lights for operation indication and trouble shooting
- .10 Pump shafts shall be installed horizontally per manufacturer's recommendations. The required inlet pressure by the pump shall be available at the pump inlet
- .11 The following control modes are to be available:
 - .1 Proportional Pressure control - The pump head is changed continuously in accordance with the water demand in the system.
 - .2 Constant Pressure control - A constant head is maintained, irrespective of water demand.
 - .3 AUTOADAPT - The differential pressure across the pump is automatically adjusted to match the flow requirements
- .12 Control panels on terminal boxes should enable selection of the any of the above control modes without any external devices. The control panel should also enable setting desired Pressure set-point. The control panel should show an estimation of flow rate through the pump in 0-100% range.
- .13 Controllers shall be capable of interfacing with the building digital controls (DDC) DDC system to
 - .1 Receive a reset signal for ON/OFF control
 - .2 Send a signal relay that can be programmed for Fault or Operation indication at DDC system.
 - .3 Receive 0-10 VDC speed signal for variable speed operation. The module shall have the capability of connect two MAGNA pumps for alternating between the pumps and for Duty/Standby operation.
- .14 Performance as indicated in the Pump Schedule on mechanical drawing M-10.

4 EXPANSION TANK

- .1 Vertical expansion tank with base, constructed of welded steel to the requirements of ASME Section VIII, Division 1. Factory prime coat painted and with heavy-duty butyl diaphragm. (replaceable butyl bladder). Rated for a working pressure of 861 kPa (125 PSIG) and operating temperature up to 115 deg C (240 deg F).
- .2 Supply with steel support saddle for vertical mounting, lifting ring, charging valve, 13-mm (1/2-inch) system connection and 38-mm (1-1/2-inch) charging tap.
- .3 Provide seismic restraint ring, factory welded to the tank.

- .4 Selection: Refer to Expansion Tank Schedule on mechanical drawing M-10.

5 SIDESTREAM FILTER

- .1 All closed heating water and chilled water systems shall have a sidestream filter supplied by the Chemical Treatment specialist and installed by the Contractor as indicated on the drawings.
- .2 Housing of steel construction using 250 mm x 30 micron filter cartridge, with a minimum flow rate of 0.6 L/s (9 USGPM). A Flow Indicator shall be installed in conjunction with the sidestream filter.
- .3 Connections shall be 20 mm and all isolating valves shall be installed as per manufacturer's instructions. Include filter cartridges.
- .4 Refer also to Section 15050.

END OF SECTION 15620

1 STEEL PIPE FOR HYDRONIC SYSTEMS (Including SOLAR WATER PIPING)

- .1 Pipe material to be schedule 40 steel.
- .2 Screwed fittings for piping 50-mm (2-inch) and under, with full cut standard taper threads.
- .3 Flanged or grooved mechanical couplings for piping 65-mm (2-1/2-inch) and over.
- .4 Ream piping to clean scale and dirt from inside and outside surfaces prior to installation.
- .5 Provide eccentric pipe reducers for heating water lines, installed to prevent collection of air pockets.
- .6 Ensure no joints of dissimilar metals are provided. Brass adapters can be provided where joining dissimilar materials.

2 ROUTING OF HYDRONIC WATER PIPE (Including SOLAR WATER PIPING)

- .1 Most new heating water piping is located in the mechanical room.
- .2 Where piping does rise up to ceiling level allow for drywall furring around pipe risers from floor to ceiling level (10'-0"). Also refer to the Demolition and Builder's Work drawings for additional requirements for furrings and chases.

3 REDUNDANT PIPE

- .1 Redundant heating water pipe is not required to be removed except where:
 - .1 The existing location interferes with installation of new pipe, such as where existing unit heaters are to be re-piped.
 - .2 Where the redundant pipe is exposed in an occupied area of the facility.
 - .3 Where indicated on the drawings, such as in the mechanical room.

4 VENTING AND DRAINING

- .1 Provide 20 mm drain valves at all low points in the piping to allow drainage of system.
- .2 Provide air vents at all high points, with 12-mm (1/2-inch) isolation valve.
- .3 Vents to be manual type at locations outside the mechanical room, (ie: at all unit ventilator and reheat coils). Construct from a short vertical section of 50mm diameter pipe to form air chamber. Provide 3mm brass needle valve at top of chamber.

- .4 Vents to be automatic type in service rooms where floor drains are available and on all reheat coils.

5 PIPE HANGERS

- .1 Use steel ring and clevis type hangers attached to galvanized steel rods to support all suspended piping. The use of perforated band iron or wire is not permitted.
- .2 Provide sheet metal shields to protect insulation from being crushed at hanger locations. Install piping to allow for expansion and contraction and provide adequate clearance around pipe hangers to allow installation of pipe insulation.
- .3 Hangers for copper pipe shall be copper plated and plastic dipped, or pipe wrapped with Polyken tape at hangers.
- .4 Install hangers for steel and copper pipe with a maximum separation as indicated in table below and where required elsewhere to avoid sag in pipe installation. .

<u>Pipe diameter</u>	<u>Rod diameter</u>	<u>Steel</u>	<u>Copper</u>
Up to 19mm	10mm	1.8m	1.8m
25mm to 32mm	10mm	2.4m	1.8m
38mm to 50mm	10mm	3.0m	2.4m
65mm to 75mm	13mm	3.6m	2.4m
100mm to 130mm	16mm	3.6m	2.4m
150mm	19mm	3.6m	

- .5 Provide galvanized steel, continuous threaded hanger rods.
- .6 Inserts
- .1 Insert shall be malleable iron case or galvanized steel shell with expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms.
- .2 Size inserts to suit threaded hanger rods.
- .3 Cast-in-place concrete insert shall be galvanized malleable iron or steel Grinnell Fig 281 or Fig 282 or Unistrut.
- .4 Drilled concrete insert shall be Hilti Model HSL or HVA.
- .5 All inserts shall be ICBO approved. Use only ICBO design load ratings.

6 FREEZE PROTECTION

- .1 Do not install heating water piping in exterior walls or unheated areas of the building.

7 INSTALLATION OF CONTROLS EQUIPMENT

- .1 The Contractor is to install equipment supplied by the Controls contractor for digital controls, including control valves, piping wells for temperature and pressure sensors and flow meters. The Controls Contractor is responsible for wiring of such devices. Refer also to Section 15920.
- .2 The Contractor is install equipment supplied by the Controls contractor for non-DDC applications, including flow switches, pressure switches and safety devices. The Controls Contractor is responsible for wiring of such devices. Refer also to Section 15910.
- .3 The Contractor is supply and install wells for non-DDC pressure and temperature gauges indicated in this section

8 FIRESTOPPING

- .1 Refer to Section 15340

9 PRESSURE TESTING

- .1 Test heating water piping at a pressure of 860 kPa (125 PSIG).
- .2 Demonstrate the test pressure does not fluctuate for a period of eight hours. Have test witnessed by the Consultant or the Owner's designated representative.

10 VALVES

- .1 Provide valves as indicated below and on the drawings. The valve designations apply to Red & White valves, equivalent products from alternate approved manufacturers listed in the approved equals list in Section 15020 are also acceptable.
 - .1 Gate valves Model 206
 - .2 Ball valves Model 5544
 - .3 Horizontal check valves Model 236
 - .4 Strainers Model 380B
 - .5 Drain valves Model 5044F
 - .6 Butterfly valves Not Permitted
- .2 Provide 13-mm isolation valves for all air vents and gauges.
- .3 All valves must have the manufacturer's name and recommended pressure rating clearly stamped on the valve body.

- .4 Provide all valves for heating water service rated for 860 kPa (125 PSIG) service.
- .5 Chained caps are required on all drain valves.
- .6 Provide isolation ball valves on both the heating water supply and heating water return lines serving ALL hydronic heating appliances (heating coils, force flow heaters, radiant panels, radiation, etc.). All required isolation valves may or may not be shown on the mechanical drawings and / or mechanical details. It is the Contractor's responsibility to provide the required isolation valves whether they are shown on the drawings and / or details or not.
- .7 Provide threaded unions on all piping connections to control valve assemblies. Install unions to facilitate the quick maintenance removal and replacement of control valve piping assemblies.

11 BALANCING VALVES

11.1 Circuit Balance Valves

- .1 Install on the return line at the following locations:
 - .1 Heating secondary circuits and heat exchangers
 - .2 Air handling unit heating coils
- .2 Install Armstrong model CBV or approved equivalent circuit balance valves with read-out ports, position read-out and memory and insulated valve body packaging at the following locations:

12 PRESSURE GAUGES

- .1 Provide pressure gauges for the following locations:
 - .1 Suction and discharge of pumps and air handling unit coils and heat exchangers
 - .2 Expansion Tanks
- .2 Magnehelic Gauges - 225mm diameter dial in case, diaphragm actuated, black figures on white background, front recalibration adjustment. Inclined type manometer and tubing, static pressure tips, and mounting assembly.
- .3 Photohelic Gauges - 120/1/60 adjustable photohelic pressure gauge c/w 90mm dial in case, external 4 - 20 Ma signal for connection to remote system.

13 THERMOMETERS

- .1 Provide stem type thermometers at the following locations:
 - .1 Inlets and outlets of air handling unit coils

.2 Main supply and return lines of building secondary heating circuits and heat exchangers.

.2 Thermometers shall have 225 mm scale with adjustable angle setting, readout in deg C and deg F.

14 PRE-OPERATIONAL CLEANING AND CHEMICAL TREATMENT

.1 Refer to Section 15050

15 GROOVED MECHANICAL PIPING SYSTEM

.1 Victaulic is acceptable in all locations on hot water to -30 F to 250 F, equipment drains and overflows. All components to be compatible for use together.

.2 Couplings: 1.5" to 12" Contractor shall use Victaulic Style 107 Quick Vic or Style 07 "Zero Flex" rigid couplings in all applications except where flexible Style 177 Quick Vic or Style 77 couplings are approved by the Engineer for use at equipment connections: i.e. pumps. An installation diagram will need to be approved by Engineer prior to installation.

.3 Gaskets shall be manufactured by Victaulic, and shall be verified as suitable for the intended service prior to installation.

.1 Grade "EHP" EPDM for water and oil-free air services -30°F to + 250°F. (UL classified in accordance with ANSI/NSF-61 for hot & cold potable water services.)

.4 Field Grooved Joints:

.1 For grooved joints, pipe ends shall be clean and free from indentations, projections and roll marks in the area from pipe end to groove for proper gasket seating.

.2 Contractor shall verify the pipe and grooves meet Manufacturer's current specifications. Groove depth dimension "C" shall be verified by using a Pi tape. A copy of Manufacturer's product field installation hand book shall be present on site during construction and shall be read by tradesman before installing products.

.3 Grooving tools shall be manufactured by Fitting Company. The tools shall be used in strict accordance with the latest Manufacturer's instructions. Contractor will make sure that the correct rolls are used for each pipe type and system.

.4 Install all products in accordance with the latest installation instructions as published by the Manufacturer of the product.

.5 The grooved coupling manufacturer's factory trained representative shall provide on-site training for contractor's field personnel in the use of grooving tools, application of groove, and installation of grooved joint products. The

manufacturer's direct representative shall periodically visit the jobsite and review installation. Contractor shall remove and replace any joints deemed improperly installed.

END OF SECTION 15630

1 PLATE AND FRAME HEAT EXCHANGERS

- .1 Heat exchangers constructed of corrugated, type 304 stainless steel plates mounted on stainless steel or aluminum carrying bats, with gaskets between plates constructed of nitrile, double gasketed to prevent mixing or cross contamination of fluids.
- .2 Heat exchangers to be designed for a minimum working pressure of 1035 kPa (150 PSIG) and constructed in accordance with ASME standards.
- .3 For performance data, sizes and capacities refer to the mechanical equipment schedules, mechanical drawing M-10.
- .4 Approved Model: ITT Bell and Gossett Series "GPX" or approved equal

END OF SECTION 15660

1 CHILLED WATER PIPE MATERIALS

- 1 Pipe material to be schedule 40 steel, with screwed fittings for piping 2 inch and under and flanged or grooved mechanical couplings fittings for larger piping.
- .2 Screwed fittings to have full cut standard taper threads. Ream piping to clean scale and dirt from inside and outside surfaces prior to installation.
- .3 Provide eccentric pipe reducers for heating water lines, installed to prevent collection of air pockets.
- .4 Ensure no joints of dissimilar metals are provided. Brass adapters can be provided where joining dissimilar materials.
- .3 Flanged or grooved mechanical couplings for piping 65-mm (2-1/2-inch) and over.

2 CHILLED WATER COOLING COILS

2.1 Coils

- .1 Coils constructed of copper tubes, aluminum fins and steel frame and pipe headers, self-venting and with drainable coil connections. Ensure coils fins and flanges are not damaged. If so replace coil or comb out fins.
- .2 For performance data, sizes and capacities refer to the mechanical equipment schedules, mechanical drawing M-10.

3 PIPE CONNECTIONS TO COOLING COILS

- .1 The drawings indicate piping connections required for the air handling unit chilled water coils with isolation valves on inlet and outlet lines, a two or three-port, diverting type control valve on the supply line and a balancing valve on the return line.

4 VENTING AND DRAINING

- .1 Provide 20 mm drain valves at all low points in the piping to allow drainage of system.
- .2 Provide air vents at all high points. Vents to be manual type at locations outside the mechanical rooms. Provide a 12 mm isolation valve ahead of each air vent.

5 PIPE HANGERS

- .1 Use steel ring and clevis type hangers attached to galvanized steel rods to support all suspended piping. The use of perforated band iron or wire is not permitted.

- .2 Provide sheet metal shields to protect insulation from being crushed at hanger locations. Install piping to allow for expansion and contraction and provide adequate clearance around pipe hangers to allow installation of pipe insulation.
- .3 Hangers for copper pipe shall be copper plated and plastic dipped, or pipe wrapped with Polyken tape at hangers.
- .4 Install hangers for steel and copper pipe with a maximum separation as indicated in table below and where required elsewhere to avoid sag in pipe installation. Provide sheet metal shields to protect insulation from being crushed at hanger locations on cold water installations.

Pipe diameter	Rod diameter	Steel	Copper
Up to 19mm	10mm	1.8m	1.8m
25mm to 32mm	10mm	2.4m	1.8m
38mm to 50mm	10mm	3.0m	2.4m
65mm to 75mm	13mm	3.6m	2.4m
100mm to 130mm	16mm	3.6m	2.4m
150mm	19mm	3.6m	

- .5 Provide galvanized steel, continuous threaded hanger rods.
- .6 Inserts
 - .1 Insert shall be malleable iron case or galvanized steel shell with expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms.
 - .2 Size inserts to suit threaded hanger rods.
 - .3 Cast-in-place concrete insert shall be galvanized malleable iron or steel Grinnell Fig 281 or Fig 282 or Unistrut.
 - .4 Drilled concrete insert shall be Hilti Model HSL or HVA.
 - .5 All inserts shall be ICBO approved. Use only ICBO design load ratings.

6 FREEZE PROTECTION

- .1 Do not install chilled water piping in exterior walls or unheated areas of the building.

7 FIRESTOPPING

- .1 Refer to Section 15340.

8 PRESSURE TESTING

- .1 Test new chilled water piping at a pressure of 860 kPa (125 PSIG) and propane gas piping to the requirements of CAN/CSA B149.2.

- .2 Demonstrate the test pressures do not fluctuate for a period of eight hours.
- .3 Have test witnessed by the Consultant or the Owner's designated representative.

9 VALVES

- .1 Provide valves as indicated below. The valve designations apply to Red & White valves, equivalent products from alternate approved manufacturers listed in the approved equals list below are also acceptable.
 - .1 Gate valves Model 206
 - .2 Ball valves Model 5544
 - .3 Butterfly valves Model 937
 - .4 Horizontal check valves Model 236
 - .5 Strainers Model 380B
 - .6 Drain valves Model 5044F
- .2 Provide 12 mm isolation valves for all air vents and gauges.
- .3 All valves must have the manufacturer's name and recommended pressure rating clearly stamped on the valve body. Provide valves rated for 125 PSIG service.

10 BALANCING VALVES

10.1 Circuit Balance Valves

- .1 Installed on the return line on
 - .2 Air handling unit cooling coils
- .2 Model: Armstrong model ABV-T or approved equivalent, circuit balance valves with read-out ports, position read-out and memory, insulated valve body packaging and computerized flow readout meter.

11 PRESSURE GAUGES

- .1 Provide pressure gauges for the following locations:
 - .1 Suction and discharge of pumps
 - .2 Entering and leaving lines to air handling unit coils
 - .3 Expansion Tanks

- .2 Gauges to have 225 mm diameter, 1% accuracy with dual readout in kPa and PSI. Pressure gauge taps 6 mm NPT needle valve. Gauge ranges shall be selected to read at midscale of normal system operating conditions.

12 THERMOMETERS

- .1 Provide stem type thermometers at the following locations:
 - .1 Inlets and outlets of chillers
 - .2 Main supply and return lines of building chilled water secondary circuits.
- .2 Thermometers shall have 225 mm scale with adjustable angle setting, readout in deg C and deg F.
- .3 Provide thermometer wells at all unit ventilator supply and return connections. Wells shall be machined from brass bar stock and complete with cap and chain and 15 mm NPT thread.

13 PRE-OPERATIONAL CLEANING AND CHEMICAL TREATMENT

- .1 Refer to Section 15050

14 GROOVED MECHANICAL PIPING SYSTEM

- .1 Victaulic is acceptable in all locations on hot water to -30 F to 250 F, equipment drains and overflows. All components to be compatible for use together.
- .2 Couplings: 1.5" to 12" Contractor shall use Victaulic Style 107 Quick Vic or Style 07 "Zero Flex" rigid couplings in all applications except where flexible Style 177 Quick Vic or Style 77 couplings are approved by the Engineer for use at equipment connections: i.e. pumps. An installation diagram will need to be approved by Engineer prior to installation.
- .3 Gaskets shall be manufactured by Victaulic, and shall be verified as suitable for the intended service prior to installation.
 - .1 Grade "EHP" EPDM for water and oil-free air services -30°F to + 250°F. (UL classified in accordance with ANSI/NSF-61 for hot & cold potable water services.)
- .4 Field Grooved Joints:
 - .1 For grooved joints, pipe ends shall be clean and free from indentations, projections and roll marks in the area from pipe end to groove for proper gasket seating.

- .2 Contractor shall verify the pipe and grooves meet Manufacturer's current specifications. Groove depth dimension "C" shall be verified by using a Pi tape. A copy of Manufacturer's product field installation hand book shall be present on site during construction and shall be read by tradesman before installing products.
- .3 Grooving tools shall be manufactured by Fitting Company. The tools shall be used in strict accordance with the latest Manufacturer's instructions. Contractor will make sure that the correct rolls are used for each pipe type and system.
- .4 Install all products in accordance with the latest installation instructions as published by the Manufacturer of the product.
- .5 The grooved coupling manufacturer's factory trained representative shall provide on-site training for contractor's field personnel in the use of grooving tools, application of groove, and installation of grooved joint products. The manufacturer's direct representative shall periodically visit the jobsite and review installation. Contractor shall remove and replace any joints deemed improperly installed.

END OF SECTION 15740

1 QUALITY ASSURANCE

- .1 Air Handling Units shall be built to the level of quality as herein specified and to the description of the Air Handling Unit Schedule, mechanical drawing M-10.
- .2 Substitution of any product other than that specified must assure no deviation below the stated capacities, air flow rate, heat transfer rate, filtration efficiency and air mixing quality. Power requirements must not be exceeded, and where specifically defined, sound power levels must not be exceeded.
- .3 Unless stated otherwise, air handling units are to be shipped to the job in one piece, factory assembled. All equipment shall be factory tested prior to shipment.
- .4 The air handling units and major components shall be products of manufacturers regularly engaged in the production of such equipment.
- .5 Fans and air handling equipment shall meet the requirements of AMCA performance standards.
- .6 Equipment supplied shall be constructed to meet the requirements of CSA/NRTL, ULC or ETL approvals.
- .7 Coils shall have ARI 410 certification.
- .8 The manufacturer and local representative shall provide assistance to the general contractor and mechanical subcontractor to ensure the assembly of the modules is as per the manufacturer's requirements and recommendations.
- .9 Start up assistance shall also be part of the tender package, to ensure he controls are as per the manufacturers requirements and as per the tender documents.
- .10 The air handling unit manufacturer shall carry an 18 month parts only warranty.
- .11 Custom built air handling units shall be the make, model, size, capacity, arrangement, and characteristics as scheduled and detailed on the drawings. Air handling units shall be manufactured by Haakon, with dual fan technology fan units and controls, or approved alternate.
- .12 Shipping, brokerage, customs, bonded storage, insurance, warranty costs shall be covered by the air handling unit manufacturer. These costs shall be separately identified in the air handling unit costs. All general sales tax, and provincial sales tax shall also be covered by this manufacturer.
- .13 The complete air handling unit and all ancillary equipment (controls, variable speed drive, filters, coils, fans, motors, curb base rail etc.) shall be delivered direct to site.

- .14 The air handling unit warranty will not start until the air handling unit is installed and commissioned. This commissioning shall entail the putting into service of the air handling unit and not from the date of first fan start up for testing and commissioning.
- .15 Provide industry standard size filters only in all air handling equipment. Filters to comply with the requirements of ASHRAE Standard 52.1. With minimum MERV 13 rating.

2 CUSTOM AIR HANDLING UNITS

2.1 GENERAL

.1 SCOPE

- .1 Provide air handling units designed and manufactured to the specific requirements of this project.

.2 QUALITY ASSURANCE

- .1 The following are to be used as selection criteria and are to be as specified: Airflow rates, external static pressures, water flow rates. The following are to be equaled or bettered: Coil face velocities, filter face velocities, casing leakage rates, casing and base deflection. The following are to be met within 10% of specified values: Water pressure drops.
- .2 Provide unit produced by a recognized manufacturer who maintains a local service agency and parts stock.
- .3 Air handling units and major components shall be products of the manufacturer regularly engaged in production of such equipment.
- .4 Fans shall conform to AMCA bulletins regarding testing and construction. Airfoil fans shall bear the AMCA certified rating seal for airflow and sound.
- .5 Coils shall be ARI certified.
- .6 Filter media shall be ULC listed.
- .7 Units with factory wiring shall be factory UL/ETL/CSA approved and labeled. Failure to comply with this requirement shall necessitate the manufacturer at his expense to have a certified UL/ETL/CSA representative inspect the equipment prior to affixing a label.
- .8 Air handling units and major components shall be products of manufacturing firms regularly engaged in manufacture of this equipment with characteristics and capacities required and whose products have been in satisfactory use in similar service for not less than 10 years.

.3 SUBMITTALS

- .1 Product data shall include dimensions, weights, capacities, certifications, component performance, electrical characteristics, casing construction details, wiring interconnections, gauges and finishes of materials.
- .2 Provide all technical information relevant to the product being provided, including but not limited to all the information shown in the schedules of this specification. It is the responsibility of the supplier to highlight any variances that his equipment has with the requirements of this specification whether or not pre-approval has been obtained. Provide the information in the same measurement units as indicated elsewhere in this specification.
- .3 Provide fan curves (not fan tables), with specified operating points clearly plotted.
- .4 Provide coil selection worksheets, clearly showing proper consideration for altitude, air density, and glycol corrections. Indicate coil tube fin and casing construction.
- .5 Provide filter information, including initial APD, final APD, dust spot efficiency, final dust holding capacity, filter media description, filter frame details, and filter removal details.
- .6 Submit sound power levels for both air handling unit inlet, outlet and radiated at rated capacity. If unit exceeds sound power levels at scheduled conditions, manufacturer must provide sound attenuators and meet specified BHP.
- .7 Submit electrical requirements for power supply wiring including wiring diagrams for interlock and control wiring, clearly indicating factory-installed and field-installed wiring.
- .8 Submit manufacturer's recommended installation instructions.
- .9 Omission of any of the above information will cause shop drawings to be immediately returned without review.

.4 OPERATION AND MAINTENANCE DATA

- .1 Submit operation and maintenance data.
- .2 Include instructions for lubrication, filter replacement, motor and drive replacement, spare parts lists, and wiring diagrams.

.5 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver products to site on a factory-installed base rail or shipping skid. Ship units over the road with 10 mil poly shrink-wrap.

- .2 Store in clean dry place and protect from weather and construction traffic. Handle carefully to avoid damage to components, enclosures, and finish. Units shall be heated and ventilated during storage.

.6 ENVIRONMENTAL REQUIREMENTS

- .1 Do not operate units for any purpose, temporary or permanent, until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.

.7 EXTRA STOCK

- .1 Provide one set of spare renewable media filters and spare belts.

2.2 PRODUCTS

.1 GENERAL

- .1 Provide factory assembled air handling unit in configuration as indicated on drawings. Unit shall include all specified components installed at the factory. Field fabrication of units and their components will not be accepted.
- .2 All units shall be inspected by the customer prior to shipment. Inspection shall be of unit completely assembled.
- .3 The unit shall be designed to be supported by a perimeter steel frame.
- .4 Units too large to be legally shipped on the road may be shipped to site in sections. Otherwise units shall be shipped in one piece.

.2 CASING

- .1 Walls and roofs shall be constructed of 16 gauge galvanized steel 2" thick acoustic thermal panels. **The inner liner shall be 22 gauge washdown marine grade (5052) aluminum.** Insulation shall be 2" thick 3 lbs density fiberglass. Insulation shall meet flame spread rating of less than 25 and a smoke developed rating of less than 50 when measured in accordance with ASTM E84.
- .2 Internal liner shall be suitable for washing with a pressure washer or steam cleaned without risk of wetting the insulation. The liner shall be installed over top of the panel flanges and each liner seam shall be sealed with a lap joint. The wall liner shall be installed over top of the base water dam such that any water run-off from the liner will drip into the water tight base rather into the wall panel. The roof liner shall be installed over top of the roof support so that water cannot enter the roof insulation.
- .3 Outdoor units shall have roof panels broken outward to provide a lapped joint watertight seal. Outdoor roofs shall be sloped a minimum of 5/8" away from the access side.

.4 Stiffeners of angle steel shall be supplied as required to maintain casing deflection criteria of 1/200 at 1.5 times the working pressure. If panels cannot meet this deflection, add additional internal reinforcing.

.5 **Any fasteners located in the airstream shall be stainless steel.**

.6 Acoustical Performance:

.1 The housing shall have been tested for acoustical performance by an independent laboratory that is accredited.

.2 Test methods and facilities used to establish sound transmission loss values shall conform explicitly with the ASTM designation E90-85 and E413-73.

.3 Sound Transmission Loss DB ASTM E-90 & E413-73

	1	2	3	4	5	6	7	8	
2" Walls	18	19	27	33	43	52	52	52	STC=37
4" Walls	20	20	28	41	51	56	55	57	STC=40

.4 Test methods and facilities used to establish sound absorption values shall conform explicitly with the requirements of the ASTM Standard Test Method for Sound Absorption Coefficients by the Reverberation Method: ASTM C423-84A and E795-83.

Sound Absorption ASTM C423-84A & E795-83

	1	2	3	4	5	6	7	8	
2" Walls	.10	.23	.75	1.08	1.05	.99	.97	.95	STC=37
4" Walls	.40	.65	1.38	1.28	1.09	1.05	1.02	1.02	STC=40

Submit lab report for approval.

.3 **BASE CONSTRUCTION**

.1 Units shall be constructed from structural steel C-channel iron around the perimeter of the unit, with intermediate channel and angle iron supports. Units less than or equal to 20' long shall have a minimum 4" channel, and units greater than 20' shall have a minimum 6" channel.

.2 **A 0.12" thick marine grade aluminum (5052) floor shall be installed on the base. Floor shall be flat reinforced from below, with all seams continuously welded. Drive screw attachment and caulking are not acceptable.** Base shall be provided with lifting lugs, minimum four (4) per unit section. The base shall be insulated with 3" fiberglass insulation and sheeted with a 22 gauge galvanized steel liner. **Blown foam insulation is not acceptable.** Floors that "oil can" are not acceptable.

- .3 Provide a 1.5" perimeter collar around the entire unit, and around each floor opening to ensure the unit is internally watertight. The entire base shall act as an auxiliary drain pan and hold up to 1.5" of water.
- .4 Provide auxiliary 1.25" drains in fan sections downstream of cooling coils, and in mixing sections.
- .5 All drain connections on floor mounted air handling units shall terminate at the side of the unit.
- .6 Maximum base deflection shall be $\frac{1}{4}$ " on 240" unsupported span.

.4 ACCESS DOORS

- .1 Access doors shall be manufactured from 16 gauge galvanized steel. The doors shall be double wall construction with 18 gauge washdown marine grade aluminum solid metal liner on the inside. Corners of the doors shall be continuously welded for rigidity. Doors must be the same thickness as the unit casing to maximize thermal and acoustical resistance. A 12" round hermetically sealed Double Glazed Laminated glass window shall be provided in each door. Hinges shall be continuous piano type stainless steel. **Strap hinges are not acceptable on access doors and any units that arrive on site with such shall be remedied to continuous hinges at the manufacturer's expense.**
- .2 Two chrome plated "Ventlok" Model #310 high pressure latches operable from either side of the door shall be provided. No exceptions. Door opening shall be fully gasketed with continuous $\frac{1}{2}$ " closed cell hollow round black gasket with a metal encapsulated reinforcing backing that mechanically fastens to the door frame. Door frames shall be made from 16 gauge galvanized steel with the outside size of the door flush with the unit. Minimum door opening size shall be 18" x 70" (where height permits). Fan compartments must have a door of minimum width to remove the motor.
- .3 All access doors must swing against the air pressure (i.e. positive pressure plenum doors must swing in).

.5 NON-SCROLLED FANS—PLENUM TYPE

- .1 Fans shall be manufactured by Haakon, Twin City, Barry Blower or Mechanovent. Fans shall be TEFC plenum (plug) type, designed without a scroll type housing. Fans shall incorporate a wheel, heavy gauge reinforced steel inlet plate with removable spun inlet cone, structural steel frame, and shaft and bearings in AMCA Arrangement 3 configuration as an entire assembly.
- .2 All fan wheels shall have tapered spun wheel cones or shrouds providing stable flow and high rigidity. The wheels shall be non-overloading type.

- .3 The blades shall be continuously-welded, die-formed Airfoil type, designed for maximum efficiency and quiet operation. Partial welding will not be acceptable on airfoil blades.
- .4 Impellers shall be statically and dynamically balanced and complete fan assembly shall be test balanced at the operating speed prior to shipment.
- .5 Shafts to be sized for first critical speed of at least 1.43 times the maximum speed for the class. Bearings are to be heavy duty, grease lubricated, anti-friction ball or roller, self-aligning, pillow block type and selected for an L10 200,000 hour life at the maximum class RPM.
- .6 Cantilevered vane blades are to be used through Size 490 to minimum air performance insertion losses and noise. Operating mechanism shall be out of the inlet airstream.
- .7 Fans shall be direct drive type. Belt driven fans not acceptable.
- .8 Fans and fan base shall be heresite coated for corrosion protection.**

.8 VIBRATION ISOLATION

- .1 An integral all welded epoxy coated steel vibration isolation base shall be provided for the fan and motor.
- .2 Isolators shall be free standing with sound deadening pads and leveling bolts.
- .3 Spring diameter to compressed operating height ratio shall be 1 to 1.
- .4 Spring deflection shall be a minimum of 2".

.9 MOTORS AND DRIVES

- .1 Fan motors to be mounted and isolated on the same integral base as the fan.
- .2 Fan motors shall be heavy duty, Design B, TEFC. Motors shall meet NEMA Premium standard MG 1 – 2006.
- .3 Motors used with variable frequency drives shall be provided with motor shaft grounding devices, a minimum insulation class of F, and shall meet NEMA MG1 Part 31.

.10 COILS

- .1 All coils shall meet or exceed all capacities specified on the mechanical schedule for the project. All coil performance shall be certified by the manufacturer in accordance with ARI Standard 410.

- .2 Construct coils of configuration plate fins and seamless tubes. Aluminum fins shall have collars drawn, belled and firmly bonded to tubes by means of mechanical expansion of tubes. Do not use soldering or tinning in bonding process.
- .3 **Construct coil casings of minimum 16 gauge 316 stainless steel with formed end supports and top and bottom channels.**
- .4 All Coils shall be fully enclosed within casing and cooling coils shall be on mounted **316 Stainless Steel** angle racks manufactured to allow coils to slide out individually.
- .5 Removable coil access panels shall be provided to remove coils through casing wall. Coils shall be individually removable towards (away from) the access side. Coils must be individually racked, removable through the side access panels.
- .6 Drain pans shall be continuously welded marine grade aluminum. Coil section must have intermediate drain pans and shall be interconnected with 1" drain lines. Drain pans shall be recessed into the unit floor, extend 18" downstream of the leaving edge of the coil, IAQ sloped, and fully drainable. **Floor mounted drains are not acceptable**
- .7 Pipe connections shall be on the same end, extended through the casing for ease of connection, employing a plate over the connection to minimize leakage.
- .8 Water coils handling recently mixed air, or direct outside air, shall be drainable.
- .9 Clearly label supply and return headers on outside of units such that direction of coil water-flow is counter to direction of unit air-flow.
- .10 Coils shall be proof tested to 300 psig and leak tested to 200 psig air pressure under water.
- .11 Construct headers of round copper pipe.
- .12 **All coil tubes and fins shall have electrofin treatment.**
- .11 FILTERS
 - .1 Prefilters: Filters shall be 30% efficient, MERV 8 pleated, disposable types. Each filter shall consist of a non-woven cotton and synthetic fabric media, media support grid and enclosing frame. The filter shall be listed by Underwriters' Laboratories as Class 2.
 - .2 Prefilters shall be installed in prefabricated channel rack.
 - .3 Prefilters shall be lift-out where access is available upstream of the filter, or slide out when access is not available.

.12 FINAL FILTERS

- .1 Final filters shall be high performance, deep pleated, totally rigid and disposable type. Each filter shall consist of high density microfine glass fiber media, media support grid, contour stabilizer and enclosing frame.
- .2 Final filter media shall be of high density microfine glass fibers that are laminated to a non-woven synthetic backing to form a lofted filter blanket. The filter media shall have MERV 13 rating.
- .3 Holding Frames: Holding frames shall be factory fabricated of **12 gauge marine grade aluminum** and shall be equipped with gaskets on all 4 sides of the filter and 2 heavy duty positive sealing fasteners. Each fastener shall be capable of withstanding 25 lbs. pressure without deflection and be attached or removed without the use of tools.
- .4 Final filters shall be lifted out where access is available upstream of the filter, or side slideout when access is not available.

.13 LIGHTS

- .1 Marine lights with protective metal cage and glass seals complete with duplex receptacles shall be installed on the wall across from the access doors. A switch with an indicator light shall be installed on the unit. Electrical power shall be 120V/1/60. Lights shall be equipped with compact fluorescent bulbs. Wiring for lighting shall be in rigid EMT conduit with rain tight fittings. A separate green bonding wire shall be provided. Each lighting circuit shall be 15A.

.14 FILTER GAUGES

- .1 Provide Dwyer 2000 magnehelic gauges.
- .2 Magnehelic gauges shall be accurate to $\pm 2\%$ of full range.
- .3 One gauge shall be provided for each filter bank.
- .4 Gauges shall be recessed into cabinet casing.

.15 BELLMOUTH DISCHARGES AND INLETS

- .1 Where shown on the plans or where a discharge is 1500 fpm or more, discharges shall have a radiused curve equal to the thickness of the casing.

.16 FINISH

- .1 Unit shall be finished painted with two components, etch bond primer and finish painted with alkyd enamel, as selected by Owner. All uncoated steel shall be painted with grey enamel. All metal surfaces shall be prepainted with vinyl wash primer to ensure paint bonds to metal. Outdoor unit shall be finish coated with polyurethane paint. Paint for outdoor units shall be tested to ATSM B117 for 5000hr salt spray endurance.

.17 HOODS

- .1 Fresh air and exhaust air hoods shall be provided complete with 0.5" x 0.5" birdscreen and finished to match the units.
- .2 Hoods shall be 16 gauge galvanized steel construction, finished to match the unit.
- .3 Provide continuous rain gutters around the perimeter of the hood with drain connections.
- .4 Hoods shall be sized for maximum of 500 fpm on the free area of the inlet.

.18 ALUMINUM AIRFOIL DAMPERS

- .1 Aluminum airfoil frames and blades shall be a minimum of 12 gauge extruded aluminum clear anodized to a depth of 0.7mil (18 microns). Blades shall be of a single unit airfoil design 6" wide.
- .2 Frames shall be extruded aluminum channel with grooved inserts for vinyl seals. Standard frames: 2" x 4" x 5/8" on linkage side, 1" x 4" x 1" on the other 3 sides.
- .3 Pivot rods shall be 7/8" hexagon extruded aluminum interlocking into blade section. Bearings shall be of a double sealed type with a Celcon inner bearing on a rod within a Polycarbonate outer bearing inserted into frame so that the outer bearing cannot rotate.
- .4 Bearing shall be designed so that there is not metal-to-metal or metal-to-bearing riding surfaces. Interconnecting linkage shall have a separate Celcon bearing to eliminate friction in linkage.
- .5 Blade linkage hardware shall be installed in frame out of air-stream. All hardware shall be non-corrosive stainless steel.
- .6 Damper seals shall be designed for minimum air leakage by means of overlapping seals.
- .7 Jack shaft assemblies shall be provided for multiple damper installations.

- .8 **Standard of Acceptance: TAMCO 1000 SW (salt water). No exceptions.**
- .19 DAMPER OPERATORS
- .1 Provide factory installed electric damper operators with all linkage and hardware internally mounted.
- .2 Ensure operators are mounted in easily accessible sections of the air handling unit.
- .20 ELECTRICAL
- .1 Factory wire and test all air handling units. Have units approved by CSA, ETL or UL.
- .2 Supply one (1) single point 208 V/60 Hz/3 Ph power connection for each unit. Wire all 120 V/208 V/60 Hz/1 Ph components such as lights, convenience outlet, controls, heaters, etc. from a panel with circuit breakers for each type of electric device. Panel for 120 V/208 V/60 Hz/3 Ph is fed from a separate service.
- .3 Label and number code all wiring and electrical devices in accordance with the unit electrical diagram. Mount the devices in a control panel inside the unit's service enclosure or on the outside. Ensure the control panel meets the CSA, ETL or UL.
- .4 Provide a through the door type disconnect at the main power connection point.
- .21 DRAINS
- .1 Provide 1.25" capped floor drain connections on the side of the unit for complete drain ability of the base pan for the following sections:
- Fresh Air Plenums
 - Humidifier Sections
 - Service Corridors
 - Fan Sections
 - Section upstream and downstream of coils
 - All sections if unit was washdown liner
- .22 CONDUIT AND CONTROLS
- .1 Air Handling Units to be provided with factory installed empty conduits for control wiring inside unit. The controls contractor will be responsible for pulling wires and installing controls devices.
- .2 DDC terminal strip in each air handling unit to be sufficient for 20 DDC points.

.23 SHIPPING

- .1 Units shall be cleaned and wrapped in a 10 mil shrink wrap prior to shipping.

.24 INSTALLATION

- .1 On units which are mounted on roof curbs, pre-insulate the inside of the roof curb prior to installing the units.
- .2 Any floor penetrations are to be thoroughly sealed to ensure the water tightness and integrity of the entire floor.
- .3 Install units on a flat surface level within 1/8" and of sufficient strength to support the units.
- .4 Provide components furnished as per manufacturer's literature.
- .5 Provide all water piping so water circuits are serviceable, without having to dismantle excessive lengths of pipe.
- .6 Provide valves in water piping upstream and downstream of each coil for isolating the coils for maintenance and to balance and trim the system.
- .7 Provide drain valves and vent cocks to each coil.
- .8 Provide strainers ahead of all pumps and automatic modulating valves.
- .9 Provide certified wiring schematics to the electrical division for the equipment and controls.
- .10 Provide all necessary control wiring as recommended by the manufacturer.
- .11 Provide condensate traps in accordance with manufacturers recommendations.

END OF SECTION 15810

1 QUALITY ASSURANCE

- .1 Fans shall be constructed to the level of quality as herein specified and to the description of the Fan Schedule, Mechanical drawing M-10.
- .2 Fans shall be products of manufacturers regularly engaged in the production of such equipment.
- .3 Fans shall meet the requirements of AMCA performance standards.
- .4 Equipment supplied shall be constructed to meet the requirements of CSA/NRTL, ULC or ETL approvals.

2 CEILING PROPELLOR FANS (HIGH VOLUME, LOW SPEED FANS)

2.0 PRODUCT

- .1 Complete Unit
 - .1 Regulatory Requirements: The entire fan assembly shall be ETL-certified and built pursuant to the construction guidelines set forth by UL standard 507 and CSA standard 22.2.
 - .2 Sustainability Characteristics: The fan shall be designed to move an effective amount of air for cooling and destratification in industrial applications over an extended life. The fan components shall be designed specifically for high volume, low speed fans to ensure lower operational noise. Sound levels from the fan operating at maximum speed measured in a laboratory setting shall not exceed 55 dBA. Actual results of sound measurements in the field may vary due to sound reflective surfaces and environmental conditions.
 - .3 Color: Custom colors can be selected by the architect or owner.
 - .4 Good workmanship shall be evident in all aspects of construction. Field balancing of the airfoils shall not be necessary.
- .2 Airfoil System
 - .1 The fan shall be equipped with eight (8) PowerfoilPlus airfoils of precision extruded aluminum alloy. The airfoils shall be connected by means of two (2) high strength locking bolts per airfoil. The airfoils shall be connected to the hub and interlocked with zinc plated steel retainers. As an option, airfoils may have a variety of finish treatments, e.g., powder coat or wet paint, as specified by the architect or owner.
 - .2 The fan shall be equipped with eight (8) PowerfoilPlus winglets on the ends of the airfoils and eight (8) AirFences™ positioned on the airfoils at the optimum location for performance. Both the winglets and AirFences shall be molded of polypropylene. The standard color of the winglet and AirFence shall be "Safety Yellow."

- .3 Motor
 - .1 The fan motor shall be an AC induction type inverter rated at one of the following:
 - .1 1725 RPM, 200–250/400–480 VAC, 50/60 Hz, three-phase
 - .2 1725 RPM, 200–250 VAC, 50/60 Hz, single-phase
 - .2 The motor shall be totally enclosed, fan cooled (TEFC) with an IP56 NEMA classification. A NEMA 56C standard frame shall be provided for ease of service. The motor shall be manufactured with a double baked Class F insulation and be capable of continuous operation in -30oF to 122oF (-34oC to 50oC) ambient conditions.
- .4 Gearbox
 - .1 The gearbox shall be a helical gear reducer, precision finished from hardened steel for low noise and long service life with double lip seals to retain oil and prevent contamination. The gearbox shall be lubricated for life. The gear reducer shall have a standard backlash of less than 25 arc minutes and be equipped with a 17-4 stainless steel shaft of 1-1/4" (3.2 cm) diameter.
- .5 Motor Frame
 - .1 The motor frame and mount shall be constructed of steel and powder coated for corrosion resistance and appearance. Non-visible, steel, threaded rods in each structural member of the motor frame shall provide a redundant safety feature in the event of a catastrophic event.
- .6 Mounting System
 - .1 The fan mounting system shall be designed for quick and secure installation on a variety of structural supports. The mounting yoke shall be of welded construction and made from low carbon A36 steel no less than 3/16" (0.5 cm) thick, per ASTM A36, and be powder coated for appearance and resistance to corrosion.
 - .2 All mounting bolts shall be SAE Grade 8 or equivalent.
- .7 Hub
 - .1 The fan hub shall be made of laser cut aluminum for high strength and light weight. The hub shall consist of two aluminum plates, eight (8) aluminum spars and one (1) spacer fastened with a pin and collar rivet system.
 - .2 The hub shall be secured to the output shaft of the gearbox by means of a steel coupling interface. The hub shall incorporate four (4) safety retaining clips made of 1/4" (0.6 cm) thick steel that shall restrain the hub/airfoil assembly.

.8 Safety Cable

- .1 The fan shall be equipped with a safety cable that provides an additional means of securing the fan assembly to the building structure. The safety cable shall be at least 1/4" (0.6 cm) in diameter and fabricated out of 7 x 19 zinc galvanized steel cable. The end loops shall be secured with swaged Nicopress® sleeves, pre-loaded and tested to 3,200 lbf (13,345 N).
- .2 Field construction of safety cables is not permitted.

.9 Wall Control

- .1 The fan controller shall consist of a NEMA 4X variable speed drive (VSD) that is mounted to the wall at ground-level and factory programmed to minimize starting and braking torques. The wall control shall be equipped with touchpad controls and an LED display for controlling the fan's direction, operation, speed, and programming. The wall controller shall provide 100% control of all fan functions. The wall control shall be equipped with an EMI/RFI filter to limit interference with other electronic equipment and a rotary switch disconnect for lock-out/tag-out requirements.

.10 Guy wires

- .1 Included for installations with extension tubes 4 ft (1.2 m) or longer to limit potential for lateral movement.

2.1 PREPARATION

- .1 Fan location must have a typical bar joist or existing I-beam structure from which to mount the fan. Additional mounting options may be available.
- .2 Mounting structure must be able to support weight and operational torque of fan. Consult structural engineer if necessary.
- .3 Fan location must be free from obstacles such as lights, cables, or other building components.
- .4 Check fan location for proper electrical requirements. Consult installation guide for appropriate circuit requirements.
- .5 Each fan requires dedicated branch circuit protection.

2.2 INSTALLATION

- .1 Install the fan according to the manufacturer's Installation Guide, which includes acceptable structural dimensions and proper sizing and placement of angle iron for bar joist applications. Big Ass Fans recommends consulting a structural engineer for installation methods outside the manufacturer's recommendation and a certification, in the form of a stamped print or letter, submitted prior to installation.
- .2 Minimum Distances
 - .1 Airfoils must be at least 10 ft (3 m) above the floor.
 - .2 3.2 Installation area must be free of obstructions such as lights, cables, sprinklers or other building structures with the airfoils at least 2 ft (0.61 m) clear of all obstructions.
 - .3 The structure the fan is attached to shall be capable of supporting a torque load of up to 300 ft·lb (407 N·m) of torque
- .3 The fan shall not be located where it will be continuously subjected to wind gusts or in close proximity to the outputs of HVAC systems or radiant heaters. Additional details are in the Big Ass Fans 3.2 Installation Manual.
- .4 For performance data refer to the Propeller Fan Schedule on Mechanical Drawing M-10.

END OF SECTION 15860

1 QUALITY ASSURANCE

- .1 Fabricated sheet metal ductwork shall conform to SMACNA standards for materials used and fabrication methods.
- .2 Ductwork specialties shall confirm to applicable CSA, UL and ULC standards

2 DUCTWORK

2.1 General and Quality Assurance

- .1 Construct all ductwork to the appropriate sections of SMACNA standards for the specified classifications of ductwork.
- .2 All ductwork used on this project shall be clean and free of scale.
- .3 All outdoor, supply, return, relief and exhaust air ductwork on this project is classified as low pressure. Sheet metal screws may be used for fastening joints in low pressure ductwork.
- .4 Prior to fabrication of ductwork, check all ceiling spaces and heights and conflict with other trades. Include and provide necessary offset to maintain ceiling height, headroom etc.

2.2 Low Pressure Aluminum Ductwork

- .1 Aluminum sheet, ASTM B209, lock forming ductwork, with alloy 1100, 3003 or 5052, fabricated to the requirements of SMACNA standards
- .2 Wrap all joints with fire and water resistive duct tape and sealant. Sealant shall be water resistant, Robson's Duct Seal or Duro Dyne S-2 with FT-2 tape Flexmaster duct band.
- .3 Seal all ducts and plenums located outdoors with Robson's RT-80 or approved equal.

2.3 Exterior Mounted, Internally Insulated Ductwork

- .1 Aluminum sheet, ASTM B209, lock forming ductwork, with alloy 1100, 3003 or 5052, fabricated to the requirements of SMACNA standards for the specified classifications.
- .2 Insulation: 50-mm (2-inch) thick internal acoustic duct liner, as described in Section 15320, Clause 3.1
- .3 To anchor duct liner material in place provide 38-mm (1.5-inch) wide, 24-gauge steel bands on inside surface of duct liner at each joint of liner material.
- .4 Paint exterior surface of ducts with weatherproof coating as described in Section 15320, Clause 4.1.

3 HOODS

3.1 Sheet Metal Shields for Electrical Equipment

- .1 The sheet metal Contractor is to supply and install shields to protect electrical equipment from damage by automatic sprinkler systems.
- .2 Fabricate from gauge of metal appropriate for size of shield, as directed by SMACNA standards.
- .3 Refer to the Fire Protection drawings for locations of required shields.

4 DUCTWORK SPECIALTIES

4.1 Acoustic Duct Lining

- .1 Where acoustic duct lining is indicated, duct dimensions on the drawings designate the clear inside dimensions required. Make allowance in the overall sheet metal dimensions to accommodate this requirement.
- .2 This requirement does NOT apply to ductwork associated with classroom unit ventilators.
- .3 Refer to Section 15320 for installation requirements.

4.2 Duct Access Doors

- .1 Provide wherever access to coils and dampers is required, on both upstream and downstream sides of device.
- .2 Minimum size of access doors for hand access to be 225-mm x 225-mm (9-inch x 9-inch).
- .3 Minimum size of access doors for man access to be 450-mm x 450-mm (18-inch x 18-inch) except where duct width is insufficient.

4.3 Balancing Dampers

- .1 Single Blade Dampers;
 - .1 Fabricated of same material as duct, 16 ga. V-groove stiffened.
 - .2 Size, configuration and construction as per recommendations of SMACNA, except maximum height for rectangular ducts to be 300mm (12").
 - .3 Locking quadrant with shaft extension to accommodate insulation thickness.
 - .4 Inside and outside end bearings. Nylon on dampers up to 300mm (12") high, oilite bronze on dampers over 300mm (12") high or diameter.
 - .5 Channel frame of same material as adjacent duct, complete with angle stop.

- .2 Double Blade Dampers;
 - .1 Factory manufactured of same material as duct, 16 ga.
 - .2 Opposed Blade: configuration and construction as per recommendations of SMACNA.
 - .3 Maximum blade height: 200mm (8")
 - .4 Bearings: bronze oilite bushings.
 - .5 Linkage: shaft extension with locking quadrant
 - .6 Channel frame of same material as adjacent duct, complete with angle stop.
- .3 Provide as indicated on the drawings and in all main and branch ducts whether indicated on drawings or not. Provide additional balance dampers at the request of the balancing agent to facilitate balancing.
- .4 Install balance dampers at least 2 metres (6-feet) upstream of grilles and diffusers where space allows.

4.4 Backdraft Dampers

- .1 Fabricated of aluminum with frame minimum of 20 mm thick and blades minimum 2 mm thick. Axles minimum 12 mm diameter ball bearing pressed into the frame. Blade seals to have extruded vinyl seals.
- .2 Provide adjustable counterbalances.
- .3 Provide backdraft dampers at inlet to any exhaust fans not provided with automatic control dampers.

4.5 Flexible Connections

- .1 Install canvas flexible connections on inlet and outlet of all exhaust fans, and inlet and outlet of roof mounted air handling units.
- .2 Ensure that flex does not impede airflow and allows movement of equipment without transmitting vibration into the ductwork.

4.6 Turning Vanes

- .1 Airfoil type with runner channels.
- .2 Provide for all square or rectangular duct elbows.

5 GRILLES, REGISTERS, DIFFUSERS AND LOUVRES

- .1 For performance and manufacturing data refer to the schedule on the drawings.

6 DUCT CLEANING

- .1 Maintain all new ductwork installed on this project clean and free from dust and other workplace debris.

- .2 If in the Consultant's opinion any new ductwork installed has not been maintained in a clean condition the Contractor shall retain the services of a certified duct cleaning company to thoroughly vacuum and clean ALL outdoor, supply and return air ductwork installed.
- .3 For all existing ductwork on the systems indicated below retain the services of a certified duct cleaning company to thoroughly vacuum and clean ALL outdoor, supply and return air ductwork

7 COUNTERFLASHINGS FOR ROOF CURBS

- .1 Galvanized sheet steel of 0.8 mm minimum thickness.
- .2 Counterflashings are attached to mechanical equipment and lap the base flashings on the roof curbs.
- .3 All joints in counterflashings shall be flattened and solder double seam. Storm collars shall be adjustable to draw tight to pie with bolts. Caulk around the top edge. Storm collars shall be used above all roof jacks.
- .4 Vertical flange section of roof jacks shall be screwed to face of curb.
- .5 Install in accordance with latest RCABC Standards.

END OF SECTION 15880

1 GENERAL

- .1 The scope of work for the controls contractor in addition to installing a fully function DDC (direct digital control) system for the new building systems, it also includes the field installation and wiring, (both low and line voltage wiring), of sensors, devices, and control panels that are supplied with other mechanical equipment specified in other sections of the mechanical division. It is the responsibility of the Controls contractor to read the other sections and to include this in their scope of work along with the scope of work defined in Section 15915. This work shall include, but is not limited to, the following:
 - .1 Relay panels,
 - .2 BACnet communication interfaces
 - .3 Remote control panels
- .2 The approved control contractor for this project is **ESC Automation** which will match the existing Delta Control system on site.
- .3 **This scope of work is covered under Cash Allowance No.1. (\$60,000.00 excl. GST)**
 - .1 Cash Allowance to include:
 - .1 Supply and install DDC conduits and wiring, DDC programming, graphics, and commissioning as per plans and specifications to expand the existing Delta Controls System.
 - .2 Supply of water flow meter for 25m lap pool preheat system.
 - .3 Supply and installation of actuators for control dampers packaged with AHU's.
 - .4 Supply to mechanical contractor (13) new control valves for installation as per valve schedule.
 - .5 Supply and installation of new controllers, expanders, and cabinets as required in order to accommodate the new point load requirements as outlined in the points list included in the specification.
 - .6 DDC Shop drawings and As-built shop drawings.
 - .7 Electrical Permit.
 - .1 Cash Allowance does not include:
 - .1 Any Division 16/26 work
 - .2 Supply of control dampers for AHU's
 - .3 Any access hatches, cutting, coring, patching, or painting
- .4 **Alternative Price No. 1: This scope of work is covered under Cash Allowance No.2. (\$12,000.00 excl. GST)**
 - .1 Cash Allowance to include:
 - .1 Supply and install DDC conduits and wiring, DDC programming, graphics, and commissioning as per plans and specifications to expand the existing Delta Controls System.
 - .2 Supply of water flow meter for 25m lap pool preheat system.
 - .3 DDC Shop drawings and As-built shop drawings.

- .2 Cash Allowance does not include:
 - .1 Any Division 16/26 work
 - .2 Supply of control dampers for AHU's
 - .3 Any access hatches, cutting, coring, patching, or painting

2 REFERENCED CODES AND STANDARDS AND REGULATORY BODIES

- .1 Worksafe BC Occupational Health and Safety Regulation
- .2 BC Safety Authority.
- .3 British Columbia Building Code.
- .4 British Columbia Electrical Code.
- .5 CAN/ULC.
- .6 Local Municipal or City Bylaws
- .7 Local Authority Having Jurisdiction

3 EXECUTION

- .1 Installation of all new controls hardware, wiring and programming of software as required for a completely operational, commissioned control and monitoring installation for the mechanical systems described herein. New systems to be integrated with existing systems for seamless operations.
- .2 The HVAC control system shall be based on Direct Digital Control, hard-wired, with electronic sensors and actuators.
- .3 The system, provided shall comply with the requirements of the latest version of ANSI/ASHRAE Standard 135 "Data Communication Protocol for Building Automation and Control Networks"
- .4 The controls equipment will be manufactured by Delta Controls or Reliable Controls and installed by a contracting firm licensed as a Delta or Reliable vendor/installer.
- .5 The Controls Contractor shall review all specification divisions and coordinate the requirements of all mechanical and electrical equipment to be controlled and be responsible for the coordination and interface requirements between the Controls, HVAC and Electrical Systems, as well as existing conditions.
- .6 Allow and include for all control points listed in the Typical Equipment Points List attached.
- .7 All DDC controllers to be BTL listed.
- .8 All electrical control components shall be CSA and ULC approved.
- .9 The Owner will provide a high speed internet connection for remote access.
- .10 Provide at least one licensed copy of the successful vendors OWS software or as many copies required to meet the project requirements.

- .11 Wiring:
 - .1 Provide all control wiring, whether line or low voltage, all system components, devices, actuators, relays, etc. as necessary for complete operation of the system.
 - .2 All wiring shall conform to the requirements of Division 26 and the Canadian Electrical Code.
 - .3 Control wiring to be a minimum of 18 gauge, run in conduit or as plenum rated cable where described below.
 - .4 Controls wiring shall be continuous without splices between the DDC panel and end device.
 - .5 Controls wiring shall be terminated at sensor locations with the use of insulated butt splices, T&B RBB25 or equivalent with both wires crimped together at one end leaving the other end open for the insertion of multi-meter probes for troubleshooting. The use of marrettes is not acceptable.
 - .6 Include for any Ethernet or other wiring required between the DDC control system and the internet connection point provided by the owner.
- .13 For each motor program analog currents values to provide on/off/trouble indication. Fan currents are to be measured and recorded as a REMARK statement in the control coding for future reference in establishing the on/off/trouble indications. For fans that operate on low medium and high speeds the fan currents are to be measured and recorded as a REMARK statement in the control coding for future reference. These measured values will be used to establish on/off/trouble indications for operation at any of the selected speeds. System graphics are to visually indicate "ON", "Off", and "Status does not equal Command" for controlled equipment.
- .14 Commissioning the control system installed, including
 - .1 VISUAL end-to-end checks on all actuated devices
 - .2 Provide verification and calibration check sheets for all actuated devices for inclusion in the Operation and Maintenance manual.
 - .3 Cooperate with the Testing, Adjusting and Balancing (TAB) agency for the following operations
 - .1 Actuating of control valves and dampers to assist with air and water systems balancing
 - .2 Provide access to programming and software code for review

- .3 Assist with random end-to-end checks for verification of controls operation
- .4 Provide remote access to the TAB agency for the duration of the warranty period.
- .15 Provide a minimum of 8 hours training and instruction to the Owner's maintenance personnel. This should occur in two 4 hour sessions, at mutually agreeable times.
- .16 The Contractor is to include for two service visits during the warranty period. One at the start of the first heating season and one at the start of the first cooling season after substantial completion.
- .17 Provide for inclusion in the Operation and Maintenance manual complete As-Built control drawings, sequences of operation, product data sheets for all newly installed products and end-to-end verification check sheets. Control drawings are to completely replace all existing control drawings for projects undergoing retrofit.
- .18 Provide and install point labels / baggage tags for all connected DDC points. The labeling standard Panduit LS9 Labeller or equal
- .19 The Controls Contractor is to coordinate all shutdowns and system switchovers with the Owner prior to the activity taking place. Allow 2 weeks notice to allow adequate time for the Owner to coordinate the activity.

3.1 System Description

- .1 General Requirements
 - .1 The Control System shall be an on-line network of distributed, communicating microprocessor based stand-alone controllers, field sensors, control devices, enclosures and interconnecting conduit and wire.
 - .2 The networked components of the system shall make up a BACNet network - including at least a high speed and/or other LAN's interconnecting BACNet devices. Those devices on the BACNet inter-network shall be peer to peer and communicate utilizing the BACNet protocol on BACNet LAN types.
 - .3 Actuation of control devices shall be electronic. Fail-safe actuation shall be provided on all control dampers and primary equipment valves when property damage is possible without fail-safe operation.
- .2 Basic System Architecture
 - .1 The system components shall include but not be limited to:
 - .1 Operator Workstation with operating software (B-OWS)

- .2 Third Party Application Software
- .3 Building Controllers (B-BC)
- .4 Advanced Application Controllers (B-AAC)
- .5 Application Specific Controllers (B-ASC)
- .6 Panels and Enclosures
- .7 Field Sensors
- .8 Controlled Devices
- .9 Interconnecting Wire & Cabling
- .10 Network LAN's & Communication Protocols
- .11 Interfaces for Hardwire Connection to Variable Frequency Controls, Chillers and Lighting
- .12 Serial interface to other system listed below:
 - .2 Field Sensors and Control Devices shall connect to peer-to-peer, fully programmable B-BC, B-AAC & B-ASC as required to achieve the point monitoring and control sequences specified by the Consultant.
 - .3 All devices are to be monitored by B-OWS. Controlled devices are to be electronically actuated.
 - .4 Each mechanical system shall have a controller that shall be connected to all field sensors and control devices for that system.
 - .5 Sensors and Control devices shall be UL listed.

3.2 Quality Assurance

- .1 Control System components shall be manufactured by firms regularly engaged in manufacture of equipment of the types and sizes required.
- .2 The Controls Contractor shall be a licensed contractor specializing and experienced in control system installations for not less than 5 years and with experience in networked microprocessor based commercial HVAC and Electrical control systems installation with point counts equal to this project.
- .3 All employees of the Controls Contractor involved in the engineering, programming, and commissioning of the DDC system shall have successfully completed the manufacturer's classes on the control system. Provide proof of certification copies through to the Design Authority or to the Owner if requested.
- .4 The BACNet inter-network shall be based on the manufacturer's standard

integrated hardware and software product offering, which has been installed and fully operational in similar service for not less than 2 years.

- .5 To the extent practical, all equipment of the same type serving the same function shall be identical and from the same manufacturer.
- .6 Meet the requirements of all governing and applicable local or national standards and codes, except when more detailed or stringent requirements are indicated by the Contract Documents, including the requirements of this Section and the following:
 - .1 The latest version of the American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE) Standard 135 “Data Communication Protocol for Building Automation and Control Networks”
 - .2 National Institute of Standards And Technology NIST IR 6392 Annex B Profiles of Standard BACNet Devices
 - .3 Underwriters Laboratories UL 916: Energy Management Systems.
 - .4 Institute of Electrical and Electronic Engineers (IEEE) 142 Recommended Practice for Grounding of Industrial and Commercial Power Systems
 - .5 Electronics Industries Associations
 - .1 EIA-232 Interface Between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange
 - .2 EIA-485 Standard for Electrical Characteristics of Generator and Receivers for use in Balanced Digital Multi-point Systems
 - .6 Federal Communications Commission- Part J for class “A” application.

3.3 System Performance

- .1 The system shall conform to the following performance standards:
 - .1 Graphics shall display with a minimum of 50 dynamic current data points and within 2 seconds of the request.
 - .2 The maximum time between the command of a binary object by the operator and the reaction by the device shall be 2 seconds. Analog objects shall start to adjust within 2 seconds of being commanded to change.
 - .3 All changes of state or change of analog values shall be transmitted such that no reporting of a value is more than 2 seconds old.
 - .4 The maximum time from when an object goes into alarm to when it is annunciated at the B-OWS shall not exceed 2 seconds.

- .5 B-BC, B-AAC, & B-ASC shall be able to execute control loops at a selectable frequency at least 5 times every second. The controller shall scan and update the process value and output generated by this calculation at this same frequency.
- .6 All B-OWS on the network shall receive alarms within 5 seconds of each other.
 - .1 Each controller/sensor combination shall be selected and designed to perform within the accuracy and repeatability limits specified herein.
 - .2 Unless noted otherwise in these Specifications the overall combined system accuracy of sensors, controllers and readout devices shall be as noted in the following.

Measured Variable	Reported Accuracy
Space temperature	+/-0.5 deg C
Ducted air	+/-0.5 deg C
Outside air	+/-0.5 deg C
Water temperature	+/-0.5 deg C
Delta-T	+/-0.15 deg C
Relative humidity	+/-3% RH 10-95% RH
Water flow	+/-2% of actual valve
Air pressure (ducts)	+/-25 Pa (+/-0.1 WG)
Air pressure (space)	+/-3 Pa (+/-0.01 WG)
Water pressure	+/-1PSI (Note 2)
Carbon Dioxide (CO ₂)	+/- 50 PPM
Note 1: (10% to100% of scale) (can't read accurately below 10%)	
Note 2: for both absolute and differential pressure	
Note 3: * not including utility supplied meters	

- .3 Overall combined system repeatability of sensors, controllers and readout devices for a particular application shall be plus or minus 2 percent of full scale of the operating range. Repeatability of overall combined system of sensor, controller and readout device in a control loop application will be plus or minus 5 percent of full scale of the operating range.
- .4 Long-term electronic drift shall not exceed 0.4 percent per year.
- .7 The system to have an ultimate capacity of at least 2,000,000 points.

- .8 All components provided as part of this system shall operate under indoor ambient environmental conditions of: 35 to 122 °F dry bulb and 10 percent to 95 percent relative humidity, non-condensing as a minimum. Outdoor conditions shall be -30°F to 150°F and 0 percent to 100 percent relative humidity. Sensors and control elements shall operate under the ambient environmental temperature, pressure, humidity, and vibration conditions encountered for the installed location. B-OWS equipment, such as CRTs and printers, shall, unless designated otherwise, operate properly under ambient environmental conditions of 45 to 90 °F and a relative humidity of 10 percent to 90 percent.
- .9 Networked components of the system shall be able to operate at 90-percent to 110-percent of nominal voltage rating and shall perform an orderly shutdown below 80-percent.
- .10 All sensors and control devices exposed directly to a controlled media shall be rated to withstand 150 percent of maximum conditions found where in contact with the controlled media, and shall be constructed of material suitable for the media sensed.

3.4 Submittals

- .1 Indicate at the beginning of each submittal known substitutions and deviations from requirements of Contract Documents.
- .2 Submit the following within 30 days of Contract award:
 - .1 A complete bill of materials of equipment to be used, indicating manufacturer and model number.
 - .2 A schedule of all control valves including the valve size, dimensions, model number (including pattern and connections), close-off rating, flow, CV, pressure rating and location.
 - .3 A schedule of all control dampers, including damper size, pressure drop, manufacturer and model number.
 - .4 Provide manufacturers cut sheets for major system components. When manufacturer's cut sheets apply to a product series rather than a specific product, the data specifically applicable to the project shall be highlighted or clearly indicated by other means. Include:
 - .1 Operator Workstation (B-OWS)
 - .2 Building Controllers (B-BC)
 - .3 Advanced Application Controllers (B-AAC)
 - .4 Application Specific Controllers (B-ASC)

- .5 Proposed Control System architecture riser diagram.
 - .6 Provide a BACNet Product Implementation Conformance Statement (PICS) or BIBB table for each BACNet device type in the submittal.
 - .7 Color prints of complete set of graphics with a list of points for display.
- .3 Contractor shall submit shop drawings and manufacturers' standard specification data sheets on all hardware and software to be provided. Submittals shall contain the following information:
- .1 Bill of materials showing manufacturer, model number, and description for each control component.
 - .2 System architecture one-line diagram.
 - .3 Schematic flow diagram of each air and water system showing fans, coils, dampers, valves, pumps, heat exchange equipment and control devices. Include sequence of operation including alarm and emergency sequences, equipment interlocks, and manual override capabilities.
 - .4 Indicate all required electrical wiring. Identify sources for all power to each device.
 - .5 Details of control panels, including controls instruments and labeling.
 - .6 Application Programming
 - .1 Complete input output point schedule identifying, function, type, location, and identification code.
 - .2 Description of system operation under failure conditions.
- .4 Project Record Documents: upon completion of installation submit the following for the Owner's review, prior to inclusion in the Operation and Maintenance manuals. "As-Built Documents" should include:
- .1 Project Record Application Engineering Drawings.
 - .2 Operating and Maintenance (O&M) Manual including:
 - .1 Operators' Manual with system manufacturers complete operations manual.
 - .2 Programming Manual including:
 - .1 Documentation on application and DDC programs.
 - .2 Information required for independent programming of system.

- .3 Point schedules; include all points, real and virtual.
- .4 Hard copy of all analogue calibration settings for Inputs, Outputs, Variables and PID Loops.
- .5 Hardcopy of every graphic with a signoff of all verified and commissioned points, and a summary of deficient items per graphic.
- .3 Maintenance Manual including the following:
 - .1 Routine preventive maintenance procedures, corrective diagnostic troubleshooting procedures, and calibration procedures.
 - .2 Parts lists with manufacturers catalog numbers and ordering information.
 - .3 One set of magnetic media containing files of all color graphic screens created for the project.
 - .4 A list of recommended spare parts with part numbers and supplier.

3.5 Calibration, Start-Up, Verification and Acceptance

- .1 Calibration, Start-Up and Commissioning
 - .1 Calibrate all components of the control system prior to acceptance testing.
 - .2 Upon completion of the installation, all control equipment supplied under this contract shall be calibrated and adjusted to place the system in automatic operation.
 - .3 Verify that each control panel has been installed according to the shop drawings and test, calibrate and bring on-line each control device.
 - .4 Allow for time on site as required to coordinate
 - .1 With the TAB Agency's balancing contractor, to initiate operation of equipment and to open and close valves and dampers to allow Balancing Agent to balance air and water systems
 - .2 With the TAB Agency's verification contractor, to tune mechanical sequences and demonstrate correct systems performance.
 - .3 With the Chemical Treatment agency, to position control valves to ensure chemical flushing of all piping and terminal heating and cooling components is accomplished
 - .4 Maintain up to date commissioning record sheets. Include copy

with final submission for inclusion in the Operation and Maintenance Manual.

.2 Verification

- .1 Verify the overall networked system performs as specified.
- .2 Carry out end-to-end checks for all control points, verifying their proper operation. End-to-end checks are defined as VISUAL confirmation that an input or output signal from the DDC system results in correct operation of physical system components, not assumed operation as implied by output status indicated on system interface screens or graphics. Produce documentation indicating the date and results of all end-to-end checks, including calibration factors entered.
- .3 Subsystems not controlled electronically shall also be tested and commissioned.

.3 Demonstration and Acceptance Testing

- .1 Complete sequences of operation shall be demonstrated to the TAB Agency and the Owner's representative prior to substantial completion.
- .2 Using the documented calibration and commissioning test data the Owner and /or his representative shall select, at random, results to be demonstrated. At least 95 percent of the results demonstrated must perform as specified and documented on commissioning data sheets or the system must be re-calibrated and re-commissioned before being re-tested.
- .3 After the acceptance tests are complete a seven-day endurance test period shall begin. If the system functions as specified throughout the endurance test period requiring only routine maintenance and adjustment, the system shall be accepted. If during the endurance test period the system fails to perform as specified and cannot be corrected within eight hours, the Owner may request that the endurance tests be repeated after problems have been corrected.
- .4 For completion, all device and wire tagging is to be complete. All Box covers are to be installed and labeled with the contractor's identification stickers. Power circuits identified. Panel lamacoids and panel stuff sheets are to be installed. As Built documentation complete. Analog inputs, analog outputs and analog variables placed on trend logs. Digital inputs, digital outputs and digital variable control flags placed on runtime logs.

.4 Operational Training Program

- .1 The Contractor shall furnish the services of competent instructors who will give instruction on the adjustment, operation, and maintenance of the control system provided.

- .2 This Contractor shall conduct two separate four hour operational training programs for the building operating crew. Training shall be done on the owners Control System and shall include:
 - .1 General equipment layout.
 - .2 Sequences of operation.
 - .3 Maintenance and repair.
 - .4 Troubleshooting.
 - .5 Preventative maintenance.
 - .6 Sensor calibration.
 - .7 Proper use of service material, and tools.

3.6 Coordination and Work by Other Trades

- .1 By Sheet Metal Contractor:
 - .1 Supply and installation of all dampers not controlled by the EMCS, including back-draft dampers shall be by the Sheet Metal Contractor.
 - .2 Installation of all control dampers supplied by the control contractor.
- .2 By Electrical Contractor:
 - .1 All power wiring to mechanical equipment, including line voltage wiring for controls which directly switch the power to single phase motors.
- .3 By Mechanical Contractor
 - .1 Installation of all valves, temperature wells, flow meters, and flow switches supplied by the Controls Contractor.
 - .2 Installation of differential water pressure sensors.

3.7 Warranty, Maintenance, Normal and Emergency Service

- .1 The Contractor shall warranty the Control System to be free from defects in workmanship and material under normal expected service and use for a period of one (1) year from date of final acceptance by the Owner.
- .2 During this period, the Contractor shall furnish all labor to repair or replace all items or components that fail due to defects in workmanship or material at no charge or reduction in service to the owner. Provide this service within acceptable terms of notice from the Owner's representative.

- .3 Manufacturer shall provide a five-year warranty for all B-BC, B-AAC and B-ASC controllers.

4 Products

4.1 Control System Application Software

- .1 Provide licensed copy of current Delta Controls Orcaview Application Software.

4.2 Communications and Protocols

- .1 B-OWS information access for the control system shall utilize the BACNet protocol and any other open protocol or proprietary protocol.
- .2 B-OWS shall reside on the same LAN as B-BC's. B-OWS shall as a minimum support point-to-point (PTP) and BACNet/IP physical/data link layer protocols.
- .3 The B-OWS specified here may, at the Owner's option, be located remote from the BACNet. Other than the difference in B-OWS communication speed, the system shall be capable of remote operation via BACNet LAN types with no - degradation in application performance.

4.3 OWS PC Systems Operating System Software

- .1 All PC based OWS provided as part of this contract shall be provided with the same type and version of Operating System software.
- .2 The Operating System software shall be Microsoft Windows XP Pro or Windows Vista Business.

4.4 Control System Operator's Workstation Application Software

- .1 The Control System Application software is to be stored on the PC.
- .2 New systems to be integrated with existing on current user interface.

4.6 Weekly and Annual Scheduling

- .1 Maintain existing.

4.7 Trend Log Graphing

- .1 Any system point either real or calculated shall be assignable to the historical trending program by gathering historical samples of object data stored in the field equipment (global controllers, field controllers).
- .2 All trend log information shall be displayable in text and graphic format, and shall be able to be printed in black & white or color. Long-term archives shall be stored onto a dedicated machine or server.

4.8 Runtime Log Information

- .1 The system shall monitor equipment status and generate maintenance messages based upon user designated run time. All Digital outputs and Digital inputs shall be monitored with Runtime logs.
- .2 The DDC system will programmed to prevent all controlled equipment from simultaneously restarting after a power outage. The order in which equipment (or groups of equipment) is started; along with the time delay between starts shall be user-selectable.
- .3 All binary output points shall be protected from short cycling. This feature shall allow minimum on time and off-time to be selected.

4.9 System Configuration, Set-Up and Definition.

- .1 Device and network status shall be displayed for any device on the BACNet.
- .2 All control strategies and energy management routines shall be stored in the controller and shall be definable by the operator.
- .3 B-OWS shall be able to back-up and restore the programming and data for any BACNet device on the BACNet. Users shall also have the ability to manually execute downloads of any or all portions of a device database.
- .4 Provide a context sensitive, on-line help system to assist the operator in operation and editing of the system.
- .5 Provide the tools to create, modify, or debug all application programming.

4.10 Color Graphics

- .1 Expand upon existing and upgrade where applicable to current software format.

4.11 Control Summaries, Reports and Logging

- .1 The system shall provide self-documentation reporting to summarize control strategies for any point or any user selected group of points within the Control System.
- .2 The B-OWS shall provide reporting and logging functions for user defined point value and status information.
- .3 The B-OWS reporting package shall allow the user to configure the point information display in custom format.

4.12 Printers

- .1 The system shall accept line printers with a serial interface for offsite alarming

and reporting, and either serial or parallel interface for on-site alarming and reporting.

4.13 LAN Types and Communications

- .1 This Control System shall comprise a BACNet, as described in Part 1.
- .2 The Controls Contractor shall provide all communication media, connectors, repeaters, modems, switches, hubs, bridges and routers and half-routers necessary for the BACNet.

4.14 Building Controllers (B-BC)

- .1 Hardware and Operating System. Expand upon existing as applicable.

4.15 Advanced Application Controllers (B-AAC)

- .1 Hardware & Operating System. Expand upon existing as applicable.

4.16 Application Specific Controllers (B-ASC)

- .1 Expand upon existing as applicable.

4.17 Control Enclosures and Sub-Panels

- .1 Expand upon existing as applicable.
- .2 Provide wall mounted local control enclosure to house all control components associated with each area, system or mechanical equipment room. The enclosures shall be minimum 16 gage steel or aluminum bonded on both sides to a plywood core, totally enclosed on all sides and painted with a baked enamel finish. Provide a continuous piano hinged door, keyed locking latch and removable sub-panel. A single key shall be common to all control enclosures.
- .2 Enclosures shall be the same NEMA classification as all other enclosures located in the same environment, except if location requires additional protection due to potential vandalism or environmental conditions. At a minimum enclosures located in dry indoor conditions shall conform to NEMA 1 standards. Enclosures located in wet indoor conditions such as garages or located outdoors shall be fully gasketed and shall conform to NEMA 4X standards, and enclosures located outside for cooling tower condenser water controls shall be constructed of stainless steel.
- .3 Provide “baggage tags” for all control system components. The baggage tags shall be laminated to ensure that they are waterproof and they shall be affixed to all control components with ty-wraps. The baggage tags shall indicate the Control Company name, point description, panel number, input/output number, and panel location. The printing shall be Arial Font, minimum size 10 point. Control panels shall be identified with a Black Nameplate with White Lettering and shall be a minimum 1 inch by 3 inches [2.5 cm X 7.5 cm], with minimum 1/2 inch high block lettering.

- .4 Provide each DDC panel with a line filter, electrical disconnect, control fuse, and control transformer. All sized and provided by the control system contractor.

4.18 General Field Devices

- .1 All control relays shall be UL listed plug-in type with dust cover and with contacts and coils rated for the application.
- .2 Relays used for in-line control start/stop of line voltage motors and shall have a current rating at least 1.5 times full load amps.
- .3 Control transformers shall be CSA and US listed. Primary and secondary sides shall be fused in accordance with the NEC or shall be class 2 current limiting type.
- .4 Voltage/Current to Pneumatic Transducer shall be non-bleed type 0-5V or 0-10V input and output pressure to match spring range of controlled device.

4.19 Interconnecting Wire and Cable

- .1 Wire & cable for power, interlock, communications, sensor, and control device wiring shall be as specified in Div 16, the National Electric Code, Network Standards, control system manufacturer recommendations, and applicable local codes.
- 2 All control wiring shall be in conduit in accordance with Division 26 Section "Raceways and Boxes".

4.20 Analog Temperature Sensors

- .1 Temperature sensors shall be linear precision elements either Resistance Temperature Device (RTD) or Thermistor type.
- .2 Single point duct temperature sensor shall consist of 316 stainless steel sensing element, junction box for wiring connections and gasket to prevent air leakage or vibration noise.
- .3 Averaging duct temperature sensor shall consist of a copper or stainless steel averaging element, junction box for wiring connections and gasket to prevent air leakage or vibration noise.
- .4 Liquid immersion temperature sensor shall include thermowell, sensor and connection head for wiring connections.
- .5 Outside air temperature sensor shall consist of a single device sensor, ventilated non-metallic sun shield, utility box for terminations, and watertight gasket to prevent water seepage.
- .6 Space temperature sensor shall consist of an element within a ventilated cover.
 - .1 Sensors located in mechanical areas, plenums, lobbies, or other public spaces shall be simple sensor with no display or setpoint adjustment.

- .2 Include the following options inherent to the equipment provided.
 - .1 Override switch
 - .2 LAN connection
 - .3 Service tool connection
 - .4 LCD display.
- .7 All sensors which are not located in public spaces and are associated with B-ASC or B-AAC that are located in normally inaccessible locations shall be the same. Sensors accuracy shall be unaffected by wiring up to 250-feet.
- .8 Insulated mounting base shall prevent temperature of mounted wall or drafts due to outside wall mounting from effecting sensor temperature.
- .9 Sensor guards shall protect sensor from damage.
- .10 Provide brass or stainless steel thermo-wells for each immersion type temperature sensor and switch.
- .11 Outside Air Mount: Provide element with non-corroding watertight enclosure and fitting for conduit connection.
- .12 Duct Mount Probe: Provide element with handi-box for terminations, flange and 233 mm long element holder for duct insertion.
- .13 Duct Mount Averaging: Provide 2438 mm averaging element with handi-box for terminations, flange for duct insertion and adequate support to prevent vibration.
- .14 Pipe Well Mount Probe: Provide a threaded brass or stainless steel temperature well filled with thermal transmission grease sized to match temperature probe.

4.21 Switching Temperature Sensors

- .1 Low limit thermostat shall be of the vapor pressure remote element, automatic reset type with adjustable set point. Sensing element shall be 20 feet long. The device shall respond to the lowest temperature to which any 1 foot of the 20 foot long element is exposed.
- .2 Capillary Type Thermostats shall have liquid or vapor-filled thermal system consisting of stainless steel or copper sensing element, connected to a fully compensating capillary tube, and operating bellows or spiral.

4.22 Control Dampers

- .1 Automatic control dampers shall be composed of 16-mm galvanized steel or extruded aluminum multiple blades mounted in a 2.8-mm steel or extruded aluminum frame. Individual blades shall not exceed 150-mm in width or 1200 mm in length with interlocking edges and compressible neoprene edge seals.

- .2 Provide self-compensating santoprene blade end seals.
- .3 Provide oil impregnated bronze or nylon bearings with additional thrust bearings for vertical blades. Damper leakage shall not exceed 15 L/s per m² at 250 Pa (3 CFM per ft²) static differential.
- .4 Provide insulated dampers where provided for outdoor air or relief air applications and installed in building envelope elements (walls or roofs).

4.23 Control Damper Actuators

- .1 Provide drive-pin mounted, synchronous motor driven damper actuators with adjustable stroke and spring return fail-safe to normally open or normally closed position as required by the sequence of operation. Provide sufficient actuators and total torque on each damper to achieve smooth travel throughout full range of damper and tight shut-off.
- .2 Provide fully modulating or two-position actuators as required by the sequence of operation. Modulating actuators shall have adjustable minimum setpoint and span range to allow sequencing.

4.24 Control Valves

- .1 Provide fully modulating valves with pressure ratings suitable for system operating pressures. Two-way hydronic valves shall have equal percentage characteristics. **All heating control valves to be Belimo characterized ball valve.**
- .2 Two-port valves shall be screwed type, NPT connections with ANSI 125 bronze body, field adjustable Cv, field replaceable packings, stainless steel stem, brass plug with EPT disk, and brass seat, constructed to ANSI Leakage Class IV. Size with a maximum of 3 PSI pressure drop when fully open.
- .3 Provide the following types of modulating valves:
 - .1 Air Handling Units Three way mixing

4.25 Control Valve Actuators

- .1 Provide fully modulating motor driven valve actuators with adjustable stroke, failing to the last commanded position on a loss of power. **Minimum acceptance shall be Belimo LM actuators**

4.26 Carbon Dioxide Sensors

- .1 Sensors for mounting in rooms and supply/return air streams shall use non-dispersive infrared technology to monitor carbon dioxide concentration over the 0-2000 PPM range with a 5 year stability rating less than 100 PPM deviation (without calibration). Sensors shall have a maximum response time of 1 minute, and be suitable for an operating temperature range of 0 to 35 deg C.

- .2 Sensors shall accept 24 VAC power, and have a variable output of 0-10 VDC or 4 – 20 mA corresponding to the 0 to 2000 PPM range.
- .3 Room mounted sensors shall have an impact resistant tamper-proof cover without display screen.
- .4 Sensors for duct and RTU sensing points shall be located within panels located within the conditioned space of the building to minimize temperature and humidity effects.

4.27 Building Differential Pressure Sensors

- .1 For supply plenum, supply duct and building pressure sensing applications, provide differential pressure sensor/transmitters designed for panel mounting, with PVC tube running to static pressure sensing locations as specified. The sensor shall utilize a diaphragm/capacitance cell, range appropriate for differential pressure sensed, transmitter with VDC linear output, zero and span adjustments.
- .2 Overall accuracy of the unit including linearity, hysteresis and repeatability shall not exceed plus or minus 1% of range. These units shall be located within panels located within the conditioned space of the building to minimize temperature and humidity effects.
- .3 For the outdoor static pressure reference pick-up, provide a static pressure station designed specifically to minimize wind effects, and located away from doors, windows and HVAC equipment to minimize pressure fluctuation 'noise'.
- .4 For duct static pressure pick-ups, provide a metal insertion tube and duct flange, incorporating a fitting for the connection of poly tubing.
- .5 For room static pressure pick-ups, run poly-tubing into a standard room temperature sensor housing, labeled appropriately.

4.28 Analog Current Sensitive Relays

- .1 Provide a sealed unit incorporating the current transformer and relay with dry contact output for motors with a rating of ½ HP or less.
- .2 Provide a current transformer with analog output calibrated such that power consumption can be calculated and trended for all motors with a rating of greater than ½ HP.

4.29 Variable Frequency Drives

- .1 Single NEMA enclosure to house all components, including key locking mechanism.
 - .1 VFD-AHU3 NEMA 1 enclosure

- .2 VFD-AHU4 NEMA 1 enclosure
- .3 VFD-RF3 NEMA 1 enclosure

- .4 VFD-RF4 NEMA 1 enclosure

- .2 5% Line Reactors for the input power to each frequency drive.
- .3 Full line Bypass for each frequency drive.
- .3 Separate fused disconnect for the input power to each frequency drive, to enable one drive to be powered down and worked on while the other drive remains operational.
- .4 208/3/60 power supply, HP as noted below:
 - .1 VFD-AHU3 5 HP
 - .2 VFD-AHU4 5 HP
 - .3 VFD-RF3 3 HP
 - .4 VFD-RF4 3 HP
- .5 Include cooling fan(s) as necessary to minimize overheating.
- .6 Include thermostatically controlled heater to ensure minimum enclosure temperature and reduce humidity and condensation.

- .2 Acceptable products: Pulse Width Modulated (PWM) type drives manufactured by Danfoss/Graham, Baldor, Hitachi or ABB.
- .3 Include start-up of the VFD's by a factory-trained technician, with a complete start-up report submitted to the commissioning agent for approval. The report shall include input and output voltages and currents for each leg, transistor switching frequency, minimum and maximum speed setting, maximum amperage warning, alarm, and shut-down limits, DDC input vs drive output test, and all other drive set-up parameters.
- .4 Provide line over and under voltage protection, phase loss protection, instantaneous electronic over-current protection, and phase unbalance protection.
- .5 Provide interface points for each VFD, brought to a terminal strip for use by the DDC system, including:
 - .1 DDC start command
 - .2 DDC speed command (0-10 VDC)
 - .3 VFD run status
 - .4 VFD speed feedback (0-10 VDC)

- .5 VFD Power Demand (0-10 VDC)
 - .6 VFD Output Current (0-10 VDC)
 - .7 VFD Common Alarm
- .6 Provide a microprocessor driven operator display/keypad mounted on each drive. The display shall continuously display speed, current, and output voltage when the drive is in run mode. Provide designated keys to select Hand, Off, Auto mode, and to allow an operator to manually command the drive to a fixed speed in Hand mode. The keypad shall allow display and adjustment of all drive parameters, including the following;
- .1 Minimum and maximum speed settings
 - .2 Acceleration and deceleration rates
 - .3 Current limits for warning, regenerating limit, and drive shutdown
 - .4 Up to three frequency reject points to avoid operating at resonant speeds.
 - .5 Password protection of keyboard parameters.
 - .6 Complete fault diagnostics
 - .7 Adjust motor nameplate parameters
- .7 Provide a 2 year manufacturer's warranty for the VFD's, beginning at the date of substantial completion, covering all defects of manufacture and installation. The warranty shall include parts, labour, travel costs and living expenses incurred to provide factory authorized representative on-site service. Supply one signed and dated copy of this manufacturer's warranty at substantial completion.

5 INSTALLATION

5.1 General

- .1 Control System component locations are the responsibility of the System Contractor. All control system components shall be installed in locations as required to properly sense the controlled medium and shall be easily accessible for adjustment and service. All components shall be installed in accordance with the component manufacturer's recommendations.
- .2 The system shall be installed such that all wiring, communication, analog or digital, input or output shall be capable of sharing single conduit runs without affecting signal performance.
- .3 The Contractor shall protect all work and material from damage by his/her work or workers, and shall be liable for all damage thus caused.

- .4 The Contractor shall be responsible for his/her work and equipment until finally inspected, tested and accepted. The Contractor shall protect his/her work against theft or damage, and shall carefully store material and equipment received on site that is not immediately installed.
- .5 After completion of installation, calibrate and commission all components provided as part of the Control System and demonstrate proper sequence of operation in compliance with Section 1.6. Equipment not operating correctly shall be field corrected or replaced.

5.2 Control System Application Software

- .1 At the time of acceptance all operating system, Third party and Control System Application software shall be at least the latest version available.
- .2 The Application software provided shall incorporate the feature described fully implemented and optimized to provide the sequences described, minimize energy consumption and prolong equipment life.
- .3 The following naming convention shall be standards for the naming of BACNet Devices on the BACNet inter-network. The convention for object names viewed by B-OWS shall consist of a string made up of components indicating, as appropriate, the building location, the building, the system, the subsystem, and point function of the object.
- .4 When programming the system BACNet addressing rules will be strictly adhered to. All addressing strategies will have to be approved by the Owners representative prior to terminating any LAN types.
- .5 All analog and binary values shall be programmed with appropriate alarms.
- .6 Except as specified otherwise, throttling ranges, proportional bands, and cycle differentials be centered on the associated set point.
- .7 All set points unless otherwise indicated are adjustable and shall be programmed for all control loops.
- .8 Each control loop or interlock for all mechanical system including terminal unit systems shall be programmed with a control loop specific graphical trend to trend all values associated with each specific control loop or system interlock.
- .9 Where any sequence or occupancy schedule calls for more than one motorized unit to start simultaneously, the system shall start commands shall be staggered by 60-second (adjustable) intervals to minimize inrush current.
- .10 Scheduling shall be developed for each mechanical system to the following:
 - .1 Match existing.

- .11 Optimal start/ stop programs shall be applied to all regularly scheduled mechanical and electrical systems.
- .12 Trend logs shall be implemented for every analog hardware and software point on the system. Point trends shall be grouped into logically interrelated points for individual mechanical systems. Initial set-up shall be to log values once every 15 minutes.
- .13 Runtime logs shall be implemented on every digital hardware and virtual point on the system.
- .14 B-OWS Graphics
 - .1 All sensors, control devices and set points shall be visible on a B-OWS in graphical form.
 - .2 All mechanical systems shall have a programmed real time color graphic for primary graphical user interface.
 - .3 Individual floor plan graphics will be programmed for each floor or area of the building. All space sensors and their associated setpoints will be visible on floor plan graphics and system graphic.
- .15 Each floor plate graphic to have facility map with hot points for navigation.
- .16 Floor plates shall indicate both Architectural and facility room numbers or shall provide some method of switching between room numbering schemes.
- .17 Provide an overall graphics floor plan of the facility which shall include in addition to room temperatures, all DDC panel locations, room sensors, exhaust fans and links to specific equipment. Zones serviced by each system should also be identified by color. Deviation from set point shall also be represented by color. Rooms/zones within 0.5 deg C of set point shall be green, rooms/zones above set point shall be red and rooms below set point shall be blue.
- .18 A sample of the graphic screens will be reviewed by the facility manager and Rocky Point Engineering prior to implementation.

5.3 Operator's, Remote and Portable Workstation (B-OWS) Hardware

- .1 Expand upon existing where applicable.

5.4 Printers

- .1 Set-up and connect printers as required.
- .2 Printers will only be accepted after demonstrating that the most complicated graphic prints with amount of RAM in printer.

5.5 LAN Types

- .1 The control system shall be configured so that any individual network shall not exceed 80 percent of its total design capacity. The system shall have a reserve of 20 percent point capacity.
- .2 Where possible all Hubs, Switches, Half and Full Routers will be from the same manufacturer. Switches will be all "Store and Forward" type and will be installed in accordance with manufacturer specifications.
- .3 Inverted Networks will not be allowed. Networks with minimum packet sizes smaller than those it connects to will not interconnect networks with larger minimum packet sizes. If three or more networks are interconnected the network with the highest speed and minimum packet size will be utilized to interconnect the slower networks.
- .4 Where BACNet/IP LAN type is used with non-IP devices tunneling routers shall be used to maintain complete connectivity. Where BACNet/IP is provided new then the hardware provided for the project will meet the Addendum to ANSI/ASHRAE 135-1995 BACNet/IP.

5.6 Remote Support

- .1 Supply an ADSL modem for remote connection to the internal LAN. Supply of the ADSL phone line will be the owner.
- .2 The line shall have a static IP address so the contractor can provide remote support of the system.

5.7 Verification of Software

- .1 Demonstrate exclusive communication utilizing the BACNet Protocol on all segments of the BACNet Inter-network.

5.8 Building Controllers (B-BC)

- .1 Provide as required to meet performance requirements of the system with a 20 percent increase in connected B-AAC and B-ASC on any individual network.
- .2 Locate strategically such that B-BC locations are as equally distributed throughout the project as possible.

5.9 Advanced Application Controllers (B-AAC)

- .1 Provide a dedicated B-AAC for each major mechanical system.
- .2 All points used for a single mechanical system shall be connected to the same B-AAC. Points used for control loop reset based on outside air, or space/zone temperature, or extremely remote differential pressure sensors on slow acting control loops are exempt from this requirement.

- .3 Provide minimum of 15 percent spare I/O point capacity for each point type found at each B-AAC. If input points are not universal, 15 percent of each type is required. A minimum of one spare is required for each type of point used.
- .4 Future use of spare capacity shall require providing only the field device, field wiring, point database definition and custom software. Additional point modules may be required to implement use of these spare points.

5.10 Application Specific Controllers (B-ASC)

- .1 Provide a dedicated B-ASC for each Terminal Unit Mechanical Device on the project. Those include Fan Coils and Individual Fans. Terminal Units specifically called out in the sequence of operation, as “Non-DDC” shall be excluded from this requirement.
- .2 All points used for a single Terminal Unit Mechanical Device shall be connected to a dedicated B-ASC. Points used for control loop reset based on outside air, or space/zone temperature, or extremely remote differential pressure sensors on slow acting control loops are exempt from this requirement.

5.11 Control Enclosures and Sub-Panels

- .1 All system components not designed for or required to be field installed shall be mounted in a control enclosure. Those components shall be sub panel mounted except components that are mounted on the panel face. Provide on/off power switch with over-current protection for control power sources in each local enclosure.
- .2 All control enclosures shall be located so visual observation and adjustment can be accomplished while standing flatfooted on the floor in a convenient location adjacent to the equipment served. Label all control system components.
- .3 Copies of the “As-built” application engineering for the system served shall be legible and laminated in clear plastic and suspended within enclosure.
- .4 All B-BC, B-AAC and B-ASC shall be mounted in an enclosure.

5.12 Interconnecting Wire and Cable

- .1 General
 - .1 It shall be the System Contractor's responsibility to provide all wiring required for a complete Control System.
 - .2 Control system wiring and cabling installed for this project shall include but may not be limited to the following:
 - .1 Include all power wiring required not indicated on the electrical plans and specifications.

- .2 Power to all actuators and, where required, sensors.
- .3 Provide all wiring and cabling for network communications except for owner provided LAN's/WAN's.
- .4 All sensor and control device input and output wiring.
- .5 All interconnecting cabling between and amongst network devices, PCs printers, modems, etc.
- .6 Interlock wiring between devices, and between motor starters.
- .7 All other necessary wiring for fully complete and functional system as specified.

- .8 Field mounting and wiring of control devices applicable to the Control System but specified elsewhere shall be field installed by System Contractor.
- .9 Install piping, wiring/cabling parallel to building lines.

- .3 Maximum allowable voltage for control wiring shall be 120-volts.
- .4 All wiring shall be installed as continuous links, where possible. Any required splices shall be made only within an approved junction box or other approved protective device.
- .5 Verify integrity of all wiring to ensure continuity and freedom from shorts and grounds.
- .6 This Contractor shall terminate all control and/or interlock wiring and shall maintain updated (as-built) wiring diagrams with terminations identified at the job site.

- .2 Power Wiring and Cabling
 - .1 Power wiring for all enclosures and equipment, including branch circuit wiring from circuit breaker panels shall be the responsibility of the System Contractor.
 - .2 All B-OWS equipment shall be served from isolated ground receptacles via UPS by dedicated branch circuits.
 - .3 All other enclosures, sensor and control devices shall be fed from separate circuits in the electrical distribution panels and shall not be served from the typical floor receptacle or lighting circuits.

- .3 Network Wiring and Cabling
 - .1 Network installation shall conform to standards for the LAN types and

cabling types selected. Specific network rules inherent to the ANSI/AHRAE Standard 135-1995, BACNet will be followed. Those include but are not limited to:

- .1 Only one path can exist from any BACNet device to another.
- .2 Each BACNet device connected to an inter-network LAN must have a unique device instance (0-4,194,303).
- .3 Each inter-network LAN must have a unique Network Number (1-65,545).
- .2 Primary LAN Network wire and cable shall be run in metallic conduit separately from all other wiring.
- .3 Other LAN Network wire and cabling shall be installed separate from any wiring over thirty (30) volts.
- .4 All communications shielding shall be grounded as per Networked System manufacturer's recommendations. All RS-485 network cabling shall done using low capacitance cable – Beldon no. 9841 or equivalent for FT4 applications or 98241 or equivalent for FT6 applications.
- .5 Contractor may elect to run unshielded cable if noise immunity is ensured by other means. Contractor will be fully responsible for noise immunity and rewire with shielded cable if electrical or RF noise affects performance.
- .4 Power Distribution
 1. Power distribution for all remote DDC devices to be home run from the mechanical room. Remote panels in air handling units can be provided with local transformer. Door contact switch in air handling units and fan disconnect switch shall be separate from DDC power supply.
 2. Provide a power distribution diagram in the DDC system shop drawings.
 3. Include location of division 26 panel # and circuit in DDC system as-built shop drawings for all remote power to air handling units DDC panels.

5.13 Analog Temperature Sensors

- .1 All wires attached to sensors shall be air sealed in their conduits or in the wall to stop air transmitted from other area affecting sensor readings.
- .2 Install and properly support all enclosures and sensing elements as much as possible in the center of duct cross section and in straight duct runs. In condensing environments use stainless steel flanges to support sensing elements.

- .3 Sensors mounted on air ducts having exterior insulation shall be provided with handy-box mounting with insulating material firmly fitted around hand-box.
- .4 Sensors for mixed air and air streams greater than 6 square feet or 24 inches in either direction shall be averaging type. Provide a minimum of 1 linear foot of sensor per 4 square feet of duct area or equal to duct width where installed, whichever is longer.
- .5 Temperature sensors installed in piping or tanks shall be in separable thermo-wells. Sensors shall be inserted into thermo-wells with conductive fluid. Assembly shall allow removal of sensor without loss of fluid.
- .6 At a minimum two outside air temperature sensor shall be installed. It shall be mounted outside on a northern exposure as high as serviceable on the building. The sensor shall be mounted within a ventilated enclosure to shield the sensor from the effects of the sun.
- .7 Zone temperature sensors located on perimeter walls shall have insulated mounting bases to prevent false room temperature readings.
- .8 Where wall sensors are mounted in an area subject to damage provide suitable metal guard.
- .9 Provide matched temperature sensors for differential temperature measurement. Differential accuracy shall be within 0.1 deg C (0.2 deg F).

5.14 Combined Sensors (Temperature, Occupancy and Carbon Dioxide)

- .1 Provide combined sensors where indicated on plans in attractive enclosure.
- .2 Combined sensor to accurately measure Temperature, Occupancy and Carbon Dioxide levels for effective zone and system control. Humidity to be included where noted.

5.15 Valve and Damper Actuators

- .1 Check operation of valve and damper actuator combinations to confirm that actuator modulates damper smoothly throughout stroke to both open and closed positions.
- .2 Spring return actuators shall be provided except as follows. Terminal or unitary equipment without direct introduction of outside air are permitted to have actuators that maintain their last commanded position when power is lost. Valve and damper actuators shall not be required to be provided with spring return provided that a failure of the damper to return to its "normal" position will not incur damage to the system it serves. (Typically but not limited to OA dampers).
- .3 Modulating actuators shall be provided except that terminal unit mechanical devices may use an actuator that responds to a floating or tri-state signal.
- .4 Minimum torque and power output requirements of actuators shall not be less than 1.2 times required design load.

- .5 When an air handling units or major mechanical equipment is not in operation, control valve and dampers shall remain in their “off” positions defined as follows:

<u>Devices</u>	<u>“Off” Position</u>
Air Handling Unit Heating Valves	Closed
Outside air damper	Closed
Return air damper	Open
Exhaust/relief air damper	Closed

END OF SECTION 15910

TREND LOGS

- .1 In general, all DDC system points shall be trended and each trend log point shall be minimum 200 samples. Trend logs shall be set up to meet the following requirements:
 - .1 Storage:
 - .1 Trend log sample frequency shall be setup to have the trend log information display meaningful data that can be used to Trend logs must reside in the controller of the points being trended.
 - .2 All trend logs shall be archived to the trend archival system.
 - .2 Sample Frequency:
 - .1 Sample frequencies shall be configured to gather meaningful data required to analyze system performance, confirm loop tuning, and aid system troubleshooting.
 - .2 Control points and loops that have a slow dynamic response shall have lower sample frequencies (E.g.: outdoor air temperature, radiant slab heating, etc.).
 - .3 Control points and loops that have a faster dynamic response shall have higher sample frequencies (E.g.: mixed air temperature, water differential pressure, etc.).
 - .4 Trend logs used to verify loop tuning shall be set at the fastest possible sample frequency for the duration of the loop tuning interval.
 - .1 Loop tuning trend logs shall have a high enough sample frequency to accurately describe the loop response to rapid changes in set point or input variables.
 - .2 The trend logs shall be archived and the trend sample frequency set to an interval used for day-to-day operation.
 - .3 Trended Points:
 - .1 All physical input and out points.
 - .2 All setpoint values (this is to include loop setpoints, high and low limit setpoints, and all room setpoints).
 - .4 Trend Log Grouping:
 - .1 Trend logs shall be grouped to display the performance of the various control loops required to control the system.
 - .2 Trend groups shall be accessible directly from the graphics.
 - .3 Trend logs shall contain all input variable, all controlled variables, and all setpoint for the system being trended.

2 GRAPHICS POINTS

- .1 In general, all DDC system points and global variables for each piece of mechanical equipment shall appear on the DDC graphics.

The mechanical consultant and Owner may request additional points on each graphic screen to facilitate ease of monitoring of the systems.

3 GENERAL SEQUENCES

.1 AIR HANDLING UNIT (AHU-1 AND AHU-2) – SERVING NATATORIUM

.1 Sequence of Operations

- .1 Space design setpoints:
 - .1 27.8°C (82°F) drybulb
 - .2 55% relative humidity (90.7 gr/lb (0.01296 g/g) humidity ratio)
 - .3 7.5 pa (0.03" W.C.) negative pressure (pool area relative to adjacent public building areas)
 - .4 Chloramine (trichloramine) 0.3 mg/m³
- .2 Start-up and shutdown of the unit will be controlled by DDC schedule.
- .3 AHU-1 and AHU-2 to be operated in tandem.
- .4 AHU-1 and AHU-2 are the first stage of heating for the Natatorium. (AHU-3 and AHU-4 are the second stage of heating)
- .5 AHU-1 and AHU-2 outdoor air supply is the first stage of cooling for the Natatorium. AHU-1 and AHU-2 cooling coils are the third stage of cooling for the Natatorium. (AHU-3 and AHU-4 outdoor air supply is the second stage of cooling for the Natatorium)
- .6 Include supply air temperature controller to determine unit supply calculated from average room temperature, outside air temperature, high room variance, low room variance, and room temperature setpoint.
- .7 Provide optimum start calculation to bring room temperature up to day setpoint for the start of the occupied scheduled start time. Optimum start calculated start time variable shall hold start time value for that day.
- .8 On start-up of the unit, run with the heating coil control valve fully open, the circulating pump running and the outdoor air damper fully closed for a period of ten minutes.
- .9 The heating coil circulating pump is to run whenever the AHU heating coil control valve is open to heating or whenever outdoor temperature is lower than 4°C (40°F).
- .10 Provide inlet air temperature sensor to modulate heating coil pump to prevent coil freeze-up.
- .11 The cooling coil diverting valve is to operate whenever the AHU control valve is open for cooling or whenever outdoor temperature is higher than 13°C (55°F). Verification required if Free Cooling is available based on calculation of difference in indoor enthalpy relative to outside
- .12 Provide inlet air temperature sensor to modulate cooling coil to prevent coil freeze-up.

- .13 Freezestat controls shall switch the power to both outdoor/return air dampers and AHU coil heating valve actuators to allow these devices to spring-return to a fail-safe position
- .14 Provide separate controller points for heating control valve and outdoor air damper actuator (no split-range control). Interlock valve and damper outputs in program to prevent overlapping operation.
- .15 Provide exercise program to fully open damper actuator and heating and cooling valve for 2 minutes on supply fan shutdown.
- .16 When the enthalpy of the outside air is lower than the room enthalpy and there is a cooling demand for the room, initiate free cooling signal to the air-handling unit. Simultaneously operate the unit relief air dampers to maintain a slight negative pressure of 7.5 pa (0.03" WG) relative to outside ambient pressure.
- .17 CO2 shall be measured in the space and the return air plenum to maintain air quality with a CO2 level of 900 PPM or lower.
- .18 In addition to discharge air temperature control, dewpoint temperature of the supply air shall be calculated and controlled, based on the monitored supply enthalpy and space temperatures. When the supply air dewpoint temperature is above 16°C (60.8°F) initiate a de-humidification cycle which will de-humidify the air to 13°C (55.4°F). This shall only be done when mechanical cooling in the building is enabled and there is a cooling demand.
- .19 Space relative humidity shall be calculated and controlled, based on the monitored space enthalpy and space temperatures. Modulate cooling coil leaving air temperature to maintain a space humidity of 55% (overcooling). Reheat chilled air as required to maintain space temperature setpoint at 27.8°C (82°F).
- .20 Space chloramine (trichloramine) shall be monitored and controlled. Modulate outdoor air and return air dampers to maintain space chloramine concentrations in the air below 0.3 mg/m³.
- .21 When there is a call for cooling in the space and the cooling coil cannot maintain space temperature for 5 minutes, open the control valve and start the pump serving the heat rejection coil with a discharge air temperature setpoint of 32.2°C (90°F). Every 5 minutes increase the discharge air temperature setpoint by 1°C (1.8°F) if the cooling demand is not met. Maximum discharge air temperature setpoint of 46.1°C (115°F).
 - .1 This is the third stage of heat rejection.
 - .2 Provide reverse out strategy with 10 minute intervals at 1°C (1.8°F).

- .22 AHU-2 ONLY: If control valves CV-P3-1 and CV-P3-2 are in boiler heat operation (Admin loop is receiving heat from the boilers), AHU-2 heat rejection coil control valves to remain closed (coil circulation mode) and pump P-HRJC-2 to be turned off. No heat rejection is possible when AHU-2 is receiving heat from the boiler system.
- .23 Provide full BACnet interface to the air handling unit VFD and map all points to the DDC system graphics.

.2 EXISTING AIR HANDLING UNIT AND RETURN FAN SET (AHU-3 AND RF-3) AND (AHU-4 AND RF-4)

.1 Sequence of Operations

- .1 Space design setpoints:
 - .1 27.8°C (82°F) drybulb
 - .2 55% relative humidity (90.7 gr/lb (0.01296 g/g) humidity ratio)
 - .3 7.5 pa (0.03" W.C.) negative pressure relative to outdoors
 - .4 Chloramine (trichloramine) 0.3 mg/m³
- .2 Start-up and shutdown of the units will be controlled by DDC schedule.
- .3 Supply and Return fans are constant speed.
- .4 Return fan to run whenever associated supply fan is running.
- .5 AHU-3/RF-3 and AHU-4/RF-4 to be operated in tandem.
- .6 AHU-3 and AHU-4 are the second stage of heating for the Natatorium. (AHU-1 and AHU-2 are the first stage of heating)
 - .1 Minimum supply discharge air temperature to be 26.7°F (80°F) when there is a call for heat in the space.
- .7 AHU-3 and AHU-4 outdoor air supply is the second stage of cooling for the Natatorium. (AHU-1 and AHU-2 outdoor air supply is the first stage and AHU-1 and AHU-2 cooling coils are the third stage)
- .8 Include supply air temperature controller to determine unit supply calculated from average room temperature, outside air temperature, high room variance, low room variance, and room temperature setpoint.
- .9 On start-up of the unit, run with the heating coil control valve fully open, the circulating pump running and the outdoor air damper fully closed for a period of ten minutes.
- .10 The heating coil circulating pump is to run whenever the AHU heating coil control valve is open to heating or whenever outdoor temperature is lower than 4°C (40°F).
- .11 Provide inlet air temperature sensor to modulate heating coil pump to prevent coil freeze-up.

- .12 The cooling coil diverting valve is to operate whenever the AHU control valve is open for cooling or whenever outdoor temperature is higher than 13°C (55.4°F). Verification required if Free Cooling is available based on calculation of difference in indoor enthalpy relative to outside
- .13 Provide inlet air temperature sensor to modulate cooling coil to prevent coil freeze-up.
- .14 Existing freezestat controls to remain in place.
- .15 Provide separate controller points for heating control valve and outdoor air damper actuator (no split-range control). Interlock valve and damper outputs in program to prevent overlapping operation.
- .16 Provide exercise program to fully open damper actuator and heating and cooling valve for 2 minutes on supply fan shutdown.
- .17 When the enthalpy of the outside air is lower than the room enthalpy and there is a cooling demand for the room, initiate free cooling signal to the air-handling unit. Simultaneously operate the relief air dampers to maintain a slight negative pressure of 12.5 pa (0.05" WG) relative to outside ambient pressure.
- .18 CO2 shall be measured in the space to maintain air quality with a CO2 level of 900 PPM or lower.
- .19 Space relative humidity shall be calculated and controlled, based on the monitored space enthalpy and space temperatures. Modulate cooling coil leaving air temperature to maintain a space humidity of 60% (overcooling). Reheat chilled air as required to maintain space temperature setpoint at 27.8°C (82°F).
- .20 Space chloramine (trichloramine) shall be monitored and controlled. Modulate outdoor air and return air dampers to maintain space chloramine concentrations in the air below 0.3 mg/m³.
- .21 When the total water source heat pump (WSHP) cooling load is less than the total WSHP heating system load then cooling of the exhaust air (by way of heat recovery coil) shall be permitted to allow for heat recovery.
 - .1 Modulate the cooling coil diverting valve in relation to the heat recovery load requirements. The discharge air temperature set point shall be 13 °C (55.4°F) and shall be further reset based on cooling demand. Cooling load of the Natatorium shall be maintained at all times. Reset shall occur at 1 °C (1.8°F) every 15 minutes. Minimum and maximum discharge air set points shall be adjustable.
 - .1 The de-loading of the heat recovery coils is the first stage of heat rejection.

- .22 When there is a call for cooling in the space and the space temperature cannot be maintained for 10 minutes, switch the operation of the heat recovery coil to heat rejection coil. Close the heat recovery control valve and open the heat rejection control valve to 50% setting. Every 10 minutes increase the control valve setting by 10% if the cooling demand is not met.
 - .1 This is the second stage of heat rejection.
 - .2 Provide reverse out strategy with intervals of 15 minutes and 10% control valve setting.

Provide full BACnet interface to the air handling unit VFD and map all points to the DDC system graphics.

.3 DDC CONTROLLED PROPELLER EXHAUST FANS (PF-1, PF-2, PF-3 AND PF-4)

.1 Sequence of Operation

- .1 The fans shall be enabled by DDC schedule.
- .2 The fans are provided with a variable frequency drive which is to be used for initial balancing and destratification purging.
- .3 The fans are to run continuously at minimum speed (14% or 10 Hz (max speed is 60 Hz)) during occupied hours. This setpoint is to be adjustable.
- .4 If the destratification strategy satisfies the space temperature and humidity setpoints then AHU-1 and AHU-2 coils do not have to operate. If after 10 minutes operation of the propeller fans the space temperature or humidity is not satisfied then AHU-1 and AHU-2 coils will be enabled. The propeller fans are to continue to run.
- .5 During AHU-1 and AHU-2 optimum start operation, run the propeller fans at 85% speed (60.4 Hz).
- .6 Provide full BACnet interface to the air handling unit VFD and map all points to the DDC system graphics.

.4 Alarms.

- .1 High Chloramine Concentration in Air – (Chloramine concentration above 0.35 mg/m³)
- .2 AHU-1 Supply Fan Motor/VFD Failure – (Commanded On, Status Off)
- .3 AHU-1 Return Fan Motor/VFD Failure – (Commanded On, Status Off)
- .4 AHU-2 Supply Fan Motor/VFD Failure – (Commanded On, Status Off)
- .5 AHU-2 Return Fan Motor/VFD Failure – (Commanded On, Status Off)
- .6 AHU-3 Supply Fan Motor Failure – (Commanded On, Status Off)
- .7 AHU-3 Supply Fan VFD Failure – (Commanded On, Status Off)
- .8 AHU-4 Supply Fan Motor Failure – (Commanded On, Status Off)
- .9 AHU-4 Supply Fan VFD Failure – (Commanded On, Status Off)
- .10 RF-3 Supply Fan Motor Failure – (Commanded On, Status Off)
- .11 RF-3 Supply Fan VFD Failure – (Commanded On, Status Off)
- .12 RF-4 Supply Fan Motor Failure – (Commanded On, Status Off)
- .13 RF-4 Supply Fan VFD Failure – (Commanded On, Status Off)

- .14 Circulating Pump P-HC1 Failure – (Commanded On, Status Off)
- .15 Circulating Pump P-CC1 Failure – (Commanded On, Status Off)
- .16 Circulating Pump P-HRJC1 Failure – (Commanded On, Status Off)
- .17 Circulating Pump P-HC2 Failure – (Commanded On, Status Off)
- .18 Circulating Pump P-CC2 Failure – (Commanded On, Status Off)
- .19 Circulating Pump P-HRJC2 Failure – (Commanded On, Status Off)
- .20 PF-01 Fan Motor/VFD Failure – (Commanded On, Status Off)
- .21 PF-02 Fan Motor/VFD Failure – (Commanded On, Status Off)
- .22 PF-03 Fan Motor/VFD Failure – (Commanded On, Status Off)
- .23 PF-04 Fan Motor/VFD Failure – (Commanded On, Status Off)

2 HYDRONIC PLANT

2.1 Sequence of Operation

- .1 Existing sequence or operation to remain in place.

2.2 Sequence of Operation Existing Secondary Pump (P-3)

- .1 Existing sequence of operation to remain in place with the following additions:
 - .1 Control valves CV-P3-1 and CV-P3-2 control whether AHU-2 the admin loop reheat coils, radiant ceiling panels and unit heaters receive hot water from the boilers or the water source heat pumps.
 - .1 Normal operation is for the water source heat pumps to provide the hot water.
 - .2 CV-P3-1 and CV-P3-2 setting at the start of each day is to match the setting from the end of the day before.

If 1.5°C less than space temperature setpoint cannot be met in any of the spaces served by the admin heating loop for a period of 30 minutes, switch the operation of the control valves (CV-P3-1 and CV-P3-2) so that the admin heating loop is served by the hot water boilers.
 - .1 After 30 minutes, if all spaces served by the admin heating loop space temperature setpoints are met AND the average control valve position for these spaces is 40% or less then switch the operation of the control valves (CV-P3-1 and CV-P3-2) so that the admin heating loop is served by the water source heat pumps.

2.3 Sequence of Operation Solar System Pumps (Duty & Standby P-114A and P-114B)

- .1 General
 - .1 Pumps **P-114A and P-114B (Duty & Stand-by)** consist of constant speed pumps, one (1) solar heating water supply temperature sensor, one (1) solar heating water return temperature sensor and one (1) domestic Pre-Heat Tank Temperature
 - .2 Pumps P-114A and P-114B (Duty & Stand-by) serve the solar hot water heating loop that originates in Mechanical Room 129 and serves the existing solar panels on the roof.
- .2 Normal Operation – Constant Speed Pumps (P-114A and P-114B Duty-Standby)
 - .1 Pumps P-114A and P-114B are to be operated in Duty and Stand-by control. Only one pump to run at a time. Pumps shall alternate duty or stand-by mode every 72 hours of operating time.
 - .2 DDC shall monitor the loop SHWS and SHWR temperature sensors, and domestic Pre-Heat Tank Temperature at all times.
 - .3 Define variable Solar Water Temperature Difference (SWTD) = SHWR Temperature minus Pre-Heat Tank Temperature.
 - .4 The circulating pumps are to start running when the SWTD reaches 15°F (adjustable).
 - .5 The circulating pumps shall be turned off when the SWTD reaches 5°F (adjustable).
 - .6 The circulating pump P-114A or P-114B to run whenever the outdoor air temperature is below 12°F to avoid freezing the glycol solution.
 - .7 If the Pre-Heat Tank (PHT-1) temperature is 200°F or above and the time of day is between 11pm and 5am, run the circulating pumps. This will help relieve overheating conditions.
 - .1 Stop the circulating pumps with the Pre-Heat Tank temperature drop below 195°F.
- .3 Alarms.
 - .1 Secondary Pump P-114A Failure – (Commanded On, Status Off)
 - .2 Secondary Pump P-114B Failure – (Commanded On, Status Off)

2.4 Sequence of Operation 25m Lap Pool Pre-heat Loop (P-115 and HE-101)

.1 General

- .1 System consists of constant speed pump **P-115**, heat exchanger HE-101, one (1) pool water control valve, one (1) domestic water pre-heat flow switch, one (1) domestic water supply temperature sensor, one (1) domestic water return temperature sensor, one (1) domestic Pre-Heat Tank Temperature, one (1) pool water HE-101 supply temperature sensor and one (1) pool water HE-101 return temperature sensor.
- .2 Pump P-115 serve the source side loop of the heat exchanger HE-101 located in Mechanical Room 129. HE-101 provides pre-heating of the 25m Lap pool water.

.2 Normal Operation – Constant Speed Pump (P-115)

- .1 DDC shall monitor the loop domestic water supply and domestic water return temperature sensors, and domestic Pre-Heat Tank Temperature at all times.
- .2 Whenever the 25m Lap pool pre-heat valve is open, pump P-115 is to run. Modulate the speed of pump P-115 based on the 25m Lap pool pre-heat control valve position as per the following table:

25m Lap Pool Pre-Heat Control Valve Position (% open)	Pump P-115 speed
0%	Off
>0% to 30%	30% speed
30% to 75%	30% to 100% speed
75% to 100%	100% speed

.3 Normal Operation – 25m Lap Pool Pre-Heat Control Valve

- .1 Open the 25m Lap Pool pre-heat control valve if the following three conditions are met:
 - .1 The domestic water pre-heat flow switch meets one of the following conditions:
 - .1 Off (no flow)
 - .2 On (flow) for less than 2 minutes.
 - .2 The domestic water Pre-Heat Tank Temperature is greater than 5.6°C (10°F) higher than the 25m Lap pool water setpoint.

- .3 There is a call for heat by the 25m Lap Pool temperature sensor.
 - .2 If the conditions in point 2.4.3.1 above are met, modulate the 25m Lap Pool pre-heat control valve to maintain the 25m Lap pool water setpoint temperature.
 - .3 25m Lap Pool pre-heat control valve to remain open for a minimum of 2 minutes (adjustable) before being closed again. 25m Lap Pool pre-heat control valve to remain closed for a minimum of 5 minutes (adjustable) before being opened again.
 - .4 If the domestic Pre-Heat Tank Temperature is less than or equal to 5.6°C (10°F) higher than the 25m Lap pool water setpoint then the 25m Lap Pool pre-heat control valve is to remain closed. (Pump P-115 to be turned off)
 - .5 If the domestic water pre-heat flow switch is on for 5 minutes, close the 25m Lap Pool pre-heat control valve.
 - .6 Heat exchanger HE-101 is the first stage of the 25m Lap pool water heating. Second stage is from the existing heat exchanger PHE-1X served by the water source heat pumps and boiler system. Existing sequence of operation to remain in place.
 - .7 If the Pre-Heat Tank (PHT-1) temperature is 92.8°C (199°F) or above open the 25m Lap Pool pre-heat control valve to 100% (and run pump P-115). This is to be done regardless of the 25m Lap Pool water temperature. This will help relieve overheating conditions.
 - .1 The 25m Lap pool pre-heat control valve shall return to normal operation when the Pre-Heat Tank temperature drops below 87.8°C (190°F).
 - .2 If the 25m Lap Pool water temperature reaches 40.6°C (105°F), close the 25m Lap pool pre-heat control valve (stop pump P-115).
- .3 Alarms.
 - .1 Secondary Pump P-115 Failure – (Commanded On, Status Off)

2.5 Heating System DDC Points (REFER TO POINTS LIST)

Provide BACNet interface to propeller fans PF-1 through PF-4, VFD's for AHU-1 and AHU-2 and Pumps and review the list of available points with the building owner to determine what information will be displayed on the graphic. No control is to be done through the BACNet interface or replacing specified DDC points.

3 DOMESTIC WATER THERMOSTATIC MIXING VALVE

3.1 Sequence of Operation

.1 DDC shall monitor the domestic hot water temperature entering the thermostatic mixing valve (TMV-1) and the domestic tempered water temperature leaving TMV-1 at all times.

.2 Alarms.

.1 Domestic Tempered Water too high - greater than 60°C (140°F)

4 DDC POINT LIST
(Refer to next 4 pages)

UNIT	DESCRIPTION	LOCATION	DIGITAL IN	DIGITAL OUT	DEVICE TYPE	ANALOG IN	ANALOG OUT	DEVICE TYPE	COMMENTS:
AIR HANDLING UNIT AHU-1		ROOF MOUNTED (SERVING NANATORIUM)							
ASF-1	SPEED DRIVE ENABLE (EXISTING)			X	R				EXISTING DDC POINT
VFD-SF1	VARIABLE SPEED SET POINT					X	X	SPD	
	VARIABLE SPEED FEED BACK SIGNAL					X		SPD	
	VARIABLE SPEED DRIVE INTERFACE							INT	BACNET INTERFACE TO VARIABLE SPEED DRIVE
	VARIABLE SPEED DRIVE FAULT STATUS		X		FLT				
	SUPPLY FAN MOTOR STATUS (EXISTING)					X		CT	EXISTING DDC POINT
ARF-1	SPEED DRIVE ENABLE (EXISTING)			X	R				EXISTING DDC POINT
VFD-RF1	VARIABLE SPEED SET POINT					X	X	SPD	
	VARIABLE SPEED FEED BACK SIGNAL					X		SPD	
	VARIABLE SPEED DRIVE INTERFACE							INT	BACNET INTERFACE TO VARIABLE SPEED DRIVE
	VARIABLE SPEED DRIVE FAULT STATUS		X		FLT				
	RETURN FAN MOTOR STATUS (EXISTING)					X		CT	EXISTING DDC POINT
	RETURN AIR TEMPERATURE (EXISTING)					X		DTS	EXISTING DDC POINT
	SUPPLY AIR TEMPERATURE (EXISTING)					X		DTS	EXISTING DDC POINT
	EXHAUST AIR TEMPERATURE (EXISTING)					X		DTS	EXISTING DDC POINT
	MIXED AIR TEMPERATURE (EXISTING)					X		DTS	EXISTING DDC POINT
	OUTDOOR AIR TEMPERATURE (EXISTING)					X		DTS	EXISTING DDC POINT
CD-AHU1-OA	OUTDOOR AIR DAMPER STATUS		X		R				
	OUTDOOR AIR DAMPER POSITION (EXISTING)		X		R				EXISTING DDC POINT
	OUTDOOR AIR DAMPER MODE			X	R				
CD-AHU1-RA	RETURN AIR DAMPER STATUS		X		R				
	RETURN AIR DAMPER POSITION (EXISTING)		X		R				EXISTING DDC POINT
	RETURN AIR DAMPER MODE			X	R				
CD-AHU1-EA	EXHAUST AIR DAMPER STATUS		X		R				
	EXHAUST AIR DAMPER POSITION (EXISTING)		X		R				EXISTING DDC POINT
	EXHAUST AIR DAMPER MODE			X	R				
CV-HC1	AHU-1 HEATING VALVE (EXISTING)					X	X	VMA	SPRING RETURN OPEN. EXISTING DDC POINT
CV-CC1	AHU-1 COOLING VALVE (EXISTING)					X	X	VMA	SPRING RETURN CLOSED. EXISTING DDC POINT
CV-HRJC1	AHU-1 HEAT REJECTION VALVE					X	X	VMA	SPRING RETURN CLOSED
	AHU-1 CHILLED WATER SUPPLY TEMP					X		WTS	
	AHU-1 CHILLED WATER RETURN TEMP					X		WTS	
	AHU-1 HOT WATER SUPPLY TEMP					X		WTS	
	AHU-1 HOT WATER RETURN TEMP					X		WTS	
	AHU-1 HEAT REJECTION SUPPLY TEMP					X		WTS	
	AHU-1 HEAT REJECTION RETURN TEMP					X		WTS	
P-HC1	HEATING COIL PUMP START/ STOP STATUS (EXISTING)			X	R				EXISTING DDC POINT
	HEATING COIL PUMP FEEDBACK (EXISTING)					X		CT	EXISTING DDC POINT
P-CC1	COOLING COIL PUMP START/ STOP STATUS			X	R				
	COOLING COIL PUMP FEEDBACK					X		CT	
P-HRJC1	HEAT REJECTION COIL PUMP START/ STOP STATUS			X	R				
	HEAT REJECTION COIL PUMP FEEDBACK					X		CT	
	FILTER STATUS (EXISTING)		X		PRES				EXISTING DDC POINT
	FREEZE STAT (EXISTING)		X		FRZ				PROVIDE HARD WIRED FREEZE STAT TO SHUT DOWN FAN
	RETURN AIR CO2 SENSOR					X		CO2	TO BE LOCATED IN RETURN AIR PLENUM IN MECHANICAL ROOM
	SUPPLY AIR CO2 SENSOR					X		CO2	TO BE LOCATED IN THE SUPPLY AIR PLENUM
	SPACE TEMPERATURE SENSOR (EXISTING)					X		RTS	REFER TO PLANS FOR LOCATIONS. (EXISTING DDC POINT)
	SPACE HUMIDITY SENSOR (EXISTING)					X		HUM	REFER TO PLANS FOR LOCATIONS. (EXISTING DDC POINT)
	SUPPLY AIR HUMIDITY SENSOR (EXISTING)					X		DWPT	TO BE DUCT MOUNTED. EXISTING DDC POINT
	OUTDOOR AIR HUMIDITY SENSOR (EXISTING)					X		DWPT	EXISTING DDC POINT

**INTEGRATED AUTOMATION
SEQUENCE OF OPERATION**

UNIT	DESCRIPTION	LOCATION	DIGITAL IN	DIGITAL OUT	DEVICE TYPE	ANALOG IN	ANALOG OUT	DEVICE TYPE	COMMENTS:
AIR HANDLING UNIT AHU-2		ROOF MOUNTED (SERVING NATATORIUM)							
ASF-2	SPEED DRIVE ENABLE (EXISTING)			X	R				EXISTING DDC POINT
VFD-SF2	VARIABLE SPEED SET POINT					X	X	SPD	
	VARIABLE SPEED FEED BACK SIGNAL					X		SPD	
	VARIABLE SPEED DRIVE INTERFACE							INT	BACNET INTERFACE TO VARIABLE SPEED DRIVE
	VARIABLE SPEED DRIVE FAULT STATUS		X		FLT				
	SUPPLY FAN MOTOR STATUS (EXISTING)					X		CT	EXISTING DDC POINT
ARF-2	SPEED DRIVE ENABLE (EXISTING)			X	R				EXISTING DDC POINT
VFD-RF2	VARIABLE SPEED SET POINT					X	X	SPD	
	VARIABLE SPEED FEED BACK SIGNAL					X		SPD	
	VARIABLE SPEED DRIVE INTERFACE							INT	BACNET INTERFACE TO VARIABLE SPEED DRIVE
	VARIABLE SPEED DRIVE FAULT STATUS		X		FLT				
	RETURN FAN MOTOR STATUS (EXISTING)					X		CT	EXISTING DDC POINT
	RETURN AIR TEMPERATURE (EXISTING)					X		DTS	EXISTING DDC POINT
	SUPPLY AIR TEMPERATURE (EXISTING)					X		DTS	EXISTING DDC POINT
	EXHAUST AIR TEMPERATURE (EXISTING)					X		DTS	EXISTING DDC POINT
	MIXED AIR TEMPERATURE (EXISTING)					X		DTS	EXISTING DDC POINT
	OUTDOOR AIR TEMPERATURE (EXISTING)					X		DTS	EXISTING DDC POINT
CD-AHU2-OA	OUTDOOR AIR DAMPER STATUS		X		R				
	OUTDOOR AIR DAMPER POSITION (EXISTING)		X		R				EXISTING DDC POINT
	OUTDOOR AIR DAMPER MODE			X	R				
CD-AHU2-RA	RETURN AIR DAMPER STATUS		X		R				
	RETURN AIR DAMPER POSITION (EXISTING)		X		R				EXISTING DDC POINT
	RETURN AIR DAMPER MODE			X	R				
CD-AHU2-EA	EXHAUST AIR DAMPER STATUS		X		R				
	EXHAUST AIR DAMPER POSITION (EXISTING)		X		R				EXISTING DDC POINT
	EXHAUST AIR DAMPER MODE			X	R				
CV-HC2	AHU-2 HEATING VALVE (EXISTING)					X	X	VMA	SPRING RETURN OPEN. EXISTING DDC POINT
CV-CC2	AHU-2 COOLING VALVE (EXISTING)					X	X	VMA	SPRING RETURN CLOSED. EXISTING DDC POINT
CV-HRJC2	AHU-2 HEAT REJECTION VALVE					X	X	VMA	SPRING RETURN CLOSED
	AHU-2 CHILLED WATER SUPPLY TEMP					X		WTS	
	AHU-2 CHILLED WATER RETURN TEMP					X		WTS	
	AHU-2 HOT WATER SUPPLY TEMP					X		WTS	
	AHU-2 HOT WATER RETURN TEMP					X		WTS	
	AHU-2 HEAT REJECTION SUPPLY TEMP					X		WTS	
	AHU-2 HEAT REJECTION RETURN TEMP					X		WTS	
P-HC2	HEATING COIL PUMP START/ STOP STATUS (EXISTING)			X	R				EXISTING DDC POINT
	HEATING COIL PUMP FEEDBACK (EXISTING)					X		CT	EXISTING DDC POINT
P-CC2	COOLING COIL PUMP START/ STOP STATUS			X	R				
	COOLING COIL PUMP FEEDBACK					X		CT	
P-HRJC2	HEAT REJECTION COIL PUMP START/ STOP STATUS			X	R				
	HEAT REJECTION COIL PUMP FEEDBACK					X		CT	
	FILTER STATUS (EXISTING)		X		PRES				EXISTING DDC POINT
	FREEZE STAT (EXISTING)		X		FRZ				PROVIDE HARD WIRED FREEZE STAT TO SHUT DOWN FAN
	RETURN AIR CO2 SENSOR					X		CO2	TO BE LOCATED IN RETURN AIR PLENUM IN MECHANICAL ROOM
	SUPPLY AIR CO2 SENSOR					X		CO2	TO BE LOCATED IN THE SUPPLY AIR PLENUM
	SPACE PRESSURE SENSOR (Natatorium)					X		PRES	REFER TO PLANS FOR LOCATIONS
	SPACE PRESSURE SENSOR (Viewing Area)					X		PRES	REFER TO PLANS FOR LOCATIONS
	SPACE TEMPERATURE SENSOR (EXISTING)					X		RTS	REFER TO PLANS FOR LOCATIONS. (EXISTING DDC POINT)
	SPACE HUMIDITY SENSOR (EXISTING)					X		HUM	REFER TO PLANS FOR LOCATIONS. (EXISTING DDC POINT)
	SUPPLY AIR HUMIDITY SENSOR (EXISTING)					X		DWPT	TO BE DUCT MOUNTED. EXISTING DDC POINT
	OUTDOOR AIR HUMIDITY SENSOR (EXISTING)					X		DWPT	EXISTING DDC POINT

**INTEGRATED AUTOMATION
 SEQUENCE OF OPERATION**

UNIT	DESCRIPTION	LOCATION	DIGITAL IN	DIGITAL OUT	DEVICE TYPE	ANALOG IN	ANALOG OUT	DEVICE TYPE	COMMENTS:
AHU-3 and RF-3 (ALTERNATE PRICE NO. 3)									
ASF-3	SPEED DRIVE ENABLE (EXISTING)			X	R				EXISTING DDC POINT
VFD-SF3	VARIABLE SPEED SET POINT					X	X	SPD	
	VARIABLE SPEED FEED BACK SIGNAL					X		SPD	
	VARIABLE SPEED DRIVE INTERFACE							INT	BACNET INTERFACE TO VARIABLE SPEED DRIVE
	VARIABLE SPEED DRIVE FAULT STATUS		X		FLT				
	SUPPLY FAN MOTOR STATUS (EXISTING)					X		CT	EXISTING DDC POINT
ARF-3	SPEED DRIVE ENABLE (EXISTING)			X	R				EXISTING DDC POINT
VFD-RF3	VARIABLE SPEED SET POINT					X	X	SPD	
	VARIABLE SPEED FEED BACK SIGNAL					X		SPD	
	VARIABLE SPEED DRIVE INTERFACE							INT	BACNET INTERFACE TO VARIABLE SPEED DRIVE
	VARIABLE SPEED DRIVE FAULT STATUS		X		FLT				
	RETURN FAN MOTOR STATUS (EXISTING)					X		CT	EXISTING DDC POINT
HEAT RECOVERY COIL HRC-3X									
CV-HRC3-1	HRC-3X HEATING/COOLING SUPPLY VALVE					X	X	VMA	SPRING RETURN HEAT REJECTION
CV-HRC3-2	HRC-3X HEATING/COOLING RETURN VALVE					X	X	VMA	SPRING RETURN HEAT REJECTION
AHU-4 and RF-4 (ALTERNATE PRICE NO. 3)									
ASF-4	SPEED DRIVE ENABLE (EXISTING)			X	R				EXISTING DDC POINT
VFD-SF4	VARIABLE SPEED SET POINT					X	X	SPD	
	VARIABLE SPEED FEED BACK SIGNAL					X		SPD	
	VARIABLE SPEED DRIVE INTERFACE							INT	BACNET INTERFACE TO VARIABLE SPEED DRIVE
	VARIABLE SPEED DRIVE FAULT STATUS		X		FLT				
	SUPPLY FAN MOTOR STATUS (EXISTING)					X		CT	EXISTING DDC POINT
ARF-4	SPEED DRIVE ENABLE (EXISTING)			X	R				EXISTING DDC POINT
VFD-RF4	VARIABLE SPEED SET POINT					X	X	SPD	
	VARIABLE SPEED FEED BACK SIGNAL					X		SPD	
	VARIABLE SPEED DRIVE INTERFACE							INT	BACNET INTERFACE TO VARIABLE SPEED DRIVE
	VARIABLE SPEED DRIVE FAULT STATUS		X		FLT				
	RETURN FAN MOTOR STATUS (EXISTING)					X		CT	EXISTING DDC POINT
HEAT RECOVERY COIL HRC-4X									
CV-HRC4-1	HRC-4X HEATING/COOLING SUPPLY VALVE					X	X	VMA	SPRING RETURN HEAT REJECTION
CV-HRC4-2	HRC-4X HEATING/COOLING RETURN VALVE					X	X	VMA	SPRING RETURN HEAT REJECTION
CHLORAMINE SENSORS									
	SPACE CHLORAMINE SENSOR (TRICHLORAMINE)					X			REFER TO PLANS FOR LOCATIONS.
	SPACE CHLORAMINE SENSOR (TRICHLORAMINE)					X			REFER TO PLANS FOR LOCATIONS.
ADMIN HEATING LOOP CONTROL VALVES									
CV-P3-1	ADMIN HEATING LOOP SUPPLY VALVE					X	X	VMA	SPRING RETURN HEAT PUMP SYSTEM
CV-P3-2	ADMIN HEATING LOOP RETURN VALVE					X	X	VMA	SPRING RETURN HEAT PUMP SYSTEM

UNIT	DESCRIPTION	LOCATION	DIGITAL IN	DIGITAL OUT	ANALOG DEVICE TYPE	ANALOG IN	ANALOG OUT	ANALOG DEVICE TYPE	COMMENTS:																								
PROPELLER FAN (TYPICAL OF PF-1, PF-2, PF-3 AND PF-4) (4 IN TOTAL)		CEILING MOUNTED (SERVING NATATORIUM)																															
PF-X	SPEED DRIVE ENABLE VARIABLE SPEED SET POINT VARIABLE SPEED FEED BACK SIGNAL VARIABLE SPEED DRIVE INTERFACE VARIABLE SPEED DRIVE FAULT STATUS FAN MOTOR STATUS			X	R			X X X X	SPD SPD INT CT BACNET INTERFACE TO VARIABLE SPEED DRIVE																								
SOLAR WATER SYSTEM (ALTERNATE PRICE NO.1)																																	
P-114A	SOLAR WATER PUMP START/ STOP STATUS				X	R			DUTY/STAND-BY																								
	SOLAR WATER PUMP FEEDBACK						X	CT																									
P-114B	SOLAR WATER PUMP START/ STOP STATUS			X	R				DUTY/STAND-BY																								
	SOLAR WATER PUMP FEEDBACK						X	CT																									
	EXISTING SOLAR WATER SUPPLY TEMPERATURE SENSOR						X	WTS	EXISTING DDC POINT																								
	EXISTING SOLAR WATER RETURN TEMPERATURE SENSOR						X	WTS	EXISTING DDC POINT																								
	EXISTING PRE-HEAT TANK TEMPERATURE SENSOR						X	WTS	EXISTING DDC POINT																								
DOMESTIC WATER SYSTEM (ALTERNATE PRICE NO. 1)																																	
TMV-1	DOMESTIC HOT WATER SUPPLY TEMPERATURE					X		WTS																									
	TEMPERED DOMESTIC HOT WATER TEMPERATURE					X		WTS																									
	DOMESTIC WATER PRE-HEAT FLOW SWITCH		X					WFS																									
25M LAP POOL WATER PRE-HEATING SYSTEM (ALTERNATE PRICE NO. 1)																																	
HE-101	SOURCE SIDE SUPPLY WATER TEMP					X		WTS																									
	SOURCE SIDE RETURN WATER TEMP					X		WTS																									
	LOAD SIDE SUPPLY WATER TEMP					X		WTS																									
	LOAD SIDE RETURN WATER TEMP					X		WTS																									
P-115	HEAT EXCHANGER SYSTEM PUMP			X	R																												
	VARIABLE SPEED SET POINT					X	X	SPD	INTEGRATED VFDS																								
	VARIABLE SPEED FEED BACK SIGNAL					X		SPD																									
	VARIABLE SPEED DRIVE FAULT STATUS		X		FLT																												
	25M LAP POOL WATER PRE-HEAT FLOW METER		X					WFS																									
CV-25M-PH	25M LAP POOL WATER PRE-HEAT CONTROL VALVE					X	X	VMA	SPRING RETURN CLOSED																								
<p>LEGEND</p> <table> <tr> <td>CO2= CARBON DIOXIDE SENSOR</td> <td>OAT = OUTDOOR TEMPERATURE SENSOR</td> <td>WFS = WATER FLOW SWITCH</td> </tr> <tr> <td>CR= CONTROL RELAY</td> <td>OS= OCCUPANCY SENSOR</td> <td>WTS = WATER TEMPERATURE SENSOR</td> </tr> <tr> <td>CT= CURRENT SENSOR</td> <td>RTS = ROOM TEMPERATURE SENSOR</td> <td>HUM=HUMIDITY SENSOR</td> </tr> <tr> <td>CV= CONTROL VALVE</td> <td>PRES= PRESSURE SENSOR</td> <td>WPS = WATER PRESSURE SENSOR</td> </tr> <tr> <td>DC= DRY CONTACT</td> <td>VMA = VALVE MOTOR ACTUATOR</td> <td>VOP = VOLTAGE O/P SIGNAL</td> </tr> <tr> <td>DMA = DAMPER MOTOR</td> <td>PH=PHOTO CELL (DAYLIGHTING)</td> <td>DPS = DIFFERENTIAL PRESSURE SWITCH</td> </tr> <tr> <td>INT = BACnet INTERFACE</td> <td>AMS = AIR FLOW MONITORING STATION</td> <td>RST - DDC RESET SIGNAL</td> </tr> <tr> <td>STS = STRAP-ON TEMPERATURE SENSOR</td> <td>APS - AIR PROVING SWITCH</td> <td>FRZ - FREEZE STAT CONTACT</td> </tr> </table>										CO2= CARBON DIOXIDE SENSOR	OAT = OUTDOOR TEMPERATURE SENSOR	WFS = WATER FLOW SWITCH	CR= CONTROL RELAY	OS= OCCUPANCY SENSOR	WTS = WATER TEMPERATURE SENSOR	CT= CURRENT SENSOR	RTS = ROOM TEMPERATURE SENSOR	HUM=HUMIDITY SENSOR	CV= CONTROL VALVE	PRES= PRESSURE SENSOR	WPS = WATER PRESSURE SENSOR	DC= DRY CONTACT	VMA = VALVE MOTOR ACTUATOR	VOP = VOLTAGE O/P SIGNAL	DMA = DAMPER MOTOR	PH=PHOTO CELL (DAYLIGHTING)	DPS = DIFFERENTIAL PRESSURE SWITCH	INT = BACnet INTERFACE	AMS = AIR FLOW MONITORING STATION	RST - DDC RESET SIGNAL	STS = STRAP-ON TEMPERATURE SENSOR	APS - AIR PROVING SWITCH	FRZ - FREEZE STAT CONTACT
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STS = STRAP-ON TEMPERATURE SENSOR	APS - AIR PROVING SWITCH	FRZ - FREEZE STAT CONTACT																															

END OF SECTION 15915

MECHANICAL EQUIPMENT SCHEDULES
CONTROL DAMPERS

UNIT NO.		CD-AHU1-OA	CD-AHU1-RA	CD-AHU1-EA	CD-AHU2-OA
SERVICE		AHU-1 OUTDOOR AIR	AHU-1 RETURN AIR	AHU-1 EXHAUST AIR	AHU-2 OUTDOOR AIR
LOCATION		AHU-1	AHU-1	AHU-1	AHU-2
AIR FLOW	(L/s) (CFM)	4012 8500	4012 8500	4012 8500	4012 8500
WIDTH	(mm) (Inches)	914 36	914 36	965 38	914 36
HEIGHT	(mm) (Inches)	711 28	711 28	660 26	711 28
BLADE CONFIGURATION		OPPOSED BLADE	PARALLEL BLADE	OPPOSED BLADE	OPPOSED BLADE
INSULATED		YES	NO	YES	NO
OPERATION		MODULATING	MODULATING	MODULATING	MODULATING
NORMAL POSITION		CLOSED	OPEN	CLOSED	CLOSED
SUPPLIED BY		AHU SUPPLIER	AHU SUPPLIER	AHU SUPPLIER	AHU SUPPLIER
		(1)	(1)	(1)	(1)

1. CONTROL DAMPER (TAMCO 1000 SW) PROVIDED BY AHU SUPPLIER

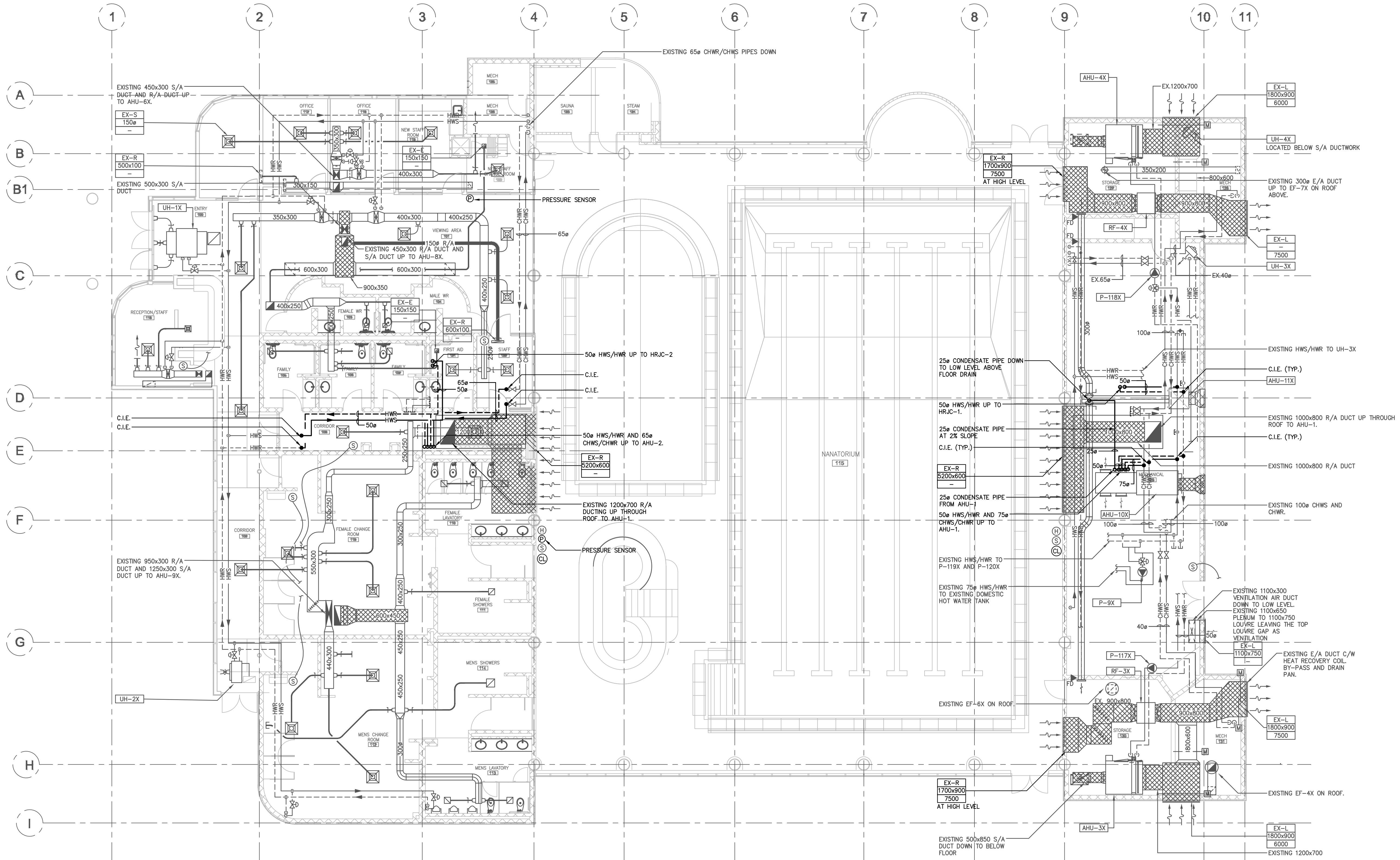
MECHANICAL EQUIPMENT SCHEDULES
CONTROL DAMPERS

UNIT NO.		CD-AHU2-RA	CD-AHU2-EA		
SERVICE		AHU-2 RETURN AIR	AHU-2 EXHAUST AIR		
LOCATION		AHU-2	AHU-2		
AIR FLOW	(L/s) (CFM)	4012 8500	4012 8500		
WIDTH	(mm) (Inches)	914 36	965 38		
HEIGHT	(mm) (Inches)	711 28	660 26		
BLADE CONFIGURATION		PARALLEL BLADE	OPPOSED BLADE		
INSULATED		NO	YES		
OPERATION		MODULATING	MODULATING		
NORMAL POSITION		OPEN	CLOSED		
SUPPLIED BY		AHU SUPPLIER	AHU SUPPLIER		

(1) (1)

1. CONTROL DAMPER (TAMCO 1000 SW) PROVIDED BY AHU SUPPLIER

AIR TERMINAL SCHEDULE				
DESIGNATION	GRILLE TYPE	MANUFACTURER	MODEL	ADDITIONAL COMMENTS
S-1	SUPPLY	E.H. PRICE	510/F/L/A/B12	STEEL LOUVERED DUCT MOUNTED GRILLE

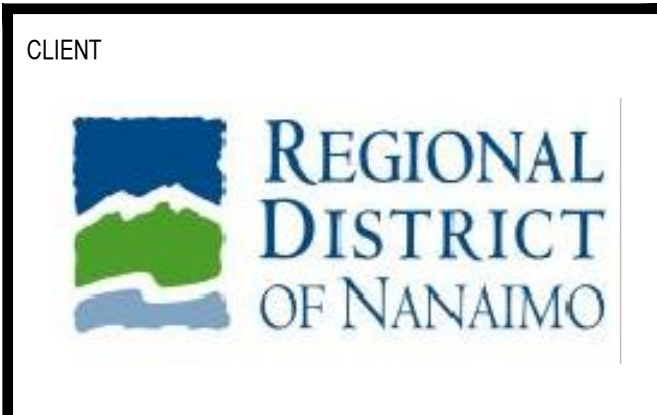


NORTH
 1 MAIN FLOOR PLAN - HVAC - NEW WORK
 M-2 1:100

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2	FEB. 01, 19	TENDER	AM
1	OCT. 26, 18	REVIEW	AM

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SEAL

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PROJECT
 RAVENSONG AQUATIC CENTRE HVAC UPGRADE
 737 Jones St
 Qualicum Beach, BC
 V9K 1S4
 SHEET TITLE
 MAIN FLOOR PLAN HVAC - NEW WORK

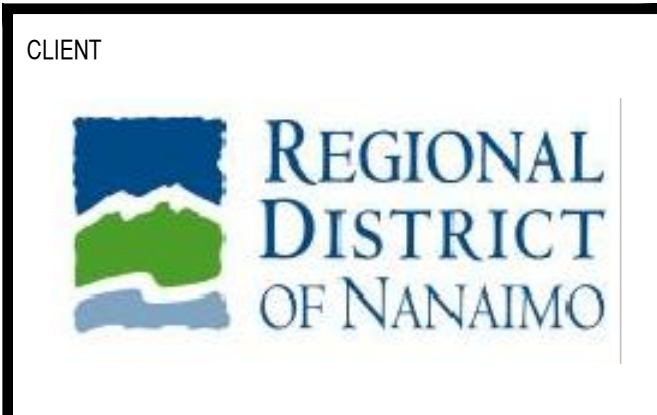
PROJECT	18078-N
SCALE	AS SHOWN
DWG DATE	FEBRUARY 2019
DESIGNED	MW
DRAWN	ANG/DL
CHECKED	AM
APPROVED	AM

DRAWING
 M-2

2	FEB. 01, 19	TENDER	AM
1	OCT. 26, 18	REVIEW	AM
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 Mechanical Consulting Engineers
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 Nanaimo Office
 102 - 3721 Sheraton Road
 Nanaimo, BC V9T 2H1
 Tel: (250) 585-0222
 Fax: (250) 585-0333

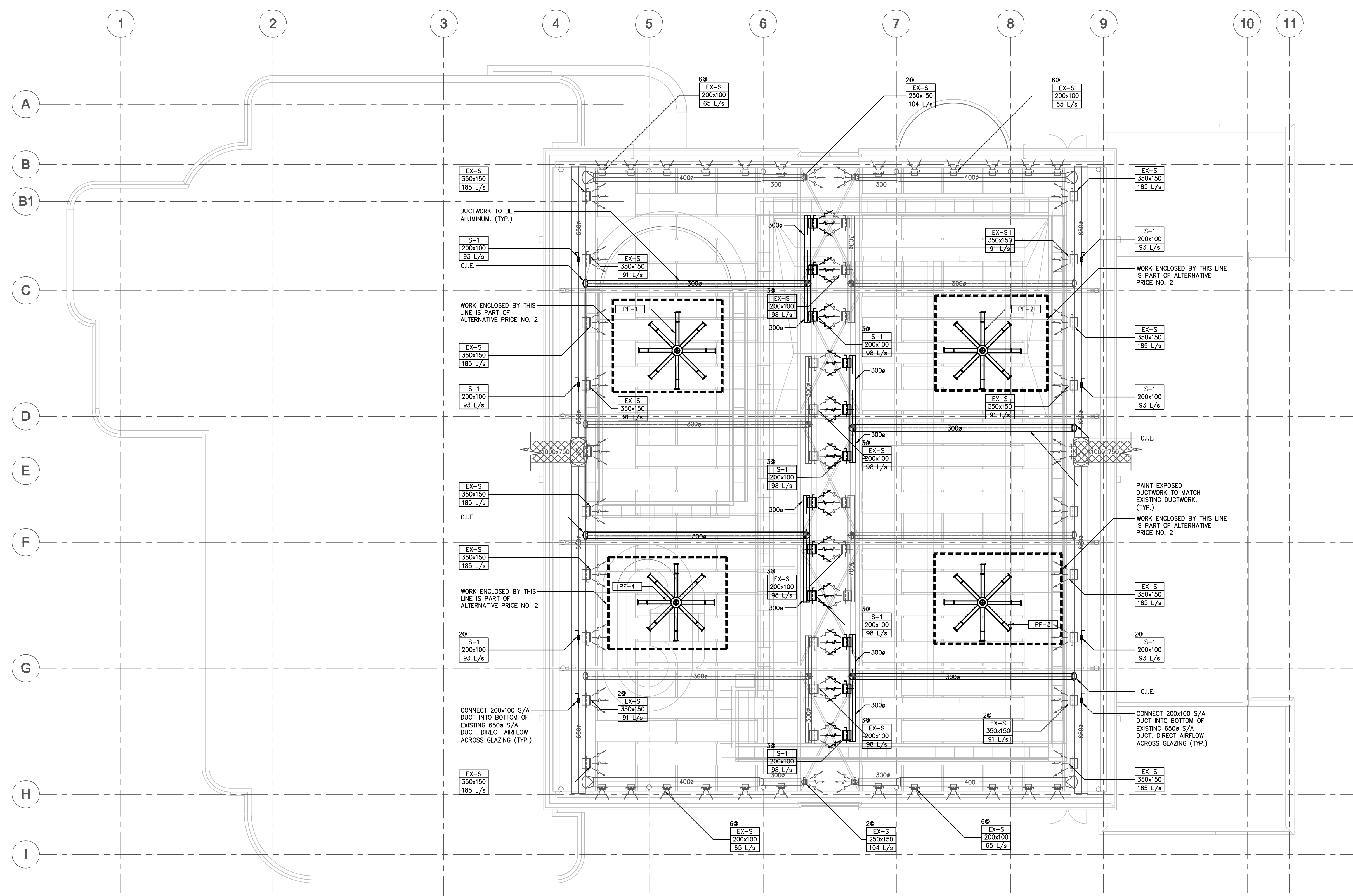
SEAL

ISSUED FOR TENDER PURPOSES

PROJECT
RAVENSONG AQUATIC CENTRE HVAC UPGRADE
 737 Jones St
 Qualicum Beach, BC
 V9K 1S4
 SHEET TITLE
UPPER POOL HALL PLAN HVAC - NEW WORK

PROJECT 18078-N
 SCALE AS SHOWN
 DWG DATE FEBRUARY 2019
 DESIGNED MW
 DRAWN ANG/DL
 CHECKED AM
 APPROVED AM

DRAWING
M-3



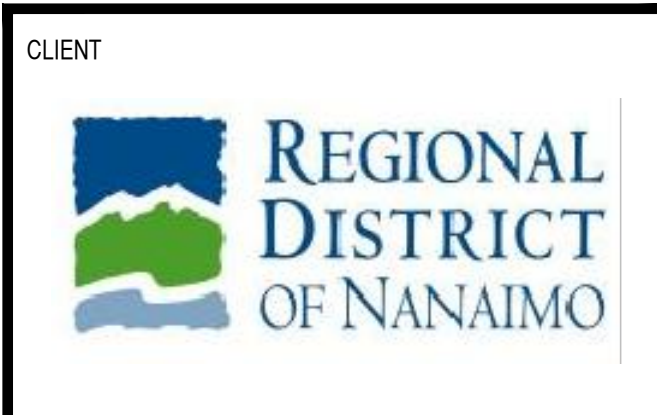
NORTH
 1 UPPER POOL HALL PLAN - HVAC - NEW WORK
 M-3 1:100

REV.	DATE	DESCRIPTION	BY
2	FEB. 01, 19	TENDER	AM
1	OCT. 26, 18	REVIEW	AM

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 Nanaimo, BC V9T 2H1
 Tel: (250) 585-0222
 Fax: (250) 585-0333

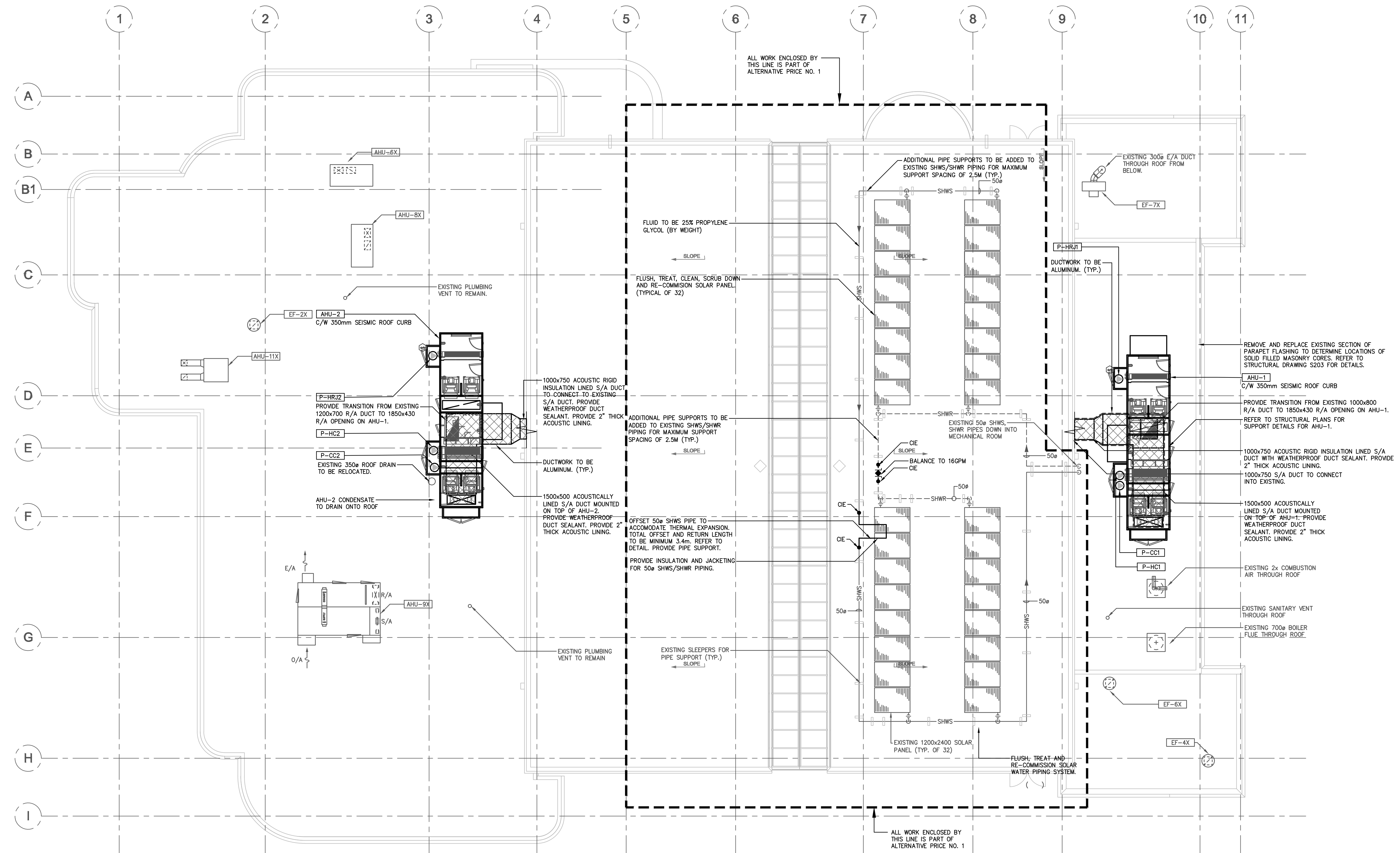
SEAL

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PROJECT
RAVENSONG AQUATIC CENTRE HVAC UPGRADE
 737 Jones St
 Qualicum Beach, BC
 V9K 1S4
 SHEET TITLE
**ROOF PLAN
 HVAC - NEW WORK**

PROJECT 18078-N
 SCALE AS SHOWN
 DWG DATE FEBRUARY 2019
 DESIGNED MW
 DRAWN ANG/DL
 CHECKED AM
 APPROVED AM

DRAWING
M-4



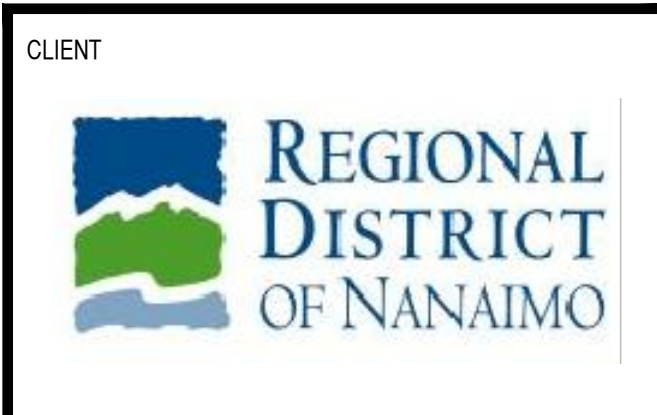
NORTH
 1:100
ROOF PLAN - HVAC - NEW WORK
 M-4

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PROJECT
RAVENSONG AQUATIC CENTRE HVAC UPGRADE

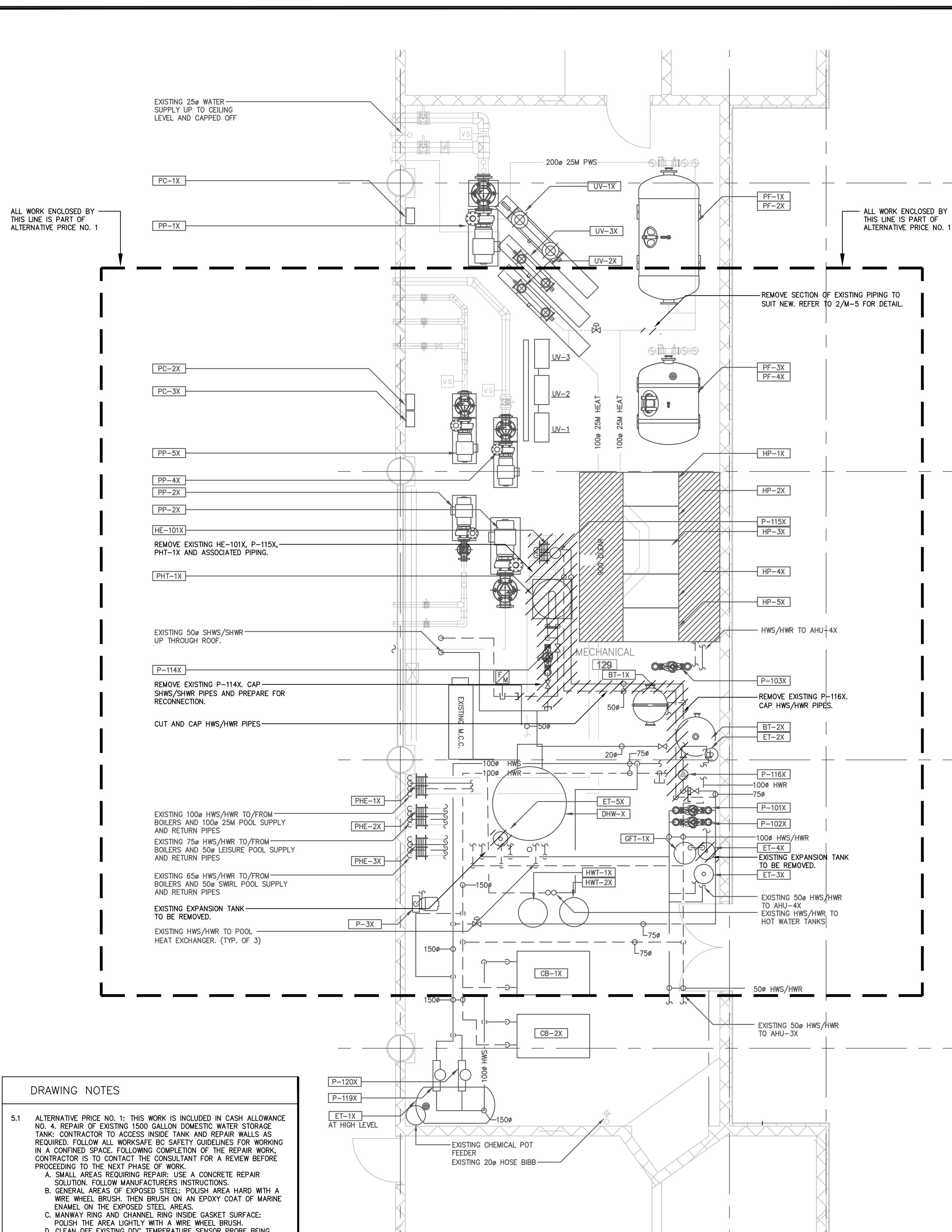
737 Jones St
Qualicum Beach, BC
V9K 1S4

SHEET TITLE
MECHANICAL ROOM PLAN HVAC - NEW WORK

PROJECT	18078-N
SCALE	AS SHOWN
DWG DATE	FEBRUARY 2019
DESIGNED	MW
DRAWN	ANG/DL
CHECKED	AM
APPROVED	AM

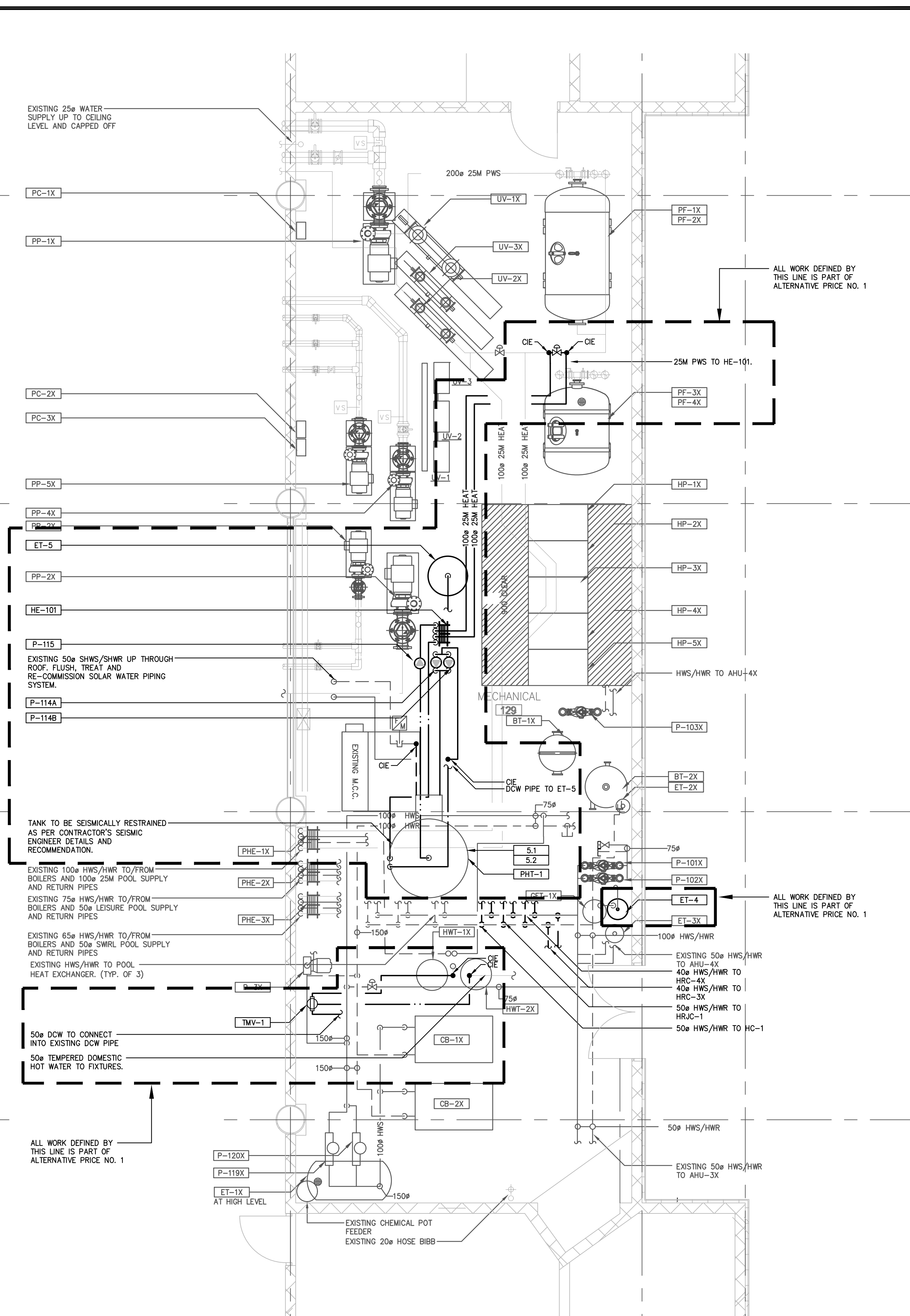
DRAWING

M-5

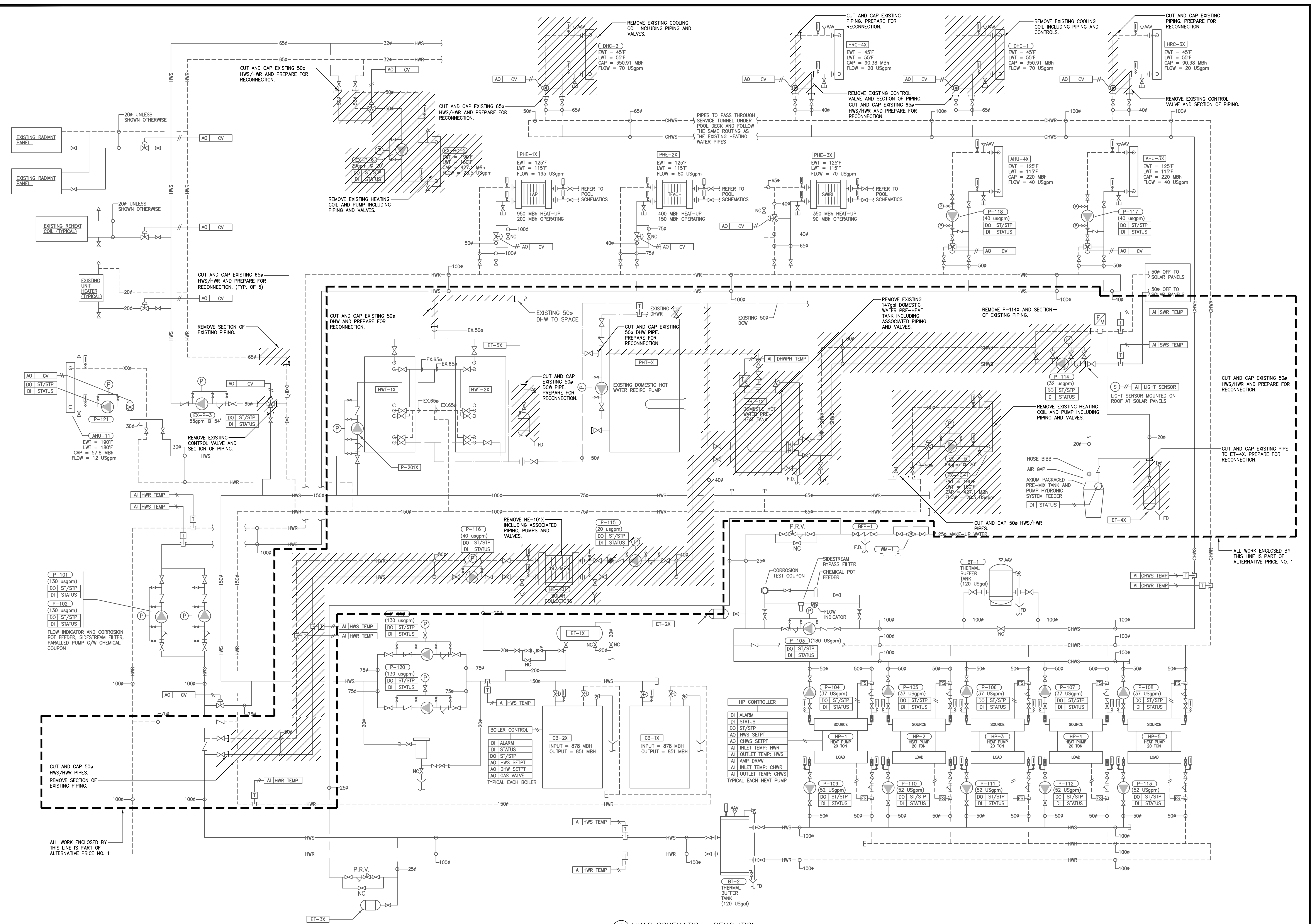


- DRAWING NOTES
- ALTERNATIVE PRICE NO. 1: THIS WORK IS INCLUDED IN CASH ALLOWANCE NO. 4. REPAIR OF EXISTING 1500 GALLON DOMESTIC WATER STORAGE TANK: CONTRACTOR TO ACCESS INSIDE TANK AND REPAIR WALLS AS REQUIRED. FOLLOW ALL WORKSAFE BC SAFETY GUIDELINES FOR WORKING IN A CONFINED SPACE. FOLLOWING COMPLETION OF THE REPAIR WORK, CONTRACTOR IS TO CONTACT THE CONSULTANT FOR A REVIEW BEFORE PROCEEDING TO THE NEXT PHASE OF WORK.
A. SMALL AREAS REQUIRING REPAIR: USE A CONCRETE REPAIR SOLUTION. FOLLOW MANUFACTURERS INSTRUCTIONS.
B. GENERAL AREAS OF EXPOSED STEEL: POLISH AREA HARD WITH A WIRE WHEEL BRUSH THEN BRUSH ON AN EPOXY COAT OF MARINE ENAMEL ON THE EXPOSED STEEL AREAS.
C. MANWAY RING AND CHANNEL RING INSIDE GASKET SURFACE: POLISH THE AREA LIGHTLY WITH A WIRE WHEEL BRUSH.
D. CLEAN OFF EXISTING DDC TEMPERATURE SENSOR PROBE BEING CAREFUL NOT TO DAMAGE IT.
E. CLEANOUT ALL CONCRETE BITS AND SEDIMENT INSIDE THE TANK.
F. WASHOUT INSIDE OF TANK TO CLEAR OFF ALL SALT LINES.
 - ALTERNATIVE PRICE NO. 1: THIS WORK IS INCLUDED IN CASH ALLOWANCE NO. 4. EXISTING 1500 GALLON DOMESTIC WATER STORAGE TANK TO BE RECOMMISSIONED FOR STORING DOMESTIC PREHEATED WATER. APPROXIMATE OUTER DIMENSIONS OF TANK IS 1524MM DIAMETER AND 409MM HIGH. REPLACE AND REINSTALL NEW MANWAY COVER. PRESSURE TEST EXISTING HEAT EXCHANGER AND REPAIR ANY DEFECTS IF POSSIBLE. REVIEW TESTING AND REPAIR PROCEDURES WITH MECHANICAL CONSULTANT PRIOR TO PROCEEDING WITH THE WORK. REMOVE AND REPLACE THE EXISTING CHANNEL AND CHANNEL COVER RUBBER LININGS WITH NEW. CONTRACTOR TO REINSTALL NEW MANWAY COVER, EXISTING HEAT EXCHANGER, EXISTING CHANNEL COVER AND EXISTING CHANNEL COVER AND NEW GASKETS AS REQUIRED. CASH ALLOWANCE IS MEANT TO COVER SHIPPING COSTS AND COSTS OF 3RD PARTY REVIEWS CONDUCTING INSPECTIONS AS NEEDED.
 - ALTERNATIVE PRICE NO. 1: (REFERRING TO EXISTING 1500 GALLON DOMESTIC WATER STORAGE TANK). CONTRACTOR TO CONNECT NEW SOLAR WATER PIPES TO EXISTING TANK CHANNEL. NEW DOMESTIC WATER PIPES TO BE CONNECTED TO EXISTING TANK CONNECTIONS.

NORTH (ALTERNATIVE PRICE NO. 1)
MECHANICAL ROOM PLAN - MECHANICAL - DEMOLITION
1:50



NORTH (ALTERNATIVE PRICE NO. 1)
MECHANICAL ROOM PLAN - MECHANICAL - NEW WORK
1:50

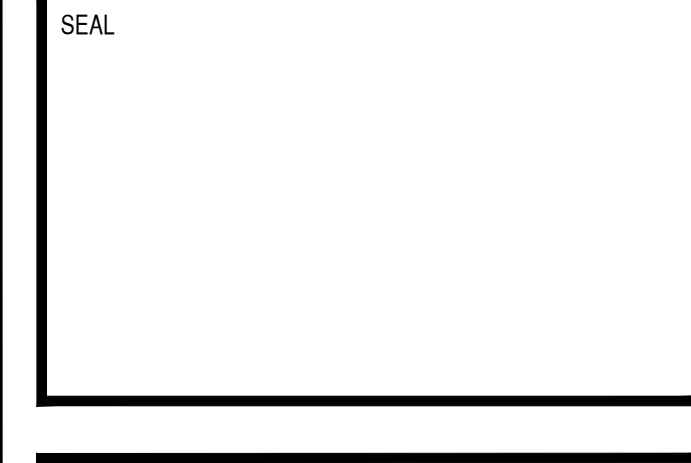
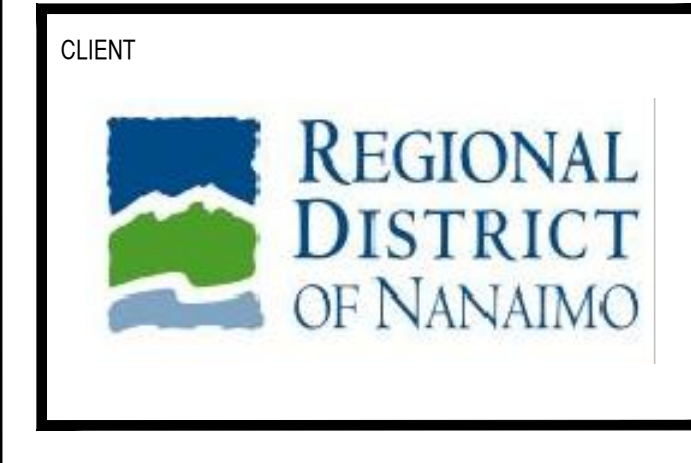
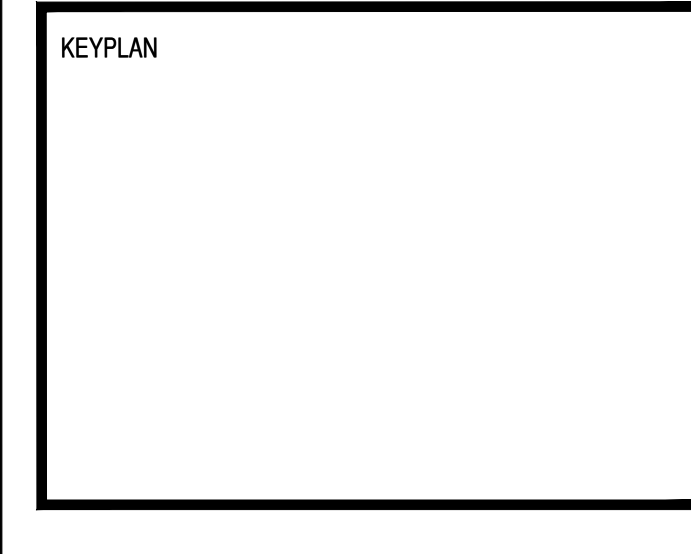


1 HVAC SCHEMATIC - DEMOLITION
M-6
NTS

REV.	DATE	DESCRIPTION	BY
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1	OCT. 26, 18	REVIEW	AM

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PROJECT
RAVENSONG AQUATIC CENTRE HVAC
UPGRADE

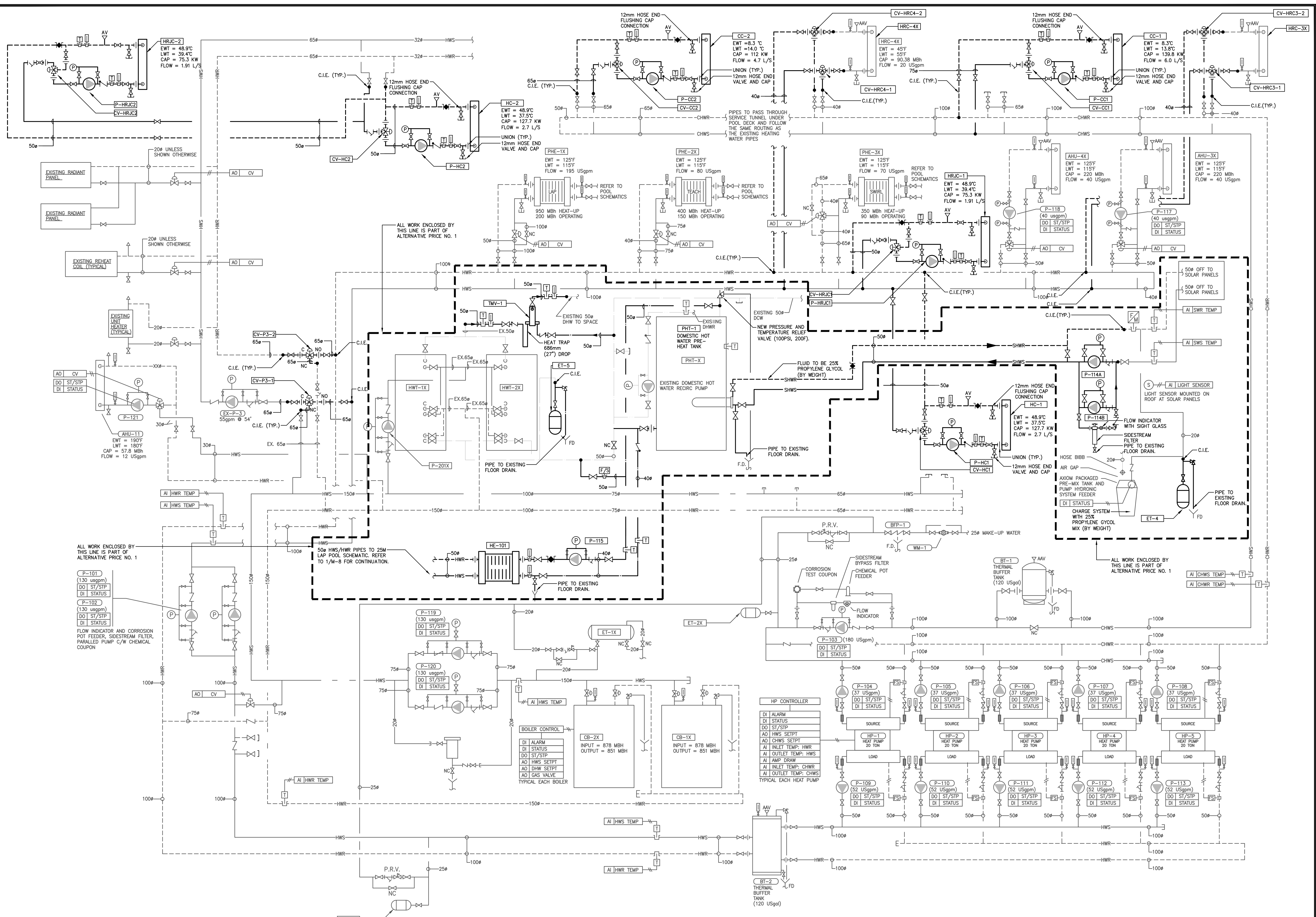
737 Jones St
Qualicum Beach, BC
V9K 1S4

SHEET TITLE
HVAC SCHEMATIC
DEMOLITION

PROJECT	18078-N
SCALE	AS SHOWN
DWG DATE	FEBRUARY 2019
DESIGNED	MW
DRAWN	ANG/DL
CHECKED	AM
APPROVED	AM

DRAWING

M-6

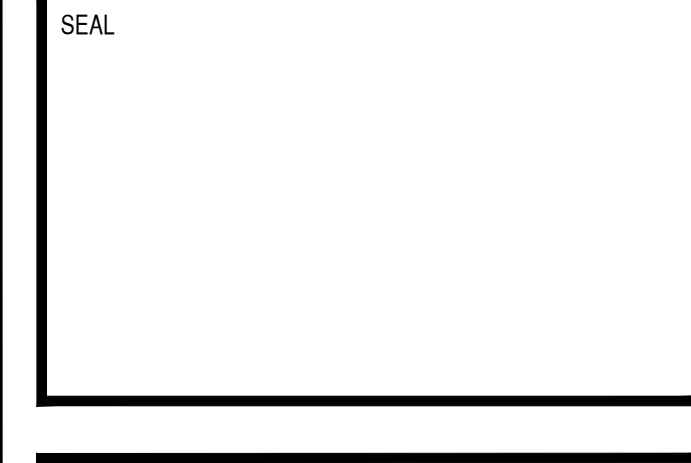
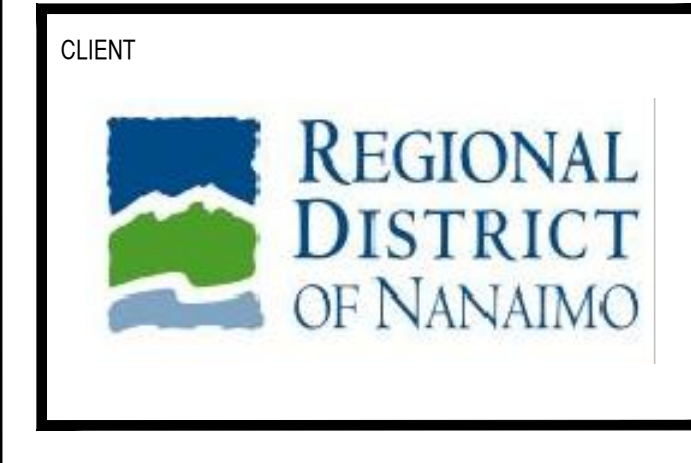
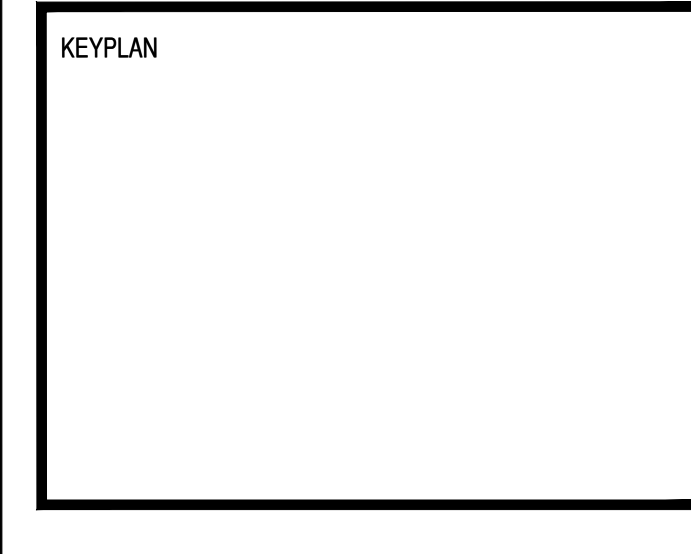


1 HVAC SCHEMATIC - NEW WORK
M-7 NTS

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PROJECT
RAVENSONG AQUATIC CENTRE HVAC UPGRADE

737 Jones St
Qualicum Beach, BC
V9K 1S4

SHEET TITLE
HVAC SCHEMATIC
NEW WORK

PROJECT	18078-N
SCALE	AS SHOWN
DWG DATE	FEBRUARY 2019
DESIGNED	MW
DRAWN	ANG/DL
CHECKED	AM
APPROVED	AM

DRAWING

M-7



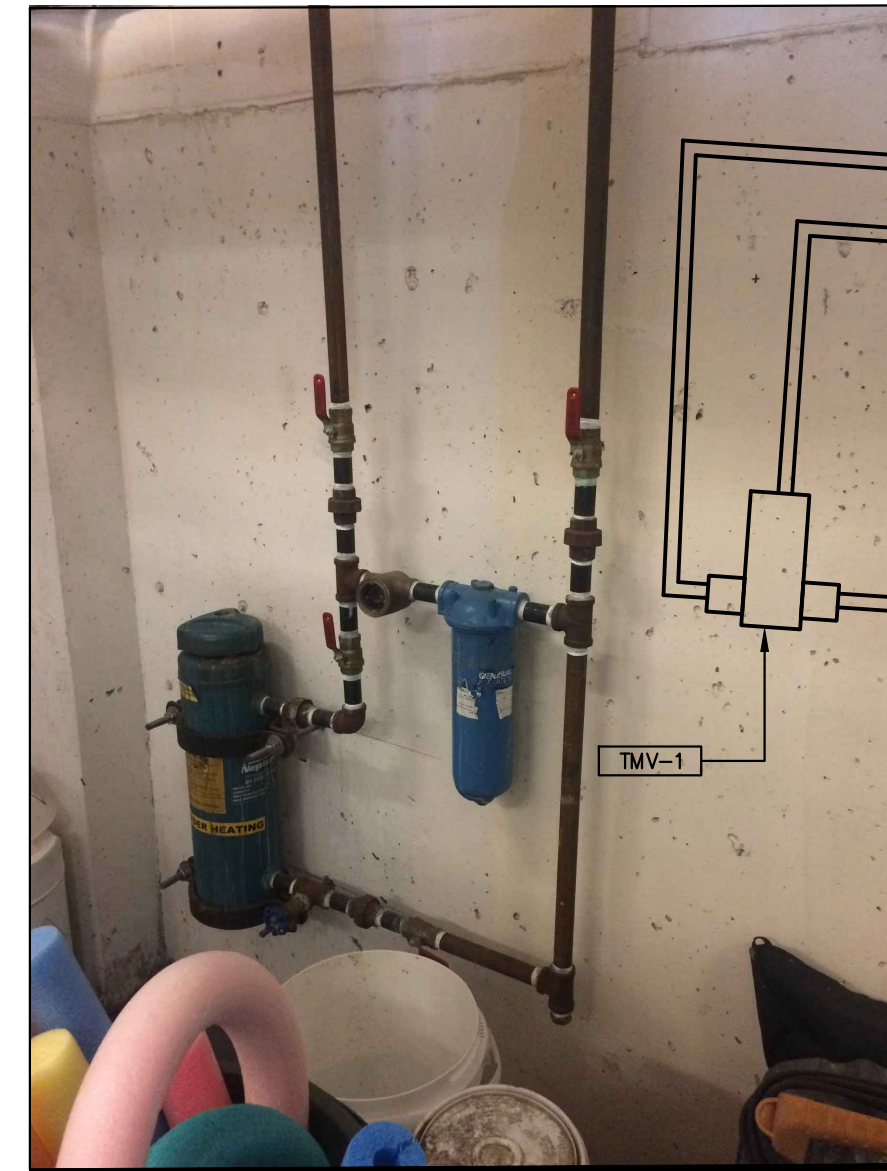
1 (ALTERNATIVE PRICE NO. 1)
ET-4X TO BE REMOVED
M-9 N.T.S.



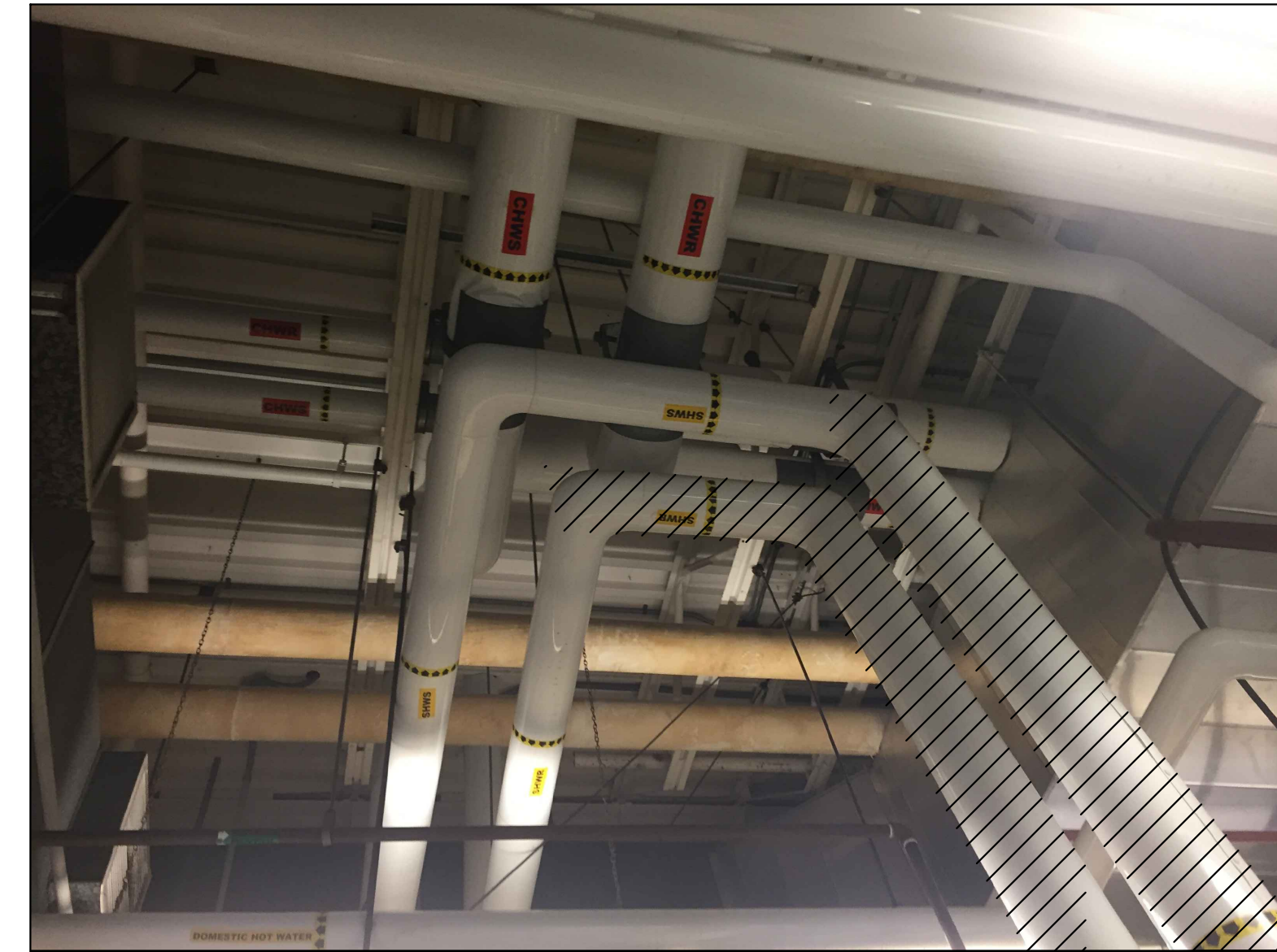
2 (ALTERNATIVE PRICE NO. 1)
EXISTING EXPANSION TANK TO BE REMOVED
M-9 N.T.S.



3 (ALTERNATIVE PRICE NO. 1)
ET-5X TO BE REMOVED
M-9 N.T.S.



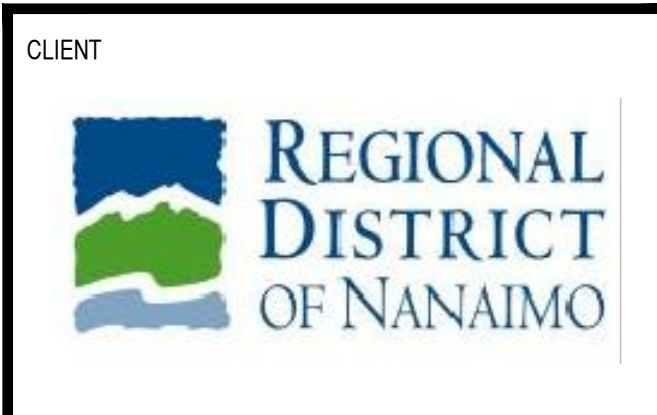
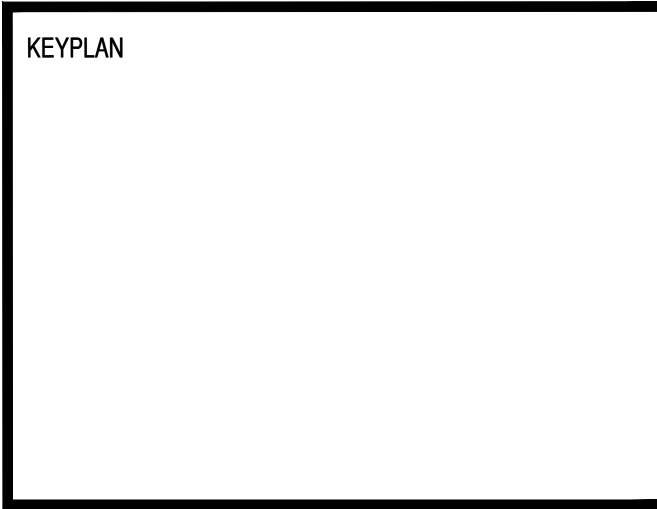
4 (ALTERNATIVE PRICE NO. 1)
LOCATION OF THERMOSTATIC MIXING VALVE
M-9 N.T.S.



5 (ALTERNATIVE PRICE NO. 1)
SECTION OF SHWS/SHWR PIPING TO BE REMOVED
M-9 N.T.S.

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1	OCT. 26, 18	REVIEW	AM

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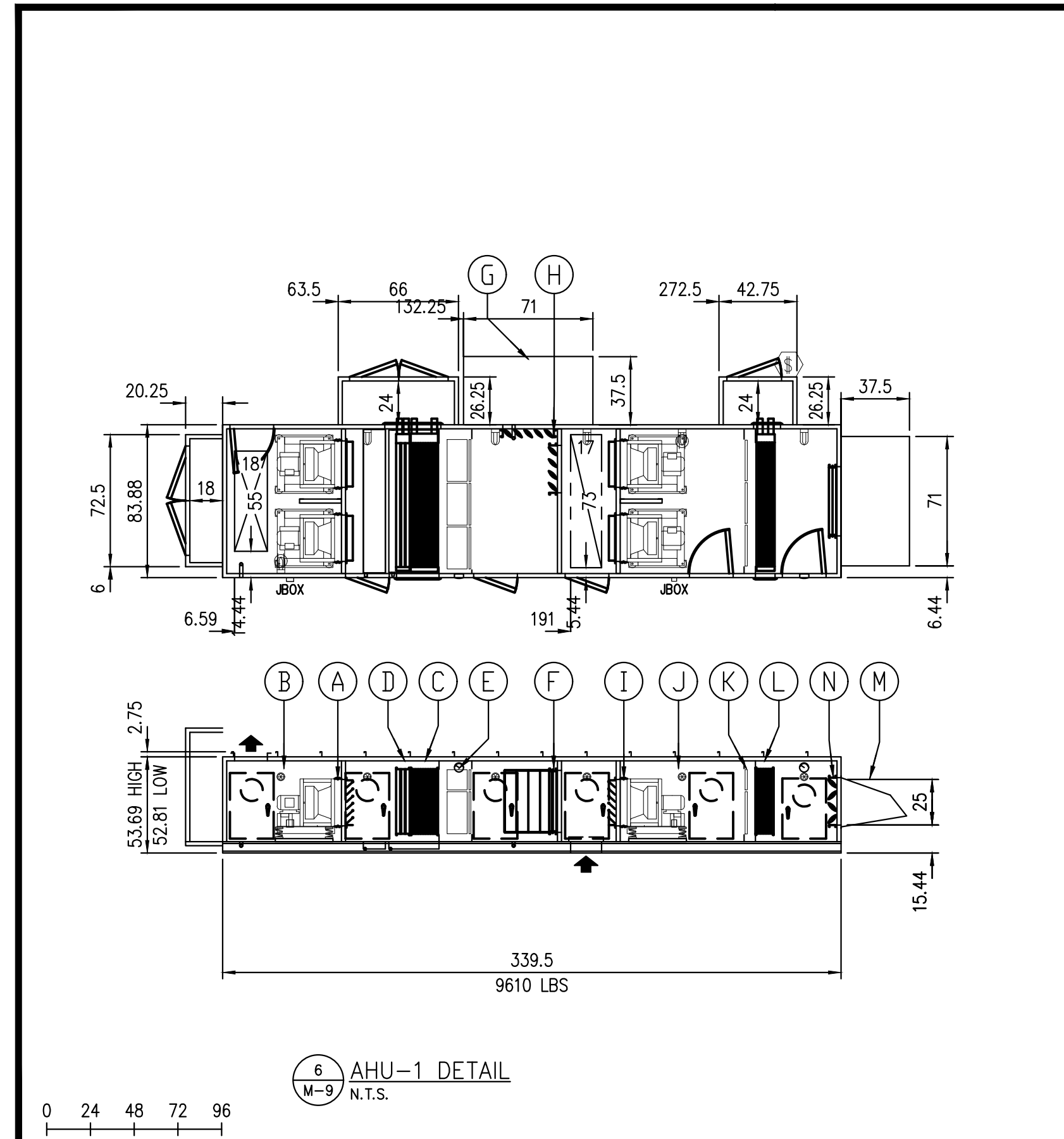


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PROJECT
RAVENSONG AQUATIC CENTRE HVAC UPGRADE
737 Jones St
Qualicum Beach, BC
V9K 1S4

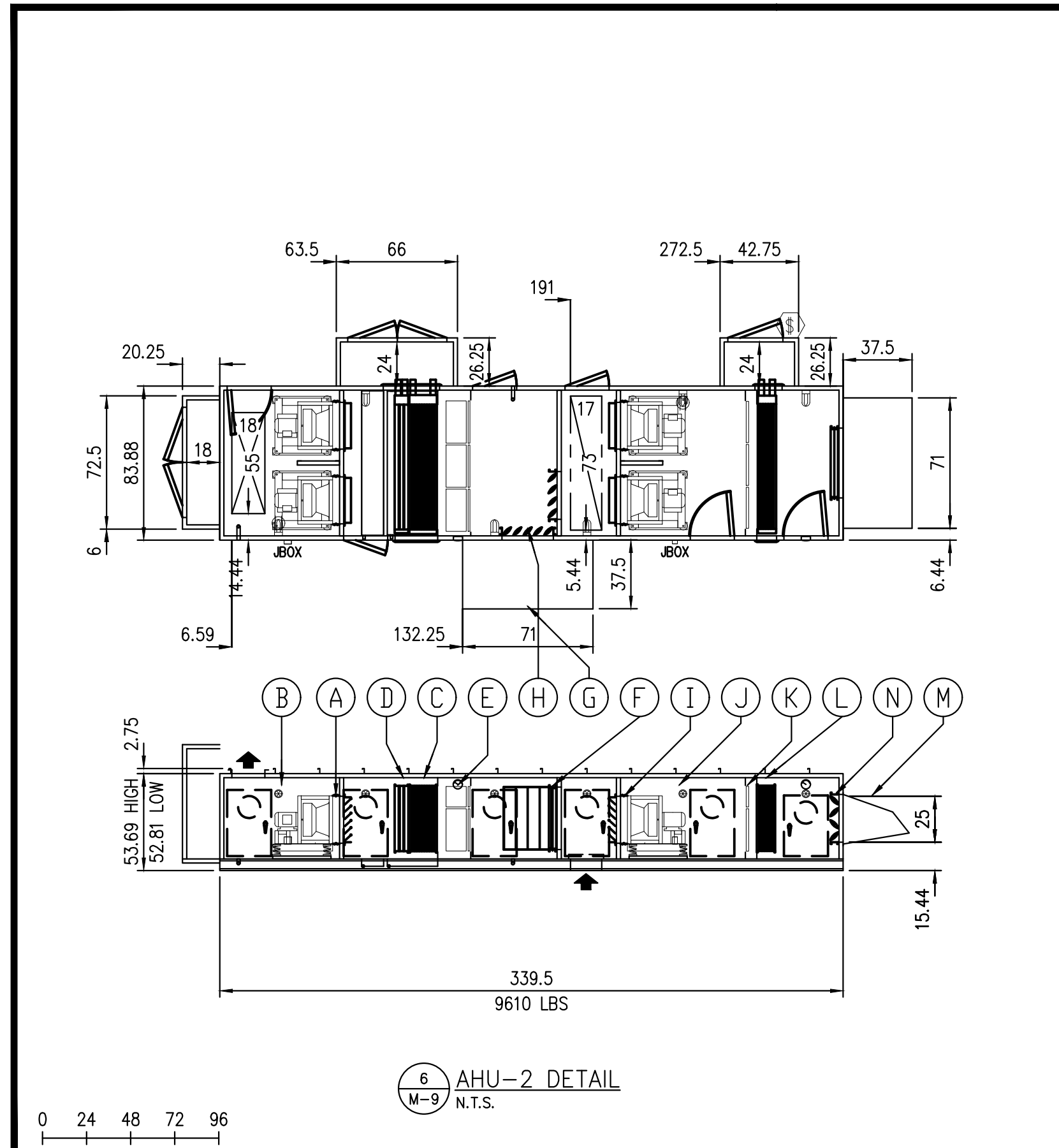
PROJECT	18078-N
SCALE	AS SHOWN
DWG DATE	FEBRUARY 2019
DESIGNED	MW
DRAWN	ANG/DL
CHECKED	AM
APPROVED	AM

DRAWING
M-9



6 AHU-1 DETAIL
M-9 N.T.S.

M	EA HOOD
N	EA DAMPER : OPPOSED BLADES MAKE : TAM 1000 Salt Water SIZE : 36 X 28
UNIT MOUNTING The unit is designed to be mounted on a roof curb. Note : Calculated unit weights are shipping weights and do not reflect operating conditions. Items which are field installed or ship loose.	
A	SF BACKDRAFT DAMPER : PARALLEL BLADES MAKE : T.A. MORRISON 7600CWA SIZE : 2 @ 25.5 X 25.5
B	FAN : (SF) 2 @ 18" EPFN SW, 80% Width, Arrangement-4 (ESP=0.75") AIR FLOW : 4250 CFM RPM : 2223 T.S.P. : 4 in wc CLASS : II MOTOR : 5 HP, TEFC Prem-Eff, 208/3/60 RPM : 1750 (GROUNDED SHAFT) ISOLATORS : OS DEF : 2 in FE80 η_{is} : 73% η_{is} / η_{is} : 93%
C	COOLING COIL TYPE : 10 ROW SIZES : 1 @ 36 X 68 CONN : LEFT PULL : RIGHT DRAIN : RIGHT VEL : 500 FPM
D	HEATING COIL TYPE : 2 ROW SIZES : 1 @ 36 X 68 CONN : LEFT PULL : RIGHT DRAIN : RIGHT VEL : 500 FPM
E	FILTERS : LIFT-OUT UPSTREAM VELOCITY : 472 FPM TYPE : 2" (MERV 8) Farr 30/30 12" (MERV 13) Farr Durafl 2V 80-85% SIZES : 3 @ 24 X 24 3 @ 24 X 12
F	RA DAMPER : PARALLEL BLADES MAKE : TAM 1000 Salt Water SIZE : 36 X 28
G	OA HOOD
H	OA DAMPER : OPPOSED BLADES MAKE : TAM 1000 Salt Water SIZE : 36 X 28
I	RF BACKDRAFT DAMPER : PARALLEL BLADES MAKE : T.A. MORRISON 7600CWA SIZE : 2 @ 25.5 X 25.5
J	FAN : (RF) 2 @ 18" EPFN SW, 80% Width, Arrangement-4 (ESP=0.5") AIR FLOW : 4250 CFM RPM : 1766 T.S.P. : 2.5 in wc CLASS : II MOTOR : 3 HP, TEFC Prem-Eff, 208/3/60 RPM : 1750 (GROUNDED SHAFT) ISOLATORS : OS DEF : 2 in FE80 η_{is} : 73% η_{is} / η_{is} : 93%
K	FILTERS : LIFT-OUT UPSTREAM VELOCITY : 472 FPM TYPE : 2" (MERV 8) Farr 30/30 SIZES : 3 @ 24 X 24 3 @ 24 X 12
L	HEAT REJECTION COIL TYPE : 6 ROW SIZES : 1 @ 36 X 68 CONN : LEFT PULL : RIGHT VEL : 500 FPM



6 AHU-2 DETAIL
M-9 N.T.S.

M	EA HOOD
N	EA DAMPER : OPPOSED BLADES MAKE : TAM 1000 Salt Water SIZE : 36 X 28
UNIT MOUNTING The unit is designed to be mounted on a roof curb. Note : Calculated unit weights are shipping weights and do not reflect operating conditions. Items which are field installed or ship loose.	
A	SF BACKDRAFT DAMPER : PARALLEL BLADES MAKE : T.A. MORRISON 7600CWA SIZE : 2 @ 25.5 X 25.5
B	FAN : (SF) 2 @ 18" EPFN SW, 80% Width, Arrangement-4 (ESP=0.75") AIR FLOW : 4250 CFM RPM : 2223 T.S.P. : 4 in wc CLASS : II MOTOR : 5 HP, TEFC Prem-Eff, 208/3/60 RPM : 1750 (GROUNDED SHAFT) ISOLATORS : OS DEF : 2 in FE80 η_{is} : 73% η_{is} / η_{is} : 93%
C	COOLING COIL TYPE : 10 ROW SIZES : 1 @ 36 X 68 CONN : LEFT PULL : RIGHT DRAIN : RIGHT VEL : 500 FPM
D	HEATING COIL TYPE : 2 ROW SIZES : 1 @ 36 X 68 CONN : LEFT PULL : RIGHT DRAIN : RIGHT VEL : 500 FPM
E	FILTERS : LIFT-OUT UPSTREAM VELOCITY : 472 FPM TYPE : 2" (MERV 8) Farr 30/30 12" (MERV 13) Farr Durafl 2V 80-85% SIZES : 3 @ 24 X 24 3 @ 24 X 12
F	RA DAMPER : PARALLEL BLADES MAKE : TAM 1000 Salt Water SIZE : 36 X 28
G	OA HOOD
H	OA DAMPER : OPPOSED BLADES MAKE : TAM 1000 Salt Water SIZE : 36 X 28
I	RF BACKDRAFT DAMPER : PARALLEL BLADES MAKE : T.A. MORRISON 7600CWA SIZE : 2 @ 25.5 X 25.5
J	FAN : (RF) 2 @ 18" EPFN SW, 80% Width, Arrangement-4 (ESP=0.5") AIR FLOW : 4250 CFM RPM : 1766 T.S.P. : 2.5 in wc CLASS : II MOTOR : 3 HP, TEFC Prem-Eff, 208/3/60 RPM : 1750 (GROUNDED SHAFT) ISOLATORS : OS DEF : 2 in FE80 η_{is} : 73% η_{is} / η_{is} : 93%
K	FILTERS : LIFT-OUT UPSTREAM VELOCITY : 472 FPM TYPE : 2" (MERV 8) Farr 30/30 SIZES : 3 @ 24 X 24 3 @ 24 X 12
L	HEAT REJECTION COIL TYPE : 6 ROW SIZES : 1 @ 36 X 68 CONN : LEFT PULL : RIGHT VEL : 500 FPM

AIR HANDLING UNIT SCHEDULE																																																			
DESIGNATION	MAKE	LOCATION	SERVING	AIRFLOW (L/s)	SUPPLY FAN DATA					RETURN FAN DATA					COOLING PERFORMANCE							HEATING PERFORMANCE							HEAT REJECTION PERFORMANCE							DIMENSIONS (mm)			ELECTRICAL SERVICE			COMMENTS									
					QTY	PER FAN				ESP (kPa)	QTY	PER FAN				COIL CAPACITY (kW)	EDB/ EWB (°C)	LDB/ LWB (°C)	FLUID	EWT (°C)	LWT (°C)	FLUID FLOW (L/s)	FLUID VELOCITY (m/s)	FLUID PRESSURE DROP (kPa)	COIL CAPACITY (kW)	EDB (°C)	LDB (°C)	FLUID	EWT (°C)	LWT (°C)	FLUID FLOW (L/s)	FLUID VELOCITY (m/s)	FLUID PRESSURE DROP (kPa)	COIL CAPACITY (kW)	EDB (°C)	LDB (°C)	FLUID	EWT (°C)	LWT (°C)	FLUID FLOW (L/s)	FLUID VELOCITY (m/s)		FLUID PRESSURE DROP (kPa)	WIDTH	LENGTH	HEIGHT	NET WEIGHT (kg)	VOLTAGE	PHASE	FREQUENCY	
						FAN MODEL/TYPE	FAN EFFICIENCY GRADE (ACTUAL)	FLOW (L/s)	MOTOR (hp)			FAN MODEL/TYPE	FAN EFFICIENCY GRADE (ACTUAL)	FLOW (L/s)	MOTOR (hp)																																				ESP (kPa)
AHU-1	HAAKON	ROOF	POOL	4011	2	EPPN/PLENUM	73%	2005	5	0.187	2	EPPN/PLENUM	73%	2005	3	0.124	139.8	27.8/21.0	11.1/11.0	WATER	8.3	13.8	6.0	1.3	41.55	127.7	-4	22.4	WATER	48.9	37.5	2.7	1.12	14.6	75.3	27.8	43.3	WATER	48.9	39.4	1.91	1.22	50.5	2131	8623	1364	4359	208	3	60	NOTE 1
AHU-2	HAAKON	ROOF	POOL	4011	2	EPPN/PLENUM	73%	2005	5	0.187	2	EPPN/PLENUM	73%	2005	3	0.124	112.0	23.3/19.1	10.8/10.8	WATER	8.3	14.0	4.7	1.3	52.31	127.7	-4	22.4	WATER	48.9	37.5	2.7	1.12	14.6	75.3	27.8	43.3	WATER	48.9	39.4	1.91	1.22	50.5	2131	8623	1364	4359	208	3	60	NOTE 1

NOTE 1: MARINE GRADE(5052) ALUMINUM WASHDOWN LINER, MARINE GRADE ALUMINUM COIL AND FILTER RACKS, TAMCO 1000 SW(SALT WATER) CONTROL DAMPERS (EXHAUST AIR, RETURN AIR, OUTDOOR AIR), TAMCO T.A. MORRISON 7600CWA BACKDRAFT DAMPERS (RETURN FAN, SUPPLY FAN), COILS WITH 316SS CASING AND ELECTROFIN COIL COATING (COIL AND CASING), POLYESTER POWDER COATED DIRECT DRIVE FANS WITH TEFC MOTOR, MERV 8 FILTERS FOR HEAT REJECTION COIL. MERV 8 PRE-FILTERS AND MERV 13 FINAL FILTERS, O/A AND E/A HOODS, TERMINAL STRIP FOR DDC CONTROL (20 DDC POINTS), PROVIDED WITH FACTORY INSTALLED EMPTY CONDUITS FOR CONTROL WIRING INSIDE UNIT.

PUMP SCHEDULE												
DESIGNATION	MAKE	MODEL	LOCATION	SERVING	FLOW (L/s)	HEAD (kPa)	MOTOR POWER (W)	ELECTRICAL SERVICE			CONN. (mm)	COMMENTS
								VOLTAGE	PHASE	FREQUENCY		
P-114A	GRUNDFOS	UPS 40-160 F	MECHANICAL ROOM	SOLAR COLLECTORS	2.02	103.0	800	208	3	60	40	3 SPEED PUMP, DUTY/STANDBY (ALTERNATIVE PRICE NO. 1)
P-114B	GRUNDFOS	UPS 40-160 F	MECHANICAL ROOM	SOLAR COLLECTORS	2.02	103.0	800	208	3	60	40	3 SPEED PUMP, DUTY/STANDBY (ALTERNATIVE PRICE NO. 1)
P-115	GRUNDFOS	MAGNA3 40-80 F (N)	MECHANICAL ROOM	HE-101	1.26	55	274	208	1	60	40	PROVIDE CIM MODULE AND BACNET INTERFACE FOR CONTROL BY DDC. INTEGRAL VFD, ALL STAINLESS STEEL BODY FOR DOMESTIC WATER USE. (ALTERNATIVE PRICE NO. 1)
P-HC1	GRUNDFOS	UPS 40-160 F	ROOF	HEATING COIL #1	2.71	77	800	208	3	60	40	3 SPEED PUMP
P-HC2	GRUNDFOS	UPS 40-160 F	ROOF	HEATING COIL #2	2.71	83	800	208	3	60	40	3 SPEED PUMP
P-CC1	GRUNDFOS	UPS 80-160 F	ROOF	COOLING COIL #1	6.00	98	2050	208	3	60	80	3 SPEED PUMP
P-CC2	GRUNDFOS	UPS 80-160 F	ROOF	COOLING COIL #2	4.70	117	2050	208	3	60	80	3 SPEED PUMP
P-HRJ1	GRUNDFOS	UPS 40-160 F	ROOF	HEAT REJECTION COIL #1	1.91	105	800	208	3	60	40	3 SPEED PUMP
P-HRJ2	GRUNDFOS	UPS 40-160 F	ROOF	HEAT REJECTION COIL #2	1.91	106	800	208	3	60	40	3 SPEED PUMP

*NOTES: PROVIDE (1) R100 CONTROLLER. ALL VFD PUMPS TO HAVE STAINLESS STEEL IMPELLERS

HEAT EXCHANGER SCHEDULE (ALTERNATIVE PRICE NO. 1)															
DESIGNATION	MAKE	MODEL	LOCATION	SERVING	CAPACITY (KW)	SOURCE SIDE(ASHP) - PERFORMANCE				LOAD SIDE(SPACE HEATING) - PERFORMANCE				FLOODED WEIGHT (kg)	COMMENTS
						FLOW RATE (L/s)	EWT (°C)	LWT (°C)	PRESSURE DROP (kPa)	FLOW RATE (L/s)	EWT (°C)	LWT (°C)	PRESSURE DROP (kPa)		
HE-101	ARMSTRONG	S-X13D-350-8	MECHANICAL ROOM	25M LAP POOL	57850	1.26	60.0	48.8	23.3	1.25	27.8	38.9	14.3	122	NOTE 1, 2 AND 3

NOTE 1: LOAD SIDE FLUID TO BE 25M LAP POOL WATER. SOURCE SIDE FLUID TO BE DOMESTIC WATER.
NOTE 2: 2" CONNECTION SIZES
NOTE 3: DOUBLE-WALL HEAT EXCHANGER, 316 STAINLESS STEEL PLATE MATERIAL.

EXPANSION TANK SCHEDULE (ALTERNATIVE PRICE NO. 1)												
DESIGNATION	MAKE	SERIES	MODEL	LOCATION	SERVING	VOLUME (L)	MAX. ACCEPTANCE VOLUME (L)	DIAMETER (M)	HEIGHT (M)	PIPE CONNECTIONS	OPERATING WEIGHT (kg)	COMMENTS
ET-4	AMTROL	EXTROL AX	AX-40V	MECHANICAL ROOM	HYDRONIC LOOP	82	42.8	0.348	0.508	12e	80	NOTE 1
ET-5	AMTROL	THERM-X-TROL	ST-453C	MECHANICAL ROOM	DOMESTIC HOT WATER	1000	1000	0.915	2.18	50e	1345	NOTE 2

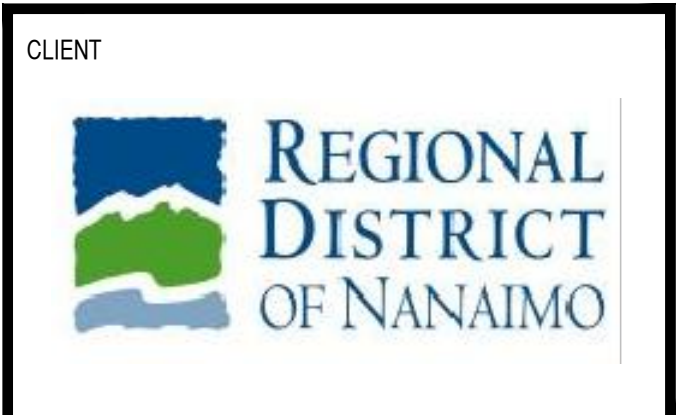
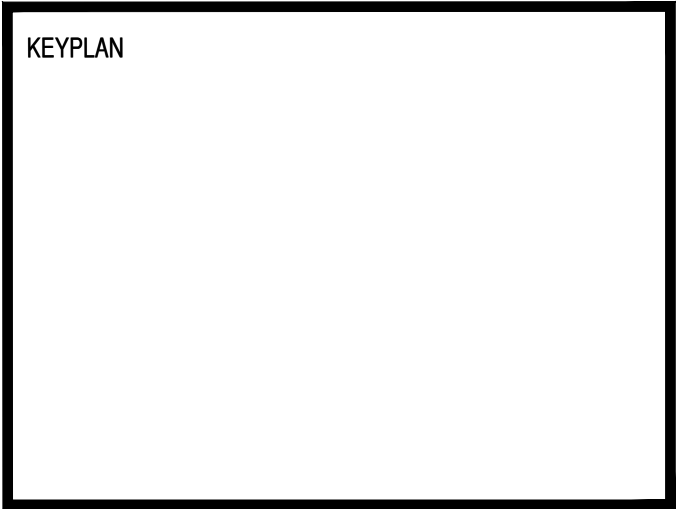
NOTE 1: HEAVY DUTY DIAPHRAGM, ATTACHMENTS FOR SEISMIC RESTRAINTS, CONTRACTOR TO PROVIDE SEISMIC RESTRAINT FOR TANK, ASME RATED 150 PSI, 25 PSI PRE-CHARGE, FINISH: GREY ENAMEL.
NOTE 2: HEAVY DUTY REPLACEABLE BLADDER, ATTACHMENTS FOR SEISMIC RESTRAINTS, CONTRACTOR TO PROVIDE SEISMIC RESTRAINT FOR TANK, ASME RATED 150 PSI, FOR POTABLE WATER, FINISH: GREY ENAMEL.

PROPELLER FAN SCHEDULE (ALTERNATIVE PRICE NO. 2)															
DESIGNATION	MAKE	MODEL	LOCATION	SERVING	DIAMETER (m)	# OF AIRFOILS	MOTOR POWER (HP)	MAX SPEED (RPM)	SOUND LEVEL (dBA)	WEIGHT (kg)	ELECTRICAL SERVICE			CONTROLS	COMMENTS
											VOLTAGE	PHASE	FREQUENCY		
PF-1	BIG ASS FANS	POWERFOIL X3.0 HARSH ENVIRONMENT	POOL	POOL	3.6	8	1.5	139	<55	111	575	3	60	VARIABLE SPEED	NOTE 1-5
PF-2	BIG ASS FANS	POWERFOIL X3.0 HARSH ENVIRONMENT	POOL	POOL	3.6	8	1.5	139	<55	111	575	3	60	VARIABLE SPEED	NOTE 1-5
PF-3	BIG ASS FANS	POWERFOIL X3.0 HARSH ENVIRONMENT	POOL	POOL	3.6	8	1.5	139	<55	111	575	3	60	VARIABLE SPEED	NOTE 1-5
PF-4	BIG ASS FANS	POWERFOIL X3.0 HARSH ENVIRONMENT	POOL	POOL	3.6	8	1.5	139	<55	111	575	3	60	VARIABLE SPEED	NOTE 1-5

NOTE 1: VERIFY EXTENSION TUBE LENGTH AND MOUNTING BRACKET WITH MANUFACTURER PRIOR TO ORDERING.
NOTE 2: FANS SHALL BE AT LEAST 0.6m (2') AWAY, IN ALL DIRECTIONS, FROM POSSIBLE OBSTRUCTIONS.
NOTE 3: EXTENSION TUBES 1.2m (4') OR LONGER SHALL BE INSTALLED WITH GUY WIRES PER THE MANUFACTURER'S INSTALLATION REQUIREMENTS. PROVIDE 0.91m(3") HSS EXTENSION TUBE. CONTRACTOR TO CONFIRM EXTENSION TUBE LENGTH PRIOR TO ORDERING.
NOTE 4: FANS SHALL BE AT LEAST TWO AND ONE-HALF TIMES THE DIAMETER OF THE LARGEST FAN AWAY FROM NEIGHBORING FANS.
NOTE 5: AIRFOILS TO BE ANODIZED. CONTROLS INTERFACE FOR CONTROL BY DDC SYSTEM. BACNET INTERFACE.

REV.	DATE	DESCRIPTION	BY
2	FEB. 01, 19	TENDER	AM
1	OCT. 26, 18	REVIEW	AM

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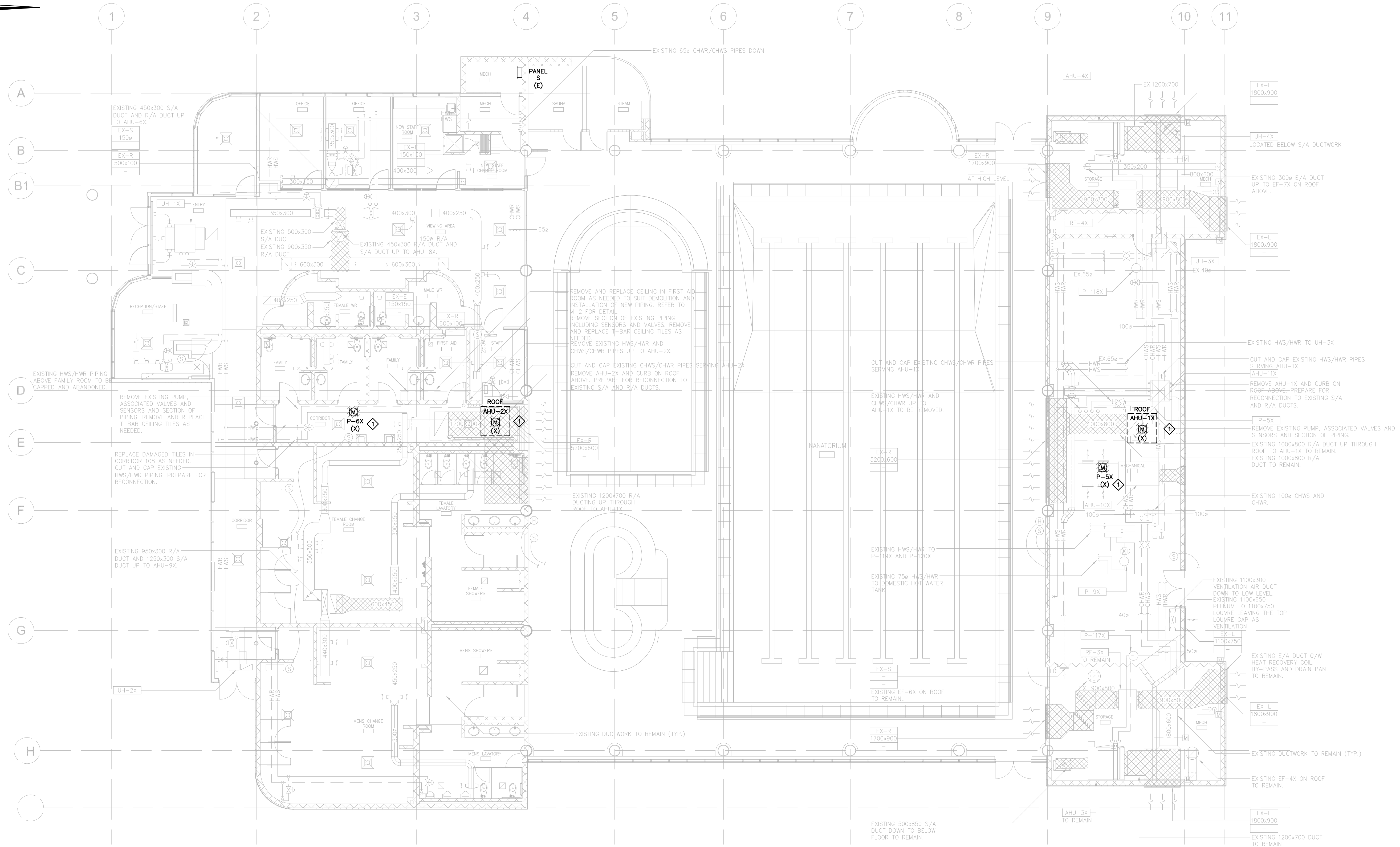
PROJECT
RAVENSONG AQUATIC CENTRE HVAC UPGRADE

737 Jones St
Qualicum Beach, BC
V9K 1S4

SHEET TITLE
MECHANICAL SCHEDULES

PROJECT	18078-N
SCALE	AS SHOWN
DWG DATE	FEBRUARY 2019
DESIGNED	MW
DRAWN	ANG/DL
CHECKED	AM
APPROVED	AM
DRAWING	

M-10



KEY NOTES:
 (X) EXISTING MECHANICAL EQUIPMENT SHOWN TO BE REMOVED.
 --- ABANDON EXISTING CIRCUIT.

NO.	DATE	TITLE	REVISION
3	FEB 01 2019	RE-ISSUED FOR TENDER	
2	NOV 05 2018	ISSUED FOR TENDER	
1	SEP 28 2018	ISSUED FOR REVIEW	

NO.	DATE	TITLE	REVISION

RB ENGINEERING LTD
 ELECTRICAL CONSULTING ENGINEERS
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 TEL 250-756-4444
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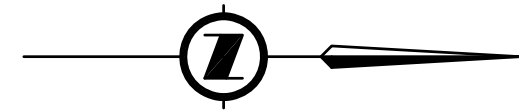
CLIENT
REGIONAL DISTRICT OF NANAIMO

PROJECT
RAVENSONG AQUATIC CENTRE HVAC UPGRADE

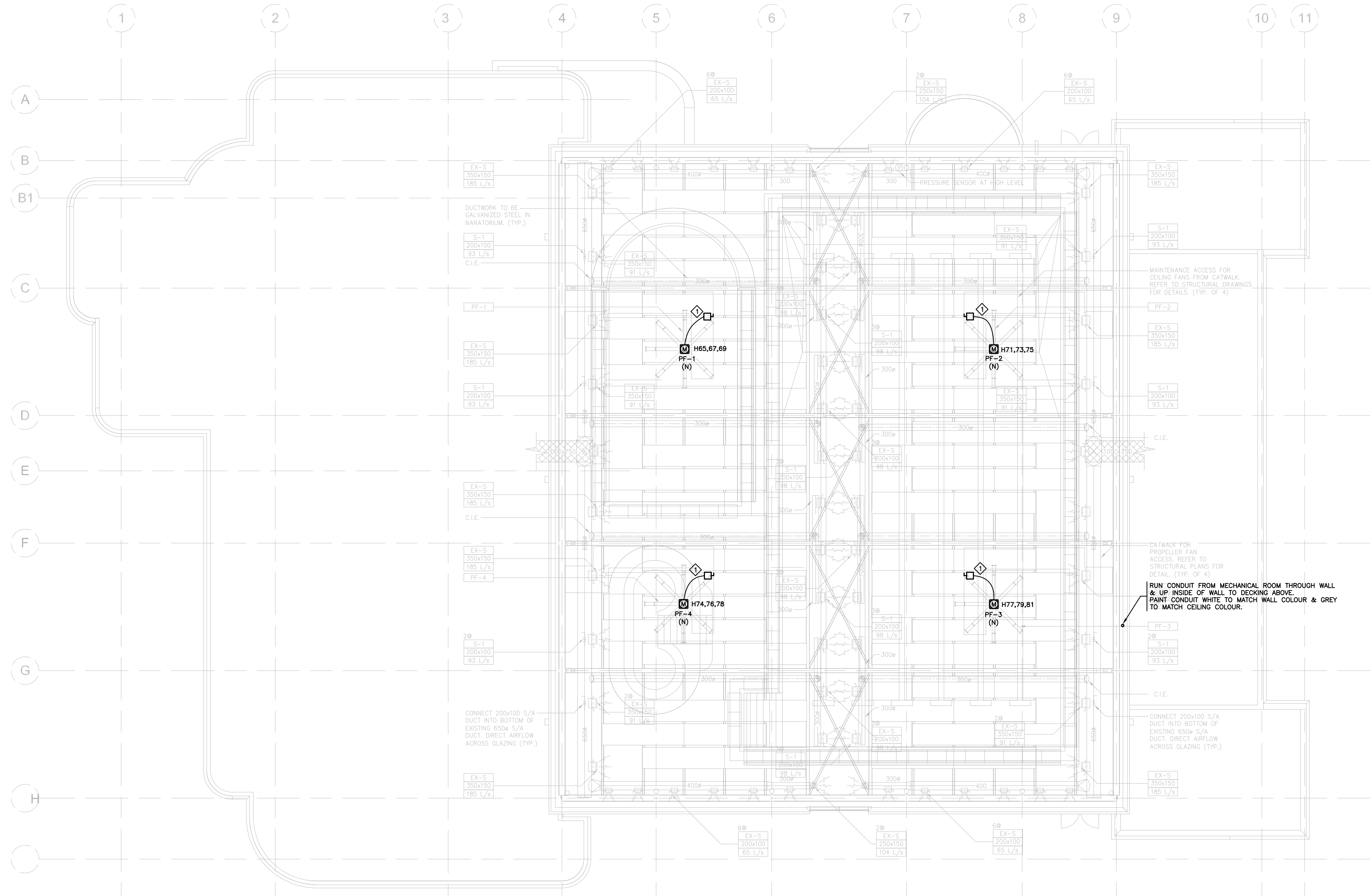
TITLE
MAIN FLOOR PLAN DEMOLITION LAYOUT

PROJECT NO. 18-2963	SEAL
DATE AUGUST, 2018	
SCALE 1:100	

DRAWING NO.
E-1



NOTE: ALL WIRING, CONDUIT, FASTENERS & EQUIPMENT INSTALLED IN POOL AREA TO BE RATED FOR INSTALLATION IN CORROSIVE ENVIORNMENT.



KEY NOTES:
 MOUNT DISCONNECT ON ADJACENT WALKWAY. SECURE WITH STAINLESS STEEL HARDWARE RATED FOR CORROSIVE ENVIRONMENT.

NO.	DATE	TITLE	REVISION
3	FEB 01 2019	RE-ISSUED FOR TENDER	
2	NOV 05 2018	ISSUED FOR TENDER	
1	SEP 28 2018	ISSUED FOR REVIEW	

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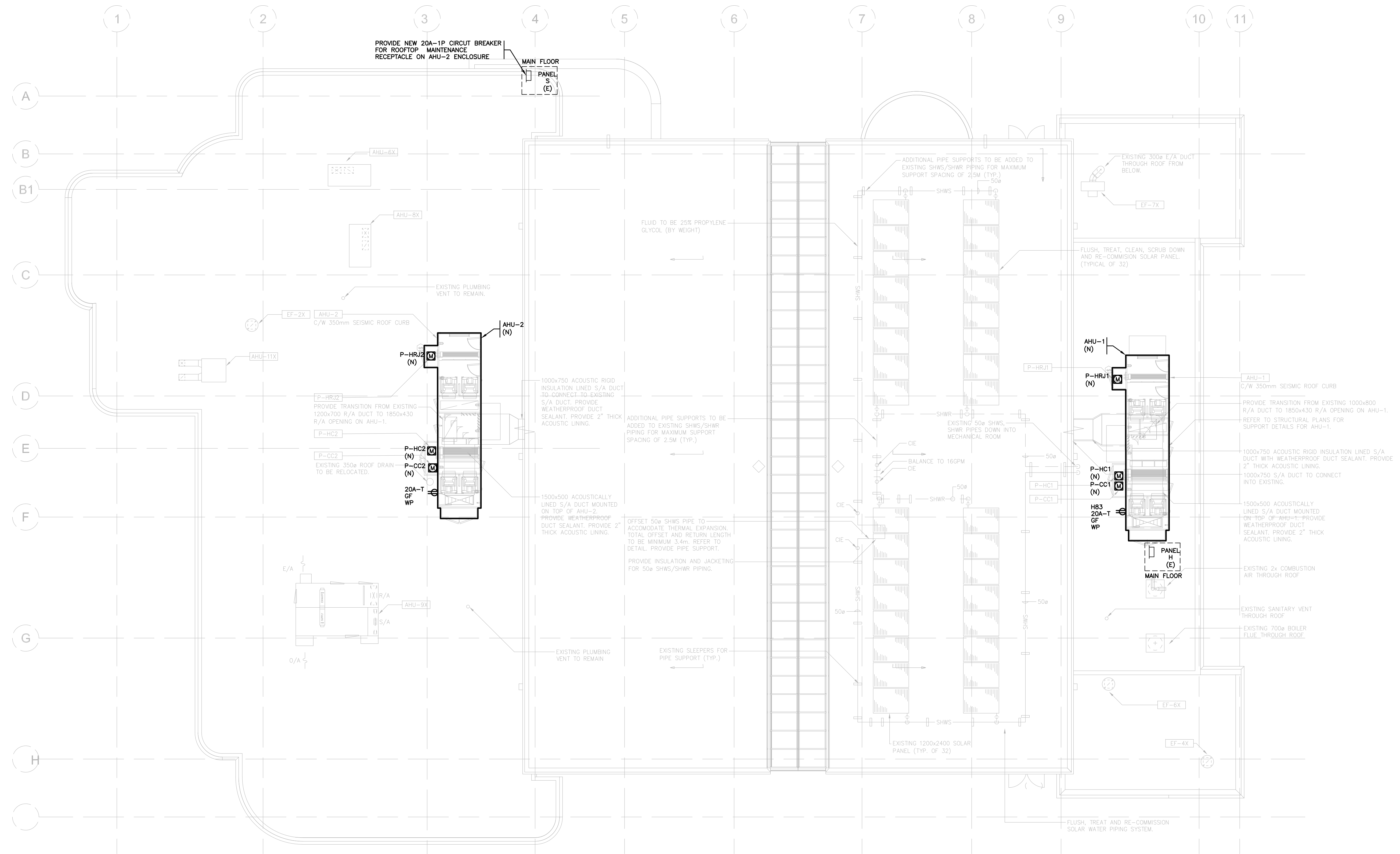


PROJECT
RAVENSONG AQUATIC CENTRE HVAC UPGRADE

TITLE
UPPER POOL HALL PROPOSED ELECTRICAL LAYOUT

PROJECT NO. 18-2963	SEAL
DATE AUGUST, 2018	
SCALE 1:100	

DRAWING NO.
E-2



NO.	DATE	TITLE	REVISION
3	FEB 01 2019	RE-ISSUED FOR TENDER	
2	NOV 05 2018	ISSUED FOR TENDER	
1	SEP 28 2018	ISSUED FOR REVIEW	

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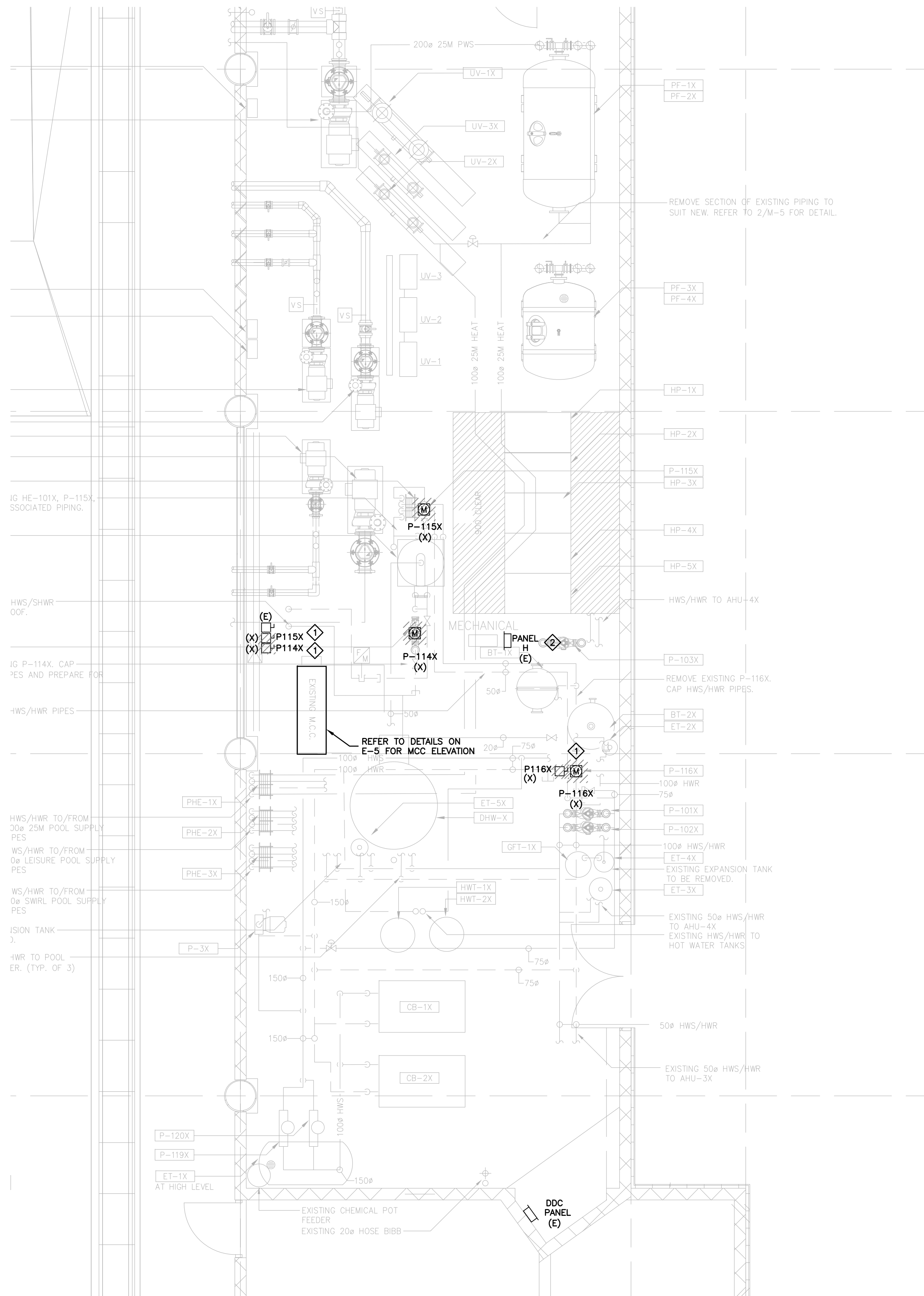


PROJECT
RAVENSONG AQUATIC CENTRE HVAC UPGRADE

TITLE
ROOF PROPOSED ELECTRICAL LAYOUT

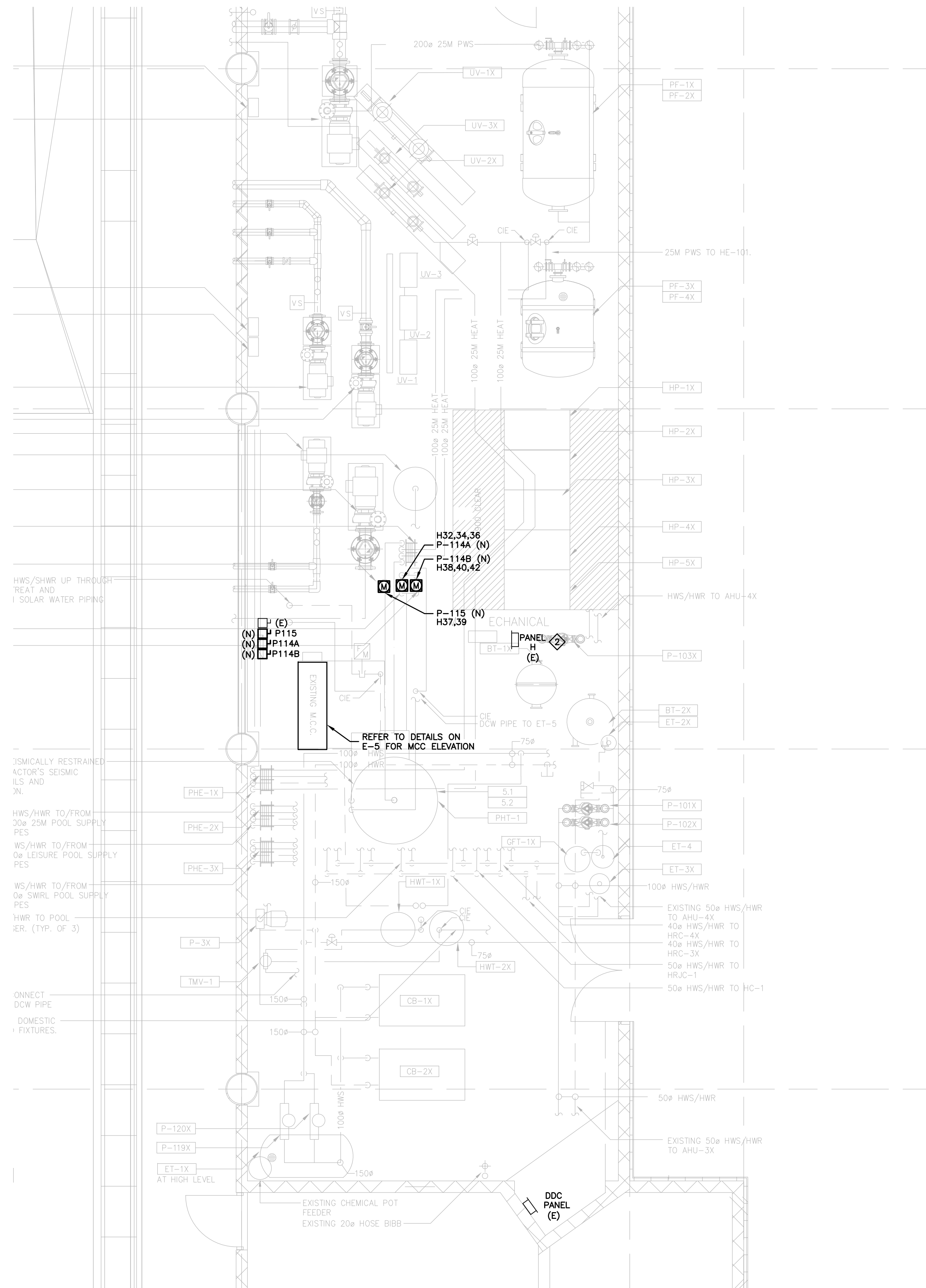
PROJECT NO. 18-2963	SEAL
DATE AUGUST, 2018	
SCALE 1:100	

DRAWING NO.
E-3



MECHANICAL ROOM PLAN - DEMOLITION

SCALE: 1:50



MECHANICAL ROOM PLAN - NEW WORK

SCALE: 1:50

KEY NOTES:

- ◊ PUMP DISCONNECT & STARTER TO BE REMOVED. REMOVE WIRING BACK TO PANEL & RE-LABEL BREAKER AS SPARE.
- ◊ LOCATION IS APPROXIMATE.

NO.	DATE	TITLE	REVISION
3	FEB 01 2019	RE-ISSUED FOR TENDER	
2	NOV 05 2018	ISSUED FOR TENDER	
1	SEP 28 2018	ISSUED FOR REVIEW	

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CLIENT

REGIONAL DISTRICT OF NANAIMO

PROJECT

RAVENSONG AQUATIC CENTRE HVAC UPGRADE

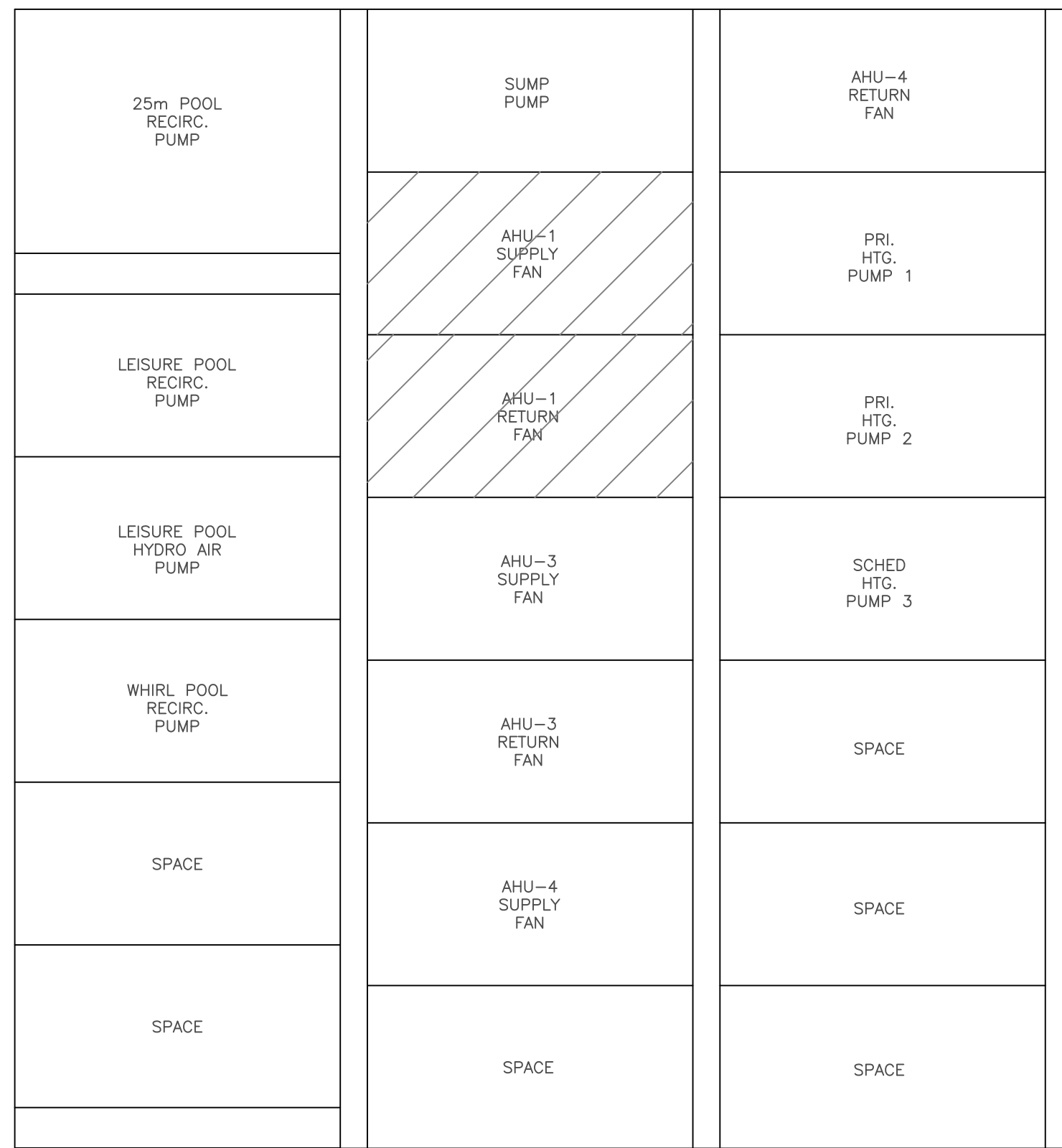
TITLE

MECHANICAL ROOM ELECTRICAL LAYOUT

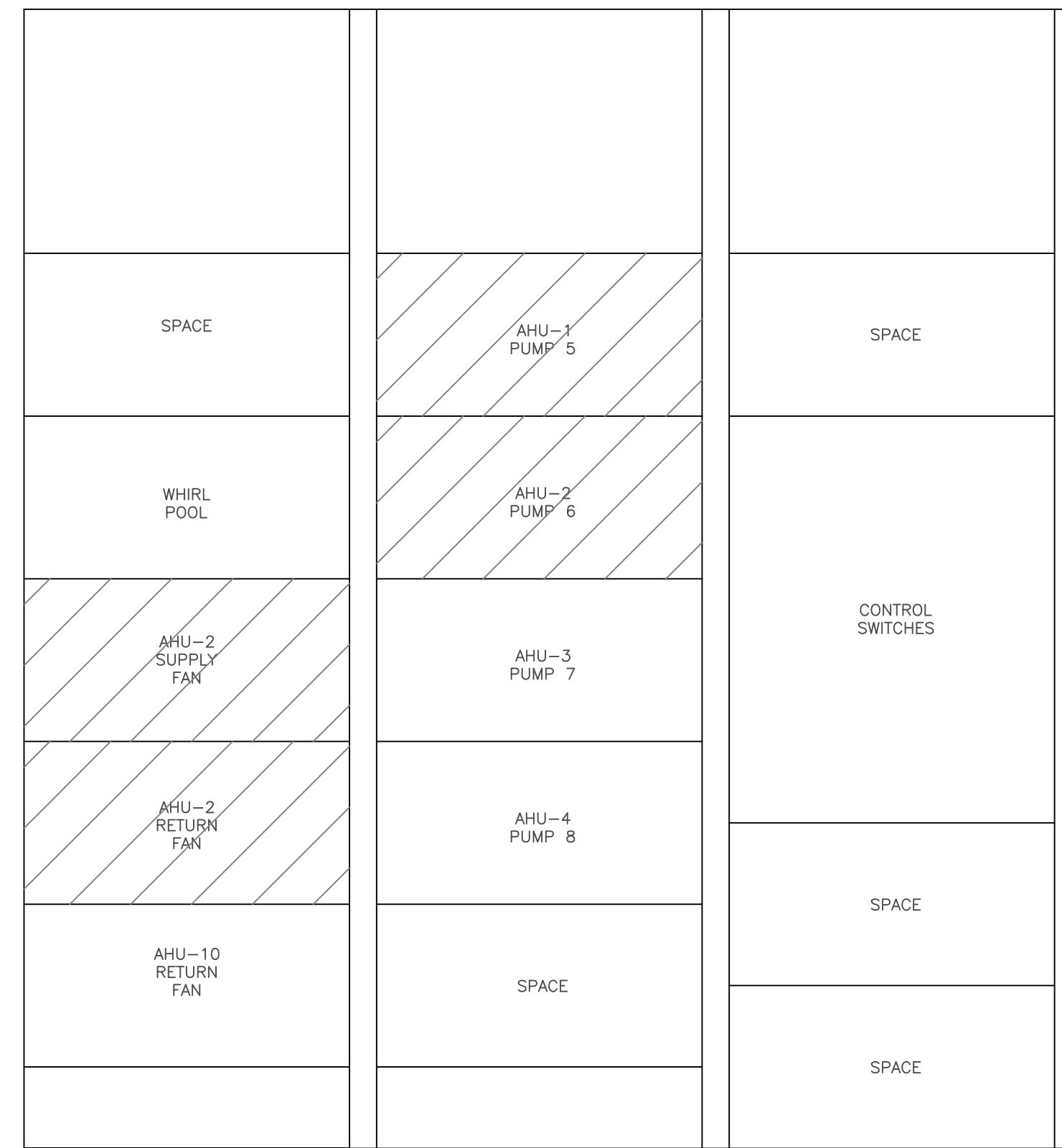
PROJECT NO. 18-2963	SEAL
DATE AUGUST, 2018	
SCALE AS SHOWN	

DRAWING NO.

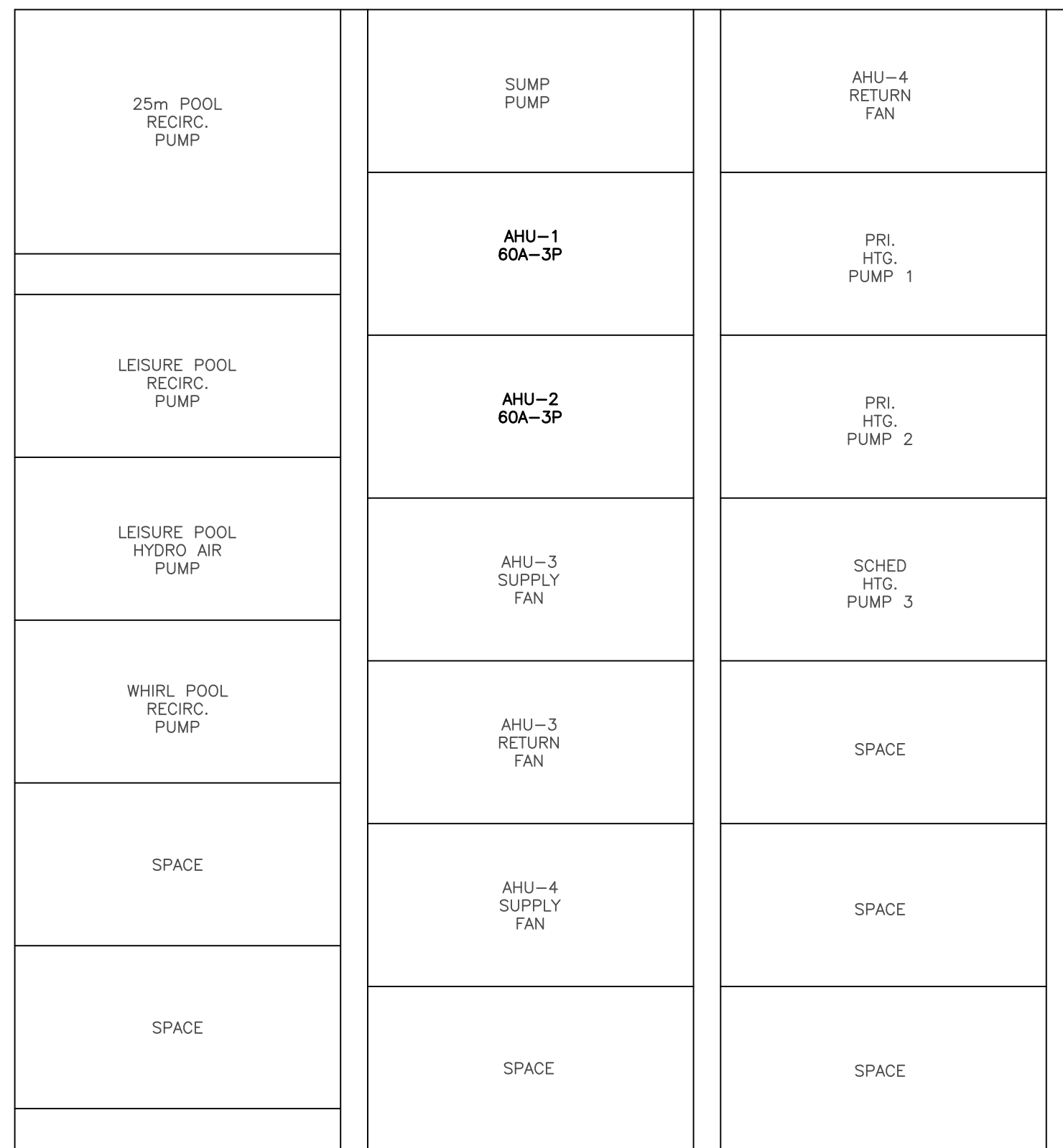
E-4



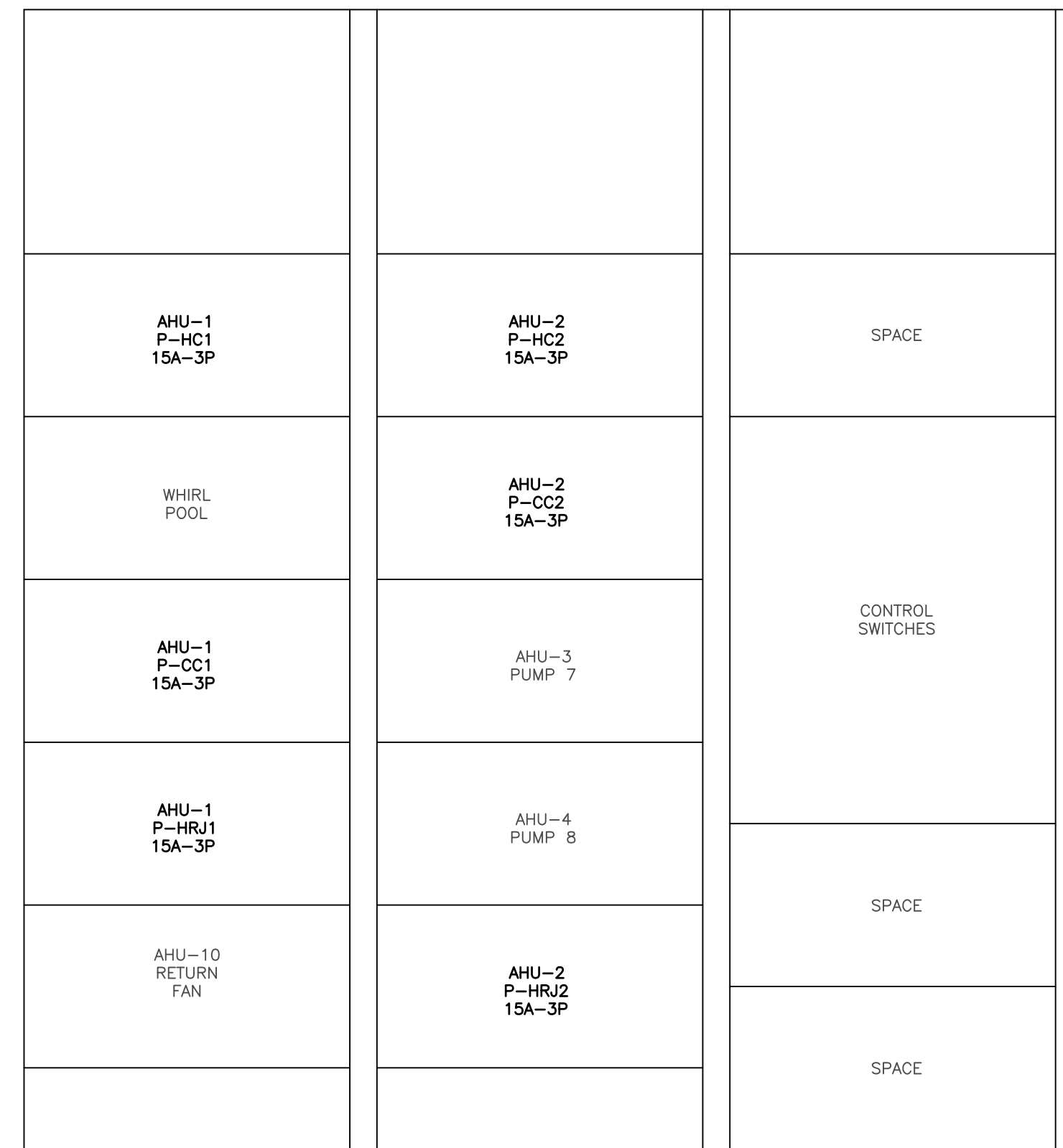
MCC FRONT ELEVATION – DEMOLITION



MCC REAR ELEVATION – DEMOLITION



MCC FRONT ELEVATION – NEW WORK



MCC REAR ELEVATION – NEW WORK

NOTES:

- ALL ITEMS IN HATCHED AREAS TO BE REMOVED.
- NEW WORK IS SHOWN IN BOLD.
- PROVIDE NEW CIRCUIT BREAKERS SHOWN IN BOLD.
- EXISTING MOTOR CONTROL CENTRE MANUFACTURER IS SIEMENS. MODEL-8PX3.

DESCRIPTION	WATTAGE			BKR	CIRC	H (EXISTING) MECHANICAL 129 SURFACE			CIRC	BKR	WATTAGE			DESCRIPTION
	#A	#B	#C			A	B	C			#A	#B	#C	
P-101				30	1				2	15				P-109
					3				4	2P				
				3P	5				6	15				P-110
P-102				30	7				8	2P				
					9				10	15				P-111
				3P	11				12	2P				
P-103				40	13				14	15				P-112
					15				16	2P				
				3P	17				18	15				P-113
P-104				30	19				20	2P				
P-105				30	21				22	30				AHU-12
P-106				30	23				24	30				P-121
P-107				30	25				26	15				GLYCOL TANK
P-108				30	27				28	20				PVT CFT
SPARE				20	29				30	15				P-20L (CIRC. PUMP)
SPARE				20	31				32	15				P-114A
SPARE				30	33				34					
PRE-HEAT SOLAR RECIRC.				15	35				36	3P				
P-115				15	37				38	15				P-114B
				2P	39				40					
					41				42	3P				
UV-2 & XFORMER				40	43				44	30				UV-1
					45				46					
				3P	47				48	3P				
UV-3 & XFORMER				40	49				50	15				CL1 & ACID PUMP
					51				52					
				3P	53				54	3P				
?				15	55				56	15				CL2 & ACID PUMP
?				15	57				58					
?				15	59				60	3P				
?				15	61				62	15				CL3 & ACID PUMP
?				15	63				64					
PF-1				15	65				66	3P				
					67				68	15				CL1
				3P	69				70	15				CL2
PF-2				15	71				72	15				CL3
					73				74	15				PF-4
				3P	75				76					
PF-3				15	77				78	3P				
					79				80					
				3P	81				82					
REC-ROOFTOP MAINT.				20	83				84					

MECHANICAL EQUIPMENT SCHEDULE

ITEM	DESCRIPTION	VOLTS/PHASE/FREQ	HP	KW	FLA	MCA	MOCP	DISC.	STARTER	CONTROL	NOTES
AHU-1	AIR HANDLING UNIT	208/3/60	2X5HP + 2X3HP					60A-3P-WP	INTEGRAL	BY MECH.	1
AHU-2	AIR HANDLING UNIT	208/3/60	2X5HP + 2X3HP					60A-3P-WP	INTEGRAL	BY MECH.	1
PF-1	PROPELLER FAN	208/3/60	1.5					15A-3P-WP		BY MECH.	1
PF-2	PROPELLER FAN	208/3/60	1.5					15A-3P-WP		BY MECH.	1
PF-3	PROPELLER FAN	208/3/60	1.5					15A-3P-WP		BY MECH.	1
PF-4	PROPELLER FAN	208/3/60	1.5					15A-3P-WP		BY MECH.	1
P-114A	SOLAR COLLECTOR PUMP	208/3/60		0.8				15A-3P	MAGNETIC	BY MECH.	1,2
P-114B	SOLAR COLLECTOR PUMP	208/3/60		0.8				15A-3P	MAGNETIC	BY MECH.	1,2
P-115	HE-101 PUMP	208/1/60		0.25				15A-2P		BY MECH.	1
P-HC1	AHU-1 PUMP	208/3/60		0.8				15A-3P-WP	MAGNETIC	BY MECH.	1,2,3
P-HC2	AHU-2 PUMP	208/3/60		0.8				15A-3P-WP	MAGNETIC	BY MECH.	1,2,3
P-CC1	AHU-1 PUMP	208/3/60		2.05				15A-3P-WP	MAGNETIC	BY MECH.	1,2,3
P-CC2	AHU-2 PUMP	208/3/60		2.05				15A-3P-WP	MAGNETIC	BY MECH.	1,2,3
P-HR1J	AHU-1 PUMP	208/3/60		0.8				15A-3P-WP	MAGNETIC	BY MECH.	1,2,3
P-HR2J	AHU-2 PUMP	208/3/60		0.8				15A-3P-WP	MAGNETIC	BY MECH.	1,2,3

NOTES:

- PROVIDE POWER POINT CONNECTION AND DISCONNECT AS REQUIRED.
- STARTER SUPPLIED AND INSTALLED BY ELECTRICAL.
- DISCONNECT TO BE INSTALLED IN AHU ENCLOSURE IN IMMEDIATE VICINITY OF PUMP.

ELECTRICAL CONTRACTOR MUST CONFIRM LOCATION, VOLTAGE, PHASE, AMPACITY OF ALL MECHANICAL EQUIPMENT BEFORE CONNECTION. REPORT ANY MAJOR DISCREPANCIES TO THE ELECTRICAL CONSULTANT. NO EXTRAS WILL BE ALLOWED FOR REMOVING INSTALLED CABLE AND BREAKERS FOR UNCOORDINATED MECHANICAL EQUIPMENT CONNECTION.

KEY NOTES:

ABANDON CIRCUIT. RE-LABEL BREAKER AS SPARE.

NO.	DATE	TITLE
3	FEB 01 2019	RE-ISSUED FOR TENDER
2	NOV 05 2018	ISSUED FOR TENDER
1	SEP 28 2018	ISSUED FOR REVIEW
		REVISION

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THIS DRAWING IS SOLELY INTENDED TO BE USED FOR THE PURPOSE OF THE DRAWING REVISION TITLE AND SHALL NOT BE USED FOR ANY OTHER PURPOSE

CLIENT
REGIONAL DISTRICT OF NANAIMO

PROJECT
RAVENSONG AQUATIC CENTRE HVAC UPGRADE

TITLE
ELECTRICAL SCHEDULES & DETAILS

PROJECT NO.	SEAL
18-2963	
DATE	
AUGUST, 2018	
SCALE	
N.T.S.	
DRAWING NO.	
E-5	

REFERENCE STANDARDS

1. MATERIAL SHALL CARRY CSA APPROVAL AND CONFORM WITH EEMAC STANDARDS.
2. EQUIPMENT WIRING AND WIRING DEVICES SHALL MEET THE REQUIREMENTS OF THE CURRENT EDITION OF THE CANADIAN ELECTRICAL CODE 22.1, PART 1.

GENERAL REQUIREMENTS

1. THE ELECTRICAL CONTRACTOR SHALL SUPPLY ALL LABOUR, MATERIALS, TOOLS, EQUIPMENT, TRANSPORTATION REQUIRED FOR THE COMPLETE INSTALLATION, WIRING AND TESTING OF THE SYSTEM SHOWN ON THE DRAWINGS AND DESCRIBED HEREIN & IS RESPONSIBLE TO REVIEW ARCHITECTURAL, MECHANICAL, STRUCTURAL DRAWINGS FOR DISCREPANCIES AND REPORT TO THE ENGINEER.
2. THE ELECTRICAL DRAWINGS INDICATE THE GENERAL LOCATION AND ROUTE. CONDUIT AND/OR WIRING SHALL BE INSTALLED TO PROVIDE A COMPLETE OPERATING SYSTEM AND SHALL BE INSTALLED PHYSICALLY TO CONSERVE HEADROOM, FURRING SPACES ETC.
3. THE WORK TO BE DONE IS DESCRIBED IN THE DRAWINGS.
4. THE DRAWINGS AND SPECIFICATIONS COMPLEMENT EACH OTHER AND WHAT IS CALLED FOR BY ONE IS BINDING AS IF CALLED FOR BY BOTH. IF THERE IS ANY DOUBT AS TO THE MEANING OR TRUE INTENT DUE TO A DISCREPANCY BETWEEN THE DRAWINGS AND SPECIFICATIONS, OBTAIN RULING FROM ENGINEER PRIOR TO TENDER CLOSING. FAILING THIS, ALLOW FOR THE MOST EXPENSIVE ALTERNATIVE.
5. ELECTRICAL DRAWINGS ARE DIAGRAMMATIC AND DO NOT SHOW ALL CONDUIT, WIRE, CABLE, ETC., THE ELECTRICAL CONTRACTOR IS TO PROVIDE CONDUIT, WIRE, CABLE, ETC. FOR A COMPLETE OPERATING JOB TO MEET IN ALL RESPECTS THE INTENT OF THE DRAWINGS AND SPECIFICATIONS. ELECTRICAL DRAWINGS DO NOT SHOW ALL ARCHITECTURAL, STRUCTURAL AND MECHANICAL DETAILS.
6. IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO DETERMINE AS TO WHICH TRADE PROVIDES SPECIFIC LABOUR AND MATERIALS. EXTRAS WILL NOT BE CONSIDERED BASED ON DIFFERENCES IN INTERPRETATION AS TO WHICH TRADE IS TO PROVIDE CERTAIN ITEMS.

SHOP DRAWINGS

1. PRIOR TO ORDERING OF ANY EQUIPMENT, THIS CONTRACTOR SHALL SUBMIT DIGITAL COPIES OF SHOP DRAWINGS AND DETAIL DRAWINGS FOR REVIEW BY THE ENGINEER. THE ENGINEER SHALL THEN RETURN COPIES OF THE REVIEWED SHOP DRAWINGS TO THE CONTRACTOR. SHOP DRAWINGS SHALL BE SUBMITTED ON ALL MAJOR EQUIPMENT.
2. ALL SHOP DRAWINGS SUBMITTED TO THE ENGINEER MUST BEAR THE CONTRACTORS APPROVALS.
3. ALL SHOP DRAWINGS SHALL BEAR THE NAME OF THE MANUFACTURER AND/OR MANUFACTURER'S REPRESENTATIVE.
4. SUBMIT SHOP DRAWINGS FOR AT LEAST THE FOLLOWING ITEMS:
 - .1 MOTOR CONTROL EQUIPMENT INCLUDING STARTERS, CONTACTORS, OVERLOAD HEATER DATA, CONTROL RELAYS, TIME DELAY RELAYS, MOTOR CIRCUIT AND CONTROL CIRCUIT FUSES/BREAKERS AND APPLICABLE PILOT LIGHTS, CONTROL TRANSFORMERS, AND SELECTOR SWITCHES, ETC.

MAINTENANCE AND OPERATION MANUAL

1. CONTRACTOR TO SUBMIT ONE COPY OF MAINTENANCE AND OPERATION MANUALS IN THREE RING BINDER TO ENGINEER FOR APPROVAL AT TIME OF SUBSTANTIAL COMPLETION.
2. MANUALS TO INCLUDE THE FOLLOWING:
 - .1 PROJECT CONTACT INFORMATION
 - .2 APPROVED SHOP DRAWINGS
 - .3 WARRANTIES AND GUARANTEES
 - .4 TEST RESULTS
 - .5 AS BUILT DRAWINGS
3. ON APPROVAL CONTRACTOR TO PROVIDE THREE COPIES OF THE MAINTENANCE AND OPERATION MANUALS IN THREE RING BINDERS c/w CD OF ALL DOCUMENTS IN PDF FORMAT.

PERMITS, CERTIFICATES, AND FEES

1. ON COMPLETION OF THE WORK, SUBMIT CERTIFICATE OF ACCEPTANCE FROM INSPECTION AUTHORITY TO THE ENGINEER.
2. PRIOR TO COMMENCEMENT OF WORK, SUBMIT THE NECESSARY DRAWINGS TO THE ELECTRICAL INSPECTION DEPARTMENT AND THE ELECTRICAL SUPPLY AUTHORITY.
3. PAY ALL ASSOCIATED FEES, AND OBTAIN DOCUMENTS POSTING AS REQUIRED.

INSPECTION OF WORK

1. UPON COMPLETION OF THE BUILDING AND IMMEDIATELY PRIOR TO FINAL INSPECTION AND TAKEOVER, CHECK LOAD BALANCE ON ALL FEEDERS AND AT DISTRIBUTION CENTRES, PANELS, ETC. IF LOAD EXCEEDS 10 PERCENT PHASE IMBALANCE, RECONNECT CIRCUITS TO BALANCE THE LOAD. RECORD EACH PHASE AMPERAGE AND VOLTAGE AND INCLUDE THE RESULTS IN THE MAINTENANCE AND SHOP DRAWING MANUALS.

ALTERNATIVES

1. ALL MATERIALS OR EQUIPMENT AS CALLED FOR ON THE DRAWINGS AND IN THE SPECIFICATIONS BY TRADE NAMES OR BY CATALOGUE REFERENCE NUMBERS, ARE THE MATERIALS ON WHICH THIS TENDER IS TO BE BASED. ALL EQUIPMENT MUST BE INSTALLED AS SHOWN ON THE DRAWINGS OR IN ACCORDANCE WITH THE MANUFACTURER'S RECOMMENDATIONS. THE REQUEST FOR APPROVAL SHALL BE ACCOMPANIED BY COMPLETE SPECIFICATIONS OF PROPOSED SUBSTITUTION, SHOWING DIMENSIONS, RATINGS, PHOTOMETRICS DATA, ETC. IT SHALL BE THIS SUB-CONTRACTOR'S RESPONSIBILITY TO MAKE AND ALLOW FOR ANY CHANGES AND CHARGES WHICH WILL OCCUR IF HE WISHES TO SUBMIT ALTERNATIVE EQUIPMENT. NO SUBSTITUTION BY THIS CONTRACTOR WILL BE PERMITTED AFTER CLOSING OF THE TENDERS.
2. THE ENGINEER RESERVES THE RIGHT TO ACCEPT OR REJECT ANY ALTERNATIVES PROPOSED.

GUARANTEE

1. AFTER THE WORK IS COMPLETED BUT BEFORE FINAL PAYMENT, FURNISH TO THE OWNER A WRITTEN GUARANTEE THAT FOR ONE YEAR FROM THE DATE OF SUBSTANTIAL COMPLETION, ANY DEFECTS IN MATERIALS OR WORKMANSHIP WILL BE CORRECTED AT NO COST TO THE OWNER, EXCEPT WHERE, IN THE OPINION OF THE ENGINEER, SUCH DEFECTS ARE DUE TO MIS-USE OR NEGLECT BY THE OWNER.

MINOR FIELD CHANGES

1. THE LOCATION, ARRANGEMENT AND CONNECTION OF EQUIPMENT AND MATERIAL AS SHOWN ON THE DRAWINGS REPRESENTS A CLOSE APPROXIMATION OF THE INTENT AND REQUIREMENTS OF THE CONTRACT. THE RIGHT IS RESERVED BY THE ENGINEERS TO MAKE REASONABLE CHANGES REQUIRED TO ACCOMMODATE CONDITIONS ARISING DURING THE PROGRESS OF THE WORK. SUCH CHANGES SHALL BE DONE AT NO EXTRA COST TO THE OWNER, UNLESS THE LOCATION, ARRANGEMENT OR CONNECTION IS MORE THAN TEN FEET FROM THAT SHOWN AND THE ITEM IN QUESTION HAS BEEN INSTALLED.
2. CONFIRM FINAL LOCATION PRIOR TO INSTALLATION.

WIRE AND CABLE

1. BUILDING WIRE: 98% CONDUCTIVITY COPPER, 90°C RATED 600V INSULATION, RW90 X-LINK FOR DAMP LOCATIONS. COPPER CONDUCTORS SHALL BE STRANDED WHEN LARGER THAN #8 AWG OR AS NOTED.
2. BRANCH CIRCUIT WIRING: THE MINIMUM SIZE OF CONDUCTORS TO BE #12 AWG CU.
3. NMD-90 CABLE ALLOWED IN WOOD FRAME CONSTRUCTION.
4. SURFACE WIRING ALLOWED IN MECH/ELEC ROOMS ONLY.
5. COLOUR CODE TO CSA C22.1 CURRENT EDITION.
6. ALUMINIUM CONDUCTORS CAN NOT BE USED UNLESS SPECIFICALLY SHOWN OR WITH SPECIAL PERMISSION.

RECEPTACLES

1. RECEPTACLES: FULL GANG SIZE, U-GROUNDING TYPE, RATED AT 15A AT 125 VAC WITH PARALLEL SLOTS, SPEC GRADE.
2. SPECIAL RECEPTACLES: GROUND FAULT INTERRUPTING (G.F.I.).
3. COLOUR: PROVIDE WHITE RECEPTACLES IN ALL AREAS. ONE MANUFACTURER THROUGHOUT PROJECT.

PLATES

1. STAINLESS STEEL.
2. WEATHERPROOF AS NOTED.

MAGNETIC / MANUAL MOTOR PROTECTION SWITCHES & STARTERS

1. SINGLE PHASE
 - .1 ACROSS THE LINE STARTERS COMPLETE WITH OVERLOAD RELAYS AND TOGGLE SWITCH TYPE HANDLES.
2. SIEMENS, ALLEN BRADLEY, WESTINGHOUSE OR SQ. D.
3. COMPONENTS
 - .1 SINGLE PHASE DISCONNECT SWITCHES: SINGLE POLE, TOGGLE SWITCH.

DISCONNECT SWITCHES

1. SWITCHES: 400 AMP AND ABOVE TO BE HEAVY DUTY RATED.
2. SWITCHES: 200 AMP AND BELOW TO BE GENERAL DUTY RATED.
3. PROVIDE FUSES FOR ALL DISCONNECTS AS SHOWN.

NAME TAGS

1. PROVIDE LAMICOID NAME TAG INDICATING AMPACITY, VOLTAGE AND PHASE OR INDICATED SYSTEM.
 2. LAMICOID TO BE 1/8" THICK PLASTIC ENGRAVING SHEET, BLACK FACE, WHITE CORE.
 3. LETTERS TO BE 1/4" HIGH UNLESS SPECIFIED OTHERWISE.
 4. ALLOW FOR AVERAGE OF 25 LETTERS PER NAMEPLATE.
 5. PROVIDE LAMICOID NAME TAG FOR BREAKERS, METERS, DISCONNECTS, MOTOR PROTECTION SWITCHES, PANEL BOARDS ETC. NAME TAGS SHALL BE MECHANICALLY FASTENED.
- PANEL BOARDS**
1. PROVIDE A TYPED WRITTEN DIRECTORY FOR EACH PANEL BOARD.
 2. BRANCH CIRCUIT BREAKERS TO BE BOLT-ON, NA RATED AT 10,000 AMPS SYM FAULT CURRENT AT THE OPERATING VOLTAGE, UNLESS NOTED OTHERWISE. THERMAL AND MAGNETIC TRIP. TWO AND THREE POLE BREAKERS TO HAVE A COMMON SIMULTANEOUS TRIP.
 3. PANEL BOARD MANUFACTURER IS SQUARE D.

MECHANICAL EQUIPMENT CONTROL

1. THIS CONTRACTOR SHALL CO-OPERATE/COORDINATE THE SUPPLY AND INSTALLATION OF CONDUIT AND WIRING FOR LINE VOLTAGE MECHANICAL CONTROLS AND EQUIPMENT INTERLOCKING. LOW VOLTAGE CONTROLS FORM PART OF THE CONTROL SPECIFICATIONS.
2. PROVIDE LINE VOLTAGE POWER SUPPLY CONNECTIONS TO ALL MECHANICAL EQUIPMENT.
3. CONFIRM LOCATION, AMPACITY, VOLTAGE AND PHASE OF ALL MECHANICAL EQUIPMENT BEFORE CONNECTION. REPORT ANY MAJOR DISCREPANCIES TO THE ENGINEER.

AS BUILT DRAWINGS

1. PROVIDE A CLEAN SET OF DRAWINGS AT THE JOB SITE, FOR AS BUILT MODIFICATIONS ONLY.
2. MARK ALL MODIFICATIONS IN RED, IN A NEAT, LEGIBLE MANNER.
3. SUBMIT AS BUILTS TO ENGINEER FOR APPROVAL.

SEISMIC

1. ALL ELECTRICAL EQUIPMENT IS TO BE SECURED TO THE BUILDING STRUCTURE TO MEET THE SEISMIC REQUIREMENTS OF THE BUILDING CODE. THE CONTRACTOR SHALL PAY FOR AND OBTAIN A SEISMIC DESIGN FROM A REGISTERED STRUCTURAL ENGINEER SHOWING THE FASTENING DETAILS OF ALL ELECTRICAL MATERIAL & HIRE THE STRUCTURAL ENGINEER TO PROVIDE APEGBC SCHEDULES S-B AND S-C PRIOR TO FINAL INSPECTION.

FIRE SEPARATIONS

1. THE CONTRACTOR SHALL PROVIDE FIRE STOPPING FOR ALL ELECTRICAL PENETRATIONS THROUGH FIRE RATED ASSEMBLIES.
2. FIRE STOP SYSTEMS SHALL, WHEN SUBJECTED TO THE FIRE TEST METHOD IN CAN/ULC S115 "STANDARD METHOD OF FIRE TESTS OF FIRE STOP SYSTEMS", HAVE AN FFR FT RATING (AS REQUIRED) NOT LESS THAN THE RATING OF THE FIRE SEPARATION.
3. CONTRACTOR SHALL PROVIDE TO ENGINEER/ARCHITECT COMPLETE LISTINGS FOR ALL FIRE STOPPING INSTALLATIONS. PROVIDE SPECIFIC DETAILS REGARDING TYPE OF FIRE STOPPING COMPOUND, APPLICABLE APPLICATIONS, MANUFACTURE, TESTING AGENCY, ETC.
4. CONTRACTOR SHALL NOTIFY ENGINEER/ARCHITECT A MIN. OF ONE WEEK PRIOR TO CONCEALING OF ENCLOSING FIRE STOP ASSEMBLIES AND BE AVAILABLE ON SITE FOR ENGINEERS FIELD REVIEW.

PROJECT CLOSE OUT PROCEDURES

1. PROVIDE 24 HOUR NOTICE TO THE ENGINEER FOR FINAL FIELD REVIEW FOR ELECTRICAL DISCIPLINE. ELECTRICAL CONTRACTOR TO ENSURE ALL LIFE SAFETY DEVICES ARE INSTALLED AND OPERATIONAL. ELECTRICAL CONTRACTOR TO ENSURE ALL ELECTRICAL WORKS NOT INSTALLED ARE MADE SAFE.
 - .1 MAINTENANCE MANUALS
 - .2 FIELD SAFETY REPRESENTATIVE (FSR) DECLARATION
2. THE FOLLOWING DOCUMENTS TO BE FORWARDED TO THE ENGINEER PRIOR TO FINAL FIELD REVIEW:

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CLIENT



REGIONAL DISTRICT OF NANAIMO

PROJECT

RAVENSONG AQUATIC CENTRE HVAC UPGRADE

TITLE

ELECTRICAL SPECIFICATIONS

PROJECT NO. 18-2963	SEAL
DATE AUGUST, 2018	
SCALE N.T.S.	

DRAWING NO.

E-6

HEROLD ENGINEERING LTD. 1110 10th Street, Nanaimo, BC V9T 2H1. Tel: 250-751-8558 Fax: 250-751-8559 Email: mail@heroldengineering.com

GENERAL HEL-001

- ALL DESIGN HAS BEEN COMPLETED IN ACCORDANCE WITH THE 2012 EDITION OF THE BRITISH COLUMBIA BUILDING CODE, INCLUDING ALL ADDENDA.
- ALL CONSTRUCTION MUST BE IN ACCORDANCE WITH THE BRITISH COLUMBIA BUILDING CODE, INCLUDING ALL ADDENDA, ALL REFERENCED CODES AND ALL FEDERAL AND MUNICIPAL REGULATIONS AND BY-LAWS.
- ALL REFERENCED CODES AND STANDARDS SHALL BE AS REFERENCED IN THE GOVERNING EDITION OF THE BRITISH COLUMBIA BUILDING CODE
- DESIGN CRITERIA: kPa (psf)
- THESE DRAWINGS INCLUDING DIMENSIONS SHALL BE READ IN CONJUNCTION WITH ALL OTHER PROJECT DRAWINGS AND SPECIFICATIONS. CONTRACTOR SHALL REPORT ANY DISCREPANCIES TO THE STRUCTURAL ENGINEER FOR CLARIFICATION PRIOR TO COMMENCING CONSTRUCTION. CONTRACTOR SHALL BE FAMILIAR WITH ALL PROJECT DRAWINGS INCLUDING THOSE OF OTHER DISCIPLINES AND SHALL MAKE ALLOWANCES FOR ALL ITEMS SHOWN ON OTHER DRAWINGS THAT AFFECT THIS CONTRACTOR'S WORK.
- THESE DRAWINGS SHOW THE COMPLETED STRUCTURE ONLY. PROVIDE TEMPORARY BRACING AND SHORING FOR THE CONSTRUCTION LOADING CONDITIONS AND STABILITY OF THE STRUCTURE DURING CONSTRUCTION. CONSTRUCTION LOADS SHALL NOT EXCEED DESIGN LOADS.
- THE CONTRACTOR SHALL RETAIN A PROFESSIONAL ENGINEER REGISTERED IN THE PROVINCE OF BRITISH COLUMBIA TO DESIGN AND TAKE RESPONSIBILITY FOR ANY TEMPORARY SHORING, BRACING OR OTHER DESIGNS REQUIRED TO COMPLETE CONSTRUCTION.
- UNDER NO CIRCUMSTANCES SHALL DRAWINGS BE SCALED.
- CONTRACTOR AND ALL SUB-TRADES SHALL VERIFY ALL DIMENSIONS ON SITE PRIOR TO COMMENCING FABRICATION.

SUBMITTALS HEL-002

- WHERE SHOP DRAWINGS ARE REQUESTED IN THE GENERAL NOTES THE CONTRACTOR SHALL PROVIDE THEM IN EITHER HARD COPY OR DIGITAL FORMAT TO THE FOLLOWING REQUIREMENTS FOR THE ENGINEER'S REVIEW PRIOR TO FABRICATION. THE SHOP DRAWINGS SHALL INDICATE DETAILS, DIMENSIONS, MATERIALS AND DESIGN LOADS.
- IF HARD COPY FORMAT IS USED FIVE PAPER COPIES SHALL BE SUBMITTED, UNLESS NOTED OTHERWISE THEY SHALL BE SIGNED AND SEALED BY A SPECIALTY ENGINEER REGISTERED IN THE PROVINCE OF BRITISH COLUMBIA.
- DRAWINGS NOT SEALED BY THE SPECIALTY ENGINEER SHALL BE ACCOMPANIED BY A LETTER WITH A DRAWING LIST IDENTIFYING ALL DRAWING NUMBERS, TITLES, MOST RECENT REVISION NUMBERS AND DATES. THE LETTER AND DRAWING LIST ARE TO BE SIGNED AND SEALED BY THE SPECIALTY ENGINEER.
- IF A DIGITAL SUBMISSION IS MADE THE FILES SHALL BE IN PDF FORMAT ON A DISC OR TRANSMITTED VIA E-MAIL. THE SUBMISSION SHALL CONTAIN A LETTER WITH A DRAWING LIST AS DESCRIBED ABOVE SIGNED AND SEALED BY THE SPECIALTY ENGINEER. THE FINAL SUBMISSION SHALL BE MADE AS A HARD COPY BEARING THE ORIGINAL SEAL AND SIGNATURE OF THE SPECIALTY ENGINEER REGISTERED IN THE PROVINCE OF BRITISH COLUMBIA.
- THE FOLLOWING SUBMISSIONS ARE REQUIRED FOR THIS PROJECT:
 - STRUCTURAL STEEL MILL CERTIFICATES IF REQUESTED
 - STRUCTURAL STEEL SHOP DRAWINGS*
 - STRUCTURAL STEEL CONNECTION DESIGN NOTES*
 - MISCELLANEOUS METAL FABRICATIONS*
 - NON-DESTRUCTIVE TEST (NDT) WELD TEST REPORTS
 - CWB PRE-QUALIFIED WELDING CERTIFICATES IF REQUESTED*

* INDICATES THE REQUIREMENT THAT SUBMISSION BE SEALED BY A SPECIALTY ENGINEER REGISTERED IN THE PROVINCE OF BRITISH COLUMBIA AND PROVIDE A SCHEDULE 'S' UPON COMPLETION OF THE WORK.
- SHOP DRAWINGS WHICH ARE REQUIRED TO, BUT DO NOT HAVE THE APPROPRIATE ENGINEERS SEAL AND SIGNATURE WILL NOT BE REVIEWED.
- SHOP DRAWINGS WILL BE REVIEWED ONLY FOR GENERAL CONFORMITY WITH THE PROJECT DRAWINGS AND SPECIFICATIONS. QUANTITIES AND DETAILED DIMENSIONS ARE THE CONTRACTORS RESPONSIBILITY. THE REVIEW SHALL NOT RELIEVE THE CONTRACTOR FROM COMPLYING WITH ALL THE REQUIREMENTS OF THE CONTRACT DOCUMENTS INCLUDING COORDINATION WITH OTHER TRADES AND DISCIPLINES. THE CONTRACTOR IS RESPONSIBLE FOR ERRORS AND OMISSIONS ON THE SHOP DRAWINGS.
- SHOP DRAWING SUBMISSIONS FOR THE WORK OF SPECIALTY ENGINEERS SHALL BE AS SET OUT IN THIS SECTION.
- THE QUALITY ASSURANCE FOR MATERIALS, FABRICATION AND INSTALLATION IS THE RESPONSIBILITY OF THE CONTRACTOR AND HIS SPECIALTY ENGINEER.
- THE SPECIALTY ENGINEER OR HIS REPRESENTATIVE SHALL VISIT THE SITE AND REVIEW THE COMPLETED WORK DESIGNED AND DETAILED ON HIS SHOP DRAWINGS TO SATISFY HIMSELF THAT THE FINISHED COMPONENTS AND ASSEMBLIES ARE IN COMPLIANCE WITH THE ENGINEERED DESIGN. THE SPECIALTY ENGINEER SHALL THEN PROVIDE THE PROJECT ENGINEER OF RECORD WITH A COMPLETED SCHEDULE 'S' FOR THIS WORK ALONG WITH ANY SKETCHES SHOWING FIELD MODIFICATIONS. THESE SKETCHES SHALL BEAR THE SEAL AND SIGNATURE OF THE SPECIALTY ENGINEER.

FIELD REVIEWS HEL-003

- THE CONTRACTOR SHALL PROVIDE THE ENGINEER WITH A MINIMUM OF 24 HOURS (1 WORKING DAY) ADVANCE NOTICE FOR FIELD REVIEWS.
 - THE FOLLOWING FIELD REVIEWS ARE CONSIDERED TO BE THE MINIMUM NUMBER OF STRUCTURAL FIELD REVIEWS REQUIRED FOR THE PROJECT:
- STEEL: STRUCTURAL STEEL SHALL BE REVIEWED AFTER THE MEMBERS HAVE BEEN FABRICATED AND ARE IN THEIR FINAL POSITION WITH ALL CONNECTIONS COMPLETE AND ALL BOLTS INSTALLED AND TIGHTENED.
- IF THE ENGINEER IS NOT PROVIDED WITH THE OPPORTUNITY TO PERFORM THE REQUIRED FIELD REVIEWS, FINAL CERTIFICATION OF THE PROJECT WILL NOT BE ISSUED.

STRUCTURAL STEEL HEL-004

- ALL STEEL WORK SHALL BE IN ACCORDANCE WITH CSA-S16, LATEST EDITION AND THE REVIEWED SHOP DRAWINGS.
- THE STEEL FABRICATOR SHALL SUBMIT SHOP DRAWINGS AS SPECIFIED UNDER 'SUBMITTALS' TO THE PROJECT ENGINEER FOR REVIEW PRIOR TO FABRICATION. SHOP DRAWINGS SHALL INDICATE ALL DETAILS, FASTENERS, MATERIAL SPECIFICATIONS, FINISHES AND DESIGN LOADS.
- A COPY OF THE FABRICATOR'S CANADIAN WELDING BUREAU CERTIFICATES SHALL BE INCLUDED WITH THE SHOP DRAWING SUBMISSION.
- ALL WELDING SHALL BE IN ACCORDANCE WITH CSA W59-03 (R2008) AND SHALL BE PERFORMED BY FABRICATORS "FULLY APPROVED" BY THE CANADIAN WELDING BUREAU UNDER CSA W55.3-08. FABRICATING SHOP TO HAVE A MINIMUM DIVISION 2.1 CERTIFICATION BY THE CANADIAN WELDING BUREAU TO THE REQUIREMENTS OF CSA W47.1-09 AND CSA W55.3-08 FOR RESISTANCE WELDING OF STRUCTURAL COMPONENTS. THE FABRICATOR SHALL SUBMIT PROOF OF CERTIFICATION PRIOR TO START OF WORK.
- ALL WELDING ELECTRODES SHALL CONFORM TO CSA W48-06 (R2011).
- CONNECTIONS NOT DETAILED ON THE STRUCTURAL DRAWINGS SHALL BE DESIGNED FOR THE LOADS INDICATED ON THE DRAWINGS. UNLESS NOTED OTHERWISE ON THE STRUCTURAL DRAWINGS CONNECTION DETAILS ARE SCHEMATIC ONLY AND FINAL CONNECTION CONFIGURATION IS THE RESPONSIBILITY OF THE FABRICATOR. USE A MINIMUM OF 2-M20 (3/4") A325 BOLTS PER CONNECTION. CONNECTIONS DESIGNED BY THE CONTRACTOR SHALL BE SEALED BY A PROFESSIONAL ENGINEER REGISTERED IN THE PROVINCE OF BRITISH COLUMBIA. CONNECTIONS SHALL BE DESIGNED TO CSA-S16-09 TO RESIST FORCES, MOMENTS AND SHEARS INDICATED ON THE PLANS. IN INSTANCES OF NON-COMPLIANCE THE FABRICATOR SHALL BE RESPONSIBLE FOR ADDITIONAL COSTS ASSOCIATED WITH ACHIEVING COMPLIANCE WITH THE STANDARD.
- CONNECTIONS DETAILED ON THESE STRUCTURAL DRAWINGS SHALL BE FABRICATED AND ERECTED AS SHOWN. ALTERNATIVES MAY BE CONSIDERED AT THE SOLE DISCRETION OF THE STRUCTURAL ENGINEER OF RECORD BUT MUST BE PRE-APPROVED BY SAME. WHERE AN ALTERNATIVE IS APPROVED IT SHALL BE AT NO ADDITIONAL COST TO THE OWNER AND SHALL NOT NEGATIVELY IMPACT THE CONSTRUCTION SCHEDULE.
- FABRICATOR SHALL INCREASE WELD SIZES TO ACCOMMODATE SLOT WIDTHS SO THAT LEG SIZE AS SPECIFIED IS FULLY ON STEEL CONNECTION ELEMENT. FINAL WELD SIZE TO BE SHOWN ON THE SHOP DRAWINGS.
- BOLTS AND ANCHOR RODS SHALL BE LONG ENOUGH THAT THE END OF THE BOLT OR ROD IS OUTSIDE THE FACE OF THE NUT.
- ALL BOLTS WITH OVERSIZED BOLT HOLES SHALL BE SLIP CRITICAL.
- SECONDARY STRUCTURAL ELEMENTS ARE TO BE DETAILED SUCH THAT THEY DO NOT IMPOSE DIRECT LOAD TRANSFER TO THE SFRS (SEISMIC FORCE RESISTING SYSTEM) WITHOUT THE APPROVAL OF THE ENGINEER OF RECORD.
- DO NOT FIELD BURN BASE PLATE HOLES OR CONNECTION BOLT HOLES UNLESS APPROVED IN WRITING BY THE ENGINEER. NO FIELD CUTTING OR ALTERATION OF STRUCTURAL MEMBERS IS TO OCCUR WITHOUT THE PRIOR WRITTEN APPROVAL OF THE ENGINEER
- IF ANCHOR BOLTS ARE MISPLACED OR BOLT HOLES MISALIGNED, INFORM THE ENGINEER.
- ALL STEEL WORK SHALL BE HOT DIPPED GALVANIZED TO CAN/CSA-G164-M92, MINIMUM ZINC COATING OF 600g/sq.m. FIELD TOUCH-UP ALL ABRASIONS, SCRATCHES, WELDS OR BOLTS WITH GALVACON OR EQUIVALENT.
- ALL EXTERIOR STEEL WORK AND STEEL PROTRUDING THROUGH THE BUILDING ENVELOPE SHALL BE HOT DIP GALVANIZED.
- GRATING TO BE GALVANIZED TO CAN/CSA-G164-M92, MINIMUM ZINC COATING OF 600g/sq.m. FIELD TOUCH-UP ALL ABRASIONS, SCRATCHES, WELDS OR BOLTS WITH GALVACON OR EQUIVALENT.
- GROUT UNDER BASE PLATES TO BE NON-SHRINK 48 MPa (7000 psi) AT 28 DAYS.
- PROVIDE STRUCTURAL STEEL TO CSA G40.20-04/G40.21-04 (R2009) OR ASTM A992 WITH THE FOLLOWING GRADES:

PIPE RAILINGS	240W (35W) TO ASTM A53
WIDE FLANGE BEAMS AND COLUMNS	350W (50W) OR ASTM A992/A992M-11
CHANNELS AND ANGLES	300W (44W)
HSS SECTIONS	350W (50W) CLASS 'C'
MISCELLANEOUS STEEL PLATES	300W (44W)
- BOLT SIZING SHALL BE AS NOTED ON DRAWINGS AND DETAILS. PROVIDE BOLTS TO CSA G40.21-04 (R2009) WITH THE FOLLOWING GRADES:

ERECTOR BOLTS TO ASTM A325-10,
FINAL BOLTED CONNECTIONS; ASTM A325, GALVANIZED TO ASTM A-153M, UNLESS NOTED OTHERWISE
ANCHOR BOLTS SHALL MEET THE REQUIREMENTS OF ASTM F1554, GRADE 36 (36ksi YIELD STRENGTH)
- THE CONTRACTOR SHALL PROVIDE TEMPORARY BRACING DURING CONSTRUCTION. THE BRACING SHALL BE DESIGNED, INSTALLED AND MAINTAINED BY THE CONTRACTOR. THE BRACING SHALL BE REMOVED ONLY AFTER PERMANENT ROOF AND FLOOR DIAPHRAGMS, SHEAR WALLS AND BRACING ARE COMPLETE.

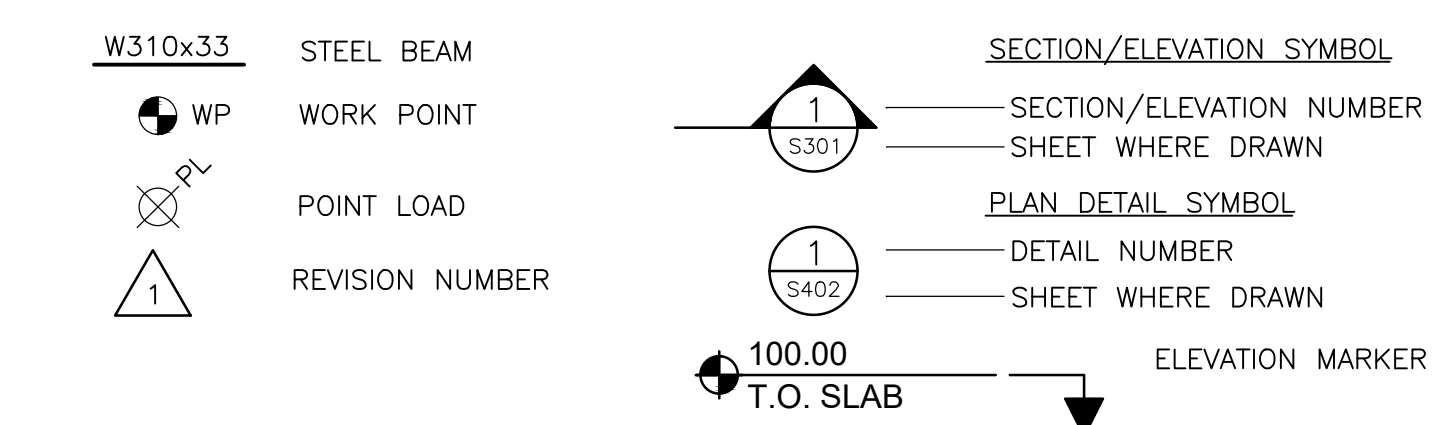
WELDING INSPECTIONS HEL-005

- ALL INSPECTIONS SHALL BE PERFORMED BY A COMPANY CERTIFIED TO CSA W178.1-08 AND EMPLOYING FIELD INSPECTORS CERTIFIED TO CSA W178.2-08. BOTH SHALL BE CERTIFIED FOR THE RELEVANT CLASS OF INSPECTION AND ARE HEREAFTER REFERRED TO AS THE INSPECTOR. INSPECTION PROCEDURES SHALL BE AS OUTLINED BELOW.
- ALL MOMENT FRAME AND BRACED FRAME WELDS SHALL BE TESTED BY NON-DESTRUCTIVE MEANS (X-RAY OR ULTRASONIC).
- ALL WELDS ARE TO BE VISUALLY INSPECTED BY AN APPROVED TESTING COMPANY RETAINED BY THE OWNER. CONTRACTOR SHALL BE RESPONSIBLE FOR COORDINATING INSPECTIONS AND PROVIDING SUITABLE AND SAFE ACCESS TO THE WORK BEING INSPECTED.
- ALL FAILURES IDENTIFIED BY THE TESTING AND INSPECTIONS SHALL BE CORRECTED AT THE CONTRACTOR'S EXPENSE. COST OF ADDITIONAL TESTING TO CONFIRM CONFORMANCE WITH SPECIFICATIONS SHALL BE BORNE BY THE CONTRACTOR.
- SUBMIT ALL TEST REPORTS TO THE STRUCTURAL ENGINEER FOR REVIEW. DO NOT COVER MEMBERS AND THEIR CONNECTIONS WITHOUT THE APPROVAL OF THE STRUCTURAL ENGINEER.

MECHANICAL AND ADHESIVE ANCHORS HEL-006

- ALL ANCHORS ARE TO BE INSTALLED IN STRICT ACCORDANCE WITH THE MANUFACTURER'S WRITTEN INSTRUCTIONS.
- ALL ANCHORS ARE TO BE THE ADHESIVE TYPE. MECHANICAL ANCHORS ARE ONLY TO BE USED WHEN SPECIFICALLY CALLED-UP ON THE DRAWINGS. SUBSTITUTIONS MUST BE APPROVED BY THE PROJECT ENGINEER PRIOR TO USE.
- UNLESS NOTED OTHERWISE ADHESIVE ANCHORS SHALL BE HILTI 'HAS-E' OR 'HIT-Z' ROD. REFER TO DRAWINGS FOR ANCHOR LOCATIONS, SIZES, CENTRES AND EMBEDMENT LENGTH.
 - USE HILTI HIT-HY200 WHEN:
 - A QUICK CURE IS REQUIRED,
 - CONDITIONS ARE DRY,
 - HOLES ARE HAMMER DRILLED,
 - HOLES ARE NOT OVER-SIZED,
 - BASE MATERIAL TEMPERATURE IS ABOVE MINUS 10° CELCIUS.
 - USE HILTI HIT RE500-V3 WHEN:
 - EXTENDED WORKING TIME IS REQUIRED AND CURE TIME IS NOT CRITICAL,
 - HOLES ARE DRILLED USING DIAMOND CORE, PNEUMATIC OR HAMMER DRILLS,
 - DEEP EMBEDMENT IS SPECIFIED,
 - THE APPLICATION IS UNDERWATER, OR
 - HOLES ARE OVERSIZED.
 - USE HILTI HIT-HY270 WHEN:
 - FASTENING INTO SOLID FILLED MASONRY CORES
 - A QUICK CURE IS REQUIRED,
 - CONDITIONS ARE DRY,
 - HOLES ARE HAMMER DRILLED,
 - HOLES ARE NOT OVER-SIZED,
 - BASE MATERIAL TEMPERATURE IS ABOVE MINUS 10° CELCIUS.
- REFER TO DRAWINGS FOR ANCHOR LOCATIONS, SIZES, CENTRES AND EMBEDMENT LENGTH.
- HOLES FOR MECHANICAL ANCHORS SHALL BE CLEANED OUT WITH HIGH PRESSURE AIR OR BRUSH PRIOR TO ANCHOR INSTALLATION.
- INSTALLERS OF HILTI PRODUCTS SHALL HAVE RECEIVED TRAINING BY HILTI (CANADA) CORP. IN THE USE OF THE SPECIFIED PRODUCTS. THE GENERAL CONTRACTOR SHALL PROVIDE THE DESIGN ENGINEER WITH A LETTER STATING THAT THIS TRAINING HAS BEEN COMPLETED.

SYMBOLS LEGEND



STRUCTURAL DRAWING LIST

S200	GENERAL NOTES
S201	GENERAL ARRANGEMENT OF CEILING FAN MAINTENANCE PLATFORMS
S202	SECTIONS OF CEILING FAN MAINTENANCE PLATFORMS
S203	SECTIONS AND DETAILS

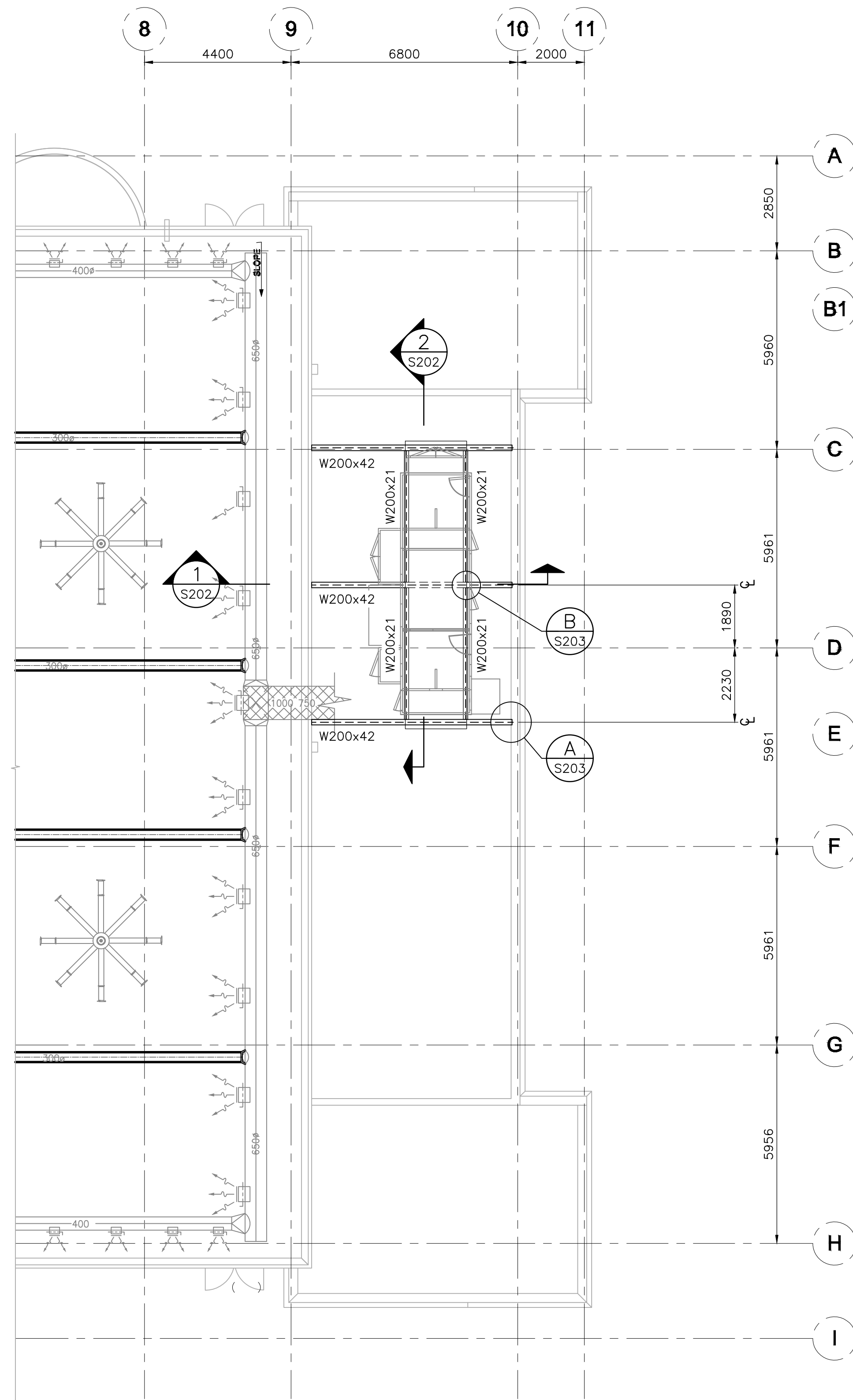
STRUCTURAL DRAWING ISSUE RECORD

ISSUE No.	ISSUE DATE (YYYY.MM.DD)	ISSUED FOR	DRAWING NUMBER			
			S200	S201	S202	S203
01	2018.10.15	REVIEW AND COMMENT	●	●	●	
02	2019.01.??	CLIENT REVIEW ONLY	●	●	●	
03	2019.02.01	TENDER	●	●		

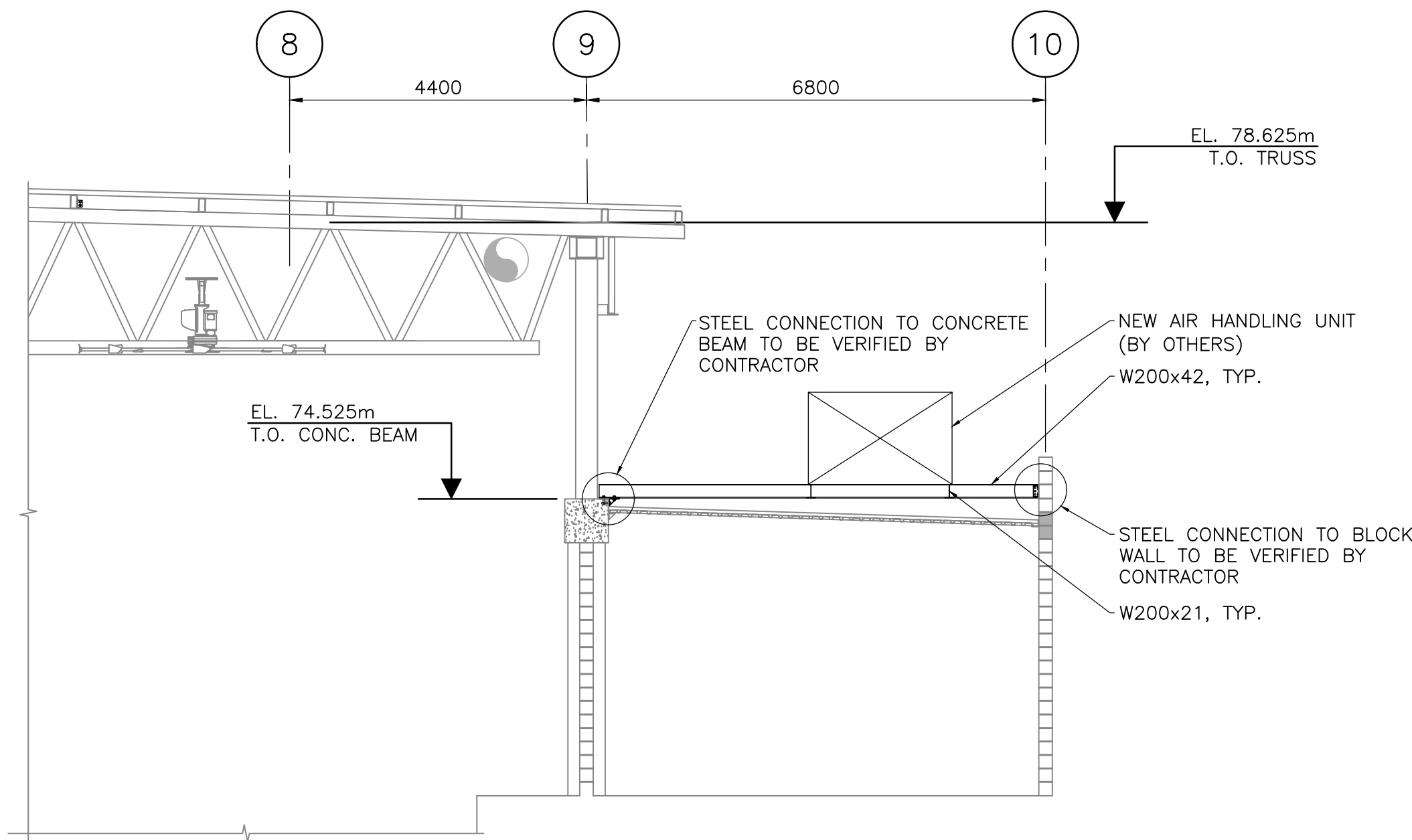
NOT FOR CONSTRUCTION

ISSUED FOR TENDER

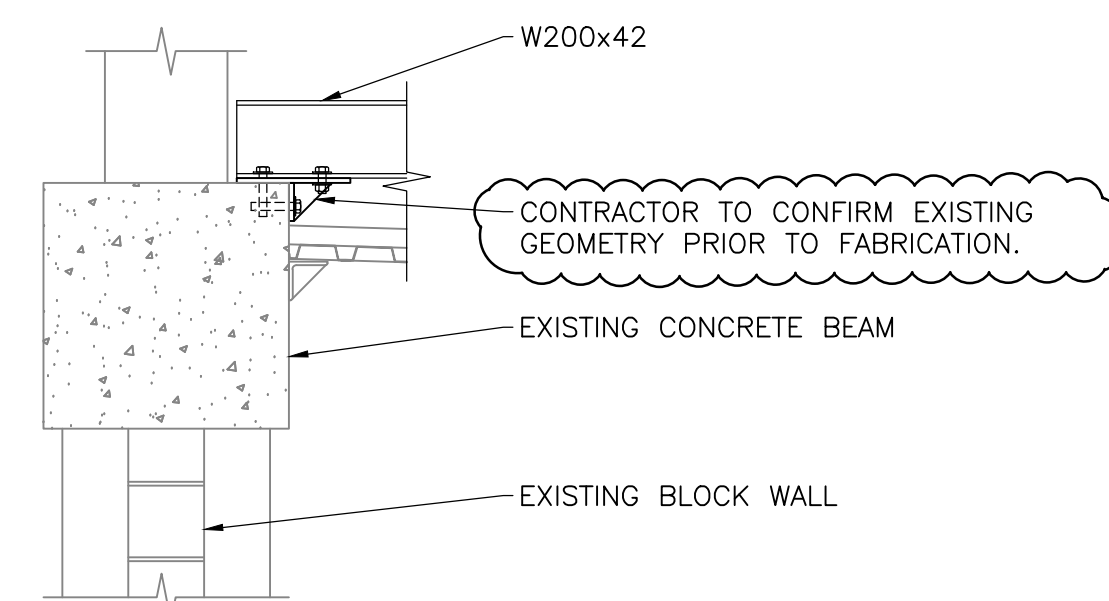
ISSUES	SUB CONSULTANT	DRAFTED GMW	HEROLD ENGINEERING	ENGINEERS SEAL	GENERAL NOTES	RAC ROOF FEASIBILITY FOR NEW MECHANICAL UNIT 102 - 3721 SHENTON ROAD NANAIMO BC V9T 2H1 ROCKY POINT ENGINEERING	HEL PROJECT No. 0417-072	CLIENT DWG. No. N/A																																										
<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>No.</th> <th>DATE</th> <th>ISSUED FOR</th> <th>No.</th> <th>DATE</th> <th>ISSUED FOR</th> <th>No.</th> <th>DATE</th> <th>ISSUED FOR</th> </tr> </thead> <tbody> <tr> <td>01</td> <td>2018.11.05</td> <td>REVIEW AND COMMENT</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>02</td> <td>2019.01.??</td> <td>REVIEW AND COMMENT</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>03</td> <td>2019.02.01</td> <td>TENDER</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </tbody> </table>	No.	DATE	ISSUED FOR	No.	DATE	ISSUED FOR	No.	DATE	ISSUED FOR	01	2018.11.05	REVIEW AND COMMENT							02	2019.01.??	REVIEW AND COMMENT							03	2019.02.01	TENDER								<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td>DESIGNED</td> <td></td> </tr> <tr> <td>DESIGN REVIEW</td> <td></td> </tr> </table>	DESIGNED		DESIGN REVIEW		<p>3701 Shenton Rd, Nanaimo, BC V9T 2H1 Tel: 250-751-8558 Fax: 250-751-8559 Email: mail@heroldengineering.com</p>			<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td>SCALE AS SHOWN</td> <td>PERMIT No. N/A</td> </tr> <tr> <td>HEL DRAWING No. S200</td> <td>REVISION 03</td> </tr> </table>	SCALE AS SHOWN	PERMIT No. N/A	HEL DRAWING No. S200	REVISION 03
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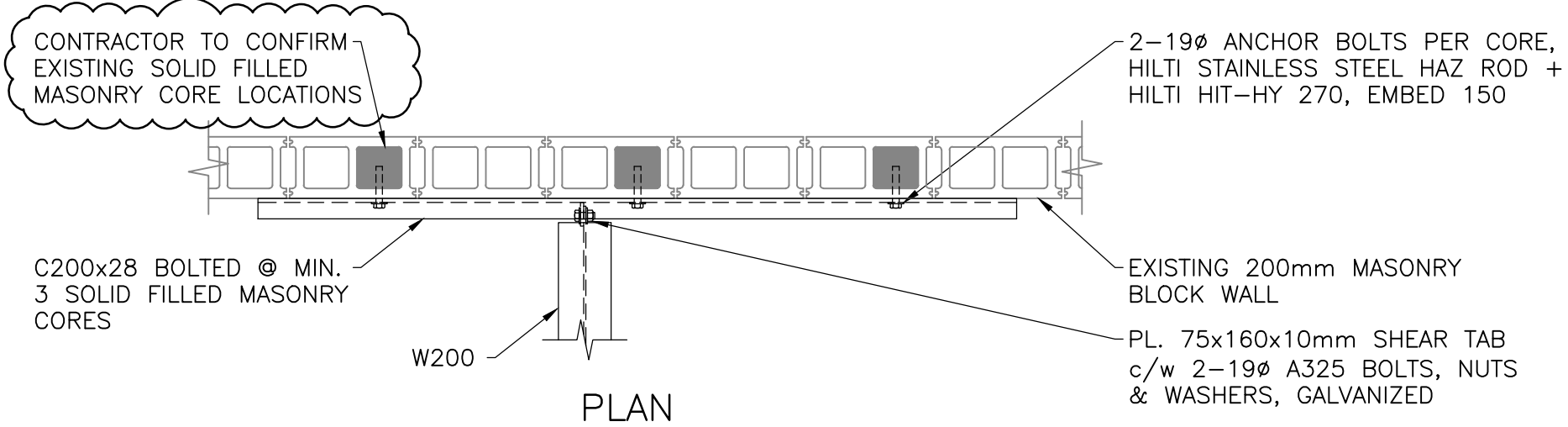
PLAN
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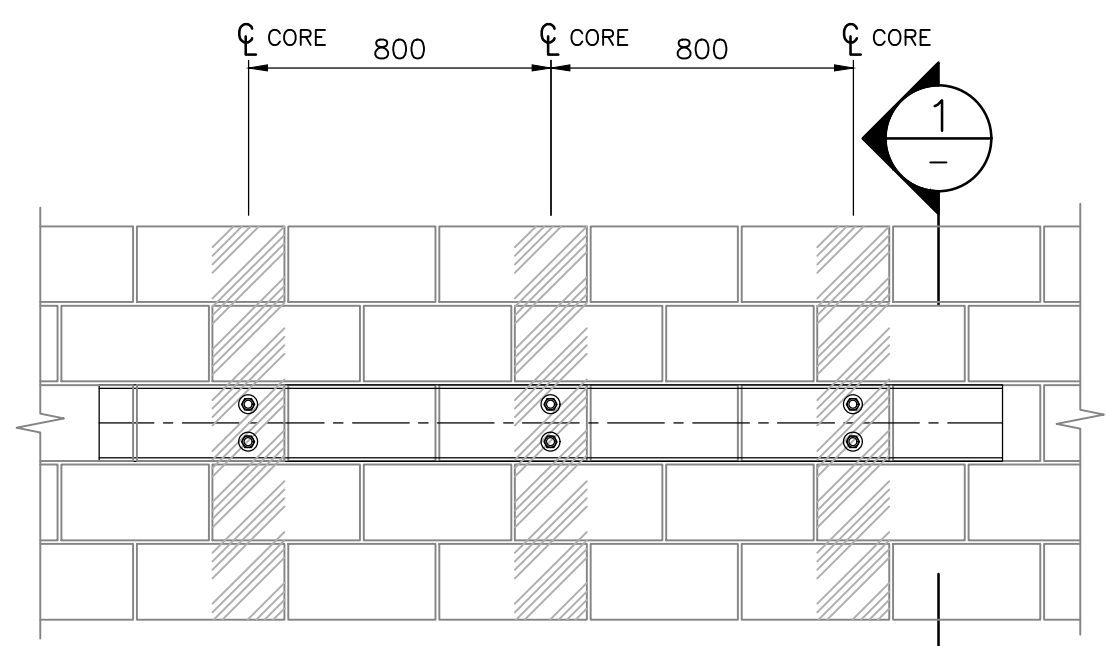
SECTION 1
1:75



STEEL BEAM TO CONCRETE BEAM CONNECTION
1:20

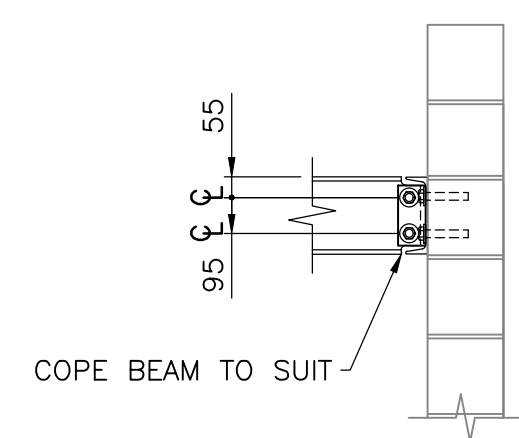


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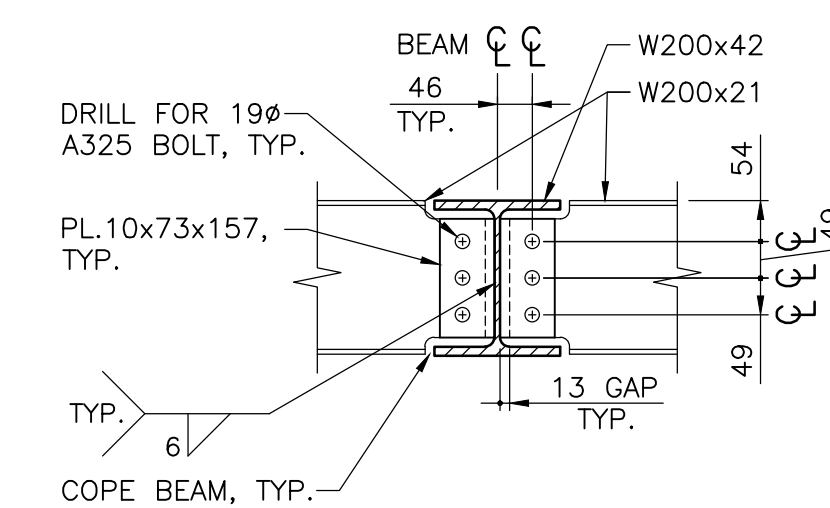
ELEVATION

DETAIL A
S201 1:50



COPE BEAM TO SUIT

SECTION 1
S201 1:50



DETAIL B
S201 1:10

NOT FOR CONSTRUCTION

ISSUED FOR TENDER

ISSUES					
No.	DATE	ISSUED FOR	No.	DATE	ISSUED FOR
01	2018.10.15	REVIEW AND COMMENT			
02	2018.11.05	REVIEW AND COMMENT			
03	2019.02.01	TENDER			

SUB CONSULTANT	

HEROLD ENGINEERING

3701 Shenton Rd, Nanaimo, BC V9T 2H1
Tel: 250-751-8558 Fax: 250-751-8559
Email: mail@heroldengineering.com

ENGINEERS SEAL

GENERAL ARRANGEMENT OF CEILING FAN MAINTENANCE PLATFORMS

RAC ROOF FEASIBILITY FOR NEW MECHANICAL UNIT 102 - 3721 SHENTON ROAD NANAIMO BC V9T 2H1
ROCKY POINT ENGINEERING

HEL PROJECT No. 0417-072	CLIENT DWG. No. N/A
SCALE AS SHOWN	PERMIT No. N/A
HEL DRAWING No. S201	REVISION 03

CCDC 2

stipulated price contract

2 0 0 8

[Name of the Project]

Apply a CCDC 2 copyright seal here. The application of the seal demonstrates the intention of the party proposing the use of this document that it be an accurate and unamended form of CCDC 2 - 2008 except to the extent that any alterations, additions or modifications are set forth in supplementary conditions.

CANADIAN CONSTRUCTION DOCUMENTS COMMITTEE
CANADIAN CONSTRUCTION DOCUMENTS COMMITTEE
CANADIAN CONSTRUCTION DOCUMENTS COMMITTEE

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The Canadian Construction Documents Committee (CCDC) is a national joint committee responsible for the development, production and review of standard Canadian construction contracts, forms and guides. Formed in 1974 the CCDC is made up of volunteer representatives from:

- Public Sector Owners
- Private Sector Owners
- Canadian Bar Association (Ex-Officio)
- * The Association of Canadian Engineering Companies
- * The Canadian Construction Association
- * Construction Specifications Canada
- * The Royal Architectural Institute of Canada

*Committee policy and procedures are directed and approved by the four constituent national organizations.

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AGREEMENT BETWEEN OWNER AND CONTRACTOR

For use when a stipulated price is the basis of payment.

This Agreement made on the _____ day of _____ in the year _____ .

by and between the parties

_____ hereinafter called the "*Owner*"

and

_____ hereinafter called the "*Contractor*"

The *Owner* and the *Contractor* agree as follows:

ARTICLE A-1 THE WORK

The *Contractor* shall:

1.1 perform the *Work* required by the *Contract Documents* for

_____ located at _____ *insert above the name of the Work*

_____ for which the Agreement has been signed by the parties, and for which _____ *insert above the Place of the Work*

_____ is acting as and is hereinafter called the "*Consultant*" and _____ *insert above the name of the Consultant*

1.2 do and fulfill everything indicated by the *Contract Documents*, and

1.3 commence the *Work* by the _____ day of _____ in the year _____ and, subject to adjustment in *Contract Time* as provided for in the *Contract Documents*, attain *Substantial Performance of the Work*, by the _____ day of _____ in the year _____ .

ARTICLE A-2 AGREEMENTS AND AMENDMENTS

2.1 The *Contract* supersedes all prior negotiations, representations or agreements, either written or oral, relating in any manner to the *Work*, including the bidding documents that are not expressly listed in Article A-3 of the Agreement - CONTRACT DOCUMENTS.

2.2 The *Contract* may be amended only as provided in the *Contract Documents*.

Note: This contract is protected by copyright. Use of a CCDC 2 document not containing a CCDC 2 copyright seal constitutes an infringement of copyright. Only sign this contract if the document cover page bears a CCDC 2 copyright seal to demonstrate that it is intended by the parties to be an accurate and unamended version of CCDC 2 – 2008 except to the extent that any alterations, additions or modifications are set forth in supplementary conditions.

ARTICLE A-3 CONTRACT DOCUMENTS

3.1 The following are the *Contract Documents* referred to in Article A-1 of the Agreement - THE WORK:

- Agreement between *Owner* and *Contractor*
- Definitions
- The General Conditions of the Stipulated Price Contract

*

* *(Insert here, attaching additional pages if required, a list identifying all other Contract Documents e.g. supplementary conditions; information documents; specifications, giving a list of contents with section numbers and titles, number of pages and date; material finishing schedules; drawings, giving drawing number, title, date, revision date or mark; addenda, giving title, number, date)*

ARTICLE A-4 CONTRACT PRICE

4.1 The *Contract Price*, which excludes *Value Added Taxes*, is:

_____/100 dollars \$ _____

4.2 *Value Added Taxes* (of _____ %) payable by the *Owner* to the *Contractor* are:

_____/100 dollars \$ _____

4.3 Total amount payable by the *Owner* to the *Contractor* for the construction of the *Work* is:

_____/100 dollars \$ _____

4.4 These amounts shall be subject to adjustments as provided in the *Contract Documents*.

4.5 All amounts are in Canadian funds.

ARTICLE A-5 PAYMENT

5.1 Subject to the provisions of the *Contract Documents*, and in accordance with legislation and statutory regulations respecting holdback percentages and, where such legislation or regulations do not exist or apply, subject to a holdback of _____ percent (_____ %), the *Owner* shall:

- .1 make progress payments to the *Contractor* on account of the *Contract Price* when due in the amount certified by the *Consultant* together with such *Value Added Taxes* as may be applicable to such payments, and
- .2 upon *Substantial Performance of the Work*, pay to the *Contractor* the unpaid balance of the holdback amount when due together with such *Value Added Taxes* as may be applicable to such payment, and
- .3 upon the issuance of the final certificate for payment, pay to the *Contractor* the unpaid balance of the *Contract Price* when due together with such *Value Added Taxes* as may be applicable to such payment.

5.2 In the event of loss or damage occurring where payment becomes due under the property and boiler insurance policies, payments shall be made to the *Contractor* in accordance with the provisions of GC 11.1 – INSURANCE.

5.3 Interest

- .1 Should either party fail to make payments as they become due under the terms of the *Contract* or in an award by arbitration or court, interest at the following rates on such unpaid amounts shall also become due and payable until payment:
 - (1) 2% per annum above the prime rate for the first 60 days.
 - (2) 4% per annum above the prime rate after the first 60 days.
 Such interest shall be compounded on a monthly basis. The prime rate shall be the rate of interest quoted by

(Insert name of chartered lending institution whose prime rate is to be used)
for prime business loans as it may change from time to time.

- .2 Interest shall apply at the rate and in the manner prescribed by paragraph 5.3.1 of this Article on the settlement amount of any claim in dispute that is resolved either pursuant to Part 8 of the General Conditions – DISPUTE RESOLUTION or otherwise, from the date the amount would have been due and payable under the *Contract*, had it not been in dispute, until the date it is paid.

ARTICLE A-6 RECEIPT OF AND ADDRESSES FOR NOTICES IN WRITING

6.1 *Notices in Writing* will be addressed to the recipient at the address set out below. The delivery of a *Notice in Writing* will be by hand, by courier, by prepaid first class mail, or by facsimile or other form of electronic communication during the transmission of which no indication of failure of receipt is communicated to the sender. A *Notice in Writing* delivered by one party in accordance with this *Contract* will be deemed to have been received by the other party on the date of delivery if delivered by hand or courier, or if sent by mail it shall be deemed to have been received five calendar days after the date on which it was mailed, provided that if either such day is not a *Working Day*, then the *Notice in Writing* shall be deemed to have been received on the *Working Day* next following such day. A *Notice in Writing* sent by facsimile or other form of electronic communication shall be deemed to have been received on the date of its transmission provided that if such day is not a *Working Day* or if it is received after the end of normal business hours on the date of its transmission at the place of receipt, then it shall be deemed to have been received at the opening of business at the place of receipt on the first *Working Day* next following the transmission thereof. An address for a party may be changed by *Notice in Writing* to the other party setting out the new address in accordance with this Article.

Owner

*name of Owner**

address

facsimile number

email address

Contractor

*name of Contractor**

address

facsimile number

email address

Consultant

*name of Consultant**

address

facsimile number

email address

** If it is intended that the notice must be received by a specific individual, that individual's name shall be indicated.*

ARTICLE A-7 LANGUAGE OF THE CONTRACT

7.1 When the *Contract Documents* are prepared in both the English and French languages, it is agreed that in the event of any apparent discrepancy between the English and French versions, the English / French # language shall prevail.
Complete this statement by striking out inapplicable term.

7.2 This Agreement is drawn in English at the request of the parties hereto. La présente convention est rédigée en anglais à la demande des parties.

Note: This contract is protected by copyright. Use of a CCDC 2 document not containing a CCDC 2 copyright seal constitutes an infringement of copyright. Only sign this contract if the document cover page bears a CCDC 2 copyright seal to demonstrate that it is intended by the parties to be an accurate and unamended version of CCDC 2 – 2008 except to the extent that any alterations, additions or modifications are set forth in supplementary conditions.

ARTICLE A-8 SUCCESSION

8.1 The *Contract* shall enure to the benefit of and be binding upon the parties hereto, their respective heirs, legal representatives, successors, and assigns.

In witness whereof the parties hereto have executed this Agreement by the hands of their duly authorized representatives.

SIGNED AND DELIVERED
in the presence of:

WITNESS

signature

name of person signing

signature

name of person signing

WITNESS

signature

name of person signing

signature

name of person signing

OWNER

name of owner

signature

name and title of person signing

signature

name and title of person signing

CONTRACTOR

name of Contractor

signature

name and title of person signing

signature

name and title of person signing

N.B. Where legal jurisdiction, local practice or Owner or Contractor requirement calls for:
(a) proof of authority to execute this document, attach such proof of authority in the form of a certified copy of a resolution naming the representative(s) authorized to sign the Agreement for and on behalf of the corporation or partnership; or
(b) the affixing of a corporate seal, this Agreement should be properly sealed.

DEFINITIONS

The following Definitions shall apply to all *Contract Documents*.

1. **Change Directive**
A *Change Directive* is a written instruction prepared by the *Consultant* and signed by the *Owner* directing the *Contractor* to proceed with a change in the *Work* within the general scope of the *Contract Documents* prior to the *Owner* and the *Contractor* agreeing upon adjustments in the *Contract Price* and the *Contract Time*.
2. **Change Order**
A *Change Order* is a written amendment to the *Contract* prepared by the *Consultant* and signed by the *Owner* and the *Contractor* stating their agreement upon:
 - a change in the *Work*;
 - the method of adjustment or the amount of the adjustment in the *Contract Price*, if any; and
 - the extent of the adjustment in the *Contract Time*, if any.
3. **Construction Equipment**
Construction Equipment means all machinery and equipment, either operated or not operated, that is required for preparing, fabricating, conveying, erecting, or otherwise performing the *Work* but is not incorporated into the *Work*.
4. **Consultant**
The *Consultant* is the person or entity engaged by the *Owner* and identified as such in the Agreement. The *Consultant* is the Architect, the Engineer or entity licensed to practise in the province or territory of the *Place of the Work*. The term *Consultant* means the *Consultant* or the *Consultant's* authorized representative.
5. **Contract**
The *Contract* is the undertaking by the parties to perform their respective duties, responsibilities and obligations as prescribed in the *Contract Documents* and represents the entire agreement between the parties.
6. **Contract Documents**
The *Contract Documents* consist of those documents listed in Article A-3 of the Agreement - CONTRACT DOCUMENTS and amendments agreed upon between the parties.
7. **Contract Price**
The *Contract Price* is the amount stipulated in Article A-4 of the Agreement - CONTRACT PRICE.
8. **Contract Time**
The *Contract Time* is the time stipulated in paragraph 1.3 of Article A-1 of the Agreement - THE WORK from commencement of the *Work* to *Substantial Performance of the Work*.
9. **Contractor**
The *Contractor* is the person or entity identified as such in the Agreement. The term *Contractor* means the *Contractor* or the *Contractor's* authorized representative as designated to the *Owner* in writing.
10. **Drawings**
The *Drawings* are the graphic and pictorial portions of the *Contract Documents*, wherever located and whenever issued, showing the design, location and dimensions of the *Work*, generally including plans, elevations, sections, details, and diagrams.
11. **Notice in Writing**
A *Notice in Writing*, where identified in the *Contract Documents*, is a written communication between the parties or between them and the *Consultant* that is transmitted in accordance with the provisions of Article A-6 of the Agreement – RECEIPT OF AND ADDRESSES FOR NOTICES IN WRITING.
12. **Owner**
The *Owner* is the person or entity identified as such in the Agreement. The term *Owner* means the *Owner* or the *Owner's* authorized agent or representative as designated to the *Contractor* in writing, but does not include the *Consultant*.
13. **Place of the Work**
The *Place of the Work* is the designated site or location of the *Work* identified in the *Contract Documents*.
14. **Product**
Product or Products means material, machinery, equipment, and fixtures forming the *Work*, but does not include *Construction Equipment*.

- 15. Project**
The *Project* means the total construction contemplated of which the *Work* may be the whole or a part.
- 16. Provide**
Provide means to supply and install.
- 17. Shop Drawings**
Shop Drawings are drawings, diagrams, illustrations, schedules, performance charts, brochures, *Product* data, and other data which the *Contractor* provides to illustrate details of portions of the *Work*.
- 18. Specifications**
The *Specifications* are that portion of the *Contract Documents*, wherever located and whenever issued, consisting of the written requirements and standards for *Products*, systems, workmanship, quality, and the services necessary for the performance of the *Work*.
- 19. Subcontractor**
A *Subcontractor* is a person or entity having a direct contract with the *Contractor* to perform a part or parts of the *Work* at the *Place of the Work*.
- 20. Substantial Performance of the Work**
Substantial Performance of the Work is as defined in the lien legislation applicable to the *Place of the Work*. If such legislation is not in force or does not contain such definition, or if the *Work* is governed by the Civil Code of Quebec, *Substantial Performance of the Work* shall have been reached when the *Work* is ready for use or is being used for the purpose intended and is so certified by the *Consultant*.
- 21. Supplemental Instruction**
A *Supplemental Instruction* is an instruction, not involving adjustment in the *Contract Price* or *Contract Time*, in the form of *Specifications*, *Drawings*, schedules, samples, models or written instructions, consistent with the intent of the *Contract Documents*. It is to be issued by the *Consultant* to supplement the *Contract Documents* as required for the performance of the *Work*.
- 22. Supplier**
A *Supplier* is a person or entity having a direct contract with the *Contractor* to supply *Products*.
- 23. Temporary Work**
Temporary Work means temporary supports, structures, facilities, services, and other temporary items, excluding *Construction Equipment*, required for the execution of the *Work* but not incorporated into the *Work*.
- 24. Value Added Taxes**
Value Added Taxes means such sum as shall be levied upon the *Contract Price* by the Federal or any Provincial or Territorial Government and is computed as a percentage of the *Contract Price* and includes the Goods and Services Tax, the Quebec Sales Tax, the Harmonized Sales Tax, and any similar tax, the collection and payment of which have been imposed on the *Contractor* by the tax legislation.
- 25. Work**
The *Work* means the total construction and related services required by the *Contract Documents*.
- 26. Working Day**
Working Day means a day other than a Saturday, Sunday, statutory holiday, or statutory vacation day that is observed by the construction industry in the area of the *Place of the Work*.

GENERAL CONDITIONS OF THE STIPULATED PRICE CONTRACT**PART 1 GENERAL PROVISIONS****GC 1.1 CONTRACT DOCUMENTS**

- 1.1.1 The intent of the *Contract Documents* is to include the labour, *Products* and services necessary for the performance of the *Work* by the *Contractor* in accordance with these documents. It is not intended, however, that the *Contractor* shall supply products or perform work not consistent with, not covered by, or not properly inferable from the *Contract Documents*.
- 1.1.2 Nothing contained in the *Contract Documents* shall create any contractual relationship between:
- .1 the *Owner* and a *Subcontractor*, a *Supplier*, or their agent, employee, or other person performing any portion of the *Work*.
 - .2 the *Consultant* and the *Contractor*, a *Subcontractor*, a *Supplier*, or their agent, employee, or other person performing any portion of the *Work*.
- 1.1.3 The *Contract Documents* are complementary, and what is required by any one shall be as binding as if required by all.
- 1.1.4 Words and abbreviations which have well known technical or trade meanings are used in the *Contract Documents* in accordance with such recognized meanings.
- 1.1.5 References in the *Contract Documents* to the singular shall be considered to include the plural as the context requires.
- 1.1.6 Neither the organization of the *Specifications* nor the arrangement of *Drawings* shall control the *Contractor* in dividing the work among *Subcontractors* and *Suppliers*.
- 1.1.7 If there is a conflict within the *Contract Documents*:
- .1 the order of priority of documents, from highest to lowest, shall be
 - the Agreement between the *Owner* and the *Contractor*,
 - the Definitions,
 - Supplementary Conditions,
 - the General Conditions,
 - Division 1 of the *Specifications*,
 - technical *Specifications*,
 - material and finishing schedules,
 - the *Drawings*.
 - .2 *Drawings* of larger scale shall govern over those of smaller scale of the same date.
 - .3 dimensions shown on *Drawings* shall govern over dimensions scaled from *Drawings*.
 - .4 later dated documents shall govern over earlier documents of the same type.
- 1.1.8 The *Owner* shall provide the *Contractor*, without charge, sufficient copies of the *Contract Documents* to perform the *Work*.
- 1.1.9 *Specifications*, *Drawings*, models, and copies thereof furnished by the *Consultant* are and shall remain the *Consultant's* property, with the exception of the signed *Contract* sets, which shall belong to each party to the *Contract*. All *Specifications*, *Drawings* and models furnished by the *Consultant* are to be used only with respect to the *Work* and are not to be used on other work. These *Specifications*, *Drawings* and models are not to be copied or altered in any manner without the written authorization of the *Consultant*.
- 1.1.10 Models furnished by the *Contractor* at the *Owner's* expense are the property of the *Owner*.

GC 1.2 LAW OF THE CONTRACT

- 1.2.1 The law of the *Place of the Work* shall govern the interpretation of the *Contract*.

GC 1.3 RIGHTS AND REMEDIES

- 1.3.1 Except as expressly provided in the *Contract Documents*, the duties and obligations imposed by the *Contract Documents* and the rights and remedies available thereunder shall be in addition to and not a limitation of any duties, obligations, rights, and remedies otherwise imposed or available by law.
- 1.3.2 No action or failure to act by the *Owner*, *Consultant* or *Contractor* shall constitute a waiver of any right or duty afforded any of them under the *Contract*, nor shall any such action or failure to act constitute an approval of or acquiescence in any breach thereunder, except as may be specifically agreed in writing.

GC 1.4 ASSIGNMENT

1.4.1 Neither party to the *Contract* shall assign the *Contract* or a portion thereof without the written consent of the other, which consent shall not be unreasonably withheld.

PART 2 ADMINISTRATION OF THE CONTRACT

GC 2.1 AUTHORITY OF THE CONSULTANT

- 2.1.1 The *Consultant* will have authority to act on behalf of the *Owner* only to the extent provided in the *Contract Documents*, unless otherwise modified by written agreement as provided in paragraph 2.1.2.
- 2.1.2 The duties, responsibilities and limitations of authority of the *Consultant* as set forth in the *Contract Documents* shall be modified or extended only with the written consent of the *Owner*, the *Contractor* and the *Consultant*.
- 2.1.3 If the *Consultant's* employment is terminated, the *Owner* shall immediately appoint or reappoint a *Consultant* against whom the *Contractor* makes no reasonable objection and whose status under the *Contract Documents* shall be that of the former *Consultant*.

GC 2.2 ROLE OF THE CONSULTANT

- 2.2.1 The *Consultant* will provide administration of the *Contract* as described in the *Contract Documents*.
- 2.2.2 The *Consultant* will visit the *Place of the Work* at intervals appropriate to the progress of construction to become familiar with the progress and quality of the work and to determine if the *Work* is proceeding in general conformity with the *Contract Documents*.
- 2.2.3 If the *Owner* and the *Consultant* agree, the *Consultant* will provide at the *Place of the Work*, one or more project representatives to assist in carrying out the *Consultant's* responsibilities. The duties, responsibilities and limitations of authority of such project representatives shall be as set forth in writing to the *Contractor*.
- 2.2.4 The *Consultant* will promptly inform the *Owner* of the date of receipt of the *Contractor's* applications for payment as provided in paragraph 5.3.1.1 of GC 5.3 – PROGRESS PAYMENT.
- 2.2.5 Based on the *Consultant's* observations and evaluation of the *Contractor's* applications for payment, the *Consultant* will determine the amounts owing to the *Contractor* under the *Contract* and will issue certificates for payment as provided in Article A-5 of the Agreement - PAYMENT, GC 5.3 - PROGRESS PAYMENT and GC 5.7 - FINAL PAYMENT.
- 2.2.6 The *Consultant* will not be responsible for and will not have control, charge or supervision of construction means, methods, techniques, sequences, or procedures, or for safety precautions and programs required in connection with the *Work* in accordance with the applicable construction safety legislation, other regulations or general construction practice. The *Consultant* will not be responsible for the *Contractor's* failure to carry out the *Work* in accordance with the *Contract Documents*. The *Consultant* will not have control over, charge of or be responsible for the acts or omissions of the *Contractor*, *Subcontractors*, *Suppliers*, or their agents, employees, or any other persons performing portions of the *Work*.
- 2.2.7 Except with respect to GC 5.1 - FINANCING INFORMATION REQUIRED OF THE OWNER, the *Consultant* will be, in the first instance, the interpreter of the requirements of the *Contract Documents*.
- 2.2.8 Matters in question relating to the performance of the *Work* or the interpretation of the *Contract Documents* shall be initially referred in writing to the *Consultant* by the party raising the question for interpretations and findings and copied to the other party.
- 2.2.9 Interpretations and findings of the *Consultant* shall be consistent with the intent of the *Contract Documents*. In making such interpretations and findings the *Consultant* will not show partiality to either the *Owner* or the *Contractor*.
- 2.2.10 The *Consultant's* interpretations and findings will be given in writing to the parties within a reasonable time.
- 2.2.11 With respect to claims for a change in *Contract Price*, the *Consultant* will make findings as set out in GC 6.6 – CLAIMS FOR A CHANGE IN CONTRACT PRICE.
- 2.2.12 The *Consultant* will have authority to reject work which in the *Consultant's* opinion does not conform to the requirements of the *Contract Documents*. Whenever the *Consultant* considers it necessary or advisable, the *Consultant* will have authority to require inspection or testing of work, whether or not such work is fabricated, installed or completed. However, neither the authority of the *Consultant* to act nor any decision either to exercise or not to exercise such authority shall give rise to any duty or responsibility of the *Consultant* to the *Contractor*, *Subcontractors*, *Suppliers*, or their agents, employees, or other persons performing any of the *Work*.

- 2.2.13 During the progress of the *Work* the *Consultant* will furnish *Supplemental Instructions* to the *Contractor* with reasonable promptness or in accordance with a schedule for such instructions agreed to by the *Consultant* and the *Contractor*.
- 2.2.14 The *Consultant* will review and take appropriate action upon *Shop Drawings*, samples and other *Contractor's* submittals, in accordance with the *Contract Documents*.
- 2.2.15 The *Consultant* will prepare *Change Orders* and *Change Directives* as provided in GC 6.2 - CHANGE ORDER and GC 6.3 - CHANGE DIRECTIVE.
- 2.2.16 The *Consultant* will conduct reviews of the *Work* to determine the date of *Substantial Performance of the Work* as provided in GC 5.4 - SUBSTANTIAL PERFORMANCE OF THE WORK.
- 2.2.17 All certificates issued by the *Consultant* will be to the best of the *Consultant's* knowledge, information and belief. By issuing any certificate, the *Consultant* does not guarantee the *Work* is correct or complete.
- 2.2.18 The *Consultant* will receive and review written warranties and related documents required by the *Contract* and provided by the *Contractor* and will forward such warranties and documents to the *Owner* for the *Owner's* acceptance.

GC 2.3 REVIEW AND INSPECTION OF THE WORK

- 2.3.1 The *Owner* and the *Consultant* shall have access to the *Work* at all times. The *Contractor* shall provide sufficient, safe and proper facilities at all times for the review of the *Work* by the *Consultant* and the inspection of the *Work* by authorized agencies. If parts of the *Work* are in preparation at locations other than the *Place of the Work*, the *Owner* and the *Consultant* shall be given access to such work whenever it is in progress.
- 2.3.2 If work is designated for tests, inspections or approvals in the *Contract Documents*, or by the *Consultant's* instructions, or by the laws or ordinances of the *Place of the Work*, the *Contractor* shall give the *Consultant* reasonable notification of when the work will be ready for review and inspection. The *Contractor* shall arrange for and shall give the *Consultant* reasonable notification of the date and time of inspections by other authorities.
- 2.3.3 The *Contractor* shall furnish promptly to the *Consultant* two copies of certificates and inspection reports relating to the *Work*.
- 2.3.4 If the *Contractor* covers, or permits to be covered, work that has been designated for special tests, inspections or approvals before such special tests, inspections or approvals are made, given or completed, the *Contractor* shall, if so directed, uncover such work, have the inspections or tests satisfactorily completed, and make good covering work at the *Contractor's* expense.
- 2.3.5 The *Consultant* may order any portion or portions of the *Work* to be examined to confirm that such work is in accordance with the requirements of the *Contract Documents*. If the work is not in accordance with the requirements of the *Contract Documents*, the *Contractor* shall correct the work and pay the cost of examination and correction. If the work is in accordance with the requirements of the *Contract Documents*, the *Owner* shall pay the cost of examination and restoration.
- 2.3.6 The *Contractor* shall pay the cost of making any test or inspection, including the cost of samples required for such test or inspection, if such test or inspection is designated in the *Contract Documents* to be performed by the *Contractor* or is designated by the laws or ordinances applicable to the *Place of the Work*.
- 2.3.7 The *Contractor* shall pay the cost of samples required for any test or inspection to be performed by the *Consultant* or the *Owner* if such test or inspection is designated in the *Contract Documents*.

GC 2.4 DEFECTIVE WORK

- 2.4.1 The *Contractor* shall promptly correct defective work that has been rejected by the *Consultant* as failing to conform to the *Contract Documents* whether or not the defective work has been incorporated in the *Work* and whether or not the defect is the result of poor workmanship, use of defective products or damage through carelessness or other act or omission of the *Contractor*.
- 2.4.2 The *Contractor* shall make good promptly other contractors' work destroyed or damaged by such corrections at the *Contractor's* expense.
- 2.4.3 If in the opinion of the *Consultant* it is not expedient to correct defective work or work not performed as provided in the *Contract Documents*, the *Owner* may deduct from the amount otherwise due to the *Contractor* the difference in value between the work as performed and that called for by the *Contract Documents*. If the *Owner* and the *Contractor* do not agree on the difference in value, they shall refer the matter to the *Consultant* for a determination.

PART 3 EXECUTION OF THE WORK

GC 3.1 CONTROL OF THE WORK

- 3.1.1 The *Contractor* shall have total control of the *Work* and shall effectively direct and supervise the *Work* so as to ensure conformity with the *Contract Documents*.
- 3.1.2 The *Contractor* shall be solely responsible for construction means, methods, techniques, sequences, and procedures and for co-ordinating the various parts of the *Work* under the *Contract*.

GC 3.2 CONSTRUCTION BY OWNER OR OTHER CONTRACTORS

- 3.2.1 The *Owner* reserves the right to award separate contracts in connection with other parts of the *Project* to other contractors and to perform work with own forces.
- 3.2.2 When separate contracts are awarded for other parts of the *Project*, or when work is performed by the *Owner's* own forces, the *Owner* shall:
- .1 provide for the co-ordination of the activities and work of other contractors and *Owner's* own forces with the *Work* of the *Contract*;
 - .2 assume overall responsibility for compliance with the applicable health and construction safety legislation at the *Place of the Work*;
 - .3 enter into separate contracts with other contractors under conditions of contract which are compatible with the conditions of the *Contract*;
 - .4 ensure that insurance coverage is provided to the same requirements as are called for in GC 11.1 - INSURANCE and co-ordinate such insurance with the insurance coverage of the *Contractor* as it affects the *Work*; and
 - .5 take all reasonable precautions to avoid labour disputes or other disputes on the *Project* arising from the work of other contractors or the *Owner's* own forces.
- 3.2.3 When separate contracts are awarded for other parts of the *Project*, or when work is performed by the *Owner's* own forces, the *Contractor* shall:
- .1 afford the *Owner* and other contractors reasonable opportunity to store their products and execute their work;
 - .2 cooperate with other contractors and the *Owner* in reviewing their construction schedules; and
 - .3 promptly report to the *Consultant* in writing any apparent deficiencies in the work of other contractors or of the *Owner's* own forces, where such work affects the proper execution of any portion of the *Work*, prior to proceeding with that portion of the *Work*.
- 3.2.4 Where the *Contract Documents* identify work to be performed by other contractors or the *Owner's* own forces, the *Contractor* shall co-ordinate and schedule the *Work* with the work of other contractors and the *Owner's* own forces as specified in the *Contract Documents*.
- 3.2.5 Where a change in the *Work* is required as a result of the co-ordination and integration of the work of other contractors or *Owner's* own forces with the *Work*, the changes shall be authorized and valued as provided in GC 6.1 – OWNER'S RIGHT TO MAKE CHANGES, GC 6.2 - CHANGE ORDER and GC 6.3 - CHANGE DIRECTIVE.
- 3.2.6 Disputes and other matters in question between the *Contractor* and other contractors shall be dealt with as provided in Part 8 of the General Conditions - DISPUTE RESOLUTION provided the other contractors have reciprocal obligations. The *Contractor* shall be deemed to have consented to arbitration of any dispute with any other contractor whose contract with the *Owner* contains a similar agreement to arbitrate.

GC 3.3 TEMPORARY WORK

- 3.3.1 The *Contractor* shall have the sole responsibility for the design, erection, operation, maintenance, and removal of *Temporary Work*.
- 3.3.2 The *Contractor* shall engage and pay for registered professional engineering personnel skilled in the appropriate disciplines to perform those functions referred to in paragraph 3.3.1 where required by law or by the *Contract Documents* and in all cases where such *Temporary Work* is of such a nature that professional engineering skill is required to produce safe and satisfactory results.

3.3.3 Notwithstanding the provisions of GC 3.1 - CONTROL OF THE WORK, paragraphs 3.3.1 and 3.3.2 or provisions to the contrary elsewhere in the *Contract Documents* where such *Contract Documents* include designs for *Temporary Work* or specify a method of construction in whole or in part, such designs or methods of construction shall be considered to be part of the design of the *Work* and the *Contractor* shall not be held responsible for that part of the design or the specified method of construction. The *Contractor* shall, however, be responsible for the execution of such design or specified method of construction in the same manner as for the execution of the *Work*.

GC 3.4 DOCUMENT REVIEW

3.4.1 The *Contractor* shall review the *Contract Documents* and shall report promptly to the *Consultant* any error, inconsistency or omission the *Contractor* may discover. Such review by the *Contractor* shall be to the best of the *Contractor's* knowledge, information and belief and in making such review the *Contractor* does not assume any responsibility to the *Owner* or the *Consultant* for the accuracy of the review. The *Contractor* shall not be liable for damage or costs resulting from such errors, inconsistencies or omissions in the *Contract Documents*, which the *Contractor* did not discover. If the *Contractor* does discover any error, inconsistency or omission in the *Contract Documents*, the *Contractor* shall not proceed with the work affected until the *Contractor* has received corrected or missing information from the *Consultant*.

GC 3.5 CONSTRUCTION SCHEDULE

3.5.1 The *Contractor* shall:

- .1 prepare and submit to the *Owner* and the *Consultant* prior to the first application for payment, a construction schedule that indicates the timing of the major activities of the *Work* and provides sufficient detail of the critical events and their inter-relationship to demonstrate the *Work* will be performed in conformity with the *Contract Time*;
- .2 monitor the progress of the *Work* relative to the construction schedule and update the schedule on a monthly basis or as stipulated by the *Contract Documents*; and
- .3 advise the *Consultant* of any revisions required to the schedule as the result of extensions of the *Contract Time* as provided in Part 6 of the General Conditions - CHANGES IN THE WORK.

GC 3.6 SUPERVISION

3.6.1 The *Contractor* shall provide all necessary supervision and appoint a competent representative who shall be in attendance at the *Place of the Work* while work is being performed. The appointed representative shall not be changed except for valid reason.

3.6.2 The appointed representative shall represent the *Contractor* at the *Place of the Work*. Information and instructions provided by the *Consultant* to the *Contractor's* appointed representative shall be deemed to have been received by the *Contractor*, except with respect to Article A-6 of the Agreement – RECEIPT OF AND ADDRESSES FOR NOTICES IN WRITING.

GC 3.7 SUBCONTRACTORS AND SUPPLIERS

3.7.1 The *Contractor* shall preserve and protect the rights of the parties under the *Contract* with respect to work to be performed under subcontract, and shall:

- .1 enter into contracts or written agreements with *Subcontractors* and *Suppliers* to require them to perform their work as provided in the *Contract Documents*;
- .2 incorporate the terms and conditions of the *Contract Documents* into all contracts or written agreements with *Subcontractors* and *Suppliers*; and
- .3 be as fully responsible to the *Owner* for acts and omissions of *Subcontractors*, *Suppliers* and of persons directly or indirectly employed by them as for acts and omissions of persons directly employed by the *Contractor*.

3.7.2 The *Contractor* shall indicate in writing, if requested by the *Owner*, those *Subcontractors* or *Suppliers* whose bids have been received by the *Contractor* which the *Contractor* would be prepared to accept for the performance of a portion of the *Work*. Should the *Owner* not object before signing the *Contract*, the *Contractor* shall employ those *Subcontractors* or *Suppliers* so identified by the *Contractor* in writing for the performance of that portion of the *Work* to which their bid applies.

3.7.3 The *Owner* may, for reasonable cause, at any time before the *Owner* has signed the *Contract*, object to the use of a proposed *Subcontractor* or *Supplier* and require the *Contractor* to employ one of the other subcontract bidders.

3.7.4 If the *Owner* requires the *Contractor* to change a proposed *Subcontractor* or *Supplier*, the *Contract Price* and *Contract Time* shall be adjusted by the differences occasioned by such required change.

- 3.7.5 The *Contractor* shall not be required to employ as a *Subcontractor* or *Supplier*, a person or firm to which the *Contractor* may reasonably object.
- 3.7.6 The *Owner*, through the *Consultant*, may provide to a *Subcontractor* or *Supplier* information as to the percentage of the *Subcontractor's* or *Supplier's* work which has been certified for payment.

GC 3.8 LABOUR AND PRODUCTS

- 3.8.1 The *Contractor* shall provide and pay for labour, *Products*, tools, *Construction Equipment*, water, heat, light, power, transportation, and other facilities and services necessary for the performance of the *Work* in accordance with the *Contract*.
- 3.8.2 Unless otherwise specified in the *Contract Documents*, *Products* provided shall be new. *Products* which are not specified shall be of a quality consistent with those specified and their use acceptable to the *Consultant*.
- 3.8.3 The *Contractor* shall maintain good order and discipline among the *Contractor's* employees engaged on the *Work* and shall not employ on the *Work* anyone not skilled in the tasks assigned.

GC 3.9 DOCUMENTS AT THE SITE

- 3.9.1 The *Contractor* shall keep one copy of current *Contract Documents*, submittals, reports, and records of meetings at the *Place of the Work*, in good order and available to the *Owner* and the *Consultant*.

GC 3.10 SHOP DRAWINGS

- 3.10.1 The *Contractor* shall provide *Shop Drawings* as required in the *Contract Documents*.
- 3.10.2 The *Contractor* shall provide *Shop Drawings* to the *Consultant* to review in orderly sequence and sufficiently in advance so as to cause no delay in the *Work* or in the work of other contractors.
- 3.10.3 Upon request of the *Contractor* or the *Consultant*, they shall jointly prepare a schedule of the dates for provision, review and return of *Shop Drawings*.
- 3.10.4 The *Contractor* shall provide *Shop Drawings* in the form specified, or if not specified, as directed by the *Consultant*.
- 3.10.5 *Shop Drawings* provided by the *Contractor* to the *Consultant* shall indicate by stamp, date and signature of the person responsible for the review that the *Contractor* has reviewed each one of them.
- 3.10.6 The *Consultant's* review is for conformity to the design concept and for general arrangement only.
- 3.10.7 *Shop Drawings* which require approval of any legally constituted authority having jurisdiction shall be provided to such authority by the *Contractor* for approval.
- 3.10.8 The *Contractor* shall review all *Shop Drawings* before providing them to the *Consultant*. The *Contractor* represents by this review that:
- .1 the *Contractor* has determined and verified all applicable field measurements, field construction conditions, *Product* requirements, catalogue numbers and similar data, or will do so, and
 - .2 the *Contractor* has checked and co-ordinated each *Shop Drawing* with the requirements of the *Work* and of the *Contract Documents*.
- 3.10.9 At the time of providing *Shop Drawings*, the *Contractor* shall expressly advise the *Consultant* in writing of any deviations in a *Shop Drawing* from the requirements of the *Contract Documents*. The *Consultant* shall indicate the acceptance or rejection of such deviation expressly in writing.
- 3.10.10 The *Consultant's* review shall not relieve the *Contractor* of responsibility for errors or omissions in the *Shop Drawings* or for meeting all requirements of the *Contract Documents*.
- 3.10.11 The *Contractor* shall provide revised *Shop Drawings* to correct those which the *Consultant* rejects as inconsistent with the *Contract Documents*, unless otherwise directed by the *Consultant*. The *Contractor* shall notify the *Consultant* in writing of any revisions to the *Shop Drawings* other than those requested by the *Consultant*.
- 3.10.12 The *Consultant* will review and return *Shop Drawings* in accordance with the schedule agreed upon, or, in the absence of such schedule, with reasonable promptness so as to cause no delay in the performance of the *Work*.

GC 3.11 USE OF THE WORK

- 3.11.1 The *Contractor* shall confine *Construction Equipment*, *Temporary Work*, storage of *Products*, waste products and debris, and operations of employees and *Subcontractors* to limits indicated by laws, ordinances, permits, or the *Contract Documents* and shall not unreasonably encumber the *Place of the Work*.
- 3.11.2 The *Contractor* shall not load or permit to be loaded any part of the *Work* with a weight or force that will endanger the safety of the *Work*.

GC 3.12 CUTTING AND REMEDIAL WORK

- 3.12.1 The *Contractor* shall perform the cutting and remedial work required to make the affected parts of the *Work* come together properly.
- 3.12.2 The *Contractor* shall co-ordinate the *Work* to ensure that the cutting and remedial work is kept to a minimum.
- 3.12.3 Should the *Owner*, the *Consultant*, other contractors or anyone employed by them be responsible for ill-timed work necessitating cutting or remedial work to be performed, the cost of such cutting or remedial work shall be valued as provided in GC 6.1 – OWNER’S RIGHT TO MAKE CHANGES, GC 6.2 - CHANGE ORDER and GC 6.3 - CHANGE DIRECTIVE.
- 3.12.4 Cutting and remedial work shall be performed by specialists familiar with the *Products* affected and shall be performed in a manner to neither damage nor endanger the *Work*.

GC 3.13 CLEANUP

- 3.13.1 The *Contractor* shall maintain the *Work* in a safe and tidy condition and free from the accumulation of waste products and debris, other than that caused by the *Owner*, other contractors or their employees.
- 3.13.2 Before applying for *Substantial Performance of the Work* as provided in GC 5.4 – SUBSTANTIAL PERFORMANCE OF THE WORK, the *Contractor* shall remove waste products and debris, other than that resulting from the work of the *Owner*, other contractors or their employees, and shall leave the *Place of the Work* clean and suitable for use or occupancy by the *Owner*. The *Contractor* shall remove products, tools, *Construction Equipment*, and *Temporary Work* not required for the performance of the remaining work.
- 3.13.3 Prior to application for the final payment, the *Contractor* shall remove any remaining products, tools, *Construction Equipment*, *Temporary Work*, and waste products and debris, other than those resulting from the work of the *Owner*, other contractors or their employees.

PART 4 ALLOWANCES

GC 4.1 CASH ALLOWANCES

- 4.1.1 The *Contract Price* includes the cash allowances, if any, stated in the *Contract Documents*. The scope of work or costs included in such cash allowances shall be as described in the *Contract Documents*.
- 4.1.2 The *Contract Price*, and not the cash allowances, includes the *Contractor's* overhead and profit in connection with such cash allowances.
- 4.1.3 Expenditures under cash allowances shall be authorized by the *Owner* through the *Consultant*.
- 4.1.4 Where the actual cost of the *Work* under any cash allowance exceeds the amount of the allowance, the *Contractor* shall be compensated for the excess incurred and substantiated plus an amount for overhead and profit on the excess as set out in the *Contract Documents*. Where the actual cost of the *Work* under any cash allowance is less than the amount of the allowance, the *Owner* shall be credited for the unexpended portion of the cash allowance, but not for the *Contractor's* overhead and profit on such amount. Multiple cash allowances shall not be combined for the purpose of calculating the foregoing.
- 4.1.5 The *Contract Price* shall be adjusted by *Change Order* to provide for any difference between the amount of each cash allowance and the actual cost of the work under that cash allowance.
- 4.1.6 The value of the work performed under a cash allowance is eligible to be included in progress payments.
- 4.1.7 The *Contractor* and the *Consultant* shall jointly prepare a schedule that shows when the *Consultant* and *Owner* must authorize ordering of items called for under cash allowances to avoid delaying the progress of the *Work*.

GC 4.2 CONTINGENCY ALLOWANCE

- 4.2.1 The *Contract Price* includes the contingency allowance, if any, stated in the *Contract Documents*.
- 4.2.2 The contingency allowance includes the *Contractor's* overhead and profit in connection with such contingency allowance.
- 4.2.3 Expenditures under the contingency allowance shall be authorized and valued as provided in GC 6.1 – OWNER’S RIGHT TO MAKE CHANGES, GC 6.2 - CHANGE ORDER and GC 6.3 - CHANGE DIRECTIVE.
- 4.2.4 The *Contract Price* shall be adjusted by *Change Order* to provide for any difference between the expenditures authorized under paragraph 4.2.3 and the contingency allowance.

PART 5 PAYMENT

GC 5.1 FINANCING INFORMATION REQUIRED OF THE OWNER

- 5.1.1 The *Owner* shall, at the request of the *Contractor*, before signing the *Contract*, and promptly from time to time thereafter, furnish to the *Contractor* reasonable evidence that financial arrangements have been made to fulfill the *Owner's* obligations under the *Contract*.
- 5.1.2 The *Owner* shall give the *Contractor Notice in Writing* of any material change in the *Owner's* financial arrangements to fulfill the *Owner's* obligations under the *Contract* during the performance of the *Contract*.

GC 5.2 APPLICATIONS FOR PROGRESS PAYMENT

- 5.2.1 Applications for payment on account as provided in Article A-5 of the Agreement - PAYMENT may be made monthly as the *Work* progresses.
- 5.2.2 Applications for payment shall be dated the last day of each payment period, which is the last day of the month or an alternative day of the month agreed in writing by the parties.
- 5.2.3 The amount claimed shall be for the value, proportionate to the amount of the *Contract*, of *Work* performed and *Products* delivered to the *Place of the Work* as of the last day of the payment period.
- 5.2.4 The *Contractor* shall submit to the *Consultant*, at least 15 calendar days before the first application for payment, a schedule of values for the parts of the *Work*, aggregating the total amount of the *Contract Price*, so as to facilitate evaluation of applications for payment.
- 5.2.5 The schedule of values shall be made out in such form and supported by such evidence as the *Consultant* may reasonably direct and when accepted by the *Consultant*, shall be used as the basis for applications for payment, unless it is found to be in error.
- 5.2.6 The *Contractor* shall include a statement based on the schedule of values with each application for payment.
- 5.2.7 Applications for payment for *Products* delivered to the *Place of the Work* but not yet incorporated into the *Work* shall be supported by such evidence as the *Consultant* may reasonably require to establish the value and delivery of the *Products*.

GC 5.3 PROGRESS PAYMENT

- 5.3.1 After receipt by the *Consultant* of an application for payment submitted by the *Contractor* in accordance with GC 5.2 - APPLICATIONS FOR PROGRESS PAYMENT:
 - .1 the *Consultant* will promptly inform the *Owner* of the date of receipt of the *Contractor's* application for payment,
 - .2 the *Consultant* will issue to the *Owner* and copy to the *Contractor*, no later than 10 calendar days after the receipt of the application for payment, a certificate for payment in the amount applied for, or in such other amount as the *Consultant* determines to be properly due. If the *Consultant* amends the application, the *Consultant* will promptly advise the *Contractor* in writing giving reasons for the amendment,
 - .3 the *Owner* shall make payment to the *Contractor* on account as provided in Article A-5 of the Agreement - PAYMENT on or before 20 calendar days after the later of:
 - receipt by the *Consultant* of the application for payment, or
 - the last day of the monthly payment period for which the application for payment is made.

GC 5.4 SUBSTANTIAL PERFORMANCE OF THE WORK

- 5.4.1 When the *Contractor* considers that the *Work* is substantially performed, or if permitted by the lien legislation applicable to the *Place of the Work* a designated portion thereof which the *Owner* agrees to accept separately is substantially performed, the *Contractor* shall, within one *Working Day*, deliver to the *Consultant* and to the *Owner* a comprehensive list of items to be completed or corrected, together with a written application for a review by the *Consultant* to establish *Substantial Performance of the Work* or substantial performance of the designated portion of the *Work*. Failure to include an item on the list does not alter the responsibility of the *Contractor* to complete the *Contract*.
- 5.4.2 The *Consultant* will review the *Work* to verify the validity of the application and shall promptly, and in any event, no later than 20 calendar days after receipt of the *Contractor's* list and application:
- .1 advise the *Contractor* in writing that the *Work* or the designated portion of the *Work* is not substantially performed and give reasons why, or
 - .2 state the date of *Substantial Performance of the Work* or a designated portion of the *Work* in a certificate and issue a copy of that certificate to each of the *Owner* and the *Contractor*.
- 5.4.3 Immediately following the issuance of the certificate of *Substantial Performance of the Work*, the *Contractor*, in consultation with the *Consultant*, shall establish a reasonable date for finishing the *Work*.

GC 5.5 PAYMENT OF HOLDBACK UPON SUBSTANTIAL PERFORMANCE OF THE WORK

- 5.5.1 After the issuance of the certificate of *Substantial Performance of the Work*, the *Contractor* shall:
- .1 submit an application for payment of the holdback amount,
 - .2 submit CCDC 9A 'Statutory Declaration' to state that all accounts for labour, subcontracts, *Products*, *Construction Equipment*, and other indebtedness which may have been incurred by the *Contractor* in the *Substantial Performance of the Work* and for which the *Owner* might in any way be held responsible have been paid in full, except for amounts properly retained as a holdback or as an identified amount in dispute.
- 5.5.2 After the receipt of an application for payment from the *Contractor* and the statement as provided in paragraph 5.5.1, the *Consultant* will issue a certificate for payment of the holdback amount.
- 5.5.3 Where the holdback amount required by the applicable lien legislation has not been placed in a separate holdback account, the *Owner* shall, 10 calendar days prior to the expiry of the holdback period stipulated in the lien legislation applicable to the *Place of the Work*, place the holdback amount in a bank account in the joint names of the *Owner* and the *Contractor*.
- 5.5.4 In the common law jurisdictions, the holdback amount authorized by the certificate for payment of the holdback amount is due and payable on the first calendar day following the expiration of the holdback period stipulated in the lien legislation applicable to the *Place of the Work*. Where lien legislation does not exist or apply, the holdback amount shall be due and payable in accordance with other legislation, industry practice or provisions which may be agreed to between the parties. The *Owner* may retain out of the holdback amount any sums required by law to satisfy any liens against the *Work* or, if permitted by the lien legislation applicable to the *Place of the Work*, other third party monetary claims against the *Contractor* which are enforceable against the *Owner*.
- 5.5.5 In the Province of Quebec, the holdback amount authorized by the certificate for payment of the holdback amount is due and payable 30 calendar days after the issuance of the certificate. The *Owner* may retain out of the holdback amount any sums required to satisfy any legal hypothecs that have been taken, or could be taken, against the *Work* or other third party monetary claims against the *Contractor* which are enforceable against the *Owner*.

GC 5.6 PROGRESSIVE RELEASE OF HOLDBACK

- 5.6.1 In the common law jurisdictions, where legislation permits and where, upon application by the *Contractor*, the *Consultant* has certified that the work of a *Subcontractor* or *Supplier* has been performed prior to *Substantial Performance of the Work*, the *Owner* shall pay the *Contractor* the holdback amount retained for such subcontract work, or the *Products* supplied by such *Supplier*, on the first calendar day following the expiration of the holdback period for such work stipulated in the lien legislation applicable to the *Place of the Work*. The *Owner* may retain out of the holdback amount any sums required by law to satisfy any liens against the *Work* or, if permitted by the lien legislation applicable to the *Place of the Work*, other third party monetary claims against the *Contractor* which are enforceable against the *Owner*.

- 5.6.2 In the Province of Quebec, where, upon application by the *Contractor*, the *Consultant* has certified that the work of a *Subcontractor* or *Supplier* has been performed prior to *Substantial Performance of the Work*, the *Owner* shall pay the *Contractor* the holdback amount retained for such subcontract work, or the *Products* supplied by such *Supplier*, no later than 30 calendar days after such certification by the *Consultant*. The *Owner* may retain out of the holdback amount any sums required to satisfy any legal hypothecs that have been taken, or could be taken, against the *Work* or other third party monetary claims against the *Contractor* which are enforceable against the *Owner*.
- 5.6.3 Notwithstanding the provisions of the preceding paragraphs, and notwithstanding the wording of such certificates, the *Contractor* shall ensure that such subcontract work or *Products* are protected pending the issuance of a final certificate for payment and be responsible for the correction of defects or work not performed regardless of whether or not such was apparent when such certificates were issued.

GC 5.7 FINAL PAYMENT

- 5.7.1 When the *Contractor* considers that the *Work* is completed, the *Contractor* shall submit an application for final payment.
- 5.7.2 The *Consultant* will, no later than 10 calendar days after the receipt of an application from the *Contractor* for final payment, review the *Work* to verify the validity of the application and advise the *Contractor* in writing that the application is valid or give reasons why it is not valid.
- 5.7.3 When the *Consultant* finds the *Contractor's* application for final payment valid, the *Consultant* will promptly issue a final certificate for payment.
- 5.7.4 Subject to the provision of paragraph 10.4.1 of GC 10.4 - WORKERS' COMPENSATION, and any lien legislation applicable to the *Place of the Work*, the *Owner* shall, no later than 5 calendar days after the issuance of a final certificate for payment, pay the *Contractor* as provided in Article A-5 of the Agreement - PAYMENT.

GC 5.8 WITHHOLDING OF PAYMENT

- 5.8.1 If because of climatic or other conditions reasonably beyond the control of the *Contractor*, there are items of work that cannot be performed, payment in full for that portion of the *Work* which has been performed as certified by the *Consultant* shall not be withheld or delayed by the *Owner* on account thereof, but the *Owner* may withhold, until the remaining portion of the *Work* is finished, only such an amount that the *Consultant* determines is sufficient and reasonable to cover the cost of performing such remaining work.

GC 5.9 NON-CONFORMING WORK

- 5.9.1 No payment by the *Owner* under the *Contract* nor partial or entire use or occupancy of the *Work* by the *Owner* shall constitute an acceptance of any portion of the *Work* or *Products* which are not in accordance with the requirements of the *Contract Documents*.

PART 6 CHANGES IN THE WORK

GC 6.1 OWNER'S RIGHT TO MAKE CHANGES

- 6.1.1 The *Owner*, through the *Consultant*, without invalidating the *Contract*, may make:
- .1 changes in the *Work* consisting of additions, deletions or other revisions to the *Work* by *Change Order* or *Change Directive*, and
 - .2 changes to the *Contract Time* for the *Work*, or any part thereof, by *Change Order*.
- 6.1.2 The *Contractor* shall not perform a change in the *Work* without a *Change Order* or a *Change Directive*.

GC 6.2 CHANGE ORDER

- 6.2.1 When a change in the *Work* is proposed or required, the *Consultant* will provide the *Contractor* with a written description of the proposed change in the *Work*. The *Contractor* shall promptly present, in a form acceptable to the *Consultant*, a method of adjustment or an amount of adjustment for the *Contract Price*, if any, and the adjustment in the *Contract Time*, if any, for the proposed change in the *Work*.
- 6.2.2 When the *Owner* and *Contractor* agree to the adjustments in the *Contract Price* and *Contract Time* or to the method to be used to determine the adjustments, such agreement shall be effective immediately and shall be recorded in a *Change Order*. The value of the work performed as the result of a *Change Order* shall be included in the application for progress payment.

GC 6.3 CHANGE DIRECTIVE

- 6.3.1 If the *Owner* requires the *Contractor* to proceed with a change in the *Work* prior to the *Owner* and the *Contractor* agreeing upon the corresponding adjustment in *Contract Price* and *Contract Time*, the *Owner*, through the *Consultant*, shall issue a *Change Directive*.
- 6.3.2 A *Change Directive* shall only be used to direct a change in the *Work* which is within the general scope of the *Contract Documents*.
- 6.3.3 A *Change Directive* shall not be used to direct a change in the *Contract Time* only.
- 6.3.4 Upon receipt of a *Change Directive*, the *Contractor* shall proceed promptly with the change in the *Work*.
- 6.3.5 For the purpose of valuing *Change Directives*, changes in the *Work* that are not substitutions or otherwise related to each other shall not be grouped together in the same *Change Directive*.
- 6.3.6 The adjustment in the *Contract Price* for a change carried out by way of a *Change Directive* shall be determined on the basis of the cost of the *Contractor's* actual expenditures and savings attributable to the *Change Directive*, valued in accordance with paragraph 6.3.7 and as follows:
- .1 If the change results in a net increase in the *Contractor's* cost, the *Contract Price* shall be increased by the amount of the net increase in the *Contractor's* cost, plus the *Contractor's* percentage fee on such net increase.
 - .2 If the change results in a net decrease in the *Contractor's* cost, the *Contract Price* shall be decreased by the amount of the net decrease in the *Contractor's* cost, without adjustment for the *Contractor's* percentage fee.
 - .3 The *Contractor's* fee shall be as specified in the *Contract Documents* or as otherwise agreed by the parties.
- 6.3.7 The cost of performing the work attributable to the *Change Directive* shall be limited to the actual cost of the following:
- .1 salaries, wages and benefits paid to personnel in the direct employ of the *Contractor* under a salary or wage schedule agreed upon by the *Owner* and the *Contractor*, or in the absence of such a schedule, actual salaries, wages and benefits paid under applicable bargaining agreement, and in the absence of a salary or wage schedule and bargaining agreement, actual salaries, wages and benefits paid by the *Contractor*, for personnel
 - (1) stationed at the *Contractor's* field office, in whatever capacity employed;
 - (2) engaged in expediting the production or transportation of material or equipment, at shops or on the road;
 - (3) engaged in the preparation or review of *Shop Drawings*, fabrication drawings, and coordination drawings; or
 - (4) engaged in the processing of changes in the *Work*.
 - .2 contributions, assessments or taxes incurred for such items as employment insurance, provincial or territorial health insurance, workers' compensation, and Canada or Quebec Pension Plan, insofar as such cost is based on wages, salaries or other remuneration paid to employees of the *Contractor* and included in the cost of the *Work* as provided in paragraph 6.3.7.1;
 - .3 travel and subsistence expenses of the *Contractor's* personnel described in paragraph 6.3.7.1;
 - .4 all *Products* including cost of transportation thereof;
 - .5 materials, supplies, *Construction Equipment*, *Temporary Work*, and hand tools not owned by the workers, including transportation and maintenance thereof, which are consumed in the performance of the *Work*; and cost less salvage value on such items used but not consumed, which remain the property of the *Contractor*;
 - .6 all tools and *Construction Equipment*, exclusive of hand tools used in the performance of the *Work*, whether rented from or provided by the *Contractor* or others, including installation, minor repairs and replacements, dismantling, removal, transportation, and delivery cost thereof;
 - .7 all equipment and services required for the *Contractor's* field office;
 - .8 deposits lost;
 - .9 the amounts of all subcontracts;
 - .10 quality assurance such as independent inspection and testing services;
 - .11 charges levied by authorities having jurisdiction at the *Place of the Work*;
 - .12 royalties, patent licence fees and damages for infringement of patents and cost of defending suits therefor subject always to the *Contractor's* obligations to indemnify the *Owner* as provided in paragraph 10.3.1 of GC 10.3 - PATENT FEES;
 - .13 any adjustment in premiums for all bonds and insurance which the *Contractor* is required, by the *Contract Documents*, to purchase and maintain;
 - .14 any adjustment in taxes, other than *Value Added Taxes*, and duties for which the *Contractor* is liable;
 - .15 charges for long distance telephone and facsimile communications, courier services, expressage, and petty cash items incurred in relation to the performance of the *Work*;
 - .16 removal and disposal of waste products and debris; and
 - .17 safety measures and requirements.

- 6.3.8 Notwithstanding any other provisions contained in the General Conditions of the *Contract*, it is the intention of the parties that the cost of any item under any cost element referred to in paragraph 6.3.7 shall cover and include any and all costs or liabilities attributable to the *Change Directive* other than those which are the result of or occasioned by any failure on the part of the *Contractor* to exercise reasonable care and diligence in the *Contractor's* attention to the *Work*. Any cost due to failure on the part of the *Contractor* to exercise reasonable care and diligence in the *Contractor's* attention to the *Work* shall be borne by the *Contractor*.
- 6.3.9 The *Contractor* shall keep full and detailed accounts and records necessary for the documentation of the cost of performing the *Work* attributable to the *Change Directive* and shall provide the *Consultant* with copies thereof when requested.
- 6.3.10 For the purpose of valuing *Change Directives*, the *Owner* shall be afforded reasonable access to all of the *Contractor's* pertinent documents related to the cost of performing the *Work* attributable to the *Change Directive*.
- 6.3.11 Pending determination of the final amount of a *Change Directive*, the undisputed value of the *Work* performed as the result of a *Change Directive* is eligible to be included in progress payments.
- 6.3.12 If the *Owner* and the *Contractor* do not agree on the proposed adjustment in the *Contract Time* attributable to the change in the *Work*, or the method of determining it, the adjustment shall be referred to the *Consultant* for determination.
- 6.3.13 When the *Owner* and the *Contractor* reach agreement on the adjustment to the *Contract Price* and to the *Contract Time*, this agreement shall be recorded in a *Change Order*.

GC 6.4 CONCEALED OR UNKNOWN CONDITIONS

- 6.4.1 If the *Owner* or the *Contractor* discover conditions at the *Place of the Work* which are:
- .1 subsurface or otherwise concealed physical conditions which existed before the commencement of the *Work* which differ materially from those indicated in the *Contract Documents*; or
 - .2 physical conditions, other than conditions due to weather, that are of a nature which differ materially from those ordinarily found to exist and generally recognized as inherent in construction activities of the character provided for in the *Contract Documents*,
- then the observing party shall give *Notice in Writing* to the other party of such conditions before they are disturbed and in no event later than 5 *Working Days* after first observance of the conditions.
- 6.4.2 The *Consultant* will promptly investigate such conditions and make a finding. If the finding is that the conditions differ materially and this would cause an increase or decrease in the *Contractor's* cost or time to perform the *Work*, the *Consultant*, with the *Owner's* approval, will issue appropriate instructions for a change in the *Work* as provided in GC 6.2 - CHANGE ORDER or GC 6.3 - CHANGE DIRECTIVE.
- 6.4.3 If the *Consultant* finds that the conditions at the *Place of the Work* are not materially different or that no change in the *Contract Price* or the *Contract Time* is justified, the *Consultant* will report the reasons for this finding to the *Owner* and the *Contractor* in writing.
- 6.4.4 If such concealed or unknown conditions relate to toxic and hazardous substances and materials, artifacts and fossils, or mould, the parties will be governed by the provisions of GC 9.2 - TOXIC AND HAZARDOUS SUBSTANCES, GC 9.3 - ARTIFACTS AND FOSSILS and GC 9.5 - MOULD.

GC 6.5 DELAYS

- 6.5.1 If the *Contractor* is delayed in the performance of the *Work* by an action or omission of the *Owner*, *Consultant* or anyone employed or engaged by them directly or indirectly, contrary to the provisions of the *Contract Documents*, then the *Contract Time* shall be extended for such reasonable time as the *Consultant* may recommend in consultation with the *Contractor*. The *Contractor* shall be reimbursed by the *Owner* for reasonable costs incurred by the *Contractor* as the result of such delay.
- 6.5.2 If the *Contractor* is delayed in the performance of the *Work* by a stop work order issued by a court or other public authority and providing that such order was not issued as the result of an act or fault of the *Contractor* or any person employed or engaged by the *Contractor* directly or indirectly, then the *Contract Time* shall be extended for such reasonable time as the *Consultant* may recommend in consultation with the *Contractor*. The *Contractor* shall be reimbursed by the *Owner* for reasonable costs incurred by the *Contractor* as the result of such delay.

- 6.5.3 If the *Contractor* is delayed in the performance of the *Work* by:
- .1 labour disputes, strikes, lock-outs (including lock-outs decreed or recommended for its members by a recognized contractors' association, of which the *Contractor* is a member or to which the *Contractor* is otherwise bound),
 - .2 fire, unusual delay by common carriers or unavoidable casualties,
 - .3 abnormally adverse weather conditions, or
 - .4 any cause beyond the *Contractor's* control other than one resulting from a default or breach of *Contract* by the *Contractor*,
- then the *Contract Time* shall be extended for such reasonable time as the *Consultant* may recommend in consultation with the *Contractor*. The extension of time shall not be less than the time lost as the result of the event causing the delay, unless the *Contractor* agrees to a shorter extension. The *Contractor* shall not be entitled to payment for costs incurred by such delays unless such delays result from actions by the *Owner*, *Consultant* or anyone employed or engaged by them directly or indirectly.
- 6.5.4 No extension shall be made for delay unless *Notice in Writing* of the cause of delay is given to the *Consultant* not later than 10 *Working Days* after the commencement of the delay. In the case of a continuing cause of delay only one *Notice in Writing* shall be necessary.
- 6.5.5 If no schedule is made under paragraph 2.2.13 of GC 2.2 - ROLE OF THE CONSULTANT, then no request for extension shall be made because of failure of the *Consultant* to furnish instructions until 10 *Working Days* after demand for such instructions has been made.

GC 6.6 CLAIMS FOR A CHANGE IN CONTRACT PRICE

- 6.6.1 If the *Contractor* intends to make a claim for an increase to the *Contract Price*, or if the *Owner* intends to make a claim against the *Contractor* for a credit to the *Contract Price*, the party that intends to make the claim shall give timely *Notice in Writing* of intent to claim to the other party and to the *Consultant*.
- 6.6.2 Upon commencement of the event or series of events giving rise to a claim, the party intending to make the claim shall:
- .1 take all reasonable measures to mitigate any loss or expense which may be incurred as a result of such event or series of events, and
 - .2 keep such records as may be necessary to support the claim.
- 6.6.3 The party making the claim shall submit within a reasonable time to the *Consultant* a detailed account of the amount claimed and the grounds upon which the claim is based.
- 6.6.4 Where the event or series of events giving rise to the claim has a continuing effect, the detailed account submitted under paragraph 6.6.3 shall be considered to be an interim account and the party making the claim shall, at such intervals as the *Consultant* may reasonably require, submit further interim accounts giving the accumulated amount of the claim and any further grounds upon which it is based. The party making the claim shall submit a final account after the end of the effects resulting from the event or series of events.
- 6.6.5 The *Consultant's* findings, with respect to a claim made by either party, will be given by *Notice in Writing* to both parties within 30 *Working Days* after receipt of the claim by the *Consultant*, or within such other time period as may be agreed by the parties.
- 6.6.6 If such finding is not acceptable to either party, the claim shall be settled in accordance with Part 8 of the General Conditions - DISPUTE RESOLUTION.

PART 7 DEFAULT NOTICE

GC 7.1 OWNER'S RIGHT TO PERFORM THE WORK, TERMINATE THE CONTRACTOR'S RIGHT TO CONTINUE WITH THE WORK OR TERMINATE THE CONTRACT

- 7.1.1 If the *Contractor* is adjudged bankrupt, or makes a general assignment for the benefit of creditors because of the *Contractor's* insolvency, or if a receiver is appointed because of the *Contractor's* insolvency, the *Owner* may, without prejudice to any other right or remedy the *Owner* may have, terminate the *Contractor's* right to continue with the *Work*, by giving the *Contractor* or receiver or trustee in bankruptcy *Notice in Writing* to that effect.
- 7.1.2 If the *Contractor* neglects to prosecute the *Work* properly or otherwise fails to comply with the requirements of the *Contract* to a substantial degree and if the *Consultant* has given a written statement to the *Owner* and *Contractor* that sufficient cause exists to justify such action, the *Owner* may, without prejudice to any other right or remedy the *Owner* may have, give the *Contractor Notice in Writing* that the *Contractor* is in default of the *Contractor's* contractual obligations and instruct the *Contractor* to correct the default in the 5 *Working Days* immediately following the receipt of such *Notice in Writing*.

- 7.1.3 If the default cannot be corrected in the 5 *Working Days* specified or in such other time period as may be subsequently agreed in writing by the parties, the *Contractor* shall be in compliance with the *Owner's* instructions if the *Contractor*:
- .1 commences the correction of the default within the specified time, and
 - .2 provides the *Owner* with an acceptable schedule for such correction, and
 - .3 corrects the default in accordance with the *Contract* terms and with such schedule.
- 7.1.4 If the *Contractor* fails to correct the default in the time specified or in such other time period as may be subsequently agreed in writing by the parties, without prejudice to any other right or remedy the *Owner* may have, the *Owner* may:
- .1 correct such default and deduct the cost thereof from any payment then or thereafter due the *Contractor* provided the *Consultant* has certified such cost to the *Owner* and the *Contractor*, or
 - .2 terminate the *Contractor's* right to continue with the *Work* in whole or in part or terminate the *Contract*.
- 7.1.5 If the *Owner* terminates the *Contractor's* right to continue with the *Work* as provided in paragraphs 7.1.1 and 7.1.4, the *Owner* shall be entitled to:
- .1 take possession of the *Work* and *Products* at the *Place of the Work*; subject to the rights of third parties, utilize the *Construction Equipment* at the *Place of the Work*; finish the *Work* by whatever method the *Owner* may consider expedient, but without undue delay or expense, and
 - .2 withhold further payment to the *Contractor* until a final certificate for payment is issued, and
 - .3 charge the *Contractor* the amount by which the full cost of finishing the *Work* as certified by the *Consultant*, including compensation to the *Consultant* for the *Consultant's* additional services and a reasonable allowance as determined by the *Consultant* to cover the cost of corrections to work performed by the *Contractor* that may be required under GC 12.3 - WARRANTY, exceeds the unpaid balance of the *Contract Price*; however, if such cost of finishing the *Work* is less than the unpaid balance of the *Contract Price*, the *Owner* shall pay the *Contractor* the difference, and
 - .4 on expiry of the warranty period, charge the *Contractor* the amount by which the cost of corrections to the *Contractor's* work under GC 12.3 - WARRANTY exceeds the allowance provided for such corrections, or if the cost of such corrections is less than the allowance, pay the *Contractor* the difference.
- 7.1.6 The *Contractor's* obligation under the *Contract* as to quality, correction and warranty of the work performed by the *Contractor* up to the time of termination shall continue after such termination of the *Contract*.

GC 7.2 CONTRACTOR'S RIGHT TO SUSPEND THE WORK OR TERMINATE THE CONTRACT

- 7.2.1 If the *Owner* is adjudged bankrupt, or makes a general assignment for the benefit of creditors because of the *Owner's* insolvency, or if a receiver is appointed because of the *Owner's* insolvency, the *Contractor* may, without prejudice to any other right or remedy the *Contractor* may have, terminate the *Contract* by giving the *Owner* or receiver or trustee in bankruptcy *Notice in Writing* to that effect.
- 7.2.2 If the *Work* is suspended or otherwise delayed for a period of 20 *Working Days* or more under an order of a court or other public authority and providing that such order was not issued as the result of an act or fault of the *Contractor* or of anyone directly or indirectly employed or engaged by the *Contractor*, the *Contractor* may, without prejudice to any other right or remedy the *Contractor* may have, terminate the *Contract* by giving the *Owner* *Notice in Writing* to that effect.
- 7.2.3 The *Contractor* may give *Notice in Writing* to the *Owner*, with a copy to the *Consultant*, that the *Owner* is in default of the *Owner's* contractual obligations if:
- .1 the *Owner* fails to furnish, when so requested by the *Contractor*, reasonable evidence that financial arrangements have been made to fulfill the *Owner's* obligations under the *Contract*, or
 - .2 the *Consultant* fails to issue a certificate as provided in GC 5.3 - PROGRESS PAYMENT, or
 - .3 the *Owner* fails to pay the *Contractor* when due the amounts certified by the *Consultant* or awarded by arbitration or court, or
 - .4 the *Owner* violates the requirements of the *Contract* to a substantial degree and the *Consultant*, except for GC 5.1 - FINANCING INFORMATION REQUIRED OF THE OWNER, confirms by written statement to the *Contractor* that sufficient cause exists.
- 7.2.4 The *Contractor's* *Notice in Writing* to the *Owner* provided under paragraph 7.2.3 shall advise that if the default is not corrected within 5 *Working Days* following the receipt of the *Notice in Writing*, the *Contractor* may, without prejudice to any other right or remedy the *Contractor* may have, suspend the *Work* or terminate the *Contract*.
- 7.2.5 If the *Contractor* terminates the *Contract* under the conditions set out above, the *Contractor* shall be entitled to be paid for all work performed including reasonable profit, for loss sustained upon *Products* and *Construction Equipment*, and such other damages as the *Contractor* may have sustained as a result of the termination of the *Contract*.

PART 8 DISPUTE RESOLUTION

GC 8.1 AUTHORITY OF THE CONSULTANT

- 8.1.1 Differences between the parties to the *Contract* as to the interpretation, application or administration of the *Contract* or any failure to agree where agreement between the parties is called for, herein collectively called disputes, which are not resolved in the first instance by findings of the *Consultant* as provided in GC 2.2 - ROLE OF THE CONSULTANT, shall be settled in accordance with the requirements of Part 8 of the General Conditions - DISPUTE RESOLUTION.
- 8.1.2 If a dispute arises under the *Contract* in respect of a matter in which the *Consultant* has no authority under the *Contract* to make a finding, the procedures set out in paragraph 8.1.3 and paragraphs 8.2.3 to 8.2.8 of GC 8.2 - NEGOTIATION, MEDIATION AND ARBITRATION, and in GC 8.3 - RETENTION OF RIGHTS apply to that dispute with the necessary changes to detail as may be required.
- 8.1.3 If a dispute is not resolved promptly, the *Consultant* will give such instructions as in the *Consultant's* opinion are necessary for the proper performance of the *Work* and to prevent delays pending settlement of the dispute. The parties shall act immediately according to such instructions, it being understood that by so doing neither party will jeopardize any claim the party may have. If it is subsequently determined that such instructions were in error or at variance with the *Contract Documents*, the *Owner* shall pay the *Contractor* costs incurred by the *Contractor* in carrying out such instructions which the *Contractor* was required to do beyond what the *Contract Documents* correctly understood and interpreted would have required, including costs resulting from interruption of the *Work*.

GC 8.2 NEGOTIATION, MEDIATION AND ARBITRATION

- 8.2.1 In accordance with the Rules for Mediation of Construction Disputes as provided in CCDC 40 in effect at the time of bid closing, the parties shall appoint a Project Mediator
- .1 within 20 *Working Days* after the *Contract* was awarded, or
 - .2 if the parties neglected to make an appointment within the 20 *Working Days*, within 10 *Working Days* after either party by *Notice in Writing* requests that the Project Mediator be appointed.
- 8.2.2 A party shall be conclusively deemed to have accepted a finding of the *Consultant* under GC 2.2 - ROLE OF THE CONSULTANT and to have expressly waived and released the other party from any claims in respect of the particular matter dealt with in that finding unless, within 15 *Working Days* after receipt of that finding, the party sends a *Notice in Writing* of dispute to the other party and to the *Consultant*, which contains the particulars of the matter in dispute and the relevant provisions of the *Contract Documents*. The responding party shall send a *Notice in Writing* of reply to the dispute within 10 *Working Days* after receipt of such *Notice in Writing* setting out particulars of this response and any relevant provisions of the *Contract Documents*.
- 8.2.3 The parties shall make all reasonable efforts to resolve their dispute by amicable negotiations and agree to provide, without prejudice, frank, candid and timely disclosure of relevant facts, information and documents to facilitate these negotiations.
- 8.2.4 After a period of 10 *Working Days* following receipt of a responding party's *Notice in Writing* of reply under paragraph 8.2.2, the parties shall request the Project Mediator to assist the parties to reach agreement on any unresolved dispute. The mediated negotiations shall be conducted in accordance with the Rules for Mediation of Construction Disputes as provided in CCDC 40 in effect at the time of bid closing.
- 8.2.5 If the dispute has not been resolved within 10 *Working Days* after the Project Mediator was requested under paragraph 8.2.4 or within such further period agreed by the parties, the Project Mediator shall terminate the mediated negotiations by giving *Notice in Writing* to the *Owner*, the *Contractor* and the *Consultant*.
- 8.2.6 By giving a *Notice in Writing* to the other party and the *Consultant*, not later than 10 *Working Days* after the date of termination of the mediated negotiations under paragraph 8.2.5, either party may refer the dispute to be finally resolved by arbitration under the Rules for Arbitration of Construction Disputes as provided in CCDC 40 in effect at the time of bid closing. The arbitration shall be conducted in the jurisdiction of the *Place of the Work*.
- 8.2.7 On expiration of the 10 *Working Days*, the arbitration agreement under paragraph 8.2.6 is not binding on the parties and, if a *Notice in Writing* is not given under paragraph 8.2.6 within the required time, the parties may refer the unresolved dispute to the courts or to any other form of dispute resolution, including arbitration, which they have agreed to use.

- 8.2.8 If neither party, by *Notice in Writing*, given within 10 *Working Days* of the date of *Notice in Writing* requesting arbitration in paragraph 8.2.6, requires that a dispute be arbitrated immediately, all disputes referred to arbitration as provided in paragraph 8.2.6 shall be
- .1 held in abeyance until
 - (1) *Substantial Performance of the Work*,
 - (2) the *Contract* has been terminated, or
 - (3) the *Contractor* has abandoned the *Work*,whichever is earlier; and
 - .2 consolidated into a single arbitration under the rules governing the arbitration under paragraph 8.2.6.

GC 8.3 RETENTION OF RIGHTS

- 8.3.1 It is agreed that no act by either party shall be construed as a renunciation or waiver of any rights or recourses, provided the party has given the *Notice in Writing* required under Part 8 of the General Conditions - DISPUTE RESOLUTION and has carried out the instructions as provided in paragraph 8.1.3 of GC 8.1 – AUTHORITY OF THE CONSULTANT.
- 8.3.2 Nothing in Part 8 of the General Conditions - DISPUTE RESOLUTION shall be construed in any way to limit a party from asserting any statutory right to a lien under applicable lien legislation of the jurisdiction of the *Place of the Work* and the assertion of such right by initiating judicial proceedings is not to be construed as a waiver of any right that party may have under paragraph 8.2.6 of GC 8.2 – NEGOTIATION, MEDIATION AND ARBITRATION to proceed by way of arbitration to adjudicate the merits of the claim upon which such a lien is based.

PART 9 PROTECTION OF PERSONS AND PROPERTY

GC 9.1 PROTECTION OF WORK AND PROPERTY

- 9.1.1 The *Contractor* shall protect the *Work* and the *Owner's* property and property adjacent to the *Place of the Work* from damage which may arise as the result of the *Contractor's* operations under the *Contract*, and shall be responsible for such damage, except damage which occurs as the result of:
- .1 errors in the *Contract Documents*;
 - .2 acts or omissions by the *Owner*, the *Consultant*, other contractors, their agents and employees.
- 9.1.2 Before commencing any work, the *Contractor* shall determine the location of all underground utilities and structures indicated in the *Contract Documents* or that are reasonably apparent in an inspection of the *Place of the Work*.
- 9.1.3 Should the *Contractor* in the performance of the *Contract* damage the *Work*, the *Owner's* property or property adjacent to the *Place of the Work*, the *Contractor* shall be responsible for making good such damage at the *Contractor's* expense.
- 9.1.4 Should damage occur to the *Work* or *Owner's* property for which the *Contractor* is not responsible, as provided in paragraph 9.1.1, the *Contractor* shall make good such damage to the *Work* and, if the *Owner* so directs, to the *Owner's* property. The *Contract Price* and *Contract Time* shall be adjusted as provided in GC 6.1 – OWNER'S RIGHT TO MAKE CHANGES, GC 6.2 - CHANGE ORDER and GC 6.3 - CHANGE DIRECTIVE.

GC 9.2 TOXIC AND HAZARDOUS SUBSTANCES

- 9.2.1 For the purposes of applicable legislation related to toxic and hazardous substances, the *Owner* shall be deemed to have control and management of the *Place of the Work* with respect to existing conditions.
- 9.2.2 Prior to the *Contractor* commencing the *Work*, the *Owner* shall,
- .1 take all reasonable steps to determine whether any toxic or hazardous substances are present at the *Place of the Work*, and
 - .2 provide the *Consultant* and the *Contractor* with a written list of any such substances that are known to exist and their locations.
- 9.2.3 The *Owner* shall take all reasonable steps to ensure that no person's exposure to any toxic or hazardous substances exceeds the time weighted levels prescribed by applicable legislation at the *Place of the Work* and that no property is damaged or destroyed as a result of exposure to, or the presence of, toxic or hazardous substances which were at the *Place of the Work* prior to the *Contractor* commencing the *Work*.
- 9.2.4 Unless the *Contract* expressly provides otherwise, the *Owner* shall be responsible for taking all necessary steps, in accordance with applicable legislation in force at the *Place of the Work*, to dispose of, store or otherwise render harmless toxic or hazardous substances which were present at the *Place of the Work* prior to the *Contractor* commencing the *Work*.

- 9.2.5 If the *Contractor*
- .1 encounters toxic or hazardous substances at the *Place of the Work*, or
 - .2 has reasonable grounds to believe that toxic or hazardous substances are present at the *Place of the Work*, which were not brought to the *Place of the Work* by the *Contractor* or anyone for whom the *Contractor* is responsible and which were not disclosed by the *Owner* or which were disclosed but have not been dealt with as required under paragraph 9.2.4, the *Contractor* shall
 - .3 take all reasonable steps, including stopping the *Work*, to ensure that no person's exposure to any toxic or hazardous substances exceeds any applicable time weighted levels prescribed by applicable legislation at the *Place of the Work*, and
 - .4 immediately report the circumstances to the *Consultant* and the *Owner* in writing.
- 9.2.6 If the *Owner* and *Contractor* do not agree on the existence, significance of, or whether the toxic or hazardous substances were brought onto the *Place of the Work* by the *Contractor* or anyone for whom the *Contractor* is responsible, the *Owner* shall retain and pay for an independent qualified expert to investigate and determine such matters. The expert's report shall be delivered to the *Owner* and the *Contractor*.
- 9.2.7 If the *Owner* and *Contractor* agree or if the expert referred to in paragraph 9.2.6 determines that the toxic or hazardous substances were not brought onto the place of the *Work* by the *Contractor* or anyone for whom the *Contractor* is responsible, the *Owner* shall promptly at the *Owner's* own expense:
- .1 take all steps as required under paragraph 9.2.4;
 - .2 reimburse the *Contractor* for the costs of all steps taken pursuant to paragraph 9.2.5;
 - .3 extend the *Contract* time for such reasonable time as the *Consultant* may recommend in consultation with the *Contractor* and the expert referred to in 9.2.6 and reimburse the *Contractor* for reasonable costs incurred as a result of the delay; and
 - .4 indemnify the *Contractor* as required by GC 12.1 - INDEMNIFICATION.
- 9.2.8 If the *Owner* and *Contractor* agree or if the expert referred to in paragraph 9.2.6 determines that the toxic or hazardous substances were brought onto the place of the *Work* by the *Contractor* or anyone for whom the *Contractor* is responsible, the *Contractor* shall promptly at the *Contractor's* own expense:
- .1 take all necessary steps, in accordance with applicable legislation in force at the *Place of the Work*, to safely remove and dispose the toxic or hazardous substances;
 - .2 make good any damage to the *Work*, the *Owner's* property or property adjacent to the place of the *Work* as provided in paragraph 9.1.3 of GC 9.1 – PROTECTION OF WORK AND PROPERTY;
 - .3 reimburse the *Owner* for reasonable costs incurred under paragraph 9.2.6; and
 - .4 indemnify the *Owner* as required by GC 12.1 - INDEMNIFICATION.
- 9.2.9 If either party does not accept the expert's findings under paragraph 9.2.6, the disagreement shall be settled in accordance with Part 8 of the General Conditions - Dispute Resolution. If such disagreement is not resolved promptly, the parties shall act immediately in accordance with the expert's determination and take the steps required by paragraph 9.2.7 or 9.2.8 it being understood that by so doing, neither party will jeopardize any claim that party may have to be reimbursed as provided by GC 9.2 – TOXIC AND HAZARDOUS SUBSTANCES.

GC 9.3 ARTIFACTS AND FOSSILS

- 9.3.1 Fossils, coins, articles of value or antiquity, structures and other remains or things of scientific or historic interest discovered at the *Place or Work* shall, as between the *Owner* and the *Contractor*, be deemed to be the absolute property of the *Owner*.
- 9.3.2 The *Contractor* shall take all reasonable precautions to prevent removal or damage to discoveries as identified in paragraph 9.3.1, and shall advise the *Consultant* upon discovery of such items.
- 9.3.3 The *Consultant* will investigate the impact on the *Work* of the discoveries identified in paragraph 9.3.1. If conditions are found that would cause an increase or decrease in the *Contractor's* cost or time to perform the *Work*, the *Consultant*, with the *Owner's* approval, will issue appropriate instructions for a change in the *Work* as provided in GC 6.2 - CHANGE ORDER or GC 6.3 CHANGE DIRECTIVE.

GC 9.4 CONSTRUCTION SAFETY

- 9.4.1 Subject to paragraph 3.2.2.2 of GC 3.2 - CONSTRUCTION BY OWNER OR OTHER CONTRACTORS, the *Contractor* shall be solely responsible for construction safety at the *Place of the Work* and for compliance with the rules, regulations and practices required by the applicable construction health and safety legislation and shall be responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the performance of the *Work*.

GC 9.5 MOULD

- 9.5.1 If the *Contractor* or *Owner* observes or reasonably suspects the presence of mould at the *Place of the Work*, the remediation of which is not expressly part of the *Work*,
- .1 the observing party shall promptly report the circumstances to the other party in writing, and
 - .2 the *Contractor* shall promptly take all reasonable steps, including stopping the *Work* if necessary, to ensure that no person suffers injury, sickness or death and that no property is damaged as a result of exposure to or the presence of the mould, and
 - .3 if the *Owner* and *Contractor* do not agree on the existence, significance or cause of the mould or as to what steps need be taken to deal with it, the *Owner* shall retain and pay for an independent qualified expert to investigate and determine such matters. The expert's report shall be delivered to the *Owner* and *Contractor*.
- 9.5.2 If the *Owner* and *Contractor* agree, or if the expert referred to in paragraph 9.5.1.3 determines that the presence of mould was caused by the *Contractor's* operations under the *Contract*, the *Contractor* shall promptly, at the *Contractor's* own expense:
- .1 take all reasonable and necessary steps to safely remediate or dispose of the mould, and
 - .2 make good any damage to the *Work*, the *Owner's* property or property adjacent to the *Place of the Work* as provided in paragraph 9.1.3 of GC 9.1 - PROTECTION OF WORK AND PROPERTY, and
 - .3 reimburse the *Owner* for reasonable costs incurred under paragraph 9.5.1.3, and
 - .4 indemnify the *Owner* as required by GC 12.1 - INDEMNIFICATION.
- 9.5.3 If the *Owner* and *Contractor* agree, or if the expert referred to in paragraph 9.5.1.3 determines that the presence of mould was not caused by the *Contractor's* operations under the *Contract*, the *Owner* shall promptly, at the *Owner's* own expense:
- .1 take all reasonable and necessary steps to safely remediate or dispose of the mould, and
 - .2 reimburse the *Contractor* for the cost of taking the steps under paragraph 9.5.1.2 and making good any damage to the *Work* as provided in paragraph 9.1.4 of GC 9.1 - PROTECTION OF WORK AND PROPERTY, and
 - .3 extend the *Contract Time* for such reasonable time as the *Consultant* may recommend in consultation with the *Contractor* and the expert referred to in paragraph 9.5.1.3 and reimburse the *Contractor* for reasonable costs incurred as a result of the delay, and
 - .4 indemnify the *Contractor* as required by GC 12.1 - INDEMNIFICATION.
- 9.5.4 If either party does not accept the expert's finding under paragraph 9.5.1.3, the disagreement shall be settled in accordance with Part 8 of the General Conditions - DISPUTE RESOLUTION. If such disagreement is not resolved promptly, the parties shall act immediately in accordance with the expert's determination and take the steps required by paragraphs 9.5.2 or 9.5.3, it being understood that by so doing neither party will jeopardize any claim the party may have to be reimbursed as provided by GC 9.5 - MOULD.

PART 10 GOVERNING REGULATIONS

GC 10.1 TAXES AND DUTIES

- 10.1.1 The *Contract Price* shall include all taxes and customs duties in effect at the time of the bid closing except for *Value Added Taxes* payable by the *Owner* to the *Contractor* as stipulated in Article A-4 of the Agreement - CONTRACT PRICE.
- 10.1.2 Any increase or decrease in costs to the *Contractor* due to changes in such included taxes and duties after the time of the bid closing shall increase or decrease the *Contract Price* accordingly.

GC 10.2 LAWS, NOTICES, PERMITS, AND FEES

- 10.2.1 The laws of the *Place of the Work* shall govern the *Work*.
- 10.2.2 The *Owner* shall obtain and pay for development approvals, building permit, permanent easements, rights of servitude, and all other necessary approvals and permits, except for the permits and fees referred to in paragraph 10.2.3 or for which the *Contract Documents* specify as the responsibility of the *Contractor*.
- 10.2.3 The *Contractor* shall be responsible for the procurement of permits, licences, inspections, and certificates, which are necessary for the performance of the *Work* and customarily obtained by contractors in the jurisdiction of the *Place of the Work* after the issuance of the building permit. The *Contract Price* includes the cost of these permits, licences, inspections, and certificates, and their procurement.
- 10.2.4 The *Contractor* shall give the required notices and comply with the laws, ordinances, rules, regulations, or codes which are or become in force during the performance of the *Work* and which relate to the *Work*, to the preservation of the public health, and to construction safety.

- 10.2.5 The *Contractor* shall not be responsible for verifying that the *Contract Documents* are in compliance with the applicable laws, ordinances, rules, regulations, or codes relating to the *Work*. If the *Contract Documents* are at variance therewith, or if, subsequent to the time of bid closing, changes are made to the applicable laws, ordinances, rules, regulations, or codes which require modification to the *Contract Documents*, the *Contractor* shall advise the *Consultant* in writing requesting direction immediately upon such variance or change becoming known. The *Consultant* will make the changes required to the *Contract Documents* as provided in GC 6.1 - OWNER'S RIGHT TO MAKE CHANGES, GC 6.2 - CHANGE ORDER and GC 6.3 - CHANGE DIRECTIVE.
- 10.2.6 If the *Contractor* fails to advise the *Consultant* in writing; and fails to obtain direction as required in paragraph 10.2.5; and performs work knowing it to be contrary to any laws, ordinances, rules, regulations, or codes; the *Contractor* shall be responsible for and shall correct the violations thereof; and shall bear the costs, expenses and damages attributable to the failure to comply with the provisions of such laws, ordinances, rules, regulations, or codes.
- 10.2.7 If, subsequent to the time of bid closing, changes are made to applicable laws, ordinances, rules, regulations, or codes of authorities having jurisdiction which affect the cost of the *Work*, either party may submit a claim in accordance with the requirements of GC 6.6 – CLAIMS FOR A CHANGE IN CONTRACT PRICE.

GC 10.3 PATENT FEES

- 10.3.1 The *Contractor* shall pay the royalties and patent licence fees required for the performance of the *Contract*. The *Contractor* shall hold the *Owner* harmless from and against claims, demands, losses, costs, damages, actions, suits, or proceedings arising out of the *Contractor's* performance of the *Contract* which are attributable to an infringement or an alleged infringement of a patent of invention by the *Contractor* or anyone for whose acts the *Contractor* may be liable.
- 10.3.2 The *Owner* shall hold the *Contractor* harmless against claims, demands, losses, costs, damages, actions, suits, or proceedings arising out of the *Contractor's* performance of the *Contract* which are attributable to an infringement or an alleged infringement of a patent of invention in executing anything for the purpose of the *Contract*, the model, plan or design of which was supplied to the *Contractor* as part of the *Contract Documents*.

GC 10.4 WORKERS' COMPENSATION

- 10.4.1 Prior to commencing the *Work*, again with the *Contractor's* application for payment of the holdback amount following *Substantial Performance of the Work* and again with the *Contractor's* application for final payment, the *Contractor* shall provide evidence of compliance with workers' compensation legislation at the *Place of the Work*, including payments due thereunder.
- 10.4.2 At any time during the term of the *Contract*, when requested by the *Owner*, the *Contractor* shall provide such evidence of compliance by the *Contractor* and *Subcontractors*.

PART 11 INSURANCE AND CONTRACT SECURITY

GC 11.1 INSURANCE

- 11.1.1 Without restricting the generality of GC 12.1 - INDEMNIFICATION, the *Contractor* shall provide, maintain and pay for the following insurance coverages, the minimum requirements of which are specified in CCDC 41 – CCDC Insurance Requirements in effect at the time of bid closing except as hereinafter provided:
- .1 General liability insurance in the name of the *Contractor* and include, or in the case of a single, blanket policy, be endorsed to name, the *Owner* and the *Consultant* as insureds but only with respect to liability, other than legal liability arising out of their sole negligence, arising out of the operations of the *Contractor* with regard to the *Work*. General liability insurance shall be maintained from the date of commencement of the *Work* until one year from the date of *Substantial Performance of the Work*. Liability coverage shall be provided for completed operations hazards from the date of *Substantial Performance of the Work*, as set out in the certificate of *Substantial Performance of the Work*, on an ongoing basis for a period of 6 years following *Substantial Performance of the Work*.
 - .2 Automobile Liability Insurance from the date of commencement of the *Work* until one year after the date of *Substantial Performance of the Work*.
 - .3 Aircraft or Watercraft Liability Insurance when owned or non-owned aircraft or watercraft are used directly or indirectly in the performance of the *Work*
 - .4 "Broad form" property insurance in the joint names of the *Contractor*, the *Owner* and the *Consultant*. The policy shall include as insureds all *Subcontractors*. The "Broad form" property insurance shall be provided from the date of commencement of the *Work* until the earliest of:
 - (1) 10 calendar days after the date of *Substantial Performance of the Work*;

- (2) on the commencement of use or occupancy of any part or section of the *Work* unless such use or occupancy is for construction purposes, habitational, office, banking, convenience store under 465 square metres in area, or parking purposes, or for the installation, testing and commissioning of equipment forming part of the *Work*;
 - (3) when left unattended for more than 30 consecutive calendar days or when construction activity has ceased for more than 30 consecutive calendar days.
- .5 Boiler and machinery insurance in the joint names of the *Contractor*, the *Owner* and the *Consultant*. The policy shall include as insureds all *Subcontractors*. The coverage shall be maintained continuously from commencement of use or operation of the boiler and machinery objects insured by the policy and until 10 calendar days after the date of *Substantial Performance of the Work*.
- .6 The “Broad form” property and boiler and machinery policies shall provide that, in the case of a loss or damage, payment shall be made to the *Owner* and the *Contractor* as their respective interests may appear. In the event of loss or damage:
- (1) the *Contractor* shall act on behalf of the *Owner* for the purpose of adjusting the amount of such loss or damage payment with the insurers. When the extent of the loss or damage is determined, the *Contractor* shall proceed to restore the *Work*. Loss or damage shall not affect the rights and obligations of either party under the *Contract* except that the *Contractor* shall be entitled to such reasonable extension of *Contract Time* relative to the extent of the loss or damage as the *Consultant* may recommend in consultation with the *Contractor*;
 - (2) the *Contractor* shall be entitled to receive from the *Owner*, in addition to the amount due under the *Contract*, the amount which the *Owner's* interest in restoration of the *Work* has been appraised, such amount to be paid as the restoration of the *Work* proceeds in accordance with the progress payment provisions. In addition the *Contractor* shall be entitled to receive from the payments made by the insurer the amount of the *Contractor's* interest in the restoration of the *Work*; and
 - (3) to the *Work* arising from the work of the *Owner*, the *Owner's* own forces or another contractor, the *Owner* shall, in accordance with the *Owner's* obligations under the provisions relating to construction by *Owner* or other contractors, pay the *Contractor* the cost of restoring the *Work* as the restoration of the *Work* proceeds and as in accordance with the progress payment provisions.
- .7 Contractors' Equipment Insurance from the date of commencement of the *Work* until one year after the date of *Substantial Performance of the Work*.

- 11.1.2 Prior to commencement of the *Work* and upon the placement, renewal, amendment, or extension of all or any part of the insurance, the *Contractor* shall promptly provide the *Owner* with confirmation of coverage and, if required, a certified true copy of the policies certified by an authorized representative of the insurer together with copies of any amending endorsements applicable to the *Work*.
- 11.1.3 The parties shall pay their share of the deductible amounts in direct proportion to their responsibility in regards to any loss for which the above policies are required to pay, except where such amounts may be excluded by the terms of the *Contract*.
- 11.1.4 If the *Contractor* fails to provide or maintain insurance as required by the *Contract Documents*, then the *Owner* shall have the right to provide and maintain such insurance and give evidence to the *Contractor* and the *Consultant*. The *Contractor* shall pay the cost thereof to the *Owner* on demand or the *Owner* may deduct the cost from the amount which is due or may become due to the *Contractor*.
- 11.1.5 All required insurance policies shall be with insurers licensed to underwrite insurance in the jurisdiction of the *Place of the Work*.
- 11.1.6 If a revised version of CCDC 41 – INSURANCE REQUIREMENTS is published, which specifies reduced insurance requirements, the parties shall address such reduction, prior to the *Contractor's* insurance policy becoming due for renewal, and record any agreement in a *Change Order*.
- 11.1.7 If a revised version of CCDC 41 – INSURANCE REQUIREMENTS is published, which specifies increased insurance requirements, the *Owner* may request the increased coverage from the *Contractor* by way of a *Change Order*.
- 11.1.8 A *Change Directive* shall not be used to direct a change in the insurance requirements in response to the revision of CCDC 41 – INSURANCE REQUIREMENTS.

GC 11.2 CONTRACT SECURITY

- 11.2.1 The *Contractor* shall, prior to commencement of the *Work* or within the specified time, provide to the *Owner* any *Contract* security specified in the *Contract Documents*.

11.2.2 If the *Contract Documents* require surety bonds to be provided, such bonds shall be issued by a duly licensed surety company authorized to transact the business of suretyship in the province or territory of the *Place of the Work* and shall be maintained in good standing until the fulfillment of the *Contract*. The form of such bonds shall be in accordance with the latest edition of the CCDC approved bond forms.

PART 12 INDEMNIFICATION, WAIVER OF CLAIMS AND WARRANTY

GC 12.1 INDEMNIFICATION

12.1.1 Without restricting the parties' obligation to indemnify as described in paragraphs 12.1.4 and 12.1.5, the *Owner* and the *Contractor* shall each indemnify and hold harmless the other from and against all claims, demands, losses, costs, damages, actions, suits, or proceedings whether in respect to losses suffered by them or in respect to claims by third parties that arise out of, or are attributable in any respect to their involvement as parties to this *Contract*, provided such claims are:

- .1 caused by:
 - (1) the negligent acts or omissions of the party from whom indemnification is sought or anyone for whose acts or omissions that party is liable, or
 - (2) a failure of the party to the *Contract* from whom indemnification is sought to fulfill its terms or conditions; and
- .2 made by *Notice in Writing* within a period of 6 years from the date of *Substantial Performance of the Work* as set out in the certificate of *Substantial Performance of the Work* issued pursuant to paragraph 5.4.2.2 of GC 5.4 – SUBSTANTIAL PERFORMANCE OF THE WORK or within such shorter period as may be prescribed by any limitation statute of the province or territory of the *Place of the Work*.

The parties expressly waive the right to indemnity for claims other than those provided for in this *Contract*.

12.1.2 The obligation of either party to indemnify as set forth in paragraph 12.1.1 shall be limited as follows:

- .1 In respect to losses suffered by the *Owner* and the *Contractor* for which insurance is to be provided by either party pursuant to GC 11.1 – INSURANCE, the general liability insurance limit for one occurrence as referred to in CCDC 41 in effect at the time of bid closing.
- .2 In respect to losses suffered by the *Owner* and the *Contractor* for which insurance is not required to be provided by either party in accordance with GC 11.1 – INSURANCE, the greater of the *Contract Price* as recorded in Article A-4 – CONTRACT PRICE or \$2,000,000, but in no event shall the sum be greater than \$20,000,000.
- .3 In respect to claims by third parties for direct loss resulting from bodily injury, sickness, disease or death, or to injury to or destruction of tangible property, the obligation to indemnify is without limit. In respect to all other claims for indemnity as a result of claims advanced by third parties, the limits of indemnity set forth in paragraphs 12.1.2.1 and 12.1.2.2 shall apply.

12.1.3 The obligation of either party to indemnify the other as set forth in paragraphs 12.1.1 and 12.1.2 shall be inclusive of interest and all legal costs.

12.1.4 The *Owner* and the *Contractor* shall indemnify and hold harmless the other from and against all claims, demands, losses, costs, damages, actions, suits, or proceedings arising out of their obligations described in GC 9.2 – TOXIC AND HAZARDOUS SUBSTANCES.

12.1.5 The *Owner* shall indemnify and hold harmless the *Contractor* from and against all claims, demands, losses, costs, damages, actions, suits, or proceedings:

- .1 as described in paragraph 10.3.2 of GC 10.3 – PATENT FEES, and
- .2 arising out of the *Contractor's* performance of the *Contract* which are attributable to a lack of or defect in title or an alleged lack of or defect in title to the *Place of the Work*.

12.1.6 In respect to any claim for indemnity or to be held harmless by the *Owner* or the *Contractor*:

- .1 *Notice in Writing* of such claim shall be given within a reasonable time after the facts upon which such claim is based became known;
- .2 should any party be required as a result of its obligation to indemnify another to pay or satisfy a final order, judgment or award made against the party entitled by this contract to be indemnified, then the indemnifying party upon assuming all liability for any costs that might result shall have the right to appeal in the name of the party against whom such final order or judgment has been made until such rights of appeal have been exhausted.

GC 12.2 WAIVER OF CLAIMS

- 12.2.1 Subject to any lien legislation applicable to the *Place of the Work*, as of the fifth calendar day before the expiry of the lien period provided by the lien legislation applicable at the *Place of the Work*, the *Contractor* waives and releases the *Owner* from all claims which the *Contractor* has or reasonably ought to have knowledge of that could be advanced by the *Contractor* against the *Owner* arising from the *Contractor's* involvement in the *Work*, including, without limitation, those arising from negligence or breach of contract in respect to which the cause of action is based upon acts or omissions which occurred prior to or on the date of *Substantial Performance of the Work*, except as follows:
- .1 claims arising prior to or on the date of *Substantial Performance of the Work* for which *Notice in Writing* of claim has been received by the *Owner* from the *Contractor* no later than the sixth calendar day before the expiry of the lien period provided by the lien legislation applicable at the *Place of the Work*;
 - .2 indemnification for claims advanced against the *Contractor* by third parties for which a right of indemnification may be asserted by the *Contractor* against the *Owner* pursuant to the provisions of this *Contract*;
 - .3 claims for which a right of indemnity could be asserted by the *Contractor* pursuant to the provisions of paragraphs 12.1.4 or 12.1.5 of GC 12.1 – INDEMNIFICATION; and
 - .4 claims resulting from acts or omissions which occur after the date of *Substantial Performance of the Work*.
- 12.2.2 The *Contractor* waives and releases the *Owner* from all claims referenced in paragraph 12.2.1.4 except for those referred in paragraphs 12.2.1.2 and 12.2.1.3 and claims for which *Notice in Writing* of claim has been received by the *Owner* from the *Contractor* within 395 calendar days following the date of *Substantial Performance of the Work*.
- 12.2.3 Subject to any lien legislation applicable to the *Place of the Work*, as of the fifth calendar day before the expiry of the lien period provided by the lien legislation applicable at the *Place of the Work*, the *Owner* waives and releases the *Contractor* from all claims which the *Owner* has or reasonably ought to have knowledge of that could be advanced by the *Owner* against the *Contractor* arising from the *Owner's* involvement in the *Work*, including, without limitation, those arising from negligence or breach of contract in respect to which the cause of action is based upon acts or omissions which occurred prior to or on the date of *Substantial Performance of the Work*, except as follows:
- .1 claims arising prior to or on the date of *Substantial Performance of the Work* for which *Notice in Writing* of claim has been received by the *Contractor* from the *Owner* no later than the sixth calendar day before the expiry of the lien period provided by the lien legislation applicable at the *Place of the Work*;
 - .2 indemnification for claims advanced against the *Owner* by third parties for which a right of indemnification may be asserted by the *Owner* against the *Contractor* pursuant to the provisions of this *Contract*;
 - .3 claims for which a right of indemnity could be asserted by the *Owner* against the *Contractor* pursuant to the provisions of paragraph 12.1.4 of GC 12.1 - INDEMNIFICATION;
 - .4 damages arising from the *Contractor's* actions which result in substantial defects or deficiencies in the *Work*. “Substantial defects or deficiencies” mean those defects or deficiencies in the *Work* which affect the *Work* to such an extent or in such a manner that a significant part or the whole of the *Work* is unfit for the purpose intended by the *Contract Documents*;
 - .5 claims arising pursuant to GC 12.3 - WARRANTY; and
 - .6 claims arising from acts or omissions which occur after the date of *Substantial Performance of the Work*.
- 12.2.4 The *Owner* waives and releases the *Contractor* from all claims referred to in paragraph 12.2.3.4 except claims for which *Notice in Writing* of claim has been received by the *Contractor* from the *Owner* within a period of six years from the date of *Substantial Performance of the Work* should any limitation statute of the Province or Territory of the *Place of the Work* permit such agreement. If the applicable limitation statute does not permit such agreement, within such shorter period as may be prescribed by:
- .1 any limitation statute of the Province or Territory of the *Place of the Work*; or
 - .2 if the *Place of the Work* is the Province of Quebec, then Article 2118 of the Civil Code of Quebec.
- 12.2.5 The *Owner* waives and releases the *Contractor* from all claims referenced in paragraph 12.2.3.6 except for those referred in paragraph 12.2.3.2, 12.2.3.3 and those arising under GC 12.3 – WARRANTY and claims for which *Notice in Writing* has been received by the *Contractor* from the *Owner* within 395 calendar days following the date of *Substantial Performance of the Work*.
- 12.2.6 “*Notice in Writing* of claim” as provided for in GC 12.2 – WAIVER OF CLAIMS to preserve a claim or right of action which would otherwise, by the provisions of GC 12.2 – WAIVER OF CLAIMS, be deemed to be waived, must include the following:
- .1 a clear and unequivocal statement of the intention to claim;
 - .2 a statement as to the nature of the claim and the grounds upon which the claim is based; and
 - .3 a statement of the estimated quantum of the claim.
- 12.2.7 The party giving “*Notice in Writing* of claim” as provided for in GC 12.2 – WAIVER OF CLAIMS shall submit within a reasonable time a detailed account of the amount claimed.

- 12.2.8 Where the event or series of events giving rise to a claim made under paragraphs 12.2.1 or 12.2.3 has a continuing effect, the detailed account submitted under paragraph 12.2.7 shall be considered to be an interim account and the party making the claim shall submit further interim accounts, at reasonable intervals, giving the accumulated amount of the claim and any further grounds upon which it is based. The party making the claim shall submit a final account after the end of the effects resulting from the event or series of events.
- 12.2.9 If a *Notice in Writing* of claim pursuant to paragraph 12.2.1.1 is received on the seventh or sixth calendar day before the expiry of the lien period provided by the lien legislation applicable at the *Place of the Work*, the period within which *Notice in Writing* of claim shall be received pursuant to paragraph 12.2.3.1 shall be extended to two calendar days before the expiry of the lien period provided by the lien legislation applicable at the *Place of the Work*.
- 12.2.10 If a *Notice in Writing* of claim pursuant to paragraph 12.2.3.1 is received on the seventh or sixth calendar day before the expiry of the lien period provided by the lien legislation applicable at the *Place of the Work*, the period within which *Notice in Writing* of claim shall be received pursuant to paragraph 12.2.1.1 shall be extended to two calendar days before the expiry of the lien period provided by the lien legislation applicable at the *Place of the Work*.

GC 12.3 WARRANTY

- 12.3.1 Except for extended warranties as described in paragraph 12.3.6, the warranty period under the *Contract* is one year from the date of *Substantial Performance of the Work*.
- 12.3.2 The *Contractor* shall be responsible for the proper performance of the *Work* to the extent that the design and *Contract Documents* permit such performance.
- 12.3.3 The *Owner*, through the *Consultant*, shall promptly give the *Contractor Notice in Writing* of observed defects and deficiencies which occur during the one year warranty period.
- 12.3.4 Subject to paragraph 12.3.2, the *Contractor* shall correct promptly, at the *Contractor's* expense, defects or deficiencies in the *Work* which appear prior to and during the one year warranty period.
- 12.3.5 The *Contractor* shall correct or pay for damage resulting from corrections made under the requirements of paragraph 12.3.4.
- 12.3.6 Any extended warranties required beyond the one year warranty period as described in paragraph 12.3.1, shall be as specified in the *Contract Documents*. Extended warranties shall be issued by the warrantor to the benefit of the *Owner*. The *Contractor's* responsibility with respect to extended warranties shall be limited to obtaining any such extended warranties from the warrantor. The obligations under such extended warranties are solely the responsibilities of the warrantor.

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CCDC INSURANCE REQUIREMENTS

PUBLICATION DATE: JANUARY 21, 2008

1. General liability insurance shall be with limits of not less than \$5,000,000 per occurrence, an aggregate limit of not less than \$5,000,000 within any policy year with respect to completed operations, and a deductible not exceeding \$5,000. The insurance coverage shall not be less than the insurance provided by IBC Form 2100 (including an extension for a standard provincial and territorial form of non-owned automobile liability policy) and IBC Form 2320. To achieve the desired limit, umbrella or excess liability insurance may be used. Subject to satisfactory proof of financial capability by the *Contractor*, the *Owner* may agree to increase the deductible amounts.
2. Automobile liability insurance in respect of vehicles that are required by law to be insured under a contract by a Motor Vehicle Liability Policy, shall have limits of not less than \$5,000,000 inclusive per occurrence for bodily injury, death and damage to property, covering all vehicles owned or leased by the *Contractor*. Where the policy has been issued pursuant to a government-operated automobile insurance system, the *Contractor* shall provide the *Owner* with confirmation of automobile insurance coverage for all automobiles registered in the name of the *Contractor*.
3. Aircraft and watercraft liability insurance with respect to owned or non-owned aircraft and watercraft (if used directly or indirectly in the performance of the *Work*), including use of additional premises, shall have limits of not less than \$5,000,000 inclusive per occurrence for bodily injury, death and damage to property including loss of use thereof and limits of not less than \$5,000,000 for aircraft passenger hazard. Such insurance shall be in a form acceptable to the *Owner*.
4. "Broad form" property insurance shall have limits of not less than the sum of 1.1 times *Contract Price* and the full value, as stated in the *Contract*, of *Products* and design services that are specified to be provided by the *Owner* for incorporation into the *Work*, with a deductible not exceeding \$5,000. The insurance coverage shall not be less than the insurance provided by IBC Forms 4042 and 4047 (excluding flood and earthquake) or their equivalent replacement. Subject to satisfactory proof of financial capability by the *Contractor*, the *Owner* may agree to increase the deductible amounts.
5. Boiler and machinery insurance shall have limits of not less than the replacement value of the permanent or temporary boilers and pressure vessels, and other insurable objects forming part of the *Work*. The insurance coverage shall not be less than the insurance provided by a comprehensive boiler and machinery policy.
6. "Broad form" contractors' equipment insurance coverage covering *Construction Equipment* used by the *Contractor* for the performance of the *Work*, shall be in a form acceptable to the *Owner* and shall not allow subrogation claims by the insurer against the *Owner*. Subject to satisfactory proof of financial capability by the *Contractor* for self-insurance, the *Owner* may agree to waive the equipment insurance requirement.
7. Standard Exclusions
 - 7.1 In addition to the broad form property exclusions identified in IBC forms 4042(1995), and 4047(2000), the *Contractor* is not required to provide the following insurance coverage:
 - Asbestos
 - Cyber Risk
 - Mould
 - Terrorism