



REQUEST FOR PROPOSAL 016321
WITH ADDENDA 1 TO 6

VOLUME 1 OF 3

KEYASK GENERATING STATION

DESIGN, MANUFACTURE, SUPPLY AND
INSTALLATION OF HYDROELECTRIC TURBINES
& GENERATORS

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SEPTEMBER 22, 2011

ADDENDA 1 TO 6

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**KEYYASK GENERATING STATION
DESIGN, MANUFACTURE, SUPPLY AND INSTALLATION OF
HYDROELECTRIC TURBINES & GENERATORS**

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Accompanying CD containing the Appendices A through FF for Volume 1 of Request for Proposal 016321 will be sent to Proponents.

VOLUME 2 - TECHNICAL REQUIREMENTS

VOLUME 3 – BURNTWOOD/NELSON COLLECTIVE AGREEMENT (BNA)

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DEFINITIONS

DEFINITIONS

“Actual Cost”	shall mean the actual and direct costs to the Contractor which excludes GST and PST of all labour (including the cost of workers’ compensation assessments, vacation pay, employment insurance, pension plan payments and any other employee benefits paid by the Contractor), equipment rentals, all supplies and materials, and delivery and transportation, reasonably and properly incurred by the Contractor but shall not include any allowance to any person, including without limitation the Contractor, for profit, office expenses, general superintendence, any mark-up, or any other expenses claimed by the Contractor to result from an addition to, deletion from or modification of the Work or termination of the Contract, as applicable.
“Association”	shall have the meaning set out in Section 31 HYDRO PROJECT MANAGEMENT ASSOCIATION of the General Requirements.
“BNA”	shall mean the Burntwood/Nelson Agreement dated October 7, 2005 as amended from time to time.
“Change Order”	shall mean the document or documents by which the Contractor is authorized to proceed with an amendment, deletion from or, addition to the Work as specified in such document and in accordance with the terms and conditions set out therein and in the Contract.
“Completion Certificate”	shall mean the certificate issued by the Purchaser in accordance with Section 31 COMPLETION CERTIFICATE of the General Conditions.
“Contract”	shall mean the agreement entered into between the Purchaser and the Contractor for the Work to be done and material and equipment to be furnished in accordance with the Cover Agreement, the Definitions, the General Requirements, the General Conditions, the Technical Requirements, the Terms and Conditions of Payment, the Contractor’s Proposal, and any Purchase Orders issued in relation to the Work, all of which will be either referred to in or attached to and form part of said agreement. It shall also mean the Notice to Proceed and all Work Instructions, Extra Work Orders, Change Orders, specifications and drawings which further detail, explain or modify the Work, even though such documents are issued after the execution of said agreement.
“Contract Dates”	shall mean those dates and durations identified as such in Section 8 CONTRACT SCHEDULE of the General Requirements.
“Contract Price”	shall mean i) in respect of the whole of the Work, the total price to be paid by the Purchaser to the Contractor for the whole of the Work exclusive of all applicable taxes and ii) in respect of any given ITEM of the Work, the total price to be paid by the

	Purchaser to the Contractor for that ITEM of the Work, exclusive of all applicable taxes, in both cases in accordance with the terms and conditions of the Contract.
“Contract Schedule”	shall mean the schedule that has been approved by the Engineer in accordance with Section 8 CONTRACT SCHEDULE of the General Requirements and any revisions properly approved thereto.
"Contractor"	shall mean the party or parties named as such in the Contract and the legal personal representatives, successors and assigns of the Contractor.
“Council”	shall have the meaning set out in Section 32 BURNTWOOD/NELSON AGREEMENT of the General Requirements.
“Cover Agreement”	shall mean the agreement which formally accepts the negotiated proposal of a Proponent and incorporates by reference all documents which will form part of the Contract as well as any modifications to such documents as may have been agreed to by the parties during the course of negotiating this Request.
“Drawings”	shall have the meaning set out in Subsection 36.1 Drawings of the General Conditions.
"Engineer"	shall mean the person or entity as the case may be, named in the Contract and appointed by the Purchaser to take charge of the Work in accordance with the Contract with all of the duties, responsibilities and authority set out therein. The term “Engineer” means the Engineer or the Engineer’s authorized representative(s).
"Environmental Regulations"	shall mean all environmental protection plans, licences, permits, statutes, laws, policies, rules, regulations, orders, directives and guidelines in effect from time to time (including any amendments thereto or replacements thereof) applicable to or concerning the Work, or any part thereof as made by Manitoba Hydro, or by governments or government boards or agencies having jurisdiction over the work and activities of Manitoba Hydro (including the Work, or any part thereof).
“Extra Work Order”	shall mean the document or documents by which the Contractor is authorized to proceed with an amendment, deletion from or, addition to the Work as specified in such document and in accordance with the terms and conditions set out therein and in the Contract.
“Form of Proposal”	shall mean the document of the same name included with this Request that is required to be completed by the Proponent in responding to this Request.
“Hydro Property”	shall mean any and all property, whether real, personal, tangible or intangible, and regardless of medium, form or format, including any information, data, documents, equipment,

	materials or supplies, provided by the Purchaser to the Contractor, or acquired by the Contractor for or on behalf of the Purchaser, or to which access has been given or made available, in the course of, or incidental to, the performance of the Work or otherwise.
“Information”	shall have the meaning set out in Section 37 CONFIDENTIALITY of the General Conditions.
"ITEM"	shall mean a separate and designated part of the Work as defined in this Request and proposed upon in the Contractor’s Proposal.
“JKDA	shall mean the Joint Keeyask Development Agreement between Tataskweyak Cree Nation and War Lake First Nation operating as Cree Nation Partners, York Factory First Nation, Fox Lake Cree Nation and the Purchaser dated May 29, 2009.
“KCN”	shall mean the Keeyask Cree Nations consisting of Tataskweyak Cree Nation and War Lake First Nation operating as Cree Nation Partners, York Factory First Nation and Fox Lake Cree Nation.
“Keeyask Project”	shall have the meaning set out in Section 4 KEYASK GENERATING STATION of the General Requirements.
“Model Test Report of Record”	shall have the meaning set out in Subsection 5.6 Model Test of the Technical Requirements.
"Notice to Proceed"	shall mean the document or documents by which the Purchaser provides notice that all conditions in favour of the Purchaser necessary to proceed with ITEMS 2 to 10 of the Work have either been satisfied or waived and that authorizes the Contractor to proceed with such ITEMS of the Work in accordance with the Contract. The Notice to Proceed may take the form of a Purchase Order, in the Purchaser’s sole discretion, provided such Purchase Order references that it is a Notice to Proceed.
“Option” and “Option Period”	shall have the respective meanings set out in Section 2 PURCHASERS OPTION of the General Requirements.
"other contractor" or "another contractor"	shall mean any person, firm or corporation employed by or having a contract directly or indirectly with Manitoba Hydro otherwise than through the Contractor.
“Performance Based Payment Milestone”	shall have the meaning set out in Subsection 7.1 Performance Based Payments of the Terms and Conditions of Payment.
"Plant”	shall mean all vehicles, transportation equipment, construction equipment, erection and installation equipment, falsework, forms, scaffolding, cofferdams, crushers, boilers, temporary storehouses and other temporary structures, lumber, timber, materials, power tools, machinery, appliances and apparatus which are brought on or constructed upon the Site by the Contractor for use in the performance of the Work.
<i>Preliminary</i>	<i>Information provided by one party to another pursuant to the Request or the Contract, as the case may be, that is subject to</i>

	<i>change but which the party providing such information represents and warrants is accurate, complete and the most current information available at the time of such provision to the best of that party's knowledge.</i>
"Proponent"	shall mean, as the context requires, any party or parties proposing on one or more of the various classes of Work and the successful Proponent who later becomes the Contractor for such Work.
"Proposal"	shall mean the Form of Proposal, as completed by a Proponent and submitted to Manitoba Hydro in response to this Request, and upon execution of the Contract, shall mean the final form of Contractor's Proposal included as part of the Contract.
"Purchase Order"	shall mean the document or documents issued, by the Purchaser, if any, entitled "Purchase Order" and shall include all Change Orders.
"Purchaser"	shall mean Manitoba Hydro, its successors and assigns.
"QAR" or "Purchaser's Quality Assurance Representative"	shall mean the person(s), firm(s) or corporation(s) authorized by the Purchaser to inspect any part or parts of the Work to be done and/or material to be furnished pursuant to the Contract, acting directly or through its respective properly authorized assistants or agents.
"Reference Points"	shall have the meaning set out in Section 4 REFERENCE POINTS of the General Conditions
"Request"	means this Request for Proposal 016321 and all addenda and documents attached to or incorporated by reference therein.
"Site"	shall mean the place or places where the Work is to be installed for the Purchaser, and the immediate vicinity of such place or places as further described in Section 4 SITE LOCATION AND ACCESS of the General Requirements.
"Subcontractor"	shall mean a person, firm or corporation having a contract with the Contractor for part of the Work, including without limitation the furnishing of labour, material, supplies, equipment or apparatus therefor.
"Superintendent"	shall mean the duly appointed representative of the Contractor on duty at the Site.
"Tools"	shall mean all small hand tools, other than power tools, including without limitation, picks, shovels, crow bars, sledge hammers, bolt cutters, files, fish tapes, pumps, ropes, ladders, grips and clamps which are brought upon the Site by the Contractor or by any employee of the Contractor for the performance of the Work.
"Unit"	shall mean the reference to a complete turbine generator including but not limited to all concrete, structures and associated equipment required to place the turbine generator into service and as further detailed in the Contract.

"Work"	shall mean all of the various classes of work to be done, executed and performed, whether temporary or permanent, and all Drawings, equipment, apparatus, machinery and materials to be furnished and supplied by the Contractor pursuant to the Contract.
"Work Release Certificate"	shall mean the certificate issued by the Purchaser in accordance with Section 30 WORK RELEASE CERTIFICATE of the General Conditions.

NOTE: Where the context so requires, the singular number shall be read as if the plural were expressed and the masculine or neuter gender as if the masculine, feminine or neuter were expressed.



INSTRUCTIONS TO PROPONENTS

KEYYASK GENERATING STATION DESIGN, MANUFACTURE, SUPPLY AND INSTALLATION OF HYDROELECTRIC TURBINES & GENERATORS

INSTRUCTIONS TO PROPONENTS

1 INVITATION

Proposals must be submitted electronically at or before 16:00 hours, Manitoba local time, October 14, 2011. The Proposal must be submitted electronically through MERX (www.merx.com) in .pdf electronic format, with appropriate bookmarks and organization to allow for easy navigation. It is the Proponent's sole responsibility to ensure successful transmission and receipt of its Proposal by Manitoba Hydro. Manitoba Hydro shall not be responsible for any failure to receive a Proponent's Proposal or for any errors or omissions contained in such Proposal as a result of electronic submission or format.

The Proposal shall clearly reference that it is a response to:

Request for Proposal 016321

Design, Manufacture, Supply and Installation of Hydroelectric Turbines & Generators

Keeyask Generating Station

NOTE: This Request is not a legal offer but only an invitation to provide information.

2 GENERAL INTERPRETATION

Defined words and phrases used in this Request have the meanings ascribed to them in the Definitions section at the front of this Request, or as expressly defined elsewhere in this Request. All reference to days or weeks in this Request shall mean calendar days or calendar weeks, as applicable. Headings are used for convenience only, and they shall not affect the interpretation or meaning of the clauses, terms and conditions.

3 ENQUIRIES

Enquiries concerning this Request are to be in writing, using the PROPOSAL CLARIFICATION FORM attached as **Appendix A**, sent by fax or email only to:

Lucena Scanlon

Purchasing Department
Manitoba Hydro
P.O. Box 815
Winnipeg, Manitoba
R3C 2P4, Canada
e-mail: lscanlon@hydro.mb.ca

Enquiries should be submitted not less than twenty (20) calendar days prior to the date of closing for receipt of proposals. Enquiries received after that time may not be considered and/or answered.

Where a Proponent seeks clarification of this Request involving its internal intellectual property or proprietary business information, Manitoba Hydro shall not release such information to other Proponents; however, Manitoba Hydro reserves the right to notify other prospective Proponents of:

- (a) updates or changes to this Request involving correction of errors identified by one or more Proponents;
- (b) deviations from any particular constraint or requirement set forth in this Request, as a result of a request for deviation from one or more Proponents that Manitoba Hydro, in its sole discretion, deems acceptable; and
- (c) enquiries from a Proponent not involving its intellectual property or proprietary business information that Manitoba Hydro deems necessary or advisable to communicate to other prospective Proponents.

A Proponent shall not be entitled to rely on any response or interpretation received in respect of an enquiry unless that response or interpretation was provided via an addendum to this Request.

4 KEYYASK GENERATING STATION

The Keeyask Generating Station is proposed to be located in northern Manitoba on the Nelson River, at the base of Gull Rapids, 185 km northeast of Thompson, Manitoba.

The Keeyask Generating Station will consist of the proposed hydroelectric generating station and related works, including all dams, dykes, channels, excavations and roads which, if built, will contribute approximately 695 megawatts to Manitoba Hydro's integrated power system (the "Keeyask Project").

On May 29, 2009, the KCN and Manitoba Hydro signed the Joint Keeyask Development Agreement (the "JKDA") regarding potential development of the Keeyask Project. The JKDA sets out the terms and conditions upon which the

Keeyask Hydropower Limited Partnership shall proceed with the development of the Keeyask Project.

Manitoba Hydro is contracted to act as project manager to complete the planning, design and engineering and to construct and commission the Keeyask Project including the Work. The Keeyask Project will be constructed in a manner similar to other hydroelectric generation projects, pursuant to a variety of large and small contracts. Manitoba Hydro has final decision-making authority with respect to all matters arising out of the negotiation and contract award of the Work, in accordance with Section 5 PROPOSAL ACCEPTANCE PROCESS of these Instructions to Proponents, as well as with respect to the management of the Work and this Request.

5 PROPOSAL ACCEPTANCE PROCESS

5.1 *General Process*

This Request is not a legal offer and is not a tender process.

Manitoba Hydro desires, through *an evaluation and* negotiation process, to *award* a Contract for the performance of the Work described in this Request.

Proposals submitted in response to this Request are for information and *evaluation*/negotiation/discussion purposes only. A Proposal submitted by a Proponent shall not be binding upon Manitoba Hydro or the Proponent; however, any components of a Proposal *may* be relied upon by Manitoba Hydro as the Proponent's position in any negotiations for a final form of Contract. ***Manitoba Hydro will select its preferred Proponent for negotiation of a final Contract; however,*** Manitoba Hydro reserves the right, in its unfettered discretion, to undertake negotiations with *other* Proponent(s) submitting a Proposal in response to this Request ***should Manitoba Hydro determine that negotiations with its preferred Proponent are unsuccessful.***

5.2 *Evaluation*

Proposal evaluation will begin upon closing of this Request according to the date specified in Section 1 INVITATION of the Instructions to Proponents.

The evaluation period will take approximately 4 months. During this time, Manitoba Hydro may request amendments to a Proposal. Such amendments shall be submitted in accordance with Section 18 WITHDRAWAL/AMENDMENT OF PROPOSAL of the Instructions to Proponents.

Upon completion of the evaluation, Proponents will be notified that Manitoba Hydro's evaluation is complete.

Manitoba Hydro reserves the right, in its unfettered discretion, to complete its evaluation of Proposals at any time, including earlier than the above specified timeframe or to extend the completion of the evaluation period beyond the above specified timeframe without formally notifying Proponents.

5.3 Commercial Terms

The Definitions, General Requirements, General Conditions, Technical Requirements, Terms and Conditions of Payment and the Form of Proposal describe the scope of work, the technical needs, and the commercial needs of Manitoba Hydro with respect to this Request. Manitoba Hydro is interested in receiving Proposals that meet the commercial terms outlined in this Request. However, the Proponent may note on the corresponding page in the Form of Proposal, any commercial terms which it wishes to be addressed during any negotiations that may be conducted with respect to the Proponent's Proposal. In such event, the Proponent shall provide its alternative wording for addressing the term(s) in question. Such alternatives shall be taken into consideration in evaluating the Proponent's Proposal.

5.4 Clarifications/Further Information

During its evaluation, Manitoba Hydro may, in its sole unfettered discretion, request one or more Proponents to provide information or documentation clarifying any matter(s) contained in, or concerning, its Proposal. In respect of any clarifications, Manitoba Hydro shall have no duty or obligation to advise any other Proponent of the same.

5.5 Presentations

During its evaluation of Proposals, one or more Proponents may be invited, at the Proponent's expense, to attend at Manitoba Hydro's facilities in Winnipeg to make a presentation or participate in an interview concerning its Proposal after the closing date of this Request.

5.6 Negotiation Process

Following presentations and interviews with selected Proponents, Manitoba Hydro intends to select its preferred Proponent and commence final negotiations; however, Manitoba Hydro shall be free to terminate negotiations with such preferred Proponent at any time and enter into negotiations with its next preferred Proponent.

Proponents submitting a Proposal are advised that Manitoba Hydro intends to conduct any negotiation required with respect to any selected Proposals through an intensive and condensed process. Such process will require a selected Proponent to make its representative(s) with sufficient decision-making authority available in Winnipeg for day and/or week-long off-site negotiating sessions as may be required to conclude a final Contract. Proponents shall be responsible for all of their costs and expenses associated with such process.

5.7 Requirement for Contract

Manitoba Hydro and its preferred Proponent shall evidence an agreement to proceed with and to perform the Work by the execution of a formal written agreement. Until execution of Contract by both parties, there shall be no legal or other binding obligations created on the part of either party with respect to the Work or any matter related to the Work or this Request except as specifically agreed to by the Proponent in signing and submitting its Proposal in response to this Request and by the Proponent in the confidentiality agreement entered into between Manitoba Hydro and the Proponent in relation to this Request.

5.8 Manitoba Hydro Privilege/Discretion

Notwithstanding any industry or trade custom or past practices of Manitoba Hydro to the contrary, Manitoba Hydro does not represent that it will necessarily, and Manitoba Hydro shall not be obliged to, accept any Proposal, accept the lowest priced Proposal, or be precluded from accepting any Proposal or other offer or negotiating further in respect of any Proposal submitted. Manitoba Hydro reserves the right, and the Proponent acknowledges that Manitoba Hydro has the right, to reject any, or all, Proposals, for any reason, or to negotiate or accept any Proposal which Manitoba Hydro in its sole unfettered discretion deems advantageous to itself.

Manitoba Hydro reserves the right in its sole unfettered discretion to accept, waive or reject any non-compliance or irregularity, including, without limitation, the right to accept, waive, or reject non-compliance or irregularity with the proposal process and/or the submission requirements of this Request.

Manitoba Hydro reserves the right to cancel this Request for any reason whatsoever, in Manitoba Hydro's sole and unfettered discretion, either before or after the date of closing and regardless of whether or not any Proposals have been received.

Manitoba Hydro reserves the right, for any reason whatsoever, to re-issue a request for proposals or tender for all or any part of the Work referred to in this Request, at any time, including after the date of closing, in Manitoba Hydro's sole and unfettered discretion.

6 CONDITIONS FOR AWARD OF CONTRACT

Manitoba Hydro expects to award a firm Contract for ITEM 1 of the Work prior to environmental licensing and project commitment for the Keeyask Project. The following events must occur before the Purchaser will be in a position to authorize the Contractor to proceed with ITEMS 2 to 10 of the Work:

- (a) Manitoba Hydro's acceptance of successful model tests and reporting of same pursuant to ITEM 1 of the Work;
- (b) Receipt by the Keeyask Hydropower Limited Partnership of all approvals and/or licences required under any federal or provincial legislation to proceed with the construction and operation of the Keeyask Project generally and the Work in particular;
- (c) That no deficiency notice shall have been delivered to the Keeyask Hydropower Limited Partnership in respect of the licence for the Keeyask Project which has not been resolved;
- (d) That there is no order or injunction entered in any action or proceeding in any court of competent jurisdiction, or by any governmental authority having jurisdiction over the enforcement of the applicable laws, making illegal or prohibiting the development of the Keeyask Project;
- (e) That the Keeyask Hydropower Limited Partnership shall own, or be entitled to own, the lands upon which the Keeyask Project, including the Work, is to be constructed and/or installed;
- (f) Manitoba Hydro Board approval to proceed with ITEMS 2 to 10 of the Work.

In the interim period prior to the occurrence of the above events, Manitoba Hydro is prepared to enter into a Contract for the Work with its preferred Proponent, if any, upon certain conditions. The Contract shall be a firm commitment to proceed with ITEM 1 of the Work while recognizing that proceeding with ITEMS 2 to 10 of the Work will be conditional upon the satisfactory resolution of the events listed above, the satisfaction or waiver of which by the Purchaser shall be evidenced by the issuance of a Notice to Proceed by the Purchaser to the Contractor for ITEMS 2 to 10 of the Work. The Notice to Proceed shall be the Contractor's authorization to commence and proceed with ITEMS 2 to 10 of the Work in accordance with the Contract.

7 SCHEDULE OF THE WORK

Manitoba Hydro expects that the key Keeyask Project milestones in relation to the Work will proceed according to the following dates:

Award of a Contract for ITEM 1 of the Work	August 2012
Issuance of the Final Model Tests	August 2013
Purchaser's Acceptance of the Model Tests and Reports	November 2013
Receipt of Environmental License & Government Approval	June 2014
Authorization to Proceed with ITEMS 2 to 10 of the Work	September 2014
Target In-Service Date (first power)	November 2019

The above dates are subject to change at any time in Manitoba Hydro's sole discretion.

8 FORM OF PROPOSAL

The Proponent is required to use the Form of Proposal attached hereto. Detailed information with respect to its completion is located in applicable sections in the General Requirements, the Technical Requirements and on the applicable page in the Form of Proposal. If any Form of Proposal page is found to have insufficient space, the Proponent is requested to attach a sheet or sheets immediately after the applicable page.

The Proponent is encouraged to include in its Proposal thorough and sufficient information concerning matters under consideration.

Manitoba Hydro shall own all information submitted by a Proponent in its Form of Proposal and shall have the right to use such information for any purpose whatsoever. *All* information submitted in a Form of Proposal shall be treated as confidential, unless otherwise specified in this Request or agreed to in writing by a Proponent and Manitoba Hydro.

9 ADDENDA

Manitoba Hydro may, at any time prior to the date and time of closing, issue addenda changing this Request and such addenda shall be an integral part of this Request.

10 SITE EXAMINATION AND ADDITIONAL INFORMATION

Before proposing, the Proponent shall be deemed to have made a careful examination of the Site to satisfy itself as to the working conditions, the nature and extent of the Work, risks associated with the Work, the obstacles or difficulties that may be encountered, and any other matters and things necessary to a proper understanding of the Work, the Site, and the conditions under which the Contract and the Work will be performed.

The Proponent shall be solely responsible for any errors, omissions or misunderstandings resulting from the Proponent's failure to make a thorough examination of the Site and obtain such information.

Manitoba Hydro may arrange a Site visit if the demand warrants it. Proponents interested in examining the Site should contact:

Mr. Brian Beyak, P.Eng.
Keeyask Project Engineering
Manitoba Hydro
Phone:(204) 360-7747
email:bbeyak@hydro.mb.ca

11 EVIDENCE OF PROPONENT'S ABILITY, EXPERIENCE, CAPITAL AND PLANT

Manitoba Hydro may require the Proponent to furnish evidence, in addition to any provided by the Proponent in its Proposal, satisfactory to Manitoba Hydro, that the Proponent has the ability, experience, capital and Plant required to undertake and perform the Work successfully, and complete it within the time specified.

Manitoba Hydro may inspect or audit any Plant that the Proponent proposes to use for performing the Work.

12 EVALUATED COST

12.1 General

The Proponent shall optimize the design of the turbine and generator taking into consideration construction costs, maintenance and operation costs, the Contract Schedule and the Unit's performance.

The measure of optimization will be Evaluated Cost. The Proponent shall optimize the design of the turbine and generator to provide Manitoba Hydro with

the lowest Evaluated Cost. Evaluated Cost is defined in Subsection 12.2 Definition.

12.2 Definition

Manitoba Hydro defines Evaluated Cost as follows:

$$\text{Evaluated Cost} = \text{Present Value of Proposal Cost} + \text{Construction Cost Adjustment} + \text{Schedule Cost Adjustment} + \text{Performance Cost Adjustments}$$

Each component of the Evaluated Cost is described in the following subsections.

12.2.1 Present Value of the Proposal Cost

Manitoba Hydro will calculate the present value of the Proponent's proposed price for the Work using the Proponent's work schedule and detailed cashflow. An annual *discount* rate of 8.5% will be applied.

Industrial offsets will be evaluated and, if deemed acceptable, the present value of the net economic benefit shall be deducted from the Proponent's Present Value of the Proposal Cost.

12.2.2 Construction Cost Adjustment

(a) General

Manitoba Hydro will calculate the Construction Cost Adjustment (CCA) by estimating the required volumes of rock to be excavated and concrete to be placed for the powerhouse. For determining the CCA, the powerhouse will be deemed to include the intake channel and intake, powerhouse and tailrace blocks. The CCA is defined as the sum of the estimated cost of the concrete required and the estimated cost of the rock excavation required.

Manitoba Hydro will use a 3-D model to estimate the required volumes based on the Proponent's proposed water passages. An electronic copy of the 3-D model is provided with this Request to permit Proponents to evaluate their own proposed water passages.

(b) Cost of Rock Excavation and Concrete Placement

The estimated cost of the concrete required is calculated by multiplying the estimated volume of concrete placement required by the unit cost of concrete placement. The estimated cost of rock excavation is calculated by multiplying the estimated volume of rock excavation that exceeds 2,000,000 m³ by the unit cost of rock excavation in the table below. If the estimated volume of rock excavation

is less than or equal to 2,000,000 m³ then the estimated cost of rock excavation is \$0.

The following costs will be used to calculate the CCA:

Quantity	Unit Cost (per Cubic Meter)
Rock Excavation	\$30
Concrete Placement	\$1260

(c) Estimation of Required Volumes

Manitoba Hydro has developed an Autodesk[®] Inventor[™] 3-D model to estimate the quantities of rock excavation and placed concrete. Instructions on how to use the model are included in **Appendix O** of this Request.

The general layout of the Units and the Keeyask Generating Station are shown on Manitoba Hydro's drawings included in **Appendix J** of this Request. Included in these figures are dimensions for the Keeyask Project and Units which have been fixed by Manitoba Hydro and shall not be modified by the Contractor during the design of the turbines and generators. In addition, dimensions which are to be set by the Proponent and are to be included in the Proponent's Proposal are given as variables on the figures.

(d) Powerhouse Constraints

When designing its water passage, the Proponent shall respect the following constraints:

Constraint No.	Constraint	Rationale	Reference Figure (Appendix J)
1	The draft tube exit slope shall be between 1Vertical:4Horizontal to 1Vertical:20Horizontal.	This is to minimize tailrace head losses downstream of the powerhouse.	1
2	Average intake approach velocity, at a per unit flow of 571.4 m ³ /s, shall be equal to or less than 1.25m/s. The average intake approach velocity is defined as the per unit flow rate, divided by the intake area. The intake area is defined as $(CA - 3.5m) \times CB \times \cos(\alpha)$, where α is the angle between the direction	To prevent trashrack bar vibration.	1

Constraint No.	Constraint	Rationale	Reference Figure (Appendix J)
	<i>of the average velocity, at the trashracks, and a horizontal line, as shown in Figure 1. To determine the direction of the average flow, at the trashracks, the Proponent must perform a Computational Fluid Dynamics (CFD) analysis of the velocities in the intake. The CFD analysis shall begin a minimum of 50m upstream of the trashracks.</i>		
3	<p>The submergence, S, of the intake water passage roof at varying locations (dependent upon the intake floor profile) relative to a minimum forebay elevation of el 158.0m shall meet the following criteria: $S \geq 0.7 \times H$ and $Fr < 0.5$ Where:</p> <p>S = submergence (m) (See Reference Figure 1 in Appendix J for definitions of S and H). $Fr = v/(gH)^{0.5}$ v = velocity at the downstream limit of the piers (m/s) $g = 9.81 \text{ m/s}^2$</p>	To ensure that head loss and vibrations are not excessive and to prevent formation of vortices.	1
4	The intake deck elevation shall be 161.5m.	This is governed by freeboard requirements which are based on the reservoir at its normal maximum elevation, a wave run-up and reservoir setup due to a wind	1
5	The width of the intake deck is fixed at 10 m (Face of wall to curb).	This is governed by traffic requirements and safe speed criteria.	1
6	The width of the intake gate hoist housing is fixed at 6.7 m.	The hoisting width is based on minimum	1

Constraint No.	Constraint	Rationale	Reference Figure (Appendix J)
		dimensions to accommodate the hoist housing building envelope, structural steel framing, and gate hoist bearing requirements	
7	The width of the intake piers is fixed at 2.5 m.	This dimension is constrained for structural reasons	1
8	The intake base slab thickness is fixed at 2.5 m.	This dimension is constrained for structural reasons.	1
9	The minimum dimension between the semi-spiral case soffit and the generator opening is 2 m.	This dimension is constrained for structural reasons.	1
10	The semi spiral case roof minimum thickness is 3m <i>from the 3 o'clock position to the 9 o'clock position (assuming upstream is 12 o'clock).</i>	This dimension is constrained for structural reasons.	1
11	The thickness of the semi-spiral case downstream wall is fixed at 3.5m. <i>To achieve this constraint dimension SR in Section S3, the angle S° for Section S3 must be within 5° of 90°, on figure 5 must be less than or equal to the dimension $GENRADIUS + 4\text{ m}$ on figure 1.</i>	This dimension is constrained for structural reasons.	1
12	The width of the electrical gallery along the mezzanine floor is fixed at 7.5m.	This dimension is constrained to accommodate the electrical and mechanical equipment.	1
13	The thickness of the draft tube elbow base slab is fixed at 3m.	This dimension is constrained for structural reasons.	1
14	The tailrace deck width is fixed at 17.5m.	This dimension is constrained to allow room	1

Constraint No.	Constraint	Rationale	Reference Figure (Appendix J)
		for the transformer pad and to allow traffic on the deck.	
15	The minimum length of the intake piers is 16m.	This dimension is constrained for structural reasons.	1
16	The nose of the draft tube piers will be located a distance TPIER, from the Unit centerline as defined on Figure 1.	This dimension is constrained to provide structural support for the draft tube roof and gallery and the tailrace deck.	1
17	The minimum distance from the intake deck to the water passage roof at the upstream limit of the intake shall be 5.5 m.	This dimension is constrained to ensure that the top of the trashracks are below the underside of the winter ice pack at minimum headwater elevation.	1
18	The thickness of the concrete around the draft tube elbow is fixed at 2.5 m.	This dimension is constrained for structural reasons.	1
19	The minimum distance from the draft tube roof (lowest point) to the floor of the downstream scroll case is 9.0 m.	This dimension is constrained to ensure that there is sufficient room for a draft tube gallery.	1
20	The thickness of the draft tube outside walls is fixed at 2.5 m.	This dimension is constrained for structural reasons.	1
21	The thickness of the intake outside walls is fixed at 2.5 m.	This dimension is constrained for structural reasons.	1
22	The thickness of the draft tube pier is fixed at 2.2 m.	This dimension is constrained for structural reasons.	1
23	The elevation of the generator stator and rotor shall be greater than or equal to 142.1 m.	To prevent potential flooding of key components in the event of a failure of the drainage system	1
24	The minimum distance from the D/S wall of the intake gate hoist housing to the U/S end of the		

Constraint No.	Constraint	Rationale	Reference Figure (Appendix J)
	generator enclosure is 2.3 m.		
25	The volume of concrete required for the powerhouse must be less than or equal to 300,000 m ³ .	This quantity is constrained to ensure that the powerhouse can be built within the planned number of years.	
26	The maximum per unit width, dimension CA, is 32.1 m.	This represents the maximum length that can be economically constructed.	
27	The draft tube stop log slot will be located 13 m from the outside of the D/S powerhouse wall.	To address draft tube gate handling and storage requirements. It has been located as far downstream as possible.	
28	<p>The approximate dimensions of the trashrack, bulkhead stoplogs, intake gate and draft tube stop log slots are:</p> <p>Trashrack 355 mm depth x 650 mm length</p> <p>Bulkhead stoplogs 310 mm depth x 880 mm length</p> <p>Intake gates 600 mm depth x 920 mm length</p> <p>Draft tube stoplogs 310 mm depth x 1100 mm length</p> <p>Where “depth” is the dimension of the guide or slot opening perpendicular to the flow and “length” is parallel to the flow.</p> <p>Actual slot or guide dimensions will be finalized when a preliminary water passage is chosen.</p>		
29	<i>The powerhouse shall pass the</i>	<i>The Purchaser wants to</i>	

Constraint No.	Constraint	Rationale	Reference Figure (Appendix J)
	<i>stability requirements found in the worksheet titled "stability" in the powerhouse model excel file.</i>	<i>ensure there are no stability issues with the powerhouse.</i>	

12.2.3 Schedule Cost Adjustment

The following section defines the value that Manitoba Hydro has placed on installation of the Work. Schedule delays evidenced in a Proponent's Proposal will increase the Proponent's Evaluated Cost for evaluation purposes.

Schedule Advancement:

The Proponent may propose, as a Purchaser's Option, the advancement of installation schedule dates. The proposed advancement will not be used to calculate the Proponent's Evaluated Cost. This must be demonstrated as a decrease to the planned total duration of items 11 and 13 of Subsection 8.4 Contract Dates of the General Requirements.

Schedule Delay:

If the Proponent has demonstrated an increase to the planned total duration of items 11 and 13 of Subsection 8.4 Contract Dates of the General Requirements, the resulting Schedule Cost Adjustment will be:

\$1.3 million per week of delay for 1st Unit
 \$1.3 million per week of delay for 2nd Unit,
 \$1.3 million per week of delay for 3rd Unit
 \$1.3 million per week of delay for 4th Unit
 \$0.6 million per week of delay for 5th Unit
 \$0.3 million per week of delay for 6th Unit
 \$0.3 million per week of delay for 7th Unit

12.2.4 Performance Cost Adjustments

The Performance Cost Adjustment (PCA) is defined as the sum of the value of efficiency, the value of capacity and the cost of cavitation.

The value of efficiency is defined as the weighted plant efficiency (WPE) multiplied by the Unit Efficiency Value in the table below at the end of this Subsection 12.2.4.

The WPE includes entrance, trashrack and exit losses and is defined as:

$$WPE = WTE \times WGE$$

Where:

WTE is defined as the weighted turbine efficiency including entrance, trashrack and exit losses.

WGE is defined as the weighted generator efficiency

Weighted Turbine Efficiency

WTE is calculated by the following formula:

$$WTE = 0.2 \times FGTE_{17.4} \times PHL_{17.4} + 0.6(0.9 \times BGTE_{18.3} \times PHL_{BG18.3} + 0.1 \times FGTE_{18.3} \times PHL_{FG18.3}) + 0.2 \times BGTE_{19.2} \times PHL_{19.2}$$

Where

$FGTE_{17.4}$, $BGTE_{18.3}$, $FGTE_{18.3}$ and $BGTE_{19.2}$ are equal to the values as stated in the Proponent's Proposal.

$PHL_{17.4}$, $PHL_{BG18.3}$, $PHL_{FG18.3}$ and $PHL_{19.2}$ are defined below.

Weighted Generator Efficiency

WGE is calculated by the following formula:

$$WGE = 0.9 \times BGGE_{18.3} + 0.1 \times FGGE_{18.3}$$

Where:

$BGGE_{18.3}$ and $FGGE_{18.3}$ are equal to the values as stated in the Proponent's Proposal.

Hydraulic Losses

The plant hydraulic losses ($PHL_{17.4}$), at full gate, at 17.4 m gross head are defined as:

$$PHL_{17.4} := \frac{17.4 - h_{NL17.4} - h_{TL17.4} - h_{XL17.4}}{17.4}$$

$h_{NL17.4}$ are the entrance losses, at full gate, at 17.4 m gross head

$h_{TL17.4}$ are the trashrack losses, at full gate, at 17.4 m gross head

$h_{XL17.4}$ are the exit losses, at full gate, at 17.4 m gross head

The plant hydraulic losses ($PHL_{BG18.3}$), at best gate, at 18.3 m gross head are defined as:

$$PHL_{BG18.3} := \frac{18.3 - h_{NLBG18.3} - h_{TLBG18.3} - h_{XLBG18.3}}{18.3}$$

$h_{NLBG18.3}$ are the entrance losses, at best gate, at 18.3 m gross head

$h_{TLBG18.3}$ are the trashrack losses, at best gate, at 18.3 m gross head

$h_{XLBG18.3}$ are the exit losses, at best gate, at 18.3 m gross head

The plant hydraulic losses ($PHL_{FG18.3}$), at full gate, at 18.3 m gross head are defined as:

$$PHL_{FG18.3} := \frac{18.3 - h_{NLFG18.3} - h_{TLFG18.3} - h_{XLFG18.3}}{18.3}$$

$h_{NLFG18.3}$ are the entrance losses, at full gate, at 18.3 m gross head

$h_{TLFG18.3}$ are the trashrack losses, at full gate, at 18.3 m gross head

$h_{XLFG18.3}$ are the exit losses, at full gate, at 18.3 m gross head

The plant hydraulic losses ($PHL_{19.2}$), at best gate, at 19.2 m gross head are defined as:

$$PHL_{19.2} := \frac{19.2 - h_{NL19.2} - h_{TL19.2} - h_{XL19.2}}{19.2}$$

$h_{NL19.2}$ are the entrance losses, at best gate, at 19.2 m gross head

$h_{TL19.2}$ are the trashrack losses, at best gate, at 19.2 m gross head

$h_{XL19.2}$ are the exit losses, at best gate, at 19.2 m gross head

Entrance Losses

The entrance losses, at a gross head of XX m, are defined as:

$$h_{NLXX} := K_{NL} \cdot \left[\frac{Q}{(IGB + IGT) \cdot \cos(\theta) \cdot 3 \cdot E} \right]^2$$

Where:

K_{NL} = entrance loss coefficient = 0.15

Q = Volumetric flow rate

IGB, IGT and E are equal to the values as stated in the Proponent's Proposal.

θ is defined as the angle in a vertical plane between the direction of the average velocity, at the intake gate slot, and a horizontal line. The direction of the average velocity, at the intake gate slot, is defined as the average of the angle of the intake floor at the intake gate slots, with respect to a horizontal plane, and the angle of the intake ceiling at the intake gate slots, with respect to a horizontal plane.

$$g = 9.81 \text{ m/s}^2$$

Trashrack Losses

The trash rack losses, at a gross head of XX m, are defined as:

$$h_{TLXX} := K_{TL} \cdot \frac{\left[\frac{Q}{CB \cdot (CA - 3.5) \cdot \cos(\alpha)} \right]^2}{2g}$$

Where:

K_{TL} = trashrack loss coefficient = 0.38

CA and CB are equal to the values as stated in the Proponent's Proposal. *α is the angle between the direction of the average velocity, at the trashracks, and a horizontal line, as shown in Figure 1.*

Exit Losses

The exit losses, at a gross head of XX m, are defined as:

$$h_{XLXX} := K_{XL} \cdot \alpha \cdot \frac{\left[\frac{Q}{DE \cdot (DD - 0.2) \cdot \cos(\beta)} \right]^2}{2g}$$

Where:

K_{XL} = exit loss coefficient = 1.0

α = kinetic energy correction factor = 1.1

DD and DE are equal to the values as stated in the Proponent's Proposal.

β is defined as the angle in a vertical plane between the average angle of the draft tube exit and a horizontal line. The average angle of the draft tube exit is defined as the average of the angle of the draft tube floor, with respect to a horizontal plane, and the angle of the draft tube ceiling, with respect to a horizontal plane.

The value of capacity is defined as the guaranteed weighted Unit capacity multiplied by the Unit Capacity Value in the table below.

The guaranteed weighted Unit capacity is defined as:

$$0.2 \times FGC_{17.4} + 0.6(0.9 \times BGC_{18.3} + 0.1 \times FGC_{18.3}) + 0.2 \times BGC_{19.2}$$

FGC_{17.4}, BGC_{18.3}, FGC_{18.3} and BGC_{19.2} are equal to the values as stated in the Proponent's Proposal.

The cost of cavitation is defined as the guaranteed cavitation limit as stated in the Proponent's Proposal multiplied by the Cavitation Value in the table below.

Note that the Unit Efficiency and Unit Capacity Values are shown as negative values. They are being treated as credits, not costs.

The Performance Cost Adjustments are listed below:

Performance Criteria	Value
Unit Efficiency	- \$27,000,000/percent efficiency
Unit Capacity	-\$931/kW
Cavitation	\$325,500/kg/8000 hr

13 PROPOSAL VARIATIONS

13.1 Alternative Methods, Procedures, Schedules, Sequences or Environmentally Preferable Products/Services

The Proponent shall provide a Proposal for the Work in accordance with the requirements of this Request. In addition, if an alternative method, procedure, schedule, sequence or environmentally preferable product(s)/service(s) is offered, the Proponent shall state clearly in what way it differs from this Request, why such alternative is offered and how, in the Proponent's opinion, it will benefit Manitoba Hydro. This information shall be detailed in the corresponding page in the Form of Proposal, or summarized on that page and detailed in an annex to the Form of Proposal.

It is the desire of Manitoba Hydro to use environmentally preferable products and/or services, if practicable. Proponents able to supply products and/or services that are environmentally preferable, and that meet performance requirements, are encouraged to offer them as an alternative to their Proposal. If such alternative product(s) and/or service(s) can be demonstrated to be environmentally preferable when compared to that specified in this Request, Proponents are requested to provide complete details of such product(s) and/or service(s) in the Form of Proposal, or summarized on that page and detailed in an annex to the Form of Proposal.

In no event will Manitoba Hydro be required to offer any modified terms to any other Proponent prior to negotiating or entering a contract for, or containing, an alternative offered by a Proponent.

13.2 Lower Bracket

For the purpose of preparing this Request, the Purchaser has made the assumption that the generator will be supplied with a lower bracket complete with a thrust

bearing and generator guide bearing. This assumption was made to simplify the Request. The Proponent may choose to supply a lower bracket, as assumed, or may locate the thrust bearing on the head cover and have a generator guide bearings(s) above and/or below the rotor. Manitoba Hydro has no preference for the bearing arrangement. The Proponent must be able to demonstrate the successful application of its proposed arrangement in at least three applications of similar size and loading.

14 LANGUAGE

Proposals must be prepared and submitted in the English language, including the Form of Proposal and all other submissions requested by this Request.

15 UNBALANCED PROPOSALS

The Proponent is advised that manifestly unbalanced unit prices or lump sum prices proposed may not be considered by Manitoba Hydro.

16 JOINT VENTURES/CONSORTIA

A Proponent which is comprised of more than one legal entity, such as a joint venture or consortium of corporations, is to identify its duly appointed leader in its proposal.

A Proponent is to execute its proposal disclosing the proper legal name of each separate legal entity involved, and the office of each individual signing on behalf of each such separate legal entity.

Where more than one legal entity combines to form a Proponent, all such entities shall be jointly and severally bound by the Proposal submitted, and any resulting Contract awarded.

A copy of a written agreement binding the legal entities involved in each Proposal shall be provided to Manitoba Hydro upon request. If no such writing exists at the time of request, it may be necessary for such entities to document their arrangement to fulfill such requirement at any time, including after the time and date of closing for receipt of Proposals and before or after an award of a Contract.

Where a Proponent is or includes a First Nation Band, its Proposal shall be accompanied by a Band Council Resolution authorizing the provision of the Proposal on behalf of the First Nation Band.

17 SIGNING OF PROPOSALS

A Proposal submitted by:

- a) an individual shall be signed by the individual in the presence of a subscribing witness;
- b) a corporation shall be signed by the properly authorized signing officer or officers and the corporate seal affixed or by the properly authorized signing officer or officers in the presence of a subscribing witness or witnesses; or,
- c) a partnership or joint venture shall be signed by all partners or joint venturers in the presence of a subscribing witness or witnesses.

Manitoba Hydro may require evidence of the authority of any person purporting to sign a Proposal on behalf of a person, firm or corporation, whether as principal, agent or attorney. Each signature shall be accompanied by a printed name.

18 WITHDRAWAL/AMENDMENT OF PROPOSAL

Manitoba Hydro considers the Proponent's proposal to be the best offer by the Proponent. A Proponent may *not* amend its Proposal *after* the time and date of closing of this Request, *except at the written request of Manitoba Hydro. Upon written request for an amendment*, Proponents are requested to provide Manitoba Hydro with written notice of amendments *it is prepared to offer* via fax or letter as follows:

If the amendment is to be mailed, it should be addressed to Mr. Glenn W. Gray, Manager, Purchasing Department, Manitoba Hydro, P.O. Box 815, Winnipeg, Manitoba, R3C 2P4, Canada. If the amendment is to be delivered by hand, it should be brought to the Mailroom, 1st Floor, 360 Portage Avenue, Winnipeg, Manitoba, R3C 0G8, Canada.

If the amendment is to be faxed, it should be addressed to Mr. Glenn W. Gray, Manager, Purchasing Department, Manitoba Hydro, P.O. Box 815, Winnipeg, Manitoba, R3C 2P4, Canada and sent to fax number (204) 360-6130.

All amendments must be signed in accordance with the Instruction to Proponents, be on the Proponent's letterhead, and marked "Amendment of Proposal for Design, Manufacture, Supply and Installation of Hydroelectric Turbine Generators for the Keeyask Generating Station".

19 PROPONENT'S EXPENSES

The Proponent shall be solely responsible for all expenses incurred in relation to the preparation of its Proposal, including any site visit, or in relation to any presentations, interviews, discussions or negotiations held with respect to this Request and shall have no claim against Manitoba Hydro with respect to such costs or expenses in any event.

20 MANITOBA BUSINESS INVOLVEMENT

Manitoba Hydro encourages and expects any Proponent to actively promote the participation of Manitoba Business, Northern Manitoba Business and Northern Manitoba Aboriginal Business in the Work.

“Manitoba Business” is a business which is registered to do business in the Province of Manitoba, and the firm, or its principals, maintains in Manitoba on a continuous basis, the facilities, equipment and staff necessary to perform the work required, or to manufacture, or assemble, or supply, such work.

“Northern Manitoba Business” is a Manitoba Business that is located in the area north of the Manitoba Aboriginal and Northern Affairs Boundary Map included as **Appendix C**.

“Northern Aboriginal Business” (including an Aboriginal joint venture) means a Manitoba Business:

- a) that is at least 50% owned by an Aboriginal resident(s) or organization(s); and,
- b) that is based in or whose Aboriginal owner has resided within the Northern Affairs Boundary for a cumulative period of 5 years or more.

Manitoba Hydro's decision as to whether any subcontractor or supplier is a Manitoba Business, a Northern Manitoba Business or a Northern Aboriginal Business shall be final.

The Proponent can obtain assistance in identifying any Manitoba Business, Northern Manitoba Business, and Northern Aboriginal Business from the Manitoba Department of Industry, Economic Development and Mines.

21 REQUIREMENTS FOR ON-THE-JOB TRAINING

Manitoba Hydro customarily seeks to provide on-the-job training opportunities for contractor employees in accordance with the BNA for its major Northern

projects, and wishes to explore such possibility for the Keeyask Project, including with respect to ITEM 3 of the Work.

The Proponent is therefore requested to provide, in its Proposal, sufficient information of its proposed on-the-job training plan for the Work.

Manitoba Hydro's standard requirements for on-the-job training include:

- (a) For designated (apprenticable) trades as set out in the BNA, the number of apprentices employed by any contractor shall be at least the minimum set out in the BNA, and
- (b) For non-designated trades as set out in the BNA, the number of trainees employed by any contractor shall not be greater than the maximum as set out in the BNA.

Any on-the-job training opportunities agreed to by Manitoba Hydro and its preferred Proponent shall be as set out in the Contract.

22 MANITOBA CONTENT

All things being reasonably equal, preference shall be given to Proposals which maximize Manitoba Content. For the purposes of this Section, "Manitoba Content" means benefits that provide a positive economic impact to the Province of Manitoba such as manufacturing, labour, materials or transportation provided by Manitoba Businesses, Northern Manitoba Businesses or Northern Manitoba Aboriginal Businesses.

23 INDUSTRIAL OFFSETS (PURCHASER'S OPTION)

23.1 General

Manitoba Hydro invites the Proponent to propose Industrial Offsets, (i.e. activities producing economic benefits to Manitoba that are not directly related to the Work) and the associated cost of its Industrial Offset package(s). If accepted, a separate contract would be executed in relation to agreed-upon Industrial Offsets. A decision to proceed with an Industrial Offset proposal will be dependent upon the result of Manitoba Hydro and the Government of Manitoba's analysis and Manitoba Hydro is not bound in any manner to accept such proposals.

In the proposal evaluation, higher weighting will be given to Industrial Offset packages that are sustainable with lasting economic benefits (i.e. investment in Manitoba as compared to purchases). Industrial Offset packages will be analyzed on the basis of their impacts on the Manitoba economy in terms of employment, tax revenues and gross domestic product. Northern Manitoba Aboriginal related

Industrial Offset packages (e.g. technology transfers, training or Northern Aboriginal business development) will also be considered.

Manitoba Hydro's objective in inviting Industrial Offset proposals is to encourage Proponents to maximize socio-economic benefits to Manitoba and generally strengthen the province's economic position (as measured by levels of employment, tax revenues, labour income, gross domestic product growth, etc.) by:

- a) providing opportunities for employment of Manitobans;
- b) stimulating the Province's technological advancement through research and development activities and transfer of technology;
- c) investing in long-term viable business opportunities in Manitoba;
- d) enhancing the ability of Manitoba industry to compete internationally and in other parts of Canada; and
- e) providing business opportunities for employment equity designated groups including women, people of Aboriginal ancestry, persons with disabilities and members of visible minorities.

23.2 Information Requested

A Proponent providing an Industrial Offset proposal is requested to provide the following information in its Form of Proposal.

- a) A business plan for each of the Industrial Offsets proposed, providing details of location, timing and duration, related financial forecasts, relationships, if any, to the Proponent's business, conditions for proceeding, and any other relevant factors.
- b) A detailed breakdown of proposed expenditures individually valued in excess of \$10,000.00 in 2011 dollars (e.g. specific investment items, wages and salaries, etc. and noting the percentage of any expenditure in Northern Manitoba.). Purchases of products manufactured in Manitoba should be identified separately.
- c) Total direct annual employment estimates (in person years) associated with each of the Industrial Offsets proposed.
- d) A description of any proposed research and development activities to be carried out in Manitoba.
- e) A description of opportunities for technology transfer to Manitoba including licensing arrangements, training and other impacts.
- f) Details of any incremental costs, special considerations or terms of payment associated with the component of the Industrial Offset package(s) being proposed.

23.3 INTENTIONALLY LEFT BLANK

24 PROPOSAL EVALUATION CRITERIA

In an effort to determine best value to Manitoba Hydro and to assess with which, if any, of the Proponents Manitoba Hydro may wish to have make presentations, attend interviews and/or commence negotiations, Proposals will be evaluated using the following criteria. The Proponent shall be responsible for ensuring that its Proposal contains all elements of the required information.

Manitoba Hydro will assess and determine, in its sole and unfettered discretion, the overall best value for Manitoba Hydro in the evaluation of Proposals received.

24.1 Proponent's demonstrated ability to provide a reliable product optimizing performance: (20%)

- a) Technical compliance (deviation from Technical Requirements)
- b) Evidence of Proponent's and Proponent's proposed subcontractor(s) ability, experience, capital and Plant
- c) Proponent and proposed subcontractor(s) engineering facilities and their geographic location
- d) Proponent's recent performance in the supply of similar turbine runners (vertical propeller and Kaplan) placed in commercial service in the past five (5) years. This shall be in the form of proposed performance guarantees vs. measured prototype performance curves for the runners listed in the Proponent's Proposal.
- e) Qualifications of the Proponent's proposed key technical personnel
- f) Proponent's experience designing fish friendly turbines

24.2 Proponent's demonstrated ability to complete the Work successfully: (40%)

- a) Manitoba Hydro's previous experience with Proponent and the Proponent's proposed subcontractor(s)
- b) Qualifications of the Proponent's proposed key project management, site, and quality personnel; including demonstrated ability to manage relationships during the Contract
- c) Proponent's supply chain plan and proposed subcontractors' manufacturing facilities and related impact on Manitoba Hydro's resources for inspections
- d) Proponent's installation strategy, sequence, methods, and recent experience in the installation of similar turbines and generators placed in commercial service in the past five (5) years.
- e) Proponent's quality plan specific to the Work
- f) Risk management and environmental management plans specific to the Work
- g) Proponent's track record concerning workplace safety and Proponent's workplace safety system.
- h) Quality, completeness and comprehensiveness of the proposal package

- i) Commercial compliance (deviation from commercial terms and conditions)
- j) Proponent's schedule and any offer of an accelerated construction schedule
- k) Proponent's offer of alternatives, if any
- l) Proponent's proposed on-the-job training plan

24.3 Evaluated Cost as described in Section 12 EVALUATED COST of the Instructions to Proponents (40%)

24.4 Additional Criteria

All things being reasonably equal, the following additional criteria will be considered in the evaluation

- (a) Proponent's fish friendly design
- (b) Manitoba Content

25 WAIVER

By submitting a Proposal, the Proponent acknowledges Manitoba Hydro's rights, expressly reserved under this Request and absolutely waives any right, or cause of action against Manitoba Hydro, its officers, directors, employees and/or agents by reason of Manitoba Hydro's failure to accept the Proposal submitted by the Proponent, whether such right or cause of action arises in contract (including fundamental breach), negligence, bad faith, or otherwise.

END OF INSTRUCTIONS TO PROPONENTS



GENERAL REQUIREMENTS

KEYYASK GENERATING STATION DESIGN, MANUFACTURE, SUPPLY AND INSTALLATION OF HYDROELECTRIC TURBINES & GENERATORS

GENERAL REQUIREMENTS

1 SCOPE OF THE WORK

Without limiting or otherwise affecting any other term or condition of the Contract, the Work includes, without limitation, the design, manufacture, supply, supervision, labour, materials, Plant, Tools, equipment, quality control, shop assembly and shop testing, mobilization and demobilization, delivery, installation at the Site, testing and pre-commissioning, training, warranty of workmanship and materials, spare parts, Contractor's insurance and all other services and things specified herein, and/or necessary for the design, manufacture, supply, and installation of hydroelectric turbines and generators for the Keeyask Project.

Descriptions of ITEMS of the Work listed below are provided as a general overview. A detailed scope and requirements of the Work are provided in the Technical Requirements. The Work shall also, in all respects, comply with the terms and conditions of the Contract.

ITEM 1: MODEL TESTING

Consists of the provision of a Model Design, Test, and Report for the purposes of designing and manufacturing ITEM 2 in accordance with the Contract.

ITEM 2: SUPPLY AND DELIVERY OF TURBINE GENERATORS

Consists of the provision of seven (7) fixed-blade vertical propeller-type hydraulic turbines and generators, in accordance with the Contract.

ITEM 3: INSTALLATION OF TURBINE GENERATORS

Consists of installation of ITEM 2 and all associated equipment, including pre-commissioning, in accordance with the Contract.

ITEM 4: GENERATOR EFFICIENCY TEST (PURCHASER'S OPTION)

Consists of the provision of a Generator Efficiency Test, in accordance with the Contract.

ITEM 5: SUPPLY OF MISCELLANEOUS ITEMS

Consists of the provision of all As-Built Drawings, Final As-Constructed Installation and Commissioning Schedule, O&M Manuals, Installation Procedures, Commissioning Procedures, all lifting and handling devices and special tools in accordance with the Contract.

ITEM 6: SUPPLY AND DELIVERY OF SPARE PARTS (PURCHASER'S OPTION)

Consists of the provision of spare parts for the Work in accordance with the Contract.

ITEM 7: ACCELERATED INSTALLATION SCHEDULE (PURCHASER'S OPTION)

Consists of an option to accelerate the installation schedule to achieve an early in-service date. If exercised, the cost of the acceleration option shall be applied as a proportional increase to the installation Performance Based Milestone Payments for ITEM 3.

ITEM 8: CONSULTATION DURING STATION DESIGN

Consists of consultation between the Contractor's designers and the Purchaser once the Unit water passages have been defined and model test results have been reviewed.

ITEM 9: SHOP TEST ASSEMBLIES (PURCHASER'S OPTION)

Consists of an option to complete a tower assembly of the turbine(s) at the Contractor's shop.

ITEM 10: PROVISION OF COMMISSIONING SUPPORT

Consists of provision of an electrical and mechanical engineer to assist the Purchaser with Unit commissioning.

2 PURCHASER'S OPTION

The Purchaser has the option, but not the obligation, to purchase ITEMS of the Work identified in Section 1 SCOPE OF THE WORK of the General Requirements as a "Purchaser's Option" and set out in the Contractor's Proposal (the "Option") as follows:

- a) the term for the Purchaser's acceptance of an Option shall be 6 months from the signing date of the Contract for ITEM 1 (the "Option Period"),
- b) the Purchaser may exercise an Option with respect to any of the said ITEMS individually, severally, or in any combination, at any time during the Option Period, and
- c) the Purchaser shall exercise an Option by written notice to the Contractor in the form of a Change Order informing of its election to do so with respect to an ITEM within the Option Period. Such notice from the Purchaser exercising an Option shall constitute a binding agreement of

purchase and sale and the Contract shall be deemed amended thereby and all terms and conditions of the Contract shall apply mutatis mutandis.

3 PERFORMANCE SECURITY

The Contractor shall, within thirty (30) days of the signing of the Contract, deliver or cause to be delivered to the Purchaser an irrevocable letter of credit in the form attached hereto as **Appendix L** in an amount equal to 10% of ITEM 1 of the Work, with a term commencing within 30 days of the signing of the Contract and which letter of credit shall terminate upon the satisfactory approval of the Performance Based Payment Milestone for Final Model Test Report.

In addition, the Contractor shall:

- (a) within (30) days of the issuance of the Notice to Proceed for ITEMS 2 to 10 of the Work, deliver or cause to be delivered to the Purchaser an irrevocable letter of credit in the form attached hereto as **Appendix L** in an amount equal to 10% of ITEMS 2 to 10 of the Work with a term commencing within 30 days of the date of such Notice to Proceed which letter of credit shall terminate upon the issuance of the Completion Certificate as provided for in Section 31 COMPLETION CERTIFICATE of the General Conditions; and
- (b) prior to the issuance of the Work Release Certificate for the first turbine and generator of which the Purchaser shall give the Contractor 15 days notice of intention to issue, deliver or cause to be delivered to the Purchaser, a second irrevocable letter of credit in the form attached hereto as **Appendix L**, in an amount equal to 5% of ITEMS 2 to 10 of the Work which letter of credit shall terminate upon the expiration of all warranty obligations under the Contract.

All irrevocable letters of credit which the Contractor must deliver and maintain as required herein shall be issued or confirmed by *a bank listed in Appendix AA - List of Approved Banks* or another bank approved in advance by the Purchaser, acting reasonably, all in accordance with and be subject to the Uniform Customs and Practice for Documentary Credits (2007 Revision) International Chamber of Commerce – Publication 600.

Without prejudice to any other right or remedy provided or available in the Contract or at law (including contract and tort or equitable relief), if at any time the Contractor fails to perform any of its covenants or obligations in or pursuant to the Contract, including without limitation failure by the Contractor to deliver, or cause to be delivered, to the Purchaser any irrevocable letter of credit as required herein, the Purchaser shall be entitled to call upon , in any amount(s),

any irrevocable letter of credit delivered to the Purchaser pursuant to the Contract, in accordance with its terms, to hold and retain such sums until such time as the Contractor has performed such covenants or obligations in accordance with the Contract, and/or to hold and retain such sums as are proportional as continued security for the Contractor's performance of its covenants and obligations in and pursuant to the Contract, and to withhold or deduct or set-off against such sums in accordance with the Contract subject to Section 44 ARBITRATION of the General Conditions,. Any amounts called upon and held by the Purchaser pursuant to this Section shall, subject to Section 44 ARBITRATION of the General Conditions, bear no interest, and shall be so held until the breach is corrected or the dispute, if any, is resolved.

4 SITE LOCATION AND ACCESS

The site of the Keeyask Project is proposed to be located in northern Manitoba on the Nelson River, at the base of Gull Rapids, 185 km northeast of Thompson, Manitoba (the "Site").

The Site is accessible by road from Thompson and approximately 212 kilometres in distance. This consists of approximately 188 kilometres on Provincial Highway No. 280 and 24 kilometres (southeast) on a proposed controlled access all weather gravel road. Thompson is 766 kilometres from Winnipeg on paved Provincial Trunk Highway No. 6.

5 ITEM 3 OF THE WORK - INSTALLATION

5.1 General

Pursuant to ITEM 3 of the Work, the Contractor shall install the Work and shall provide competent supervision in addition to all common and skilled labour required for the purpose of the installation work.

The Purchaser will furnish, free of charge, *two (2)* operating powerhouse *cranes* (including operating staff) *with main and auxiliary hooks* of sufficient capacity for the Contractor's performance of ITEM 3 of the Work, subject to the following and its use will be scheduled by the Engineer:

- (a) All other contractors will also have the use of this equipment.
- (b) The Contractor shall furnish all slings, special hoisting equipment, small tools, jacks, braces and all materials, articles, supplies and things whatsoever necessary or proper for the performance and temporary support of ITEM 3 of the Work.
- (c) The Contractor shall provide all engineered lift plans required.

- (d) The Contractor shall provide radios for crane operator and rigger communications during the period where the Contractor is using the powerhouse crane.
- (e) ***The capacity of the main hook shall be sufficient to allow a fully assembled rotor with poles to be installed using both cranes in tandem***
- (f) ***The auxiliary hooks shall be 25 Mg each.***

5.2 Protective Measures

The Contractor shall take all necessary precautions for the safety of its employees engaged in ITEM 3 of the Work. The Contractor shall erect and properly maintain at all times, as required by the conditions and progress of ITEM 3 of the Work, all necessary safeguards for the protection of workers and the public, and shall post danger signs warning against unusual hazards and such other hazards as may be designated from time to time by the Engineer.

The Contractor shall properly and adequately protect all Work, materials and Plant against loss, damage or deterioration during performance of ITEM 3 of the Work and shall take every precaution against causing damage to property belonging to the Purchaser or to third parties located in, upon, or about the Site.

The Contractor shall cover and/or protect all Work from dust and debris that may cause damage or deterioration due to work by others in the immediate vicinity of the Work, during periods where the Contractor is not actively performing the Work (including off-shift).

The Contractor shall take all necessary precautions during performance of ITEM 3 of the Work so as not to trespass upon or cause damage, disturbance, obstruction of access, removal or disturbance of support to land, buildings or other structures or property beyond the Site.

5.3 Inspection of Work Performed by Others

The following items associated with the Work will be performed or provided by the Purchaser at the Site, and are excluded from the Work:

- (a) Final power supply connection to all of the equipment control cubicles
- (b) Installation of all anchors embedded in primary concrete for Work related to the installation of Turbines and Generators.
- (c) Placing of secondary concrete around ***turbine*** embedded parts
- (d) All required pressure grouting of embedded parts
- (e) All pipe, stairs and other such materials embedded in primary concrete
- (f) Off-loading at the Contractor's work area and transport from storage to the service bay according to the requirements of the Contract, under the direction of the Contractor.
- (g) Final connection of the Contractor's equipment to the governor and excitation equipment supplied by the Purchaser.

- (h) Final connection of the Contractor's equipment to powerhouse services (cooling water, shaft seal water, fire protection water, bearing oil fill and drain lines, compressed air, etc.)

The Contractor, however, shall be present during the work and inspect the work covered by items (a) to (h) to ensure that each item is or has been performed to its full satisfaction, all as described further in the Technical Requirements. In performing said inspections, the Contractor will be required to sign off on the position of embedded anchors/pipe/items prior to concreting operations. The Engineer will schedule all inspections. It shall be noted that timing of inspections may not be during the Contractor's regular work hours. In these cases, the Contractor shall perform this work as requested by the Engineer at no additional cost.

No compensation will be paid to the Contractor for any inconvenience or extra expense incurred as a result of inspection required for these or any other work being undertaken by the Purchaser.

6 REQUIRED LICENSES FOR CONSTRUCTION OF THE WORK

The Site upon which the Work is to be constructed is currently provincial crown owned land (the "Land"). The Keeyask Hydropower Limited Partnership will be responsible for and is in the process of securing the necessary rights for the construction of the Work to proceed on the Land. Obtaining authorizations and licences is one of the conditions that must be satisfied under any Contract awarded for the Work before the Purchaser will be in a position to authorize ITEMS 2 to 10 of the Work to proceed. The Contractor will obtain any and all other permits, licenses, and/or approvals necessary for the construction of the Work as required by provincial or federal legislation.

7 DELIVERY AND STORAGE

The Contractor shall deliver all Work, including without limitation, all ITEMS of the Work, to the Site.

The Contractor shall provide sufficient runner transport framework assemblies to meet the schedule of the Work. The Purchaser will retain ownership of one (1) framework assembly used to transport the turbine runner to the Site upon the completion of the Work.

7.1 Deliveries

The Contractor shall prepare the Work for transportation and storage so as to protect the Work from damage or deterioration during transportation and storage. The Contractor shall be responsible for, and make good, any damage to the Work during transportation or preparation for storage.

All components shall be transported in such a manner as will facilitate offloading and storage on Site by the Purchaser. Where necessary for proper handling and erection, lifting lugs and special lifting devices shall be provided by the Contractor. The Contractor shall supply detailed lift plans for all equipment to be offloaded by the Purchaser, including sealed engineered lift plans, as deemed necessary by the Purchaser for review and approval. The Contractor shall be responsible for any extra costs incurred by the Purchaser associated with wait times or crane delays or any other consequential delays caused by inadequate lift plans. Lift plans shall be transmitted to the Engineer fourteen (14) days in advance of the Site arrival date and shall also be included with the shipping documents that accompany the shipment. All materials shall be mounted on skids, pallets, or crated and any articles or materials that might otherwise be lost shall be boxed or wired in bundles and plainly marked for identification. All parts exceeding 100 kg gross weight shall be prepared for transporting so that slings for handling may be readily attached while the parts are on the truck. Where it is unsafe to attach slings to a box, boxed parts shall be packed with slings attached to the part, and the slings shall project through the box or crate so that attachment can be readily made.

7.2 Offloading, Handling, and Storage

All Work will be unloaded for storage at the Site by the Purchaser at the Purchaser's expense. The direction of the unloading and handling will be the Contractor's responsibility. The Purchaser, in assuming the cost (at Site only) of unloading, undertakes these operations only for the mutual convenience of the Purchaser and Contractor, and it shall be deemed, notwithstanding any arrangement effected to the contrary, that the Purchaser or its agent will perform the unloading under the direction of the Contractor. Repair of damage to the Work during the offloading operation that is deemed by the Engineer to be a direct result of negligence by the Purchaser's crane operator shall be repaired by the Contractor at the Purchaser's expense.

The Contractor shall be responsible for all storage of the Work at the Site. The Purchaser has made provision for a Contractor's work area to be used by the Contractor for erection of any facilities required to carry out the Work. The Contractor shall provide heated storage based on specific requirements for equipment supplied under the Contract. Refer to Section 27 CONTRACTOR'S OFFICES AND ACCOMMODATIONS of the General Requirements for further details.

Ninety (90) days prior to the mobilization date specified in Subsection 8.4 Contract Dates of the General Requirements, the Contractor shall provide a complete list of all parts to be delivered to the Site with the storage requirements identified. The following storage codes shall be used:

- S1 - Outdoor storage, elevated off of the ground, no protection required
- S2 - Outdoor storage, elevated off of the ground, tarped
- S3 - Indoor storage, unheated
- S4 - Indoor storage, heated to 10 C minimum
- S5 - Indoor storage, heated to 20 C minimum

Unloading by the Purchaser shall be limited to outdoor lifting of goods off of a transport trailer deck and placing the goods adjacent to the trailer. It is the Contractor's responsibility to ensure that the trailer is parked adjacent to the final planned storage or erection location. It is the Contractor's responsibility to ensure that the ground surface where the part shall be placed is suitable to receive the part by modifying or compacting the existing base and/or supplying and placing necessary timbers or sleepers. Parts that must be further moved to indoor storage shall be handled by the Contractor using the Contractor's equipment and operator all at the Contractor's expense. Additional lifting operations undertaken to manage space in the Contractor's Work Area or indoor storage facilities shall be undertaken by the Contractor at the Contractor's expense.

The Contractor shall manage the deliveries to the Site such that no more than three (3) trucks arrive on any given day for offloading by the Purchaser.

Further handling and transportation of parts, crates or boxes in excess of 5,000 kg gross weight from the Contractor Work Area or any other storage or laydown area to the powerhouse for erection shall be the responsibility of the Purchaser. All other transportation and handling shall be the responsibility of the Contractor. The Contractor shall make requests for handling and transportation to the powerhouse three (3) days in advance of the required date.

All containers and protective packing shall be adequately constructed to give full protection to contents during transporting, handling, storage and final transport to the installation location. Bolts shall be packed in separate packages according to length and diameter. Loose nuts, washers and other small parts shall be packed in separate packages and shipped in boxes, crates or kegs, none of which shall exceed 100 kg gross weight. On the outside of each separate closed package shall be plainly marked, a list and description of the materials therein.

The following particulars shall be clearly and indelibly marked on the outside of all separate parts, and containers and tagged on bundles:

Manitoba Hydro - Keeyask Generating Station Turbine and Generators

Name of Contractor

Work Package Number 016321

Shipping Report Number and Date

Shipping Report Reference Item Number

Shipping Dimensions and Weight

Manitoba Hydro Purchase Order Number

Any shipments arriving at Site without the above markings will be refused at the Contractor's expense.

The Contractor shall make all necessary arrangements to avoid delays which could arise from seasonal conditions affecting transportation.

Within 24 hours after each shipment has been made from the facility where the parts were manufactured or procured, the Contractor shall submit the original bills of lading and the complete shipping reports by e-mail in .pdf format to the Purchaser. The originals shall follow by mail to the Purchaser at the address shown below.

Manitoba Hydro Power Supply
Keeyask Generating Station Project
P.O. Box 815
Winnipeg, Manitoba R3C 2P4
Attn: (to be advised)
FAX: (204) 360-4897
E-mail: (to be advised)

Manitoba Hydro Power Supply
Keeyask Generating Station site
Manitoba
Attn: (to be advised)
FAX: (204) (to be advised)
E-mail: (to be advised)

The shipping reports shall include descriptions, drawing reference numbers, quantities of all items shipped, packing lists, shipping weights and dimensions, shipping dates, estimated time of arrival at the delivery point and shall include any special requirements regarding the methods of handling and storing items shipped. MSDS sheets for shipments of controlled or hazardous materials shall be included in the shipping report and attached to the shipping documents accompanying the goods.

The Contractor shall give the Engineer not less than five (5) days notice of the actual arrival times of all shipments at the Site.

The Contractor shall be responsible for tracing and expediting of all shipments and for obtaining all required clearances.

8 CONTRACT SCHEDULE

8.1 General Requirements

The Contractor shall plan and schedule the Work and report progress to the Purchaser by providing all schedules using the critical path method. The Contractor shall prepare all schedules using Primavera P6.1 or the latest accepted version of Primavera at the time.

The Contractor shall develop and submit to the Engineer for review and approval a Contract Schedule that shall include separate sections for:

- a) manufacture & delivery; and
- b) installation & commissioning

The schedule shall clearly depict and describe the durations, sequences and interdependence of all the Contractor's activities in sufficient detail to satisfy the Engineer with regard to the planning of the Work.

The Engineer shall have the right to require that the Contractor's timely delivery of all schedules and reports, in a form and content satisfactory to the Engineer. Notwithstanding any provisions to the contrary in the Contract, this shall be a prerequisite for certification by the Engineer to the Purchaser of payments due to the Contractor pursuant to the Contract. The Engineer shall give the Contractor 30 days' prior notice of his intention to implement this condition of the Contract.

The Contract Schedules shall include all Performance Based Payment Milestones identified in **Appendix T**.

These requirements supplement additional schedule reporting requirements in Section 30 CONTRACTOR'S WORK RECORDS AND REPORTING of the General Requirements.

8.2 Submission, Review and Monitoring

Within the time limits set out in Subsection 8.4 Contract Dates of the General Requirements, the Contractor shall submit to the Engineer a draft of the Contract Schedule. This draft Contract Schedule shall not deviate from the final work schedule set out in the Contractor's Proposal by more than six (6) months for any Performance Based Payment Milestones and must also respect all Contract Dates as outlined in Subsection 8.4 Contract Dates of the General Requirements.

Within sixty (60) days of receipt of the draft Contract Schedule, the Engineer will accept, reject, and identify the reason for rejection, or request more information. The Contractor shall address the reasons for rejection or provide the information requested and resubmit the revised draft Contract Schedule no more than thirty (30) days after the Engineer's response. Upon review and authorization of the final Contract Schedule, the Engineer shall provide the Contractor with the final approved Contract Schedule which shall govern the performance and delivery of the Work. The Purchaser may withhold payments due to the Contractor until such time as the Contractor has delivered and the Engineer has accepted the Contract Schedule.

The Contractor shall be required to deliver the Work by the corresponding applicable dates set out in the approved Contract Schedule. The Contract Schedule will be used to monitor the Contractor's progress during the course of the Work. The Purchaser will incorporate the Contract Schedule into the Keeyask Project master schedule. Once approved, the Contract Schedule shall not be modified, altered or revised except in accordance with Section 12 CLARIFICATIONS AND CHANGES TO THE WORK of the General Conditions.

The Engineer's acceptance of any Contract Schedule, whether baseline, updated, or revised, does not modify any other provision of the Contract or constitute endorsement or validation by the Engineer of the Contractor's logic, activity durations, or assumptions in creating such schedule. If errors are discovered by the Contractor or the Engineer after the Contract Schedule has been accepted, the Contractor shall notify the Engineer of such errors and correct the errors in the next schedule submission.

If, at any time during the course of the Work, the rate of work and/or achieved progress are, in the opinion of the Engineer, less than is required to enable the Contractor to complete the Work or any part(s) thereof by the agreed-upon scheduled time as set out in the approved Contract Schedule, the Engineer may order the Contractor to submit, in the form and in the time required by the Engineer, its mitigation plan to recover schedule.

8.3 Final As-Built Installation and Commissioning Schedule

Within 120 days of receipt of the Work Release Certificate for the final turbine and generator, the Contractor shall deliver a final update to the Contract Schedule through the Engineer, to the Purchaser, showing the actual start and finish date for each activity identified in it. The Contractor shall include with such submission a certification signed by the Contractor stating:

"To the best of my knowledge, the enclosed final Contract Schedule reflects the actual start and finish dates of the activities contained herein."

8.4 Contract Dates

The Contractor shall plan, schedule, perform and complete the Work and the applicable part(s) thereof on or before the applicable Contract Dates set forth below or as same may be amended/changed pursuant to the Contract.

The Contract Dates set forth below are based on the current Purchaser's construction schedule for the Keeyask Project. The Contract Dates shall be incorporated in and form part of the approved Contract Schedule.

Item	Description	Contract Date / Duration
1a	Supply of detailed prototype turbine water passage dimensions	Within 270 days after execution of the Contract for ITEM 1 of the Work
1b	Issuance of the final Model Test Report in accordance with Subsection 5.6 Model Test of the Technical Requirements	Within 360 days after execution of the Contract for ITEM 1 of the Work
1c	Supply of <i>Preliminary</i> load calculations for all embedded anchors in accordance with Subsection 2.3 Allowable Stresses of the Technical Requirements	April 1, 2013
1d	Successfully completed Insulation System Pre-Production Verification in accordance with Subsection 6.29 Insulation System Pre-Production Verification of the Technical Requirements	July 8, 2014
2	Issuance of Notice to Proceed for ITEM 2 to ITEM 10	September, 2014
3a	Supply of any proposed changes to Contractor's Supply Chain Plan	Within 30 days of being issued a Notice to Proceed for ITEM 2
3b	Supply of Draft Contract Schedule	Within 30 days of being issued a Notice to Proceed for ITEM 2
3c	Submit document submission list in accordance with Subsection 10.1 Document Submissions of the Technical Requirements	Within 30 days of being issued a Notice to Proceed for ITEM 2
4a	Supply of flow, pressure and filtration requirements for the shaft seal in accordance with Subsection 5.10.6 Turbine Shaft Water Seal of the Technical Requirements	Within 90 days of being issued a Notice to Proceed for ITEM 2
4b	Supply of required bearing cooler cooling water volumetric flow rates and the size of the supply piping in accordance with Technical Requirements Subsection 6.17.2 Cooling.	Within 90 days of being issued a Notice to Proceed for ITEM 2
4c	Details of the high pressure oil injection pumps in accordance with the Technical Requirements	Within 90 days of being issued a Notice to Proceed

Item	Description	Contract Date / Duration
	Subsection 6.17.3 Thrust Bearing.	for ITEM 2
4d	Supply of required surface air cooler cooling water volumetric flow rates and the size of the supply piping in accordance with the Technical Requirements Subsection 6.19.2 Surface Air Coolers.	Within 90 days of being issued a Notice to Proceed for ITEM 2
4e	Supply of required fire protection water volumetric flow rates and the size of the piping in accordance with the Technical Requirements Subsection 6.24 Fire Protection.	Within 90 days of being issued a Notice to Proceed for ITEM 2
4f	Supply of the details of generator enclosure openings for louvers and amount of heat available to heat the powerhouse in accordance with the Technical Requirements Subsection 6.19 Ventilation, Cooling, Heating	Within 90 days of being issued a Notice to Proceed for ITEM 2
4g	Supply of the size of required embedded line for turbine head cover pumps and details of AC and DC pumps in accordance with Subsection 5.10.7 Drainage Pumps of the Technical Requirements	within 90 days of being issued a Notice to Proceed for ITEM 2
5	Submit a document titled "List of Quality Dockets" with associated part of assembly names in accordance with Subsection 47.3.1 Quality Docket of the General Requirements	Within 90 days of being issued a Notice to Proceed for ITEM 2
6a	Supply of governor design information in accordance with Subsection 5.12.2 Servomotors of the Technical Requirements.	within 120 days of being issued a Notice to Proceed for ITEM 2
6b	Details of 120/240 V AC Panels	within 120 days of being issued a Notice to Proceed for ITEM 2
6c	Details of all turbine and generator instrumentation end devices.	within 360 days of being issued a Notice to Proceed for ITEM 2
7	Submit all Manufacturing Inspection and Test Plans in accordance with Subsection 48.3.2. Manufacturing Inspection And Test Plan of the General Requirements	within 360 days of being issued a Notice to Proceed for ITEM 2
8	Meeting with General Civil Works Contractor and Manitoba Hydro to develop a best-for-project installation schedule.	within 360 days of being issued a Notice to Proceed for ITEM 2
9a	Deliver seven test bars for Purchaser testing in accordance with Technical Requirements Subsection 6.27 Generator Tests by the Purchaser	360 days prior to Item 10 (a).

Item	Description	Contract Date / Duration
9b	Submit all Installation Inspection and Test Plans in accordance with General Requirements Subsection 48.3.3 Installation Inspection and Test Plan	120 days prior to Item 10 (a).
9c	Submit all pre-commissioning procedures & data sheets, and commissioning procedures in accordance with Technical Requirements Section 9 COMMISSIONING.	180 days prior to Item 10(a)
9d	<i>Delivery of turbine and generator anchors embedded in primary concrete by others (all Units).</i>	<i>600 days prior to Item 10(a)</i>
10	Contractor fully mobilized and all required equipment at Site to begin the installation of Turbine Embedded Parts in each Unit no later than:	
(a)	1 st Unit (refers to installation sequence not Unit #)	Jan 17, 2018
(b)	2 nd Unit	March 28, 2018
(c)	3 rd Unit	June 2, 2018
(d)	4 th Unit	August 3, 2018
(e)	5 th Unit	Oct 4, 2018
(f)	6 th Unit	December 5, 2018
(g)	7 th Unit	February 14, 2019
11	“Pit Free – Ready for Second Stage Concrete” no later than:	
(a)	1 st Unit	70 days after Item 10(a)
(b)	2 nd Unit	66 days after Item 10(b)
(c)	3 rd Unit	62 days after Item 10(c)
(d)	4 th Unit	62 days after Item 10(d)
(e)	5 th Unit	62 days after tem 10 (e)
(f)	6 th Unit	71 days after tem 10 (f)
(g)	7 th Unit	61 days after tem 10 (g)
12	“Pit Free – Ready for Installation of Turbine Non-Embedded Parts”:	
(a)	1 st Unit	121 days after Item 11 (a)
(b)	2 nd Unit	121 days after Item 11 (b)
(c)	3 rd Unit	121 days after Item 11 (c)
(d)	4 th Unit	130 days after Item 11 (d)

Item	Description	Contract Date / Duration
(e)	5 th Unit	130 days after Item 11 (e)
(f)	6 th Unit	120 days after Item 11 (f)
(g)	7 th Unit	120 days after Item 11 (g)
13	All Work complete including Pre-Commissioning and Unit ready for hand off to Purchaser for Final Commissioning no later than:	
(a)	1 st Unit	52 weeks after Item 12 (a)
(b)	2 nd Unit	49 weeks after Item 12 (b)
(c)	3 rd Unit	45 weeks after Item 12 (c)
(d)	4 th Unit	44 weeks after tem 12 (d)
(e)	5 th Unit	44 weeks after tem 12 (e)
(f)	6 th Unit	44 weeks after tem 12 (f)
(g)	7 th Unit	44 weeks after tem 12 (g)
14	Unit placed In-service	
(a)	1 st Unit	November 13, 2019
(b)	2 nd Unit	December 18, 2019
(c)	3 rd Unit	January 31, 2020
(d)	4 th Unit	March 1, 2020
(e)	5 th Unit	April 19, 2020
(f)	6 th Unit	June 22, 2020
(g)	7 th Unit	August 19, 2020

NOTES:

- The Purchaser reserves the right, in its sole discretion, to delay the issuance of a Notice to Proceed for ITEMS 2 to 10 of the Work by amending the Contract Dates in the Contract Schedule for Item 2 above to reflect changes to the Keeyask Project Master Schedule resulting from regulatory or other delays. Upon amendment, the remaining Contract Dates in the Contract Schedule shall also change to maintain the intended durations between tasks. The Contractor shall not be entitled to any compensation for such amendments provided that:

- (i) notice of the amendment is provided by the Purchaser to the Contractor in writing no less than 90 days prior to the date noted for Item 2; and,
 - (ii) amended dates, do not change by more than 365 days from the original dates noted in the above table.
2. The Purchaser reserves the right to delay the Contractor's installation work pursuant to ITEM 3 of the Work by amending the Contract Dates in the Contract Schedule for Item 10(a) to (g) above to suit the actual progress of the Keeyask Project site construction. Upon amendment, the remaining Contract Dates in the Contract Schedule shall also change to maintain the intended durations between tasks. The Contractor shall not be entitled to any compensation for such amendments provided that:
 - (i) notice of the amendment is provided by the Purchaser to the Contractor in writing no less than 90 days prior to the date noted for Item 10(a); and,
 - (ii) the amended dates and any subsequent amended dates, do not change by more than 365 days from the original dates noted in the above table.

Otherwise, any claims the Contractor may have in relation to amendments to such Contract Dates not in accordance with the above conditions shall be dealt with in accordance with Section 14 CONTRACTOR CLAIMS of the General Conditions.

3. Any Contract Dates that fall over a Christmas break have already been adjusted to allow for a 14 day work stoppage during this time period.
4. Unless otherwise approved by the Engineer, the Contractor shall deliver all applicable Work, or any part(s) thereof, to the Site no less than ninety (90) days prior to the scheduled installation dates set out in the above table.
5. The Purchaser shall conduct performance testing of the Units once all Units have been fully commissioned, are released for commercial service, and at a period where river conditions permit the testing to be completed to meet the specified code requirements. The schedule for such testing is at the sole discretion of the Purchaser.
6. ***Contract Dates that fall due on a non-business day shall be deemed to be due on the next business day. A "business day" for this purpose shall mean any day except for a Saturday, Sunday or a Manitoba statutory holiday on which the Purchaser's offices are open for business. For***

performance of ITEM 3 of the Work, a "business day" for this purpose shall mean any day except Sunday or a Manitoba statutory holiday on which the Purchaser's Site offices are open for business.

9 CONTRACTOR'S SUPPLY CHAIN PLAN

The Contractor's plan for *manufacture or* supply of all parts identified as Performance Based Payment Milestones in the Terms and Conditions of Payment shall be included in a supply chain plan (the "Contractor's Supply Chain Plan"). The Contractor's Supply Chain Plan shall indicate the primary location of manufacture *for all components of the Work manufactured at facilities wholly owned and operated by the Contractor or the Contractor's parent corporation. Joint ventures or consortia will be considered as sub-contractors for the purpose of the Contractor's Supply Chain Plan. The Contractor's Supply Chain Plan shall also* identify the Contractor's *pool of primary sub-contractors or* suppliers *for* all components of the Work not self-performed by the Contractor and shall identify any alternates. *Any agreements formed between the Contractor and its sub-contractors shall include the requirement to allow access by the Purchaser's QAR (whether unescorted or escorted) during all witness and hold points without having to give advance notice, and during regular business hours for general surveillance within 24 hours notice to the Contractor by the QAR.*

Any changes to the Contractor's Supply Chain Plan as set out in the Contractor's Proposal shall be submitted through the Engineer for the Purchaser's approval prior to the date set out in Subsection 8.4 Contract Dates of the General Requirements.

For approval, the Purchaser requires the Contractor to prepare a formal document setting out the change requested. A request for a change to the Contractor's Supply Chain Plan must answer the following questions and must be in English:

- (a) Why is the substitution required?
- (b) What is the scope of the work to be carried out by the alternate shop or supplier?
- (c) What are the alternatives that were considered in selecting the alternate shop or supplier?
- (d) What is the plan for monitoring the work should the substitution be accepted?
- (e) What experience does the Contractor have with this subcontractor?
- (f) Provide supporting documentation that contains, at a minimum, the following:
 - i) Copy of the latest ISO 9001 certificate and proof that the shop or supplier complies with Section 48 QUALITY of the General

- Requirements. This proof must be in the form of a letter signed by the shop operations manager or supplier representative.
- ii) If welding is required, certificates of authorization demonstrating that the Technical Requirements for the Work pursuant to the Contract have been met.
 - iii) Proof that the shop inspectors are qualified to the standards identified in the Contract.
 - iv) A list of previous experience with the shop or subcontractor
 - v) Documents demonstrating workflow in the proposed plant. These should show how non-conformances, welding inspection, measurements, etc. are handled in the plant.
 - vi) Any other information that would aid the Purchaser in determining whether to authorize the change to the Contractor's Supply Chain Plan

The Purchaser reserves the right to reject any proposed change to the Contractor's Supply Chain Plan in its sole and unfettered discretion.

10 MEETINGS

The Contractor shall arrange for a kickoff meeting in Winnipeg at the start of the Work that includes all members of its design and project management staff.

The Contractor shall make available appropriate staff from its project team to attend an installation schedule workshop in Winnipeg that will include the Purchaser and the General Civil Works Contractor. This meeting will focus on development of a best-for-project installation sequence that will take advantage of synergies between the parties at Site and identify opportunities for improvement to the Contractor's installation work at Site. Benefits realized during this process will be shared equitably and reasonably amongst all parties. At a minimum the Contractor's project manager and site superintendent must attend this meeting.

Throughout the Work, design review meetings will be held on a quarterly basis in Winnipeg, and more frequently as required by the status of the Work, to review the details of the design.

Prior to detailed design, a five day RCM analysis of the proposed equipment shall be held at the Purchaser's offices in Winnipeg in accordance with Section 13 RELIABILITY CENTERED MAINTENANCE (RCM) of the Technical Requirements.

In addition, the Contractor will provide bi-weekly updates to the Purchaser on the status of the Work through video or tele-conference meetings.

During installation of the Work, weekly meetings shall be held at the Site by the Engineer. The Superintendent and any support staff required shall attend the meetings and update the Purchaser on the progress of the Work.

11 SERVICES OF A SUPERINTENDENT

The Purchaser requires the Contractor to provide a Superintendent(s) to inspect the work performed by others, supervise the unloading, moving, handling, installing, testing and placing the Work into satisfactory operation in accordance with the Contract. The Superintendent(s) shall have a minimum of 10 years' direct experience with assembly of hydroelectric turbines and generators.

During the above-described work, the Superintendent shall be continuously on duty during working hours. The Superintendent shall be vested with the necessary authority to supervise the due and proper carrying out of the Work on Site, and to receive from time to time on behalf of the Contractor, orders and instructions from the Engineer relating thereto.

The Superintendent shall not be transferred from such Work before its completion without the written authorization of the Purchaser. Any proposed replacement personnel for such position shall require the prior written approval of the Purchaser prior to such individual commencing any duties or Work at the Site or under the Contract.

12 WEATHER CONDITIONS

In order to complete the Work in accordance with the Contract Schedule, the Contractor shall, at all times, be prepared to perform Work on Site in any and all weather conditions including without limitation, winter weather. The Contractor shall make all arrangements necessary for winter weather construction as required to properly perform the Work and as directed by the Engineer. No extra payment will be made for winter construction. For greater certainty, any and all weather and winter conditions shall not constitute grounds for claim by the Contractor.

13 PROXIMITY OF THE WORK TO HIGH VOLTAGE LINES

When any part of the Work will be in proximity to high voltage transmission lines and switching structures, the Contractor shall comply with all applicable laws and shall exercise all due caution and shall be responsible for employing construction methods that afford the maximum degree of safety to all personnel engaged in the Work.

In particular, the Contractor shall comply with Manitoba Regulation 217/2006 Part 25 - "Work in the vicinity of overhead electrical lines" when any Work is completed within 3 metres of an overhead electrical line and switching structures or using equipment or machinery from a location from which it or any part of the equipment is capable of coming within 3 metres of an overhead electrical line.

14 MOBILIZATION AND DEMOBILIZATION OF PLANT, EQUIPMENT AND PERSONNEL

As part of the Work, the Contractor is responsible for mobilization and demobilization of the Work including all assembly, transporting, setting up, taking down after completion of the Work and moving away from the Site, of the Contractor's personnel, Plant, equipment and sanitary facilities, Tools and supplies necessary for the performance of the Work or maintenance and repair of the Contractor's equipment, and all items necessary or incidental thereto.

15 COOPERATION BETWEEN CONTRACTORS

The Contractor shall cooperate with all other contractors who may be performing work at Site on behalf of the Purchaser in relation to the Keeyask Project, and with the workers who may be employed by the Purchaser on any work at/in the vicinity of the Site. The Contractor shall perform the Work under any and all job conditions, not merely those which it considers desirable. The Contractor shall perform the Work and dispose of its materials in such a manner as will not delay or interfere with the work or storage of materials and equipment of the Purchaser or of other contractors.

The Contractor must not, at any time, block access to those areas of the service bay and powerhouse where work is required to be performed by others or as dictated by the Engineer.

16 EQUAL ARTICLES, MATERIALS OR EQUIPMENT

Whenever an article, material or equipment is defined in the Contract by describing a proprietary product or by using the name of a manufacturer or vendor, the words "or equal" shall be implied. The specific article, material or equipment mentioned shall be understood as indicating the type, function, minimum standard of design, efficiency and quality desired and shall not exclude manufacturers' products of comparable quality, design and efficiency. If the Contractor wishes to propose an equal article, material or equipment, it shall make a written request to the Engineer in accordance with Section 12 CLARIFICATIONS AND CHANGES TO THE WORK of the General

Conditions, including a justification identifying the benefits to the Purchaser. The justification shall contain a comparison of the specified standard, material or component and the proposed alternative.

The Purchaser's written approval through an Extra Work Order or Change Order must be obtained prior to any equal article, material or equipment being incorporated into the Work by the Contractor.

17 LANGUAGE, DIMENSIONS AND WEIGHTS

All communications (including without limitation all notices, documents, notes on drawings and submissions) required or permitted under the Contract shall be in English.

The design of the Work shall be executed in the SI (Metric) System of Units. Dimensions shall be shown in metres and millimetres and weights shall be shown in kilograms and metric tonnes.

18 DOCUMENT MANAGEMENT AND COMMUNICATION

The Purchaser will utilize a Web-based document management application in the performance of the Work for document management and collaboration. The Purchaser will provide the Contractor and its authorized employees and subcontractors with appropriate user identifications to permit access to, and use of the website as required. Any training required by the Contractor or its authorized employees or Subcontractors on the application, initiation and maintenance of the website shall be considered included in the Contract Price for the Work.

19 PURCHASER'S DRAWINGS

The Purchaser has produced *Preliminary* engineering drawings for Site access, camp and work area, powerhouse and service bay general arrangements. The following drawings accompany and form part of the Contract:

DRAWING NUMBER	REV.	TITLE
1-00195-DE-83000-0001 0001	00	Keyyask Location Plan
1-00195-DE-83000-0001 0002	00	Work Area Space Allocation
Figure 1	05	Powerhouse General Arrangement Powerhouse Plan and Section at Turbine Water Passage
Figure 2	A	Powerhouse General Arrangement Powerhouse Channels Plan and

		Section
Figure 3	A	Powerhouse General Arrangement Powerhouse Plan
Figure 4	A	Powerhouse General Arrangement Powerhouse Cross Section at Centerline Unit
Figure 5	01	Powerhouse Section Water Passage and Major Equipment Dimensions
Figure 6	A	Powerhouse Plans Through Semi- spiral Case & Draft Tube Water Passage Dimensions

During the course of the Work, additional drawings may be issued by the Engineer, if and as required to supplement or further set forth the details shown on the above drawings, and such additional drawings shall thereupon become part of the Contract.

When required dimensions or details do not appear on the Engineer's drawings, the Contractor shall obtain such information from the Engineer before proceeding with the Work.

20 WORK SAFETY

Without limiting the generality or application of any other term or condition of the Contract, the Contractor shall comply with all laws, regulations and by-laws relating to the Work and work safety and health matters, duly enacted by federal, provincial, and municipal authorities; and further, the Contractor shall comply with any rules, guidelines, policies, and directives set forth by the Purchaser in respect of same.

- (a) The Contractor shall identify the dangers inherent in the Work, and shall at all times:
- i) follow safe working procedures and develop new procedures as required,
 - ii) employ employees, agents and Subcontractors who are properly qualified and skilled to do the Work,
 - iii) provide information, instruction and ongoing training in safe working procedures and safety documentation for its employees, agents and Subcontractors,
 - iv) use Plant, Tools and equipment which are in safe operating condition and appropriate for the Work to be performed,
 - v) comply with the requirements of the Manitoba Labour Fall Protection Guideline;
 - vi) obtain all permits, licences and clearances for the Work, and

- vii) establish compliance procedures and take all other necessary measures, to protect the safety of workers and all other persons who may be in the vicinity of the Site. At a minimum, the Contractor shall comply with:
 - (1) *The Workplace Safety and Health Act*, C.C.S.M. chapter W210, and the regulations thereunder,
 - (2) Manitoba Hydro safety rules, and other relevant laws, regulations and bylaws identified herein, included as **Appendix I**.
- viii) carry out all requests and directions of the Purchaser's safety inspector appointed pursuant to *The Workplace Safety and Health Act*.
- (b) The Contractor shall allow the Purchaser timely and complete access to the Contractor's records and documentation, to allow the Purchaser to confirm the Contractor's ongoing compliance with paragraph (a) hereof. The Contractor shall, at the Purchaser's request, provide copies of documentation related to safety at no extra cost to the Purchaser, including without limitation copies of:
 - i) résumés, licences, certification papers and like documentation for employees of the Contractor, its agents and Subcontractors engaged in the Work,
 - ii) specifications, permits, test results and licences, for all equipment to be used in the Work, and
 - iii) all other permits and licences for the Work.
- (c) At all times, the Engineer may inspect and test the Tools and equipment to be used in the Work.
- (d) The Contractor shall maintain a Workplace Hazardous Materials Information System (WHMIS) file for all controlled products used at the Site. At least two weeks prior to the commencement of the Work at Site, the Contractor shall:
 - i) submit an inventory of controlled and regulated products using Manitoba Hydro form H238 and submit the current corresponding Material Safety Data Sheets (MSDSs) to the Purchaser for all controlled products at the Site;
 - ii) in accordance with the Purchaser's practices, have all controlled products approved for use by the Purchaser prior to being allowed on the Site. Any controlled products rejected for use shall not be brought on the Site by the Contractor or its Subcontractors;
 - iii) Any controlled product brought onto Site without the prior approval and submission of an MSDS shall not be used in the Work until approval is granted and the MSDS has been submitted;

- iv) In addition, all controlled products brought on to the Site without the prior approval and submission of a MSDS and all waste materials shall be removed by the Contractor.
- (e) Without limiting the generality of any other term or condition of the Contract, the Contractor shall indemnify and save harmless the Purchaser from any and all costs, fees, fines, penalties, and expenses, incurred by the Contractor that are attributable to or that result from any breach of this section of the General Requirements by the Contractor.
- (f) If deemed necessary, the Contractor may be required to submit a Safety Mitigation Plan for approval by the Purchaser.
- (g) The Contractor shall establish a safety committee as required by Article 18 of the BNA.
- (h) During performance of ITEMS 3 & 4, the Contract shall be responsible for safety signage, barriers, egress equipment and all other things necessary to comply with The Workplace Health and Safety Act while deemed “in-control” of a work area.

21 PRIME CONTRACTOR

The Contractor and the Purchaser acknowledge and agree that the Purchaser is the “prime contractor” as that term is defined in *The Workplace Safety and Health Act (Manitoba)* for all purposes of that Act and shall have all of the duties and responsibilities of a prime contractor under *The Workplace Safety and Health Act*.

22 PRE-JOB PLANNING AND SAFETY MEETINGS

Prior to the commencement of the Work, the Contractor and all its Site personnel shall attend:

- a) a pre-job planning meeting to identify safety matters; and,
- b) a Site orientation.

The Purchaser has implemented a Safety Management System at all its facilities. During the course of the Work, all the Contractor’s Site personnel shall attend a daily job planning meeting led by the Superintendent prior to the commencement of each shift and when there has been a change introduced to the job to plan and discuss the day’s work as well as to review and identify any safety matters, concerns, or procedures pertinent to the Work.

The Contractor shall attend all such meetings at no additional cost to the Purchaser.

23 FLAME RESISTANT CLOTHING

The use of Flame Resistant Clothing (FRC), by the Contractor's workers, will not normally be required. However:

- (a) Areas where the Work is to be performed will be de-energized and/or barricaded to indicate the limits of any existing area where a clothing ignition hazard may exist;
- (b) This in no way relieves the Contractor's responsibility to comply with existing legislation, regulation and Manitoba Hydro Corporate Safety and Occupational Health Rules found in **Appendix I** where circumstances of the Work or methods used require the use of flame resistant clothing;
- (c) All individuals entering or working in an area that poses a danger of, or has been identified as, having a potential electric arc, clothing ignition or flash fire hazard shall wear flame resistant clothing that meets or exceeds the Manitoba Hydro's flame resistant clothing standards as described in the most current Manitoba Hydro Flame Resistant Clothing Program Guidelines included as **Appendix H** of this Request; and,
- (d) All flame resistant coveralls and overalls must have bright orange-red background material (CSA Z96 02 table 2b) with a minimum of 0.13 m² (201 sq. in.) CSA Z96 02 (High Visibility Safety Apparel) Class II compliant reflective trim (arm, leg, front and back horizontal bands), visible from a 360 degree radius. Reflective trim must be flame resistant. Alternatively, a CSA Z96 02 Class II compliant flame resistant vest or smock meeting the Purchaser's standards may be worn as the outer layer over non CSA Z96 02 Class II flame resistant clothing (example: shirts and pants).

24 CONTRACTOR'S EMPLOYEES, AGENTS AND SUBCONTRACTORS

The Purchaser, acting reasonably and upon advising the Contractor of its reasons, shall have the right to require the Contractor to permanently remove an employee, agent or Subcontractor of the Contractor, or any employee or agent of a Subcontractor, from the Work for any reason whatsoever, including, but not limited to, violation of camp regulations, incompetence, disorderly conduct,

insubordination, impairment due to alcohol or drugs, disciplinary suspension from employment with the Purchaser or its subsidiaries, incapacity, or inability to perform the Work without creating a danger to personal safety or to the safety of others or that the employee, agent, or Subcontractor of the Contractor, or any employee or agent of the Subcontractor, is on lawful or illegal strike or lockout with or from the Purchaser. The Contractor shall engage a substitute for any such employee, agent or Subcontractor removed from the Work, at no additional cost to the Purchaser.

The Contractor shall not permit its employees, agents or Subcontractors, or employees or agents of a Subcontractor, to possess or consume alcoholic beverages in the vicinity of the Work.

Employees, agents and Subcontractors of the Contractor and any employees or agents of a Subcontractor shall comply with all security rules and regulations which may from time to time be imposed by the Purchaser on or in connection with the Work at Site or at the Purchaser's facilities.

25 TRANSPORTATION

The Contractor shall be responsible for the transportation of its Plant, Tools, equipment, materials, and personnel, to, from and around the Site as required to perform the Work.

This section outlines some of the transportation considerations in the Thompson/Gillam area at the Site. This information is provided as reference only and in no way reflects all transportation considerations and limitations between the Contractor's facilities and Thompson, Manitoba. It shall be the Contractor's responsibility to identify any and all such considerations and limitations that may apply to its ability to deliver and perform the Work.

The Site is only accessible by road. It is anticipated that the Contractor will transport its work to Site entirely by road through Thompson or a combination of road and railway through Thompson and/or Gillam. As outlined in the following sections there are limitations for both roadway and railway transportation.

The Contractor shall transport all ITEMS of the Work and all parts thereof to the Site to meet the applicable dates in the Contract Schedule within existing transportation limitations.

25.1 Road

The Site is accessible by road from both Thompson and Gillam. The transportation distance to the Site is approximately 210 km and 145 km respectively. Both routes use portions of Provincial Road (PR) 280, which links

Thompson and Gillam. A 24 km proposed access road will link PR 280 with the Site.

PR 280 is a class A-1 Highway and is under the jurisdiction of Manitoba Infrastructure and Transportation (MIT). Further information about MIT may be found on its website at <http://www.gov.mb.ca/mit/>. The proposed access road will be a private controlled road during construction of the Keeyask Project and will be constructed to meet MIT's A-1 Highway specification. The Contractor shall verify all items related to the transportation on this route with MIT.

As of the date of execution of the Contract, maximum legal specification of class A-1 Highways are as follows:

- (a) Gross Vehicle Tare of 56 500 kg
- (b) Width: 2.6 m
- (c) Length: 23.0 m (A, B or C Train)
- (d) Height: 4.15 m

PR 280 is a seasonally restricted highway, dependent on ground conditions. PR 280 has spring restrictions which reduce loads to a maximum of 90% of normal axle loading. Timing for restrictions is dependent on freeze/thaw cycles. Further information regarding seasonal restrictions may be found on MIT's website. Conversely MIT will allow heavier weights during winter when the ground is frozen.

Vehicles that exceed the specifications of a class A-1 Highway require an over load/size permit from MIT. Transportation carriers can attain a yearly blanket oversize permit. This will allow the carrier to transport goods over 4.57 m high or 3.35 m wide under one permit. For larger oversize loads a special one-time permit is required.

The maximum oversize load that can be transported on PR 280 is determined by bridges and culverts. Table 1 identifies specific bridge locations and the corresponding restriction. The route between Thompson and Gillam also has numerous culvert locations which may have a weight restriction. These locations will likely require special consideration by MIT. The Contractor shall account for the time needed to obtain all necessary transportation permits in its delivery schedule in order to meet the applicable dates set out in the Contract Schedule.

Table 1: Oversize Load Limits

Description	Distance From Thompson	Distance From Gillam	Limiting Factor	Details

Bridge at Burntwood River	0 km	300 km	Controlled by other bridges on route from Thompson to Site	
Bridge at Odei River	50 km	250 km	Width Below Guard Rail (0.66m) 7.35 m Width Above Guard Rail (0.66m) 7.84 m Height 7.3 m	Four Span 96.16 m (L) x 8.68 m (w) Concrete I-Girder and Steel Truss Bridge
Bridge at Assean River	150 km	150 km	Width Below Guard Rail (0.66m) 7.35 m Width Above Guard Rail (0.66m) 7.84 m Height 7.3 m	Single Span 49.53 m (L) x 8.52 m (w) Steel Truss Bridge
Bridge at North Moswakot River	205 km	235 km	Width 10.70 m Height - none	Single Span 28.103 m (L) x 10.70 m (w) Concrete I-Girder Bridge
Bridge Deck at Long Spruce Generating Station	270 km	30 km	Width 8.20m Height - none	Generating Station Deck, Structure restricts width on one side

25.2 Rail

The city of Thompson and the town of Gillam have rail access via the Hudson Bay Railway (HBR) which is owned and operated by Omnitrix. This rail line is connected to the CN rail network at The Pas, Manitoba. The Contractor may transport items from its facilities to Thompson or Gillam by rail, then transport to the Site by truck.

Even if items are transported to Thompson by road it may be advantageous to transport oversize items from Thompson to Gillam by railway due to limitations on PR 280.

Off-loading from rail and reloading onto truck trailer equipment for transportation to the Site shall be the responsibility of the Contractor. Neither Thompson nor Gillam siding has a gantry system. The Contractor shall arrange for a crane to transfer equipment/materials from rail to truck. Alternatively the Contractor may

investigate establishing a temporary siding location at the junction of the HBR and highway PR 280, which is approximately 100 km in distance from the Site. This would require consultation with and approval by MIT.

To assist the Contractor in its evaluation of transportation options a rail survey has been completed on behalf of the Purchaser for the HBR railway between Thompson and Gillam. The survey assessed obstructions in a 7.315 m by 7.315 m window. Width restrictions for this railway include rock outcrops at numerous locations. Currently the maximum width that may be transported by rail between Thompson and Gillam is approximately 6 m. The detailed results of such survey shall be provided to the Contractor upon request.

26 USE OF PRIVATE ROADS OR PRIVATELY OWNED PROPERTY

During the course of the Work, the Contractor shall not enter upon or use private roads or other privately owned property unless and until it has obtained permission from the owner thereof. If permission is granted, the Contractor shall maintain the private roads and property at its own expense during the course of the Work and upon completion of the Work shall restore the same to their previous conditions.

During the course of the Work, the Contractor shall promptly remove from private roads or other privately owned property, any material which has fallen from the Contractor's vehicles, including, without limitation, rock(s), debris or waste(s).

27 CONTRACTOR'S OFFICE AND ACCOMMODATION

Accommodations for the Contractor's office, lunch room, Plant, Tools, equipment and materials (including fuel at the Site) shall be the responsibility of the Contractor.

The Purchaser has set aside a work area at the Site for use by contractors engaged to perform work on the Keeyask Project. The proposed Contractor Work Area - Work Area A has a total area of 64 HA of developable space. This area will be used by all contractors to house their site offices, plant, store equipment, tools, vehicles and construction materials. 11,900 square meters have been allocated for the Contractor in performance of the Contract. The Contractor shall be responsible for the protection of its office, lunch room, Plant, Tools, equipment, and materials stored on the Site including any fences or barriers required. Materials stored on the Purchaser's premises shall be neatly stacked and protected from the elements.

28 TOILETS AND WASHROOMS

The Contractor shall supply and maintain all necessary toilets and washrooms for all of its and its Subcontractor's personnel engaged in the Work. These facilities must comply with the requirements of The Public Health Act (Manitoba).

29 TEMPORARY HEATING AND HOARDING

Temporary heating and hoarding within the powerhouse will be provided by the Purchaser. The Purchaser will maintain an average temperature of 10 degrees C that will generally allow the Work to be performed. The Contractor shall be responsible to provide any supplementary heat in the turbine pit, scroll case, draft tube and generator enclosure that it deems necessary. Any supplementary heaters shall be 600 V AC. Oil or gas fired heaters are not allowed. Failure or interruption of the heating and hoarding system shall not constitute grounds for a claim by the Contractor.

30 CONTRACTOR'S WORK RECORDS AND REPORTING

The Purchaser may withhold payments until the Contractor delivers to the Engineer and the Engineer has accepted the applicable Monthly Status Report referenced in Subsection 30.1 Monthly Status Report of the General Requirements. The Engineer reserves the right to waive the requirement for the Contractor to submit a Monthly Status Report in periods when there is little or no Work activity.

30.1 Monthly Status Report (Applicable to ITEM 2 & ITEM 3)

Not later than the twenty-fifth day of each month, the Contractor shall prepare and deliver a monthly status report to the Engineer for his approval that depicts the status of the Work as of the end of such month, in accordance with the requirements of Section 8 CONTRACT SCHEDULE of the General Requirements (the "Monthly Status Report"). The Monthly Status Report shall report on the progress of the Work relative to the Contract Schedule projected up to the end of that month. The Monthly Status Report shall describe in full detail any activity which is behind schedule, explaining the reasons and the remedial action which the Contractor is following to regain the Contract Schedule. The Monthly Status Report may, at the Purchaser's option, be of the type commonly known as "report by exception" in which those activities not behind schedule are dealt with in a summary form only.

The following documents and information shall be included in each Monthly Status Report:

- a) a transmittal letter,
- b) a description of Work performed since the last report,
- c) a description of the current critical path,
- d) a description of changes in the critical path and scheduled completion date from the last report,
- e) a description of problems encountered or anticipated that affect the Contract Schedule,
- f) a description of current and anticipated delays, including:
 - i) identification of the delayed activity, by activity ID and description
 - ii) type of delay
 - iii) cause of the delay
 - iv) effect of the delay on other activities, milestones, and completion dates
 - v) a statement of corrective actions to be taken in response to the delay,
- g) a statement that identifies and explains proposed changes incorporated in the Contract Schedule (which remain subject to the approval of the Engineer), including, but not limited to:
 - i) added activities
 - ii) deleted activities
 - iii) changed activity descriptions
 - iv) changed relationships
 - v) changes in the original durations of activities not started
 - vi) increases in the remaining duration of unfinished, previously started activities,
- h) the status of pending items, including, but not limited to:
 - i) permits
 - ii) Requests for Information, Work Instructions, Proposals for Extra Work, Extra Work Orders, Change Orders
 - iii) time adjustments
 - iv) non-compliance notices
- i) such other information as directed by the Engineer.

Discussion/notification of any matter or issue in a schedule update, Monthly Status Report or meeting, including with respect to any delays, will not constitute notice and will not replace the requirement for the Contractor to provide notices as required by the Contract or diminish the requirement for all changes to the Contract Schedule to be formally approved in accordance with Section 12 CLARIFICATIONS AND CHANGES TO THE WORK of the General Conditions.

30.2 Safety Documentation and Records

In relation to safety documentation and records, The Contractor shall:

- (a) Maintain up to date records and report to the Purchaser, and the Keeyask Project Workplace Safety and Health Committee, and the regulator as required by law all incidents identified in paragraph 30.2(b) below and follow up with investigations and reports for all items listed below. Contractor reporting for such incidents shall require:
 - i) Verbal notification will be given to the Engineer or his delegate as soon as practical,
 - ii) Follow up written notification will occur within two hours,
 - iii) Investigation of an incident will occur within 24 hours of the incident,
 - iv) All reporting will be completed by the Contractor as required by the Purchaser and the applicable regulations;
- (b) The Contractor shall prepare and deliver to the Engineer a monthly safety report within its Monthly Status Report that depicts the number of:
 - i) lost time injuries
 - ii) medical aid injuries
 - iii) lost time days
 - iv) person hours worked in the month
 - v) dangerous occurrences
 - vi) improvement orders issued by the Provincial Workplace Safety and Health Division
 - vii) Stop work orders issued by the Provincial Workplace Safety and Health Division
 - viii) vehicle incidents
 - ix) fire incident reports
 - x) spill incident reports

(the “Monthly Safety Report”).

The Contractor will maintain a cumulative total by fiscal year starting April and ending March each year for this data and report changes by month. Monthly Safety Reports are due by the first Friday ending in the new month.

- (c) Submit with its Monthly Status Report and upon request, suitable documentation proving worker qualification on the use of all services or equipment provided for their protection. The Contractor shall provide information, instruction and training given to its workforce to ensure, so far as is reasonably practicable, the safety, and health of the worker, and that the worker is in compliance with *The Workplace Safety and Health Act*.

30.3 Four Week Look Ahead Schedule (Applies to ITEM 3 & 4 only)

The Contractor shall submit an *.xer copy of the Contract Schedule showing current progress and filtered activities to display a* four-week look ahead schedule every week (the “Four-Week Look Ahead Schedule”). *The Four-Week Look Ahead Schedule shall be progressed and submitted on a weekly basis with the Data Date being the Monday of each week. A .PDF file of the Four-Week Look Ahead Schedule shall also accompany the weekly submission.* The Four-Week Look Ahead Schedule shall show and identify:

- a) The planned activities for the previous week, indicating progress actually achieved during that week and all planned activities and deliverables for the next four weeks; and,
- b) Any and all activity to be performed outside normal hours or working days and the anticipated hours of such activities.

The Contractor shall immediately advise the Engineer, in writing, of any changes to the Four-Week Look Ahead Schedule as soon as the Contractor becomes aware that changes will be required. The form of the Four-Week Look Ahead Schedule shall be approved by the Engineer.

30.4 Progress Tracking for ITEM 3

For ITEM 3 of the Work, in addition to the Monthly Status Report described above, the Contractor shall keep a daily record of the Work at Site (the “Daily Record”), which shall be available for review by the Engineer during normal business hours. The Daily Record shall include particulars of weather conditions, number of workers at Site (by trade), details of shifts actually worked, deliveries of products, amount and location of Work, procurement and delivery status, and all other pertinent information reasonably required by the Engineer. A copy of the Daily Record sheets prepared by the Contractor shall be included with the Monthly Status Report. In addition, the Contractor shall maintain and supply in the Monthly Status Report records showing on-the-job training, safety, environmental training, and any other information reasonably requested by the Engineer to ensure compliance with the Contract and/or the Purchaser’s policies with which the Contractor is required to comply pursuant to the Contract.

The Contractor shall monitor the progress of the Work against the Contract Schedule and notify the Engineer in writing immediately upon becoming aware of any potential delays or factors that could cause a delay in achieving the Contract Dates, as well as the remedial steps the Contractor is taking or intends to take to remedy the delays.

The Contractor shall submit to the Engineer weekly reports summarizing the above listed information and any other information requested by the Engineer in sufficient detail and in a form and content acceptable to the Engineer.

Time sheets for the Contractor's labour force on Site shall also be submitted weekly to the Engineer for verification. The Contractor shall attend a weekly meeting with the Engineer to supply this information as well as its plans for the upcoming week.

30.5 Employee Report – KEEYASK PROJECT

The Purchaser maintains a project database to track all equity and non-equity hiring by contractors in order to report on specific groups affected by the Keeyask Project.

The Contractor shall collect, on behalf of the Purchaser, all information requested on Purchaser's Form 2669B titled EMPLOYEE REPORT - KEEYASK PROJECT included as **Appendix B**. The collection and handling of the personal information on Purchaser's Form 2669B shall be in compliance with the privacy provisions of The Freedom of Information and Protection of Privacy Act (Manitoba) C.C.S.M. c. F175.

The Contractor shall facilitate the completion of Form 2669B by the Contractor's or Subcontractor's employee on the same day that the Contractor's or Subcontractor's employee commences work, and submit the form to the Purchaser the same day. In addition, when the Contractor's or Subcontractor's employee has been terminated or reclassified, or the Work completed, the Contractor shall immediately forward the information contained in Part II - Separation Data or Part III - Reclassification Data of the form (as applicable) to the Purchaser.

For the purposes of this Section of the General Requirements, a Contractor's or Subcontractor's employee is defined as a person employed by the Contractor or Subcontractor as applicable to perform the Work and who is on Site for one or more working days.

30.6 Contractor Labour and Purchasing Reports – KEEYASK PROJECT

Manitoba Hydro is required to collect data on hours worked, labour income and purchasing statistics related to the Keeyask Project for socio-economic reporting purposes.

The Contractor shall provide the Purchaser with regular updates regarding labour and purchasing data as requested on the Purchaser's forms as listed below and included in **Appendix V**:

Keyask Project - Contractor Labour Report - Monthly
Keyask Project - Contractor Labour Report - Summary
Keyask Project - Contractor Purchasing Report - Monthly
Keyask Project - Contractor Purchasing Report - Summary

These updates may be submitted electronically (in Microsoft Excel Spreadsheet format) in conjunction with the Monthly Status Report.

Without limiting the Purchaser's other rights pursuant to the Contract, the Purchaser reserves the right to withhold payment to the Contractor for failure to comply with Section 30 CONTRACTOR'S WORK RECORDS AND REPORTING of the General Requirements.

31 HYDRO PROJECTS MANAGEMENT ASSOCIATION

The Purchaser has established and constituted the Hydro Projects Management Association (hereinafter called the "Association") to maintain uniform terms and conditions of employment *pertaining to the work* and to promote industrial peace and harmony during the construction of the Keyask Project.

In relation to ITEM 3 of the Work, the Contractor shall have signed and submitted as part of its Proposal, the application form found on the applicable page in the Contractor's Proposal for membership in the Association and upon execution of the Contract the Contractor shall become a Contractor Member of the Association, and all Subcontractors shall become Contractor Associate Members.

The Constitution of the Association, included as **Appendix W** HPMa Constitution is the Constitution current at the time of preparation of execution of the Contract. In submitting its Proposal and executing the Contract, the Contractor shall be deemed to have obtained from the Association complete information concerning the Association at telephone number (204) 360-3648, and the Contractor shall be solely responsible for any errors or misunderstandings resulting from the Contractor's failure to obtain such information.

Pursuant to Article 34 of the BNA referred to in the following Section, the Association will indemnify wages to a maximum of \$500 000 to ensure that the wages of an employee working for the Contractor or Subcontractor, if any, are paid and that any monies deducted from such employee's pay as defined in the applicable Appendices of the BNA will be remitted to the appropriate union, or fund, as the case may be, in accordance with the applicable Appendices. If a valid claim is made, the amount of the claim may be deducted by the Purchaser from progress payments due or to become due to the Contractor under the Contract.

The Purchaser is responsible for negotiations and administration of the BNA. It has no control or involvement in hiring or disciplining of the Contractor's employees, or in the Contractor's performance in following the BNA. The Purchaser will provide advice on interpretation of the BNA and assist in arbitration hearings through the Association but will not be liable for any compensation awards and the Contractor will be responsible for its own costs of any arbitration proceedings.

32 BURNTWOOD/NELSON COLLECTIVE AGREEMENT (BNA)

ITEM 3 of the Work shall be subject to the Burntwood/Nelson Agreement ("BNA") between the Association of the First Part, the Allied Hydro Council of Manitoba (hereinafter called the "Council") of the Second Part, the Unions of the Third Part and the Contractor of the Fourth Part. A current copy of the BNA is included in VOLUME 3 of this Request. The BNA may be amended from time to time.

In submitting its Proposal and executing the Contract, the Contractor shall have been deemed to have obtained from the Association complete information on the current terms and provisions of the BNA. The Contractor shall be solely responsible for any errors or misunderstandings resulting from the Contractor's failure to make a thorough investigation and to obtain the aforesaid information.

The Contractor and all its Subcontractors to be employed at the Site shall sign the BNA within seven working days after issuance of the Notice to Proceed for ITEMS 2 to 10 of the Work. For this purpose, the Contractor and all its Subcontractors shall make arrangements with the Administrator of the Association whose telephone number is (204) 360-3648. The seven working day period may be extended by mutual agreement between the Association and the Contractor provided the BNA is signed by the Contractor and its Subcontractors before commencement of ITEM 3 of the Work at the Site.

In addition to the provisions of Article 4 of the BNA, the Contractor and all its Subcontractors shall comply with the following provisions:

- (a) The Contractor shall be responsible for convening and chairing a pre-job conference meeting in Winnipeg at a place designated by the Contractor. This meeting shall be subsequent to the signing of the BNA and prior to the commencement of any on-Site work. Subcontractors who are not in attendance at this pre-job conference meeting shall convene a separate pre-job conference meeting.
- (b) To facilitate the designation of trade work assignments, the Contractor and all its Subcontractors shall describe in detail at the pre-job conference

meeting, the assembly or construction processes and/or services that will be performed pursuant to the Contract.

- (c) The Contractor shall prepare minutes of the pre-job conference meeting and forward a copy to the Association within 20 working days from the date of the meeting. The minutes shall contain, in addition to other information recorded, the following:
- i) In the case of work which is not in dispute, a description of and the Union to which the work has been assigned.
 - ii) In the case of work in dispute, in addition to the information set out in i) above, the name of the contesting trades and the basis on which the work assignment is made which shall be in accordance with Article 4 of the BNA.
- (d) All work assignments made by the Contractor subsequent to the pre-job conference meeting and pertaining to work in dispute which was not previously dealt with and assigned shall be recorded and distributed in the manner set out in (c) above.

33 COMPLIANCE WITH BURNTWOOD/NELSON AGREEMENT

With respect to ITEM 3 of the Work, the Contractor and all Subcontractors represent and warrant to the Purchaser that no existing or pending collective bargaining rights or agreements affecting the Contractor and Subcontractors in any way impair the capacity or legal right of the Contractor or any Subcontractor to comply with the BNA and to grant and recognize the exclusive bargaining rights of the unions and Council under the BNA in respect of employees of the Contractor and any Subcontractors engaged in ITEM 3 of the Work. If, in the opinion of the Purchaser, the Contractor or any Subcontractor is unable, at any time, for any reason, to fulfil any obligations, either as a member of the Association or under the BNA, then the Purchaser may, at its sole discretion, declare the Contractor to be in default, and give notice of intention to terminate the Contract, and the Purchaser shall have all remedies for the default provided by the Contract.

34 ADVISORY GROUP ON EMPLOYMENT

The Purchaser may require the establishment of the Advisory Group on Employment to monitor and address concerns about the referral and hiring process for jobs pertaining to the Work on Site, including job order review. The terms and conditions of reference for this committee are set out in **Appendix M**.

If requested by the Association, the Contractor shall designate an individual, to represent the Contractor on the Advisory Group on Employment. The Association will reimburse the Contractor's representative on the Advisory Group on Employment for reasonable travel and accommodation expenses within Manitoba when the Advisory Group on Employment meetings are held in locations other than the location at which the individual is employed.

The Contractor shall be required to implement programs approved by the Association and the Council in accordance with the terms of the BNA.

35 SELECTION OF PERSONNEL

The Contractor represents and warrants that in selecting persons (other than supervisory personnel not covered by the BNA) to be employed in relation to ITEM 3 of the Work at Site, those applicants for employment who have shown that they possess the Contractor's reasonable requirements as to training, experience and qualifications for the particular work to be performed, shall be given preference by following the procedure as outlined in Section 2.9 of Article 2 and Article 12 of the BNA and any applicable preference provisions arising from a signed Letter of Agreement under the BNA with respect to the Keeyask Project.

36 *ENTREPRENUERSHIP, TRAINING AND TRADE (ETT)*

The Province of Manitoba's Department of Entrepreneurship, Training and Trade (ETT) will act as the employment referral agency for the Keeyask Project.

37 ABORIGINAL AWARENESS TRAINING

For ITEM 3 of the Work, all Contractor's and Subcontractor's personnel performing Work at Site will be required to participate in aboriginal awareness training. Sessions will be conducted at Site by Manitoba Hydro or its designated contractor. The Contractor will be reimbursed for sending its employees to these sessions at the straight time rate for hours in attendance. During the course of the Work, traditional Aboriginal ceremonies may be held at the Site of which the Contractor and its Site personnel will be advised and may be asked to participate.

38 CONDITIONS REGARDING THE CONTRACTOR'S EMPLOYEES

Without limiting or otherwise affecting the generality or application of any other term or condition of the Contract:

- a) All employees of the Contractor shall be skilled in their work assignments. The Contractor shall not retain an employee whose skill or fitness is unsatisfactory and shall replace an unsatisfactory employee with a satisfactory employee.
- b) Key personnel must be fluent in the English language, both written and verbal.
- c) The Contractor shall only employ such workers who are medically fit.
- d) The Purchaser has a zero tolerance policy on the possession or use of illegal drugs or narcotics at Site. In addition, if any of the Contractor's employees is convicted during performance of the Work under the federal Criminal Code of Canada for illegal use or possession of illegal drugs or narcotics such person shall be subject to immediate removal from the Site and dismissal from the Work.
- e) Firearms will not be allowed on or at the Site, including in camps. Persons in possession of firearms shall be subject to immediate dismissal.
- f) Should the Purchaser provide accommodations to the Contractor's employees, all Contractor's employees shall abide by the facility's rules and regulations. The Purchaser reserves the right to deny accommodation privileges to any person who contravenes these rules and regulations.

39 IDENTIFICATION OF CONTRACTOR'S EMPLOYEES

The Purchaser (by means of another contractor) will provide all applicable Contractor and Subcontractor's employees with numbered photo identification that also bears the Contractor's name. Such photo identification shall be carried by the Contractor's personnel and any Subcontractor's personnel at all times during performance of the Work on Site, and will be used as means of identification for admission to the Site, including in camps, if applicable and must be shown upon any request by Site security personnel or the Engineer, or any other of the Purchaser's on-Site representatives.

40 BOARD AND LODGING FOR CONTRACTOR'S EMPLOYEES

For ITEM 3 of the Work, a camp facility for the Contractor will be established under a separate contract by the Purchaser located near the Site. This camp will be

available to the Contractor for the accommodation of it and its Subcontractors personnel engaged in ITEM 3 of the Work for its duration.

Accommodation will be offered on the basis of one person per room however, the Purchaser reserves the right to require a double accommodation if the camp capacity is exceeded, by providing two (2) days written notice to the Contractor.

Registration for camp accommodations and receipt of meals shall be recorded by the Contractor or Subcontractor's employee's payroll number and photo identification card.

All contractors working at the Site, including the Contractor will be billed by the Catering Contractor for its personnel on Site at the rate of \$15.00 per person per day for the provision of room and board (three meals per day at the camp facilities, and at the rate of \$10.00 per meal for any additional casual meals). No credit will be allowed for missed meals. Billings will be substantiated by a detailed listing of the charges made against each employee's payroll number and will be made on bi-weekly basis.

Subject to availability and authorization by the Purchaser, casual meals and lodging will be made available in the camp for the Contractor's Site visitors. The rate for this service will be periodically established by the Purchaser throughout the lifetime of the Keeyask Project. The rate in effect at the commencement of ITEM 3 of the Work will be \$10.00 for each meal and \$50.00 per person per day for lodging plus applicable GST and Manitoba Provincial retail sales tax (PST).

All of the Contractor's off-shift employees staying within the Purchaser's camp during their isolation leave periods will be considered as visitors and be billed for meals and lodging at the visitor's rate. The Purchaser retains the right to require such employees to immediately vacate their accommodations upon commencement of their isolation leave by providing written notice to such effect to the Contractor, prior to the commencement of such leave.

The Purchaser is planning to provide trailer lots for long term management staff. These will be serviced lots that include sewer, water, phone and electricity at no cost to the Contractor. Services will be available at fixed points adjacent to the lots. Final extension and termination of services to the Contractor's trailer units shall be at the Contractor's expense.

41 FIRST AID AND MEDICAL FACILITIES

For the duration of the Keeyask Project, the Purchaser is providing, by means of another contractor, first aid requirements including:

- (a) building or space within a building (facility) for first aid with a nurse or certified paramedic and ambulance, which will operate on a limited basis only in the main camp;
- (b) means of emergency transportation for the emergent patient to Thompson General Hospital; and
- (c) all supplies for the first aid room as required by law or deemed advisable by the Purchaser.

In performing ITEM 3 of the Work, the Contractor shall comply with the laws of Manitoba relating to the provision of first aid and medical facilities for its employees and in particular, *The Workplace Safety and Health Act* of Manitoba, (W210). As part of the regulatory requirements the Contractor shall provide, but not be limited to, the following:

- i) Provide and maintain suitable first aid equipment in all of the Contractor's work areas, including first aid kits in all vehicles;
- ii) Provide the required number of trained staff according to the regulations;
- iii) Ensure the staff have the required level of qualifications and provide evidence of the same;

All residents of Manitoba are required by law to participate in the Manitoba Health Services plan which entitles members to hospital and medical benefits. All persons who take up residence in Manitoba are required to register with this plan within 30 days.

There is a public hospital in Thompson. Services provided by the Purchaser and the medical officer in Thompson, when used by the Contractor or its Subcontractors' employees, will be provided free except for the following charges which will be assessed against the Contractor:

- (1) charges normally assessable to the employer, employee or Workers Compensation Board under The Workers Compensation Act, R.S.M. 1987, c. W200,
- (2) charges normally assessable to the Manitoba Hospital Services, Manitoba Health, or to other recognized medical service plan, and
- (3) charges for drugs which are normally assessable to the patient, Workers Compensation Board, Manitoba Hospital Services, Manitoba Health, or other recognized medical service plans.

42 WATER AND SEWER SERVICES FOR CONSTRUCTION PURPOSES

The Purchaser will provide for the Contractor, free of charge, a supply of water for construction purposes only. The water will be supplied from a hydrant located adjacent to the Site. The Contractor shall be responsible for delivery of water to the point of required use, and shall provide all protection necessary to prevent freezing of the hydrant and any piping during the Contractor's use thereof.

Sewer services will not generally be available. Any request for tie-in to the services present shall be made in writing to the Engineer and will be subject to the Purchaser's approval. The cost for design and installation of additional sewer lines that tie-in to the Purchaser's system is the sole responsibility of the Contractor. Scheduled outages to the Purchaser's sewer system to facilitate the tie-in of the system shall be arranged at the Engineer's convenience and will not necessarily be during normal working hours.

43 POWER FOR CONSTRUCTION PURPOSES

43.1 Power Supply

The Purchaser will provide for the Contractor, free of charge for construction purposes only, an electrical supply of 800 A @ 600 V AC, 60 HZ. This power will be supplied to a fixed point adjacent to the Site. The Contractor shall supply, install, maintain and move extensions to this service as required during the construction period, subject to the Engineer's approval.

43.2 Permits to Work

No inspecting, testing or operating which is required to take place or be done in, upon, or about, the Work or equipment or facilities owned by the Purchaser and which are or may be electrically charged from any source, shall be permitted unless and until a written "Permit to Work" has been issued for the purpose by the Engineer. When the inspecting, testing or operating sanctioned by the Permit to Work has been completed, the Contractor shall give written clearance to the Engineer.

44 COMPRESSED AIR FOR WORK RELATED PURPOSES

The Contractor shall supply and maintain all compressed air necessary for the performance of the Work.

45 WORK IN CANADA

The Contractor shall ensure that all persons employed by the Contractor or its Subcontractors to perform work in Canada pursuant to the Contract are legally entitled to work in Canada.

46 FIRE PROTECTION

Suitable fire control equipment as directed by the Purchaser shall be provided by the Contractor for the protection of its own Plant, Tools, materials and equipment and any part of the Work under construction or installation at the Site. All fire protection equipment and fuel storage shall meet the approval of the Engineer.

Storage of fuel will not be permitted in the immediate vicinity of the Work. No burning of any materials is allowed at the Site without a burn permit obtained from Manitoba Conservation by the Contractor and the approval of the Engineer.

The Contractor shall be responsible for any damage resulting from its fires and shall be solely responsible for all costs which may be incurred in extinguishing such fires.

Volunteer fire fighting forces will be organized at the Site by the Purchaser or its agents. The Contractor shall co-operate in every way with the Purchaser to quickly report and extinguish all fires, as well as take all necessary steps to prevent their occurrence. The Contractor's employees will be invited to participate in the volunteer fire crews.

47 SITE SECURITY

The Purchaser will provide security for the Keeyask Project, including at Site. The Security Contractor engaged by the Purchaser shall be responsible for the maintenance of order at the Site, provision of regular fire patrol and other normal security duties.

Notwithstanding the immediately preceding paragraph, the Contractor shall be responsible for the protection, risk of loss and security of all Work, materials and supplies, accounts and cash, equipment, Plant, Tools and all other items under the control or ownership of the Contractor during the course of the Contract and the Work, including during any warranty period set out in the Contract.

The Contractor shall be responsible for the general discipline of its employees. The Contractor is advised that the entrance to the Keeyask Generating Station Project site will be gated and not open to the public. Such gate will be manned by

the Security Contractor on a 24 hour/7 day per week basis. The Contractor and its Subcontractor's employees shall be required to follow identification and access procedures as determined by the Purchaser in order to gain access to the Keeyask Project site for the duration of ITEM 3 of the Work and/or the Contract.

48 QUALITY

The Purchaser's requirements for Quality as applicable to the performance of the Work are outlined herein and are not intended to supersede the Contractor's own Quality Management System, but establish minimum requirements that the Contractor shall adhere to. Where there is a conflict between the Contractor's Quality Management System and the requirements of this Section, the Engineer shall have sole discretion to resolve the conflict and instruct the Contractor on the course of action that meets the Purchaser's requirements. These requirements apply to all aspects of the Work regardless of the Contractor's sequence and methods or need to sub-contract any of the Work to one or more of its Subcontractors.

The Contractor shall comply with the quality assurance program requirements of ISO 9001-2000 or its equivalent in the performance of the Work, the Contract, and the Contractor's obligations in respect of both. If the Contractor's proposed program is not based on ISO 9001-2000 series of standards (latest edition), the Contractor shall submit evidence, satisfactory to the Purchaser, that the proposed program conforms fully with the spirit and intent of ISO 9001 2000.

The Purchaser may, at its sole discretion, reject Work that is not produced under the Quality requirements specified in this Section.

For the purpose of the Quality requirements specified in this Section, the Work at each manufacturing location is considered to have begun upon release of "Issued for Manufacture" drawings or documents and the Work at the Site is considered to have begun upon mobilization of the Contractor at the Site.

Quality is defined as the degree to which the characteristics of the Work fulfills the Contract requirements.

The project Quality Plan (the "Quality Plan") is a Contractor document identifying the quality requirements and standards, means and methods for managing quality, Contractor's Quality Team, all tailored for the Work and respecting the Contractor's Quality Management System and the Contract requirements.

The Contractor's Quality Management System is the organizational structure, procedures, processes and resources needed to implement the Quality Plan.

The Contractor is responsible to identify in the Quality Plan the specific activities it will undertake to perform:

- (a) Quality Assurance: The process of auditing the quality requirements and the results from Quality Control measurements to ensure quality standards are being met.
- (b) Quality Control: The process of monitoring and recording results of Quality activities to assess performance and recommend necessary changes.

48.2 Contractor's Quality Team

The Contractor's Quality Team (the "Quality Team") is the group of individuals identified as having responsibility for the Quality of the Work.

The Quality Team must be independent from the execution of the Work and shall not be assigned to any other functions that are not directly linked to inspection, conformance demonstration or Quality documentation of the Work.

Under the direction of the Quality Manager, the Contractor's Quality Team must have the authority, the autonomy and the responsibility to witness, at the manufacturer's facility and at the Site, the compliance of the components to the requirements of the Contract, the conformance to the manufacturing processes and working methods, the satisfactory installation and pre-commissioning, the application of the Quality plan and the Manufacturing & Installation Inspection and Test Plans (MITP, IITP), and finally the results collection and reporting.

The Contractor's Quality Manager must implement the Quality Plan while respecting the requirements of the Contractor's Quality Management System and coordinate all activities related to the Quality Plan, the Manufacturing & Installation Inspection and Test Plans and the Quality documentation. This includes but is not limited to:

- (a) Execution and maintenance of the Quality Plan
- (b) Execution and maintenance of the components of the MITP/IITP
- (c) Management of the Quality staff.
- (d) Control and verification of the Work and its conformance to the Contract requirements.
- (e) Verification and validation of the Quality documentation.
- (f) Verification and validation of the final Quality docket.
- (g) Management of non-conformances.
- (h) Management of Quality System deviations.
- (i) Management of Purchaser feedback.
- (j) Management and implementation of corrective actions.

48.3 Quality Documentation

All quality documentation shall be in the English language. Where the original document is in a single language other than English, the Contractor is responsible to have the document translated into English without causing delays to the documentation process.

48.3.1 Quality Docket

The Quality Docket is a compilation of all required Quality records necessary for the Work.

The Contractor shall, at each individual manufacturing shop and construction site, provide and maintain a Quality Docket for each individual part or assembly. Within 90 days of the issuance of a Notice to Proceed for ITEM 2 and prior to commencement of any Work, the Contractor shall submit a document titled "List of Quality Dockets" with associated part or assembly names to the Engineer for the Purchaser's approval. This document shall have a title block and revision block. The Purchaser shall determine if the level of detail is sufficient or if the parts and assemblies shall be broken down further into sub-parts and sub-assemblies. A reasonable level of detail is required to keep the individual docket to a manageable size without having too many individual docket to review. The document shall have a blank space for each Quality Docket listed, where the Purchaser shall note the primary Purchaser's Quality Assurance Representative (QAR) for each individual docket.

The Quality Dockets shall be kept at a location that is within the manufacturing shop where the parts are produced or in the case of installation, at the Site. The storage location shall be readily accessible to the QAR without requiring escort or supervision. The QAR shall have the authority to access any Quality Docket at any time during execution of the Work for the purpose of review and to sign off on the Quality records within, and shall be provided with copies of any or all pages within the docket upon request. The QAR will sign off on all documents in a Quality Docket as it is built up over time during the manufacturing and installation processes for the Work.

The onus is on the Contractor to maintain each Quality Docket and ensure that the documents within are current. Quality Dockets that are found to be out of date or not maintained in a neat and orderly fashion shall be remedied through issuance of a Corrective Action Request (CAR) by the Purchaser or the QAR.

Prior to commencing any part of the Work at a manufacturing location or at the Site, each Quality Docket shall be divided into sections with tabbed dividers and a table of contents. The table of contents shall, at a minimum, include the following items:

Manufacturing Shop:

Manufacturing Inspection and Test Plan (MITP)
Index of Inspection Forms
Raw Material or Consumables Certificates
Material Test Reports (Mechanical and Chemical)
Pressure Containing Equipment Documents
Dimensional Inspection Records
Welding Procedure Specifications (WPS) and Procedure Qualification Records (PQR)
Non-Destructive Testing of Weldments (NDT) Reports
Surface Preparation Reports
Painting Reports
Electrical Testing Reports
Non-Conformance Reports (NCR)
Corrective Action Requests (CAR)
Chart Recordings
As-Manufactured Drawings and Documents (hand markups)
Quality Docket Evaluation Report (QDER)
Preservation and Packaging Reports
Shipping Release Form (SR)
Photo Log

Construction Site:

Installation Inspection and Test Plan (IITP)
Index of Inspection Forms (Blank copies of all forms shall be contained within)
Raw Material or Consumables Certificates
Pressure Containing Equipment Documents
Dimensional Inspection Records
Welding Procedure Specifications (WPS) and Procedure Qualification Records (PQR)
Non-Destructive Testing of Weldments (NDT) Reports
Surface Preparation Reports
Painting Reports
Non-Conformance Reports
Corrective Action Requests
Chart Recordings
As-Constructed Drawings and Documents (hand markups)
Quality Docket Evaluation Report (QDER)
Pre-Commissioning Report
Photo Log

One PDF copy of each Quality Docket shall be provided to the designated QAR upon completion of the manufacture or installation by the Contractor for the applicable component or part and before such component or part is packaged for shipment or in the case of Site construction, released for pre-commissioning. The

Contractor shall manage the Work to ensure that no more than three Quality Dockets are submitted for review within any 14 day period. The designated QAR shall review the Quality Docket within 14 days of receipt of the Contractor's transmittal and shall return the Quality Docket with a Quality Docket Evaluation Report identifying any deficiencies. These deficiencies shall be corrected by the Contractor and re-submitted for the Purchaser's review. Any delays to the release of parts for shipment or pre-commissioning due to incomplete or deficient dockets shall remain at the sole risk of the Contractor. Only once there are no longer any deficiencies in the Quality Docket as evidenced by the Purchaser's Quality Docket Evaluation Report shall the part be prepared for shipment or released for pre-commissioning.

The QAR shall sign the Shipping Release form once the part has been packaged and has been inspected by the QAR. Within 28 days of the Shipping Release, the Contractor shall provide a PDF copy of the final Quality Docket to the Purchaser with an official transmittal form attached.

The QAR shall sign the Pre-Commissioning Report once the equipment has been pre-commissioned and has been inspected by the QAR. Within 28 days of the Pre-Commissioning Report, the Contractor shall provide a PDF copy of the final Quality Docket to the Purchaser with an official transmittal form attached.

48.3.2 Manufacturing Inspection and Test Plan (MITP)

The MITP is a detailed sequential list of activities, some of which are inspection points to be performed by the Contractor in order to complete each part or assembly comprising the Work. The current code applicable for the conformance of the MITP's is CAN\CSA-ISO 10005:05.

The Contractor shall prepare individual MITPs for each part or assembly identified in the List of Quality Dockets. The MITP must be reviewed by the Engineer and noted as "Reviewed" or "Reviewed as Noted" before any manufacturing may commence, including any procurement of raw materials. All MITPs shall be submitted for review in accordance with Subsection 8.4 Contract Dates of the General Requirements.

The Purchaser shall identify on the MITP document in a space provided, one of the following notations for each individual step in the MITP:

Witness - The Engineer or QAR shall be present to witness the activity or inspection work being performed by the Contractor. The Contractor shall notify the Engineer and QAR in writing 3 weeks in advance of the witness point for planning purposes and confirm the witness point 3 days in advance. The Engineer or QAR may waive the witness point in writing. If the Engineer or QAR is not present for the witness point as scheduled, the work in question shall proceed.

Hold - The Engineer or QAR shall be present to witness the activity or inspection work being performed by the Contractor. The Contractor shall notify the Engineer and QAR in writing 3 weeks in advance of the hold point for planning purposes and confirm the hold point 3 days in advance. The Engineer or Primary QAR may waive the hold point in writing. If the Engineer or QAR is not present for the hold point as scheduled, the work shall not proceed. The work shall be held for a minimum of 3 days to allow the Engineer or the QAR to be present for the scheduled hold point.

Report - The Engineer or QAR shall not be present for the scheduled activity or inspection work being performed. The Contractor shall provide a written report describing the results of the scheduled activity or inspection work in the Quality Docket within 5 calendar days.

N/A - The Engineer or QAR may not be present for the scheduled activity or inspection work being performed.

The Purchaser reserves the right to add activities or inspection points to the MITP document if it is found that insufficient detail has been provided for the Purchaser to plan its work.

48.3.3 Installation Inspection and Test Plan (IITP)

The IITP is a detailed sequential list of activities and inspection points to be performed by the Contractor in order to complete each part or assembly comprising the Work. The IITP does not include any pre-commissioning tests or inspections required by the Purchaser. The requirements of Subsection 48.3.2 apply to the Installation Inspection and Test Plan except as follows.

The Contractor shall prepare individual IITPs for each installed system. The IITP must be reviewed and returned by the Purchaser as "Reviewed" or "Reviewed as Noted" before any installation may commence, including any work to be undertaken at the Contractor's Work Area, in the service bay, or in any other laydown or erection area at the Site. All IITPs shall be submitted for review in accordance with Subsection 8.4 Contract Dates of the General Requirements. The following list of installed systems is intended to set a minimum standard for the level of detail required by the Purchaser:

- (a) First Stage Embedments (draft tube liner, stay ring, and all anchors)
- (b) Second Stage Embedments (bottom ring, discharge ring)
- (c) Head Cover and Wicket Gates
- (d) Runner and Shaft Assembly
- (e) Operating Ring, Links, and Levers
- (f) Servomotors and Oil Piping
- (g) Turbine Bearing
- (h) Shaft Seal and Water Piping & Valves

- (i) Turbine Walkways, Handrails, and Lifting Equipment
- (j) Turbine Electrical (Lighting, Instrumentation, Controls, Power Supply)
- (k) Generator Lower Bracket
- (l) Shaft and Thrust Block Assembly
- (m) Generator Bearing
- (n) Rotor Spider
- (o) Stator
- (p) Surface Air Coolers and Piping & Valves
- (q) Generator Upper Bracket, Covers, Ducting and Air Grilles/Baffles
- (r) Generator Oil Piping & Valves
- (s) Generator Deluge Piping & Valves
- (t) High Pressure Oil Injection System
- (u) Generator Electrical (Lighting, Instrumentation, Controls, Power Supply, Air Gap Monitoring System)
- (v) Collector Housing

If the Contractor chooses to modify any IITP, it shall provide the Engineer with a revised copy of said IITP for the Purchaser's review and approval. The revised procedure/IITP shall not be followed until the Contractor has received written approval from the Engineer.

48.3.4 Pre-Commissioning Inspection & Test Plan (PITP)

The PITP is a sequential list of activities to be performed by the Contractor to complete the pre-commissioning of the Work. The requirements of Subsection 48.3.2 apply to the PITP except as follows.

The Contractor shall prepare a single PITP for the pre-commissioning of all the systems included in the Work. The PITP shall include a single item for each system (e.g. generator thrust bearing high pressure oil injection system, turbine main shaft seal, etc.).

The PITP must be reviewed and returned by the Purchaser as "Reviewed" or "Reviewed as Noted" before any pre-commissioning work may commence. The PITP shall be submitted for review in accordance with Subsection 8.4 Contract Dates of the General Requirements.

48.3.5 Raw Material or Consumables Certificates

A Raw Material or Consumables Certificate clearly identifies the type of material and grade of raw materials and consumables used in the Work.

All raw materials and consumables used in the Work at the Contractor's facility or at a Subcontractor's facility require a Raw Material or Consumables Certificate. If the original certificate is in a language other than English, the Contractor shall provide both the original copy and an accurate translation into the English

language. Requirements for material coupons and testing are defined in the Technical Requirements.

48.3.6 Pressure Containing Equipment Documents

Pressure Containing Equipment is defined as all systems over 17 cu. ft. in volume, and/or all systems over 100 psi.

For all Pressure Containing Equipment, the following documentation is required in order of preference:

- (a) ASME U Stamp
- (b) Canadian Registration Number (CRN)
- (c) Certificate of Conformance

Prior to the start of manufacture, and after the final design is complete and has been reviewed by the Purchaser, the Contractor shall submit to, and obtain required approval for Pressure Containing Equipment from the Manitoba Department of Labour.

Pressure containing equipment is defined as all systems over 17 cu. ft. in volume, and/or all systems over 100 psi.

Pressure Containing Equipment shall have a copy of the above required documentation included in the applicable Quality Docket(s). The applicable Quality Docket shall not be considered complete until the required documents are incorporated.

48.3.7 Dimensional Inspection Records

A Dimensional Inspection Record is a Quality record that validates all equipment sizes and features required by the design and the Contract requirements.

100% Dimensional Inspection is required on all parts designed by the Contractor. If a dimension is called out on the design drawings, it must be verified by the Quality Team.

The Contractor shall record the actual dimensions on a full size copy of the design drawing(s) by hand at the time of the Dimensional Inspection. Where multiple measurements are required to confirm the finished dimension, the Contractor shall produce custom inspection sheets with the required dimensions laid out in a table with the necessary diagrams showing the part to be measured. Each custom inspection sheet shall bear a unique number and shall reference the original drawing number (Manitoba Hydro SCI number). The drawing marked for inspection shall be signed off by both the Quality Team and the QAR once all dimensions are verified as correct and all associated non-conformances are

closed. The original signed drawing shall be included in the Quality Docket with the original copies of the custom Dimensional Inspection sheets attached.

Any deviations from the specified tolerances shall be resolved through issuance of an NCR.

48.3.8 Welding Procedure Specifications (WPS) and Procedure Qualification Records (PQR)

Welding documents shall meet the requirements of **Appendix K: Manitoba Hydro Welding Specification**.

WPS and PQR documents require approval by the Purchaser's Engineer. The final approved documents with the Purchaser's Review Stamp shall be incorporated into the Quality Docket prior to any welding taking place.

48.3.9 Non-Destructive Testing of Weldments

A Non-Destructive Testing of Weldment Report is a Quality record that documents the inspection of weldments as required by Subsection 3.5.3 Non Destructive Testing of the Technical Requirements and **Appendix K: Manitoba Hydro Welding Specification**.

NDT Reports shall include, as a minimum, a sketch or diagram of the part being inspected and a list of all castings or weldments checked with a notation of "pass" or a description of the defect or flaw noted.

48.3.10 Electrical Testing Reports

An Electrical Testing Report is a Quality record that documents the results of any test that the Contractor undertakes in the manufacture or installation of the parts in addition to tests described in the Technical Requirements.

Electrical Test Reports shall be provided for all standard and non-standard testing undertaken by the Contractor or its Sub-contractors. If a decision is made to undertake a test that is not identified in the MITP & IITP, the test report must still be provided as part of the MITP document.

48.3.11 Non-Conformance Reports (NCR)

A Non-Conformance Report is a Quality record issued by the Contractor at any time a part is manufactured or installed and does not meet the requirements of the latest revision of the design drawings with the only exception being where a part can be re-worked without deviating from the design drawings. The following examples clarify this requirement:

- (a) A bar is machined to a length that is longer than the specified dimension. The machinist removes additional material to bring the part within the dimension required. NO NCR IS REQUIRED.
- (b) A hole is drilled in the wrong location of a steel fabrication. The shop fills the hole with weld and re-drills the hole in the correct location. NCR REQUIRED. The weld repair is not part of the original design and therefore an NCR must be generated for the part to be accepted.

If the Purchaser and the Contractor cannot agree that a defect requires an NCR, the Engineer shall have the authority to make a final decision. In no case shall the work in question proceed without the review and closure of the NCR.

The Purchaser or QAR has the authority to issue an NCR to the Contractor. The issuance of an NCR by the Purchaser or the QAR shall be treated as if the NCR were generated by the Contractor.

All NCRs must be accompanied by sketches or photos to adequately describe the deficiency.

48.3.12 Corrective Action Requests (CAR)

A Corrective Action Request is a Quality record issued any time the Contractor's Quality Plan fails to adequately control the quality of the Work.

The Purchaser, with input from the QAR, shall determine if a Purchaser-initiated CAR shall be issued to the Contractor. The issuance of a CAR by the Purchaser or the QAR shall be treated as if the CAR were generated by the Contractor.

48.3.13 Chart Recordings

A Chart Recording is a machine generated Quality record of a time based process.

All original Chart Recordings required in the course of the Work shall be signed by the QAR and included in the Quality Docket. If the original document is in a language other than English, the Contractor shall provide both the original copy and an accurate translation. If an error occurs where the Contractor cannot produce an official Chart Recording, an NCR must be provided.

48.3.14 As-Manufactured and As-Constructed Drawings and Documents (hand markups)

As-Manufactured and As-Built Drawings and Documents are required as a record of the condition of the Work at the end of manufacture and installation.

As-Manufactured and As-Built Drawings and Documents shall be provided as 'hand markups' and included in the Quality Docket. These drawings do not

supersede the requirement to produce a clean version of the As-Built Drawings and Documents elsewhere in the Contract.

48.3.15 Quality Docket Evaluation Report (QDER)

A Quality Docket Evaluation Report is a Quality record issued by the Purchaser to document the review of the completed Quality docket and communicate any deficiencies.

Once the manufacturing is complete or the installed part or assembly is ready for pre-commissioning, the Quality Docket shall be turned over to the Purchaser for review. No packaging or other preparation for shipment shall begin until the QDER is completed and all deficiencies in the Quality Docket have been resolved. In the case of installation, no pre-commissioning shall begin until the QDER is complete and all deficiencies in the Quality Docket have been resolved. The Purchaser shall issue a completed QDER that authorizes the Contractor to begin preparation for shipment or pre-commissioning activities for the part or assembly in question.

48.3.16 Shipping Release Form (SR)

A Shipping Release Form is a Quality record issued by the Contractor to document the satisfactory packaging of equipment prior to shipment to the Site.

Once the part or assembly is prepared for shipment, the Contractor shall issue a Shipping Release Form. The SR is required to ship any and all parts to the Site regardless of whether an MITP or IITP was required or a Quality Docket was produced. Parts or assemblies are not authorized to ship until all deficiencies identified on the SR are remedied and the document is signed by the Purchaser. The Purchaser has the right to request that all crates, boxes, or other packaging that have been closed or sealed without verification of the contents by the Purchaser be opened for complete inspection of the packed condition prior to release.

48.3.17 Photo Log

The Contractor shall maintain a record of all photographs taken during the activities identified in the MITP or IITP and to append these photos with dates and times to the Quality Docket. As a minimum, the Contractor is required to take at least one photo of the part in question and one photo of the instrument or device used in the specific inspection called out in the MITP or IITP.

48.3.18 Pre-Commissioning Report

A Pre-Commissioning Report is a Quality record issued by the Contractor documenting the result of pre-commissioning for each part or assembly.

The Contractor shall provide a Pre-Commissioning Report for all pre-commissioning activities. These reports shall be filled during pre-commissioning and signed off by the Purchaser. The completed Pre-Commissioning Reports shall be included in the installation Quality Docket for each part or assembly.

48.3.19 Material Test Reports

A Material Test Report is a Quality record documenting the results of material testing undertaken by the Contractor and required by Section 3 MATERIALS AND WORKMANSHIP of the Technical Requirements.

Reports of any material testing shall be included in the Quality Docket. If the original document is in a language other than English, the Contractor shall provide both the original copy and an accurate translation.

48.4 The Purchaser's Quality Assurance Representative (QAR)

48.4.1 Definition

The QAR is a person responsible for monitoring the Contractor's activities and reporting those activities to the Purchaser. This is not a single person or entity, but is a team of individuals assembled by the Purchaser to suit the Contractor's manufacturing plan. The team will include Manitoba Hydro engineers, inspection firms in the employ of Manitoba Hydro, and sub-contractors of the aforementioned inspection firms. Manitoba Hydro shall designate a QAR for each Quality Docket that is produced by the Contractor. The QAR is responsible to ensure the Purchaser's requirements are met, but does not always have the authority to approve dispositions to non-conformances in or deviations from the scope of the Work in which event such dispositions shall be determined by the Purchaser.

48.4.2 Responsibilities

The QAR will verify the Quality Plan implementation and compliance, the Manufacturing and Installation Inspection and Test Plan implementation and conformance, the process methods application and conformance and the Quality records and reporting.

The QAR will issue Non-Conformance Reports when a product deviation is found. The QAR will also issue a Corrective Action Request (CAR) when he finds a deviation in the application of the Contractor Quality Management System and/or the Quality Plan. The QAR has the right to perform audits in order to prevent process deviations which would potentially create product non-conformances. In case of product non-conformance, the Contractor will have two (2) days to propose a correction to the Purchaser. In the case of Quality

Management System deviations, the Contractor will have thirty (30) days to implement the correction in the system. In both cases, the QAR will validate the corrections by closing the NCRs and CARs.

The QAR is not responsible to supplement the Contractor's own Quality Team or provide assistance in executing the Contractor's Quality Plan. The QAR is intended to act as the Purchaser's presence and will work in a collaborative manner to benefit the Purchaser's and the Contractor's shared goal of maintaining quality and schedule throughout the duration of the Work. If, in the opinion of the Purchaser, the Contractor is not providing adequate quality surveillance for the Work, a CAR shall be issued and the Purchaser shall have the right to deduct any cost to provide such surveillance by the QAR from any payments due to the Contractor for the Work.

48.4.3 Access to Contractor's Facilities

The QAR shall be granted unescorted access to the Contractor's facilities and *escorted access as required* to the facilities of all of its Subcontractors, at any time during the Contractor's or Subcontractors' normal business hours to enable the QAR to verify that the Contractor and its Subcontractors are satisfactorily carrying out the Work and that the Work complies with the requirements of *the Contract*. The QAR shall at all times observe the Contractor's safety and security requirements of which the QAR has been advised. The QAR shall be allowed at any time and under any circumstance to take photographs of any portion of the Work he deems necessary.

While attending at the Contractor's facilities, the QAR will comply with the reasonable policies of the Contractor concerning confidentiality (and with respect to matters not related to the Work and the Contract) which have been disclosed in writing to the Purchaser prior to attendance and for which no objection has been made; provided further however that nothing in the Contract is altered or diminished by reason of any such policy or compliance with same. While attending at Contractor's facilities, the QAR will use best efforts to limit disruption of other activities at such facilities.

If the Contractor determines that the QAR has conducted himself in a manner that is not in accordance with shop safety rules or is not acting according to the defined scope of the Contract, the Contractor shall report the events to the Purchaser. No action may be taken to remove the QAR or restrict access to the Work until the Purchaser has been notified and has agreed to remove the QAR or restrict his access to the Work.

48.5 Tools and Equipment

All tools and equipment used to carry out inspection activities by the Contractor shall have been calibrated within the six (6) months preceding of the date of inspection. Calibration records shall be provided to the QAR upon request. If it is discovered that tools and equipment are used for the Work that have not been calibrated within six (6) months of the inspection date, the inspections shall be repeated, at the sole risk of the Contractor, with tools and equipment that are properly calibrated.

49 COMMUNICATIONS

The Purchaser will erect a communications tower in the vicinity of the main camp at Site to provide telephone, facsimile and internet communication capabilities for the Work. The Contractor shall arrange and pay for extensions of these facilities to its office(s) and stores. Basic internet services are provided free of charge. Telephone and facsimile usage shall be paid for by the Contractor. All other communication requirements by the Contractor shall be at the Contractor's cost.

Use of the internet may be subject to certain restrictions, and the Contractor may be required to sign a usage agreement in a form and content satisfactory to the Purchaser. Failure, interruption or disturbances of the Purchaser's communication systems shall not constitute grounds for claims by the Contractor.

50 CONDITIONS FOR WORK RELEASE CERTIFICATE

The Contractor shall perform the following activities immediately prior to application for a Work Release Certificate for a turbine and generator:

- a) Make a thorough inspection of all finishes, fixtures, and equipment and ensure proper workmanship and operation of the applicable Work.
- b) Carefully inspect all applicable Work and ensure that it is complete, that all processes and related equipment is fully operational, that all major and minor construction deficiencies are complete and/or corrected, and that clean up works have been completed. Notify the Engineer in writing, of satisfactory completion of inspection and request an Engineer's inspection.
- c) Forward to the Engineer all complete Quality Dockets, inspection and approval certificates, test reports, warranties, maintenance manuals, operating instructions, record drawings, and other documents specifically required by the Contract but not previously submitted.
- d) Complete all deficiencies to the satisfaction of the Engineer. During the Engineer's inspection, a list of deficiencies will be drawn up and signed

by the Engineer. This deficiency list may be amended if additional deficiencies are found during future inspections.

51 PERSONNEL RISK ASSESSMENT

All personnel of the Contractor and any of its Subcontractors, if any, that will have unescorted access to the Purchaser's facilities must be cleared by a personnel risk assessment as set out in **Appendix P** prior to being allowed on Site and have completed Manitoba Hydro Cyber Security Training.

It shall be a condition of the Contract that the Contractor arranges submission of completed forms, described in **Appendix P** in order for personnel risk assessments to be conducted a minimum of 30 days prior to the required access. The Contractor shall comply with all applicable privacy laws in carrying out its responsibilities under this Section.

Any changes to the criminal background status of the Contractor or any Subcontractor's personnel must be reported to the Purchaser immediately.

At any time during the performance of the Contract and at the Purchaser's sole discretion, the Contractor may be required to conduct further personnel risk assessments on any of the Contractor's or Subcontractor's personnel who have unescorted access to the Purchaser's facilities and an individual's existing clearance may be revoked until a follow-up personnel risk assessment is conducted and the results provided to the Purchaser.

52 CYBER SECURITY

When directed by the Purchaser, the Contractor shall, with respect to the Contract and the Work, comply with the requirements of **Appendix P** Cyber Security. *The Work does not include the supply of equipment that is classified as a critical cyber asset, however the Contractor, in execution of ITEM 3 of the Work may have access to or need to interface with equipment supplied by the Purchaser that is considered a critical cyber asset. In this case, the relevant sections of Appendix P shall apply.*

53 TERMINATION OF CONTRACT (FOR CONVENIENCE)

The Purchaser shall have the option to terminate the Contract for any reason, in its sole discretion, by providing the Contractor with a written notice to such effect and termination shall be effective as of the date of such notice. In such event, the Purchaser shall pay the Contractor for those Performance Based Payment

Milestones completed and approved to the date of such termination. The Purchaser shall further reimburse the Contractor for the Actual Cost of any proportion of an incomplete Performance Based Payment Milestone set out in the Terms and Conditions of Payment properly incurred by the Contractor to the date of such termination. The Contractor shall submit to the Purchaser vouchers, certificates, timesheets, invoices and any other supporting materials or information reasonably requested by the Purchaser showing the Actual Cost of all expenses properly committed or incurred by the Contractor for the Work to the date of termination.

The Purchaser shall not other than as provided in this section be liable or obligated to the Contractor for any claims (including third party claims), costs, losses, expenses, damages (including lost profit or any consequential damages whatsoever) howsoever incurred by the Contractor as a result of such termination.

54 TERMINATION OF CONTRACT (FOR UNSATISFACTORY MODEL TEST)

If the Model Tests indicate that the Contractor cannot meet guaranteed turbine efficiencies and turbine outputs as set forth in the Performance Data of the Contractor's Proposal, the Purchaser may, in its absolute unfettered discretion, terminate the Contract by providing written notice to such effect to the Contractor. In the event of any such termination, the Contractor shall deliver, on demand, the model to the Purchaser, and upon receipt of such model, the Purchaser shall pay the Contractor the cost of ITEM 1 as set out in the Contractor's Proposal. Upon such termination as provided herein, the Purchaser shall not be obligated or liable, in any way, to the Contractor to proceed with or make payment for ITEMS 2 to 10 or any other ITEMS of the Work, nor shall the Purchaser, other than as is provided in the immediate preceding sentence, be liable or obligated to the Contractor for any claims (including third party claims), costs, losses, expenses, damages (including lost profit or any consequential damages whatsoever) howsoever incurred by the Contractor as a result of such termination.

55 TITLE AND RISK OF LOSS

Title to the Work or any part of the Work shall pass to the Purchaser upon payment by the Purchaser for such Work provided however, that the risk of damage or loss of the Work and all other obligations arising with respect to the Work as required by the Contract shall remain solely with the Contractor and the Contractor shall make good loss thereof or damage thereto occurring between the date of the execution of the Contract and such time as:

- (a) for each turbine and generator, a Work Release Certificate has issued for the turbine and generator as provided for in Section 30 WORK RELEASE CERTIFICATE of the General Conditions; and
- (b) for all other Work, until a Completion Certificate has issued for the Work in accordance with Section 31 COMPLETION CERTIFICATE of the General Conditions.

56 LIQUIDATED DAMAGES AND PERFORMANCE BONUSES

56.1 General

Liquidated damages and performance bonuses will be calculated on a per Unit basis.

In all cases, the parties agree that any sums calculated pursuant to the formulas set out in this Section 56 in respect of liquidated damages are a genuine pre-estimate of the Purchaser's damages with respect to the Shortfalls (as such term is defined in Subsection 56.8 Aggregate Liquidated Damages of the General Requirements). The Contractor acknowledges that the precise amount of the Purchaser's actual damages would be extremely difficult to calculate and agrees that the formulas set out below represent a reasonable estimate of the actual damages of the Purchaser in respect of the Shortfalls that shall be payable as liquidated damages and not as a penalty.

All efficiency values are in percent.

56.2 Definitions

The following terms will be used for the calculation of liquidated damages and performance bonuses:

GUE is defined as the guaranteed unit efficiency.

MUE is defined as the measured unit efficiency.

TE is defined as the turbine efficiency.

GE is defined as the generator efficiency.

MTWE is defined as the Model Test Report of Record weighted efficiency.

MTEE is defined as the Model Test Report of Record efficiency error.

MTWE_{18.3} is defined as the Model Test Report of Record weighted efficiency at 18.3 m gross head.

MTEE_{18.3} is defined as the Model Test Report of Record efficiency error at 18.3 m gross head.

MTBGE_{18.3} is defined as the Model Test Report of Record best gate efficiency at 18.3 m gross head.

MTFGE_{18.3} is defined as the Model Test Report of Record full gate efficiency at 18.3 m gross head.

MTFGE_{17.4} is defined as the Model Test Report of Record full gate efficiency at 17.4 m gross head.

MTBGE_{19.2} is defined as the Model Test Report of Record best gate efficiency at 19.2 m gross head.

PTWE is defined as the prototype weighted efficiency.

PTEE is defined as the prototype efficiency error.

PTBGE_{18.3} is defined as the prototype best gate efficiency at 18.3 m gross head.

PTFGE_{18.3} is defined as the prototype full gate efficiency at 18.3 m gross head.

GWUE is defined as the unit guaranteed weighted unit efficiency, excluding intake, trashrack and draft tube losses, as stated in the Subsection 56.4.6 Guaranteed Unit Efficiency of the General Requirements.

GWUE_{18.3} is defined as the unit guaranteed weighted unit efficiency, excluding intake, trashrack and draft tube losses, at 18.3 m gross head as stated in Subsection 56.4.6 Guaranteed Unit Efficiency of the General Requirements.

MBGGE_{18.3} is defined as the measured best gate generator efficiency at 18.3 m gross head.

MFGGE_{18.3} is defined as the measured full gate generator efficiency at 18.3 m gross head.

MGEE is defined as the measured generator efficiency error.

GWUC_{18.3} is defined as the guaranteed weighted unit capacity at 18.3 m gross head.

MWUC_{18.3} is defined as the measured weighted unit capacity at 18.3 m gross head.

BGUC_{18.3} is defined as the measured best gate unit capacity at 18.3 m gross head.

FGUC_{18.3} is defined as the measured full gate unit capacity at 18.3 m gross head.

MUCE is defined as the measured unit capacity error.

MML is defined as the measured metal loss *in kg*.

GML is defined as the guaranteed metal loss *in kg*.

The MTWE, MTEE, MTWE_{18.3}, MTEE_{18.3}, MTBGE_{18.3}, MTFGE_{18.3}, MTFGE_{17.4} and MTBGE_{19.2} will be calculated in accordance with Section 5 TURBINES of the Technical Requirements.

The PTWE, PTEE, PTBGE_{18.3}, PTFGE_{18.3}, MWUC_{18.3}, BGUC_{18.3}, FGUC_{18.3} and MUCE will be calculated in accordance with Section 5 TURBINES of the Technical Requirements.

The MBGGE_{18.3}, MFGGE_{18.3} and MGEE will be calculated in accordance with Section 6 GENERATOR of the Technical Requirements.

BGC_{18.3}, FGC_{18.3}, FGTE_{17.4}, BGTE_{18.3}, FGTE_{18.3}, BGTE_{19.2}, BGGE_{18.3}, and FGGE_{18.3} are equal to the values stated in the Contractor's Proposal.

The MML will be calculated in accordance with Section 5 TURBINES of the Technical Requirements.

56.3 Performance Liquidated Damages

Performance liquidated damages are defined as the sum of the Efficiency Liquidated Damages as defined in Subsection 56.4 below and the Capacity Liquidated Damages as defined in Subsection 56.5 below (collectively referred to as the “Performance Liquidated Damages”).

The Purchaser shall calculate Performance Liquidated Damages upon completion of performance testing of the turbine and generator.

Performance Liquidated Damages for each Unit shall not in any case, exceed 4% of the total Contract Price of ITEMS 1 and 2 combined.

56.4 Efficiency Liquidated Damages

If the measured unit efficiency is less than the guaranteed unit efficiency then the Contractor shall pay the Purchaser liquidated damages in an amount calculated in accordance with the following formula:

$$\text{Efficiency Liquidated Damages} = (\text{GUE} - \text{MUE}) \times \$3,850,000/\%$$

(the “Efficiency Liquidated Damages”).

In the case where the above formula gives a negative value, no Efficiency Liquidated Damages will be assessed against the Contractor.

56.4.1 Measured Unit Efficiency

The measured unit efficiency is defined as:

$$\text{MUE} = \text{TE} \times \text{GE}$$

56.4.2 Turbine Efficiency

The turbine efficiency for liquidated damages is defined below:

If

(PTWE +/- PTEE) overlaps the value of (MTWE_{18.3} +/- MTEE_{18.3})

Then

TE = (MTWE + MTEE) or,

If

(PTWE +/- PTEE) does not overlap the value of (MTWE_{18.3} +/- MTEE_{18.3})

Then

TE = (PTWE + PTEE).

56.4.3 Model Test of Record Weighted Efficiency

The Model Test of Record weighted efficiency is defined as:

$$MTWE = 0.2 \times MTFGE_{17.4} + 0.6 \times MTWE_{18.3} + 0.2 \times MTBGE_{19.2}$$

56.4.4 Model Test of Record Weighted Efficiency at 18.3 m gross head

The Model Test of Record weighted efficiency at 18.3 m gross head is defined as:

$$MTWE_{18.3} = 0.9 \times MTBGE_{18.3} + 0.1 \times MTFGE_{18.3}$$

56.4.5 Prototype Weighted Efficiency

The prototype weighed efficiency is defined as:

$$PTWE = 0.9 \times PTBGE_{18.3} + 0.1 \times PTFGE_{18.3}$$

56.4.6 Guaranteed Unit Efficiency

The guaranteed unit efficiency is defined below:

If

(PTWE +/- PTEE) overlaps the value of (MTWE_{18.3} +/- MTEE_{18.3})

Then

GUE = GWUE, or

If

(PTWE +/- PTEE) does not overlap the value of (MTWE_{18.3} +/- MTEE_{18.3})

Then

$$GUE = GWUE_{18.3}$$

Where:

$$GWUE = (0.2 \times FGTE_{17.4} + 0.6(0.9 \times BGTE_{18.3} + 0.1 \times FGTE_{18.3}) + 0.2 \times BGTE_{19.2}) \times (0.9 \times BGGE_{18.3} + 0.1 \times FGGE_{18.3})$$

$$GWUE_{18.3} = (0.9 \times BGTE_{18.3} + 0.1 \times FGTE_{18.3}) \times (0.9 \times BGGE_{18.3} + 0.1 \times FGGE_{18.3})$$

56.4.7 Measured Generator Efficiency

The measured generator efficiency is defined as:

$$GE = (0.9 \times MBGGE_{18.3} + 0.1 \times MFGGE_{18.3}) + MGEE$$

56.5 Capacity Liquidated Damages

If the measured Unit weighted capacity is less than the guaranteed Unit weighted capacity then the Contractor shall pay the Purchaser liquidated damages in an amount calculated in accordance with the following formula:

$$\text{Capacity Liquidated Damages} = (GWUC_{18.3} - MWUC_{18.3}) \times 133/\text{kW}$$

(the “Capacity Liquidated Damages”).

In the case where the above formula gives a negative value, no Capacity Liquidated Damages will be assessed against the Contractor.

56.5.1 Guaranteed Unit Weighted Capacity

The guaranteed unit weighted capacity is defined as:

$$GWUC_{18.3} = 0.9 \times BGC_{18.3} + 0.1 \times FGC_{18.3}$$

56.5.2 Measured Unit Weighted Capacity

The measured unit weighted capacity is defined as:

$$MWUC_{18.3} = 0.9 \times BGUC_{18.3} + 0.1 \times FGUC_{18.3} + MUCE$$

56.6 Cavitation Liquidated Damages

If the cavitation metal loss of the replacement prototype turbine runner and stationary parts of the water passage exceeds the guaranteed amount of metal loss due to cavitation as stated in the Contractor’s Proposal, then the Contractor shall pay the Purchaser liquidated damages in an amount calculated in accordance with the following formula:

Cavitation Liquidated Damages = (MML - GML) x \$46,500

(the “Cavitation Liquidated Damages”).

The Purchaser shall calculate Cavitation Liquidated Damages at the conclusion of the Cavitation Warranty.

In the case where the above formula gives a negative value, no Cavitation Liquidated Damages will be assessed against the Contractor.

Cavitation Liquidated Damages for each Unit shall not in any case, exceed 2% of the total Contract Price of ITEMS 1 and 2 combined.

56.7 Schedule Liquidated Damages

Schedule liquidated damages are defined as the Purchaser’s genuine pre-estimate of the costs, losses and damage it will suffer for each calendar day the Contractor fails to achieve one or more Contract Date Items set out in the table below calculated on a daily basis for each such item until such time as a Work Release Certificate is issued in respect of the applicable turbine and generator (hereinafter “Schedule Liquidated Damages”).

The following table lists the Contract Date Items with associated liability of the Contractor to pay Schedule Liquidated Damages.

Calculations shall be performed using dates for the following Contract Date Item #'s as set out in the Contract Schedule.

Contract Date Item #	All Work complete including Pre-Commissioning and turbine and generator ready for hand off to Purchaser for Final commissioning no later than:	Liquidated Damages
13 (a)	1 st Unit	\$186,000 per calendar day late
13 (b)	2 nd Unit	\$186,000 per calendar day late
13 (c)	3 rd Unit	\$186,000 per calendar day late
13 (d)	4 th Unit	\$186,000 per calendar day late
13 (e)	5 th Unit	\$86,000 per calendar day late

13 (f)	6 th Unit	\$44,000 per calendar day late
13 (g)	7 th Unit	\$44,000 per calendar day late

The above table is based on Subsection 8.4 Contract Dates of the General Requirements.

Contract Dates are subject to change only as provided in the Contract.

The Engineer will certify the number of days which the Contractor fails to achieve one or more of the above Contract Dates as set out in the Contract Schedule.

The Purchaser shall calculate Schedule Liquidated Damages upon issuance of each turbine and generator Work Release Certificate. Schedule Liquidated Damages, if any, payable by the Contractor, shall thereupon become a debt due from the Contractor to the Purchaser to be recovered in accordance with the terms of the Contract.

Schedule Liquidated Damages for each Unit shall not in any case, exceed 3% of the total Contract Price of ITEMS 1 to 6, & 9 combined.

56.8 Aggregate Liquidated Damages

In no event shall the liquidated damages payable by the Contractor to the Purchaser under this Section 56 LIQUIDATED DAMAGES AND PERFORMANCE BONUSES for Performance Liquidated Damages, Schedule Liquidated Damages or for Cavitation Liquidated Damages (collectively the "Shortfalls") exceed in the aggregate 20% of the total Contract Price of ITEMS 1 to 6, & 9 combined.

Payment of liquidated damages shall be the Purchaser's sole remedy and the Contractor's sole obligation in respect of the Shortfalls but shall be without prejudice to any other right or remedy available to the Purchaser pursuant to the Contract, or at law, equity or otherwise, arising from the Contract or the Work not in respect of the Shortfalls.

56.9 Performance Bonuses

Performance Bonuses are defined as the sum of the Efficiency Bonuses as defined in Subsection 56.10 Efficiency Bonus and the Capacity Bonuses and defined in Subsection 56.11 Capacity Bonus of the General Requirements (collectively the "Performance Bonuses").

The Purchaser shall calculate Performance Bonuses upon completion of performance testing of the turbine and generator.

Performance Bonuses for each Unit shall not in any case, exceed 1% of the total Contract Price of ITEMS 1 and 2 combined.

56.10 Efficiency Bonus

Efficiency Bonus = $(MUE - GUE) \times \$960,000 / \%$

(the "Efficiency Bonus").

In the case where the above formula gives a negative value, no Efficiency Bonus will be paid to the Contractor.

56.10.1 Turbine Efficiency

The turbine efficiency for calculation of the Efficiency Bonus is defined below:

If

$(PTWE \pm PTEE)$ overlaps the value of $(MTWE_{18.3} \pm MTEE_{18.3})$

Then

$TE = MTWE - MTEE$, or

If

$(PTWE \pm PTEE)$ does not overlap the value of $(MTWE_{18.3} \pm MTEE_{18.3})$

Then

$TE = PTWE - PTEE$.

56.10.2 Measured Generator Efficiency

The measured generator efficiency for calculation of the Efficiency Bonus is defined as:

$GE = (0.9 \times MBGGE_{18.3} + 0.1 \times MFGGE_{18.3}) - MGEE$

56.11 Capacity Bonus

If the measured unit capacity is greater than the guaranteed unit capacity, then the Purchaser shall pay the Contractor a bonus in an amount calculated in accordance with the following formula:

$$\text{Capacity Bonus} = (\text{GWUC}_{18.3} - \text{MWUC}_{18.3}) \times \$33.25 / \text{kW}$$

(the “Capacity Bonus”)

In the case where the above formula gives a negative value, no Capacity Bonus damages on capacity will be paid to the Contractor.

56.11.1 Measured Weighted Unit Capacity

The measured weighted unit capacity for calculation of the Capacity Bonus is defined as:

$$\text{MWUC}_{18.3} = 0.9 \times \text{BGUC}_{18.3} + 0.1 \times \text{FGUC}_{18.3} - \text{MUCE}$$

END OF GENERAL REQUIREMENTS



GENERAL CONDITIONS

KEYYASK GENERATING STATION DESIGN, MANUFACTURE, SUPPLY AND INSTALLATION OF HYDROELECTRIC TURBINES & GENERATORS

GENERAL CONDITIONS

1 INTENT

The intent and spirit of the Contract is that the Work therein described or called for shall be fully completed in every detail within the timeframe and for the purpose designated therein by the Purchaser, and the Contractor shall furnish any and everything necessary for such purpose.

The Contractor shall apply to the Engineer for any explanation which the Contractor may require as to the meaning and intent of any provision in the Contract or in any document forming part thereof, and the Contractor shall be liable for any loss, damage or expense which the Purchaser may incur, suffer or be put to as a result of the Contractor's failure to obtain such explanation.

2 DEFINITIONS AND GENERAL INTERPRETATION

Defined words and phrases used in the Contract have the meanings ascribed to them in the Definitions section at the front of the Contract, or as expressly defined elsewhere in the Contract. All reference to days or weeks in the Contract shall mean calendar days or calendar weeks, as applicable. Headings are used for convenience only, and they shall not affect the interpretation or meaning of the clauses, terms and conditions.

3 PURCHASER'S DRAWINGS AND THIS REQUEST

The Work shall be executed in strict conformity with the Purchaser's drawings and the Contract, and the Contractor shall do no Work without proper drawings, the Contract and instructions. The Purchaser shall furnish the Contractor with copies of all Purchaser's drawings in .pdf format and the Contractor shall be responsible for any additional paper or electronic copies necessary to carry out the Work.

The Purchaser's drawings and the Contract are intended to complement each other, so that if anything is shown on the drawings but not mentioned in the Contract, or vice versa, it shall be of like effect as if shown or mentioned in both. If any errors, omissions or discrepancies are discovered in the figures, drawings or the Contract, or if any feature of the figures, drawings or the Contract shall appear

to the Contractor to be indefinite or unclear, the same shall be referred to the Engineer whose written confirmation, correction or explanation shall be obtained before proceeding with the Work. If the drawings conflict with the Contract in any particular, the Contractor shall apply to the Engineer for an explanation.

Approval of the Contractor's drawings by the Engineer shall not release the Contractor from liability for errors or omissions thereon nor from any loss, cost, damage or expense which may result from any such error or omission or from entire responsibility for the complete and accurate performance of the Work in accordance with the Purchaser's drawings and the Contract, neither shall such approval release the Contractor from any liability placed upon it by the Contract.

4 REFERENCE POINTS

All baselines, benchmarks, and necessary reference points (hereinafter "Reference Points") will be established by the Engineer. The Contractor shall be responsible for the accurate location or setting of the Work with reference to the said Reference Points.

The Contractor shall be liable for the preservation of all Reference Points established at the Site, and for any disturbance, movement, damage or destruction thereof caused by the Contractor, its agents or employees. Any errors in the Work resulting from the failure of the Contractor to notify the Engineer concerning the disturbance, movement, damage, or destruction of Reference Points shall be corrected and made good at the Contractor's expense. Further, any costs incurred by other contractors working at the Site due to errors resulting from failure of the Contractor to notify the Engineer concerning the disturbance, movement, damage, or destruction of Reference Points shall be the responsibility of the Contractor.

5 LAYOUT OF WORK AND SURVEYS

The Contractor shall set out the Work from the Reference Points and shall provide an efficient staff for that purpose and shall be solely responsible for the accuracy of such setting out. The Contractor shall provide, fix and be responsible for the maintenance of all stakes, templates, elevation marks, profiles and batter boards and other such things, and shall take all necessary precautions to prevent their removal or disturbance and shall be responsible for the consequences of any such removal or disturbance and for the efficient reinstatement of all such marks. The Work shall be set out to the satisfaction of the Engineer in all respects, but his approval thereof, or his joining with the Contractor in setting out the Work, shall not relieve the Contractor of any of its responsibilities for the due fulfillment of the Contract.

No additional payment will be made to the Contractor for the cost of any Work or delay occasioned by the establishment of lines and grades or of the checking of same and the taking of any other measurements by the Engineer, and no extension of time will be allowed for any delay occasioned by the Engineer's process for approval or required correction of same.

6 OBSERVANCE OF LAWS AND REGULATIONS

The Contractor shall comply with all laws, regulations, and by-laws, relating to the Contract and/or the Work which are lawfully imposed by any federal, provincial, or municipal authority.

Until the Work shall have been fully completed and accepted by the Purchaser, the Contractor shall be liable for the due and proper observance, both by itself, and by its officers, agents, employees and Subcontractors, of all statutes, by laws, rules and regulations and Environmental Regulations in any way affecting or relating to the Work, which are lawfully imposed by any federal, provincial or municipal authority.

The Contractor shall fully indemnify and save harmless the Purchaser from and against any and all losses, costs, damages, expenses, suits, claims and demands which the Purchaser may suffer or be put to, or which may be brought or made against the Purchaser, as a result of the breach or non observance of all or any of such statutes, by laws, rules and regulations and Environmental Regulations by the Contractor, its officers, agents, employees and Subcontractors.

7 CONTRACTOR PERFORMANCE, REPRESENTATIONS AND WARRANTIES

The Contractor shall commence the Work or one or more ITEM(S) of the Work immediately upon receipt of instructions from the Purchaser to do so as provided for in the Contract, and shall fully and completely perform the Work in every detail within the timeframe(s) and for the purpose(s) designated in the Contract. The Contractor shall do or cause to be done and shall furnish any and everything necessary for such purpose(s), all in accordance with the Contract. The Contractor shall fully and completely perform all of its covenants and obligations in, from and in respect of the Contract.

The Contractor represents and warrants that it:

- a) understands the Purchaser's requirements under the Contract, failing which it will promptly give written notice to the contrary to the Engineer;

- b) possesses the expertise, skills, personnel, equipment and materials to properly perform the Contract and the Work;
- c) shall perform the Work in accordance with and in the manner specified in the Contract and in a good and workmanlike manner; and
- d) has the full power, right and proper authority to execute the Contract, deliver the Work and duly perform all of its obligations under the Contract.

The Contractor acknowledges and agrees that the Purchaser has entered into the Contract in reliance upon the representations and warranties contained in the Contract and that each said representation and warranty by the Contractor together with all other provisions of the Contract necessary to give effect thereto shall survive the execution of the Contract by the parties and the expiry or termination of all or any part of the Contract and the provision of some or all of the Work hereunder.

8 JOINT AND SEVERAL LIABILITY

The obligations of the Contractor are and shall be deemed for all purposes to be the joint and several obligations of each and every one of the persons who entered into the Contract as a member of a partnership or a joint venture. A copy of the written partnership or joint venture agreement shall be provided to the Purchaser within 10 days of its request.

9 CONTRACTOR VERIFICATION OF RELEVANT CONDITIONS

The Contractor represents and warrants that in proposing to do the Work and prior to executing the Contract, the Contractor:

- a) investigated and made a careful examination of the Site, access to the Site, power supplies and location of existing services and utilities;
- b) satisfied itself as to the nature, extent and character of the Work to be done and the obstacles or difficulties that may be encountered and the risks associated therewith;
- c) satisfied itself as to the working conditions, local business and labour requirements, local labour supply and all other general and local conditions relevant to performance of the Contract; and
- d) satisfied itself as to any other matters and things necessary to a proper understanding of the Work, the Site and the conditions under which the Contract and/or the Work will be performed.

Failing such above investigation, the Contractor shall nevertheless assume all risk of such relevant conditions now existing or arising in the course of the Work which make or could make performance of the Work more costly, onerous or time consuming to perform than the Contractor in fact contemplated at time of execution of the Contract and shall be solely responsible for any errors, omissions or misunderstandings resulting from the Contractor's failure to make a thorough examination of the Site and obtain such information and shall not make a claim against the Purchaser for reasons resulting from such failure.

The Contractor also declares that upon proposing to do the Work and entering into the Contract, the Contractor did not rely on information furnished by the Purchaser or any of its employees or agents respecting the character or nature of the surface or sub-surface conditions at the Site, the location, character, quality or quantity of the materials to be removed or to be incorporated into the Work, the character of the plant needed to perform the Work or any other local or general relevant conditions including local business and labour resources and requirements.

10 AUTHORITY OF THE ENGINEER

The Engineer has no authority to amend the Contract.

The Contractor acknowledges and agrees that the Engineer is an employee of the Purchaser.

The Engineer may exercise the authority that is attributable to the Engineer and expressed in or implied from the Contract. Whenever the Engineer exercises an express authority for which the Purchaser's approval is required, the Purchaser shall be deemed to have given its approval.

Except as otherwise expressly stated in the Contract, the Engineer's decision shall govern the interpretation of the Contract and anything arising out of the observance or performance or non-observance or non-performance of any of the provisions of the Contract, and he shall be the sole judge of the quality, quantity, suitability and efficiency of labour, workmanship, materials, Plant, apparatus, equipment, appliances and methods used, furnished or supplied by the Contractor pursuant to the Contract.

Except as otherwise expressly stated in the Contract:

- (a) whenever carrying out duties or exercising authority, expressed in or implied from the Contract, the Engineer shall be deemed to act for the Purchaser;

- (b) the Engineer has no authority to relieve either party of any duties, obligations or responsibilities under the Contract; and
- (c) any approval, acceptance, check, certificate, consent, examination, inspection, instruction, notice, proposal, request, test, or similar act by the Engineer (including absence of disapproval) shall not relieve the Contractor from any responsibility it has under the Contract, including responsibility for errors, omissions, discrepancies and non-compliances.

The Purchaser, may, with written notice to the Contractor, replace the Engineer.

The Engineer may from time to time assign duties and delegate authority to assistants, and may also revoke such assignment or delegation. Such assistant(s) may be an individual or other legal entity. *The Engineer will give both the Purchaser and the Contractor notice of such assignment, delegation or revocation which shall be effective as of the date specified in such notice.*

Each assistant to whom duties have been assigned or authority has been delegated shall only be authorized to issue instructions to the Contractor to the extent defined in the delegation. Any approval, check, certificate, consent, examination, inspection, instruction, notice, proposal, request, test, or similar act by an assistant, in accordance with the delegation, shall have the same effect as though the act had been an act of the Engineer; provided however:

- i) any failure to disapprove any Work, Plant, equipment or materials shall not constitute approval, and shall therefore not prejudice the right of the Engineer to reject the Work, Plant, equipment or materials; and
- ii) if the Contractor questions any determination or instruction of an assistant, the Contractor may refer the matter to the Engineer, who shall confirm, reverse or vary the determination or instruction.

The Contractor shall comply with the instructions given by the Engineer or delegated assistant, on any matter related to the Contract. These instructions shall be in writing.

The Contractor and the Purchaser shall give effect to each determination of the Engineer unless and until revised pursuant to Section 44 ARBITRATION of the General Conditions.

11 TIME OF THE ESSENCE

Time is of the essence in performance of the Contract.

12 CLARIFICATIONS AND CHANGES TO THE WORK

12.1 General

There will be four (4) mechanisms for clarifying and making changes to the Work as summarized in the table below:

Mechanism	Initiated by	Function
Work Instruction (WI)	Engineer	Clarification to the Work
Request for Information	Contractor <i>or Engineer</i>	Clarification to the Work
Extra Work Order (EWO)	Purchaser	Approves change to the Work, related to the Contract Scope
Change Order	Purchaser	Approves change to the Work, not related to the Contract Scope

Each of these mechanisms are described in this Section 12 of the General Conditions.

The Purchaser will not recognize and neither party shall be able to enforce clarifications or changes to the Work unless they are a Work Instruction, a Request for Information, an Extra Work Order or a Change Order.

All clarifications and changes to the Work shall be performed strictly in accordance with the terms of the Contract insofar as terms of the Contract are applicable thereto.

The class and competency of employee used on changes to the Work shall be the same as that used or employed on Work of similar character done in the course of the Contract.

12.2 Clarifications to the Work

12.2.1 Work Instructions

Work Instructions are instructions and clarifications issued by the Engineer using the Work Instruction form set out in **Appendix Q: Manitoba Hydro Forms for Clarification and Changes to the Work**. The Work Instruction may take the form of a specification, drawing, schedule, sample, model, written instruction, explanation, clarification, confirmation, correction or other directive containing additional information that is consistent with the intent of the Contract and that directs the proper performance of the Work.

Work Instructions may be issued in response to a Request for Information from the Contractor or may be issued at the initiative of the Purchaser or Engineer.

Work Instructions are enforceable clarifications or refinements of the Contract, not amendments thereto.

Upon receipt of a Work Instruction, the Contractor shall promptly proceed with the Work as clarified therein.

The Contractor is not entitled to additional compensation or to changes in the time for performance of the Work as a result of the issuance of a Work Instruction.

12.2.2 Requests for Information

Requests for Information are requests for clarifications to the Work made by the Contractor to the Engineer *or the Engineer to the Contractor* using the Request for Information form set out in **Appendix Q: Manitoba Hydro Forms for Clarification and Changes to the Work**. The Request for Information is a written request, containing sufficient information that is necessary to fully describe the request and that will allow the *recipient* to respond without requiring additional clarification from the *requestor*.

Upon receipt of a Request for Information, the *recipient* shall take the time necessary to fully respond. If the time to respond will exceed 28 days, the *recipient* will notify the *requestor* in writing.

If the Request for Information did not contain sufficient detail to allow the *recipient* to respond, the Request for Information form shall be returned to the *requestor* within 7 days with a description of the information required. Only once the required details are obtained by the *recipient* as attachments to the Request for Information form, will the *recipient* be required to respond within 28 days or notify the *requestor* of a required extension to the response period.

12.3 Changes to the Work

The Purchaser shall have the right, without notice to sureties on any bond, and without invalidating the Contract, and for any reason whatsoever, to make changes to the Work or any part thereof, that are within the general scope of the Contract, either before or after the commencement thereof, including additions, deductions, alterations and extras

Such changes must in all cases be in writing signed by the Engineer titled “Extra Work Order”.

Upon receipt of a written Extra Work Order from the Engineer, the Contractor shall promptly proceed with the change in the Work.

Adjustments to the Contract Price as a result of the change directed by the Engineer in an Extra Work Order shall be determined in accordance with Section 13 Pricing and Payment Methods for Changes to the Work of the General Conditions.

12.3.1 Proposal for Extra Work

A Proposal for Extra Work is a request made by the Engineer or Contractor using the Proposal for Extra Work form set out in **Appendix Q: Manitoba Hydro Forms for Clarification and Changes to the Work**.

When initiated by the Engineer, the Proposal for Extra Work is a formal request for quotation for additional work required. The Contractor's responding quotation shall be attached to the Proposal for Extra Work form initiated by the Engineer and the whole of the two documents together shall be treated as a Proposal for Extra Work. The quoted price set out in such Proposal for Extra Work shall include the detail described in Subsection 13.1 Additions to the Work or Claims of the General Conditions.

When initiated by the Contractor, the Proposal for Extra Work is a formal proposal for an alternate to the Work. The proposed price set out in such Proposal for Extra Work shall include the detail described in Subsection 13.1 Additions to the Work or Claims of the General Conditions.

Upon receipt of a Proposal for Extra Work the Contractor, in the case of a request for quotation, or Engineer, in the case of a proposal for an alternate, shall take the time necessary to fully respond. If the time to respond will exceed 28 days, the requesting party shall be notified in writing.

If the Proposal for Extra Work did not contain sufficient detail to allow a response, the Proposal for Extra Work form shall be returned within 7 days to the initiating party with a description of the information required. Only once the required details are obtained by the responding party, as attachments to the Proposal for Extra Work form, will the responding party be required to respond within 28 days or notify the requesting party of a required extension to the response period.

When the Contractor responds to a Proposal for Extra Work, in the case of a request for quotation, the Proposal for Extra Work shall be valid for a period of 28 days from the date of receipt by the Engineer. The Engineer may accept the Proposal for Extra Work by providing written notice to the Contractor in the form of an Extra Work Order or Change Order.

When the Contractor initiates a Proposal for Extra Work, the proposal shall be valid for a period of 28 days from the date of receipt by the Engineer. The

Engineer may accept the proposal by providing written notice to the Contractor in the form of an Extra Work Order or Change Order.

12.3.2 Extra Work Orders

The Purchaser through the Engineer may issue a written Extra Work Order using the Extra Work Order set out in **Appendix Q: Manitoba Hydro Forms for Clarification and Changes to the Work.**

Where time permits, the Extra Work Order shall attach or reference the Proposal for Extra Work accepted by the Engineer that documents the agreed upon details regarding the change.

Notwithstanding any provision of Subsection 12.3.1 Proposal for Extra Work of the General Conditions or the preceding sentence, if the Purchaser requires the Contractor to proceed with a change in the Work prior to the parties reaching agreement regarding the details of the applicable Proposal for Extra Work, or in the absence of such agreement, Hydro, through the Engineer, shall be entitled to issue an Extra Work Order to proceed with the change.

12.3.3 Change Orders

Change Orders are formal approval of changes to the Work by the Purchaser where the change is not related to, or is outside of, the original Contract scope of the Work. The Change Order is issued by the Purchaser's Purchasing Department, through the Engineer, as an additional Item of the Work. The Change Order shall attach or reference the Proposal for Extra Work that documented the agreed upon details regarding the change. ***Change Orders must be signed by both the Purchaser and the Contractor and upon such execution shall form part of the Contract.***

12.4 Contract Amendments

No amendment to any other terms or conditions of the Contract, other than those recognized to be made by Extra Work Order or Change Order set out in Subsection 12.3.2 Extra Work Order and Subsection 12.3.3 Change Order of the General Conditions shall be made unless first approved and authorized in writing by both the Purchaser and the Contractor. The Purchaser may provide further detail to the Contractor regarding the form of documentation to be used. The Purchaser may choose to issue a Change Order in lieu of a formal written amendment agreement.

The Engineer shall provide notice in writing, in the form of a letter to the Contractor describing the proposed change of a specified Contract term. The Contractor shall respond in writing by letter issued to the Engineer regarding the proposed change.

13 PRICING AND PAYMENT METHODS FOR CHANGES TO THE WORK

The method for pricing and payment of all adjustments to the Contract Price due to changes to the Work by virtue of Extra Work Order or Change Order at the direction of the Engineer pursuant to Section 12 CLARIFICATION AND CHANGES TO THE WORK of the General Conditions or pursuant to Section 14 CONTRACTOR CLAIMS of the General Conditions (hereinafter “Claims”), shall, at the option of the Engineer, be one or more of the following unless otherwise agreed to between the Purchaser and the Contractor.

13.1 Additions to the Work or Claims

Additions to the Work or Claims may, at the option of the Engineer, be paid for on a lump sum or time and material basis.

13.1.1 Lump Sum

Where the Engineer has directed that an addition to the Work or Claim be dealt with by lump sum, the Contractor shall prepare and submit to the Engineer a detailed quoted lump sum cost of the requested addition or Claim. The quote shall not include any mark-up for overhead, profit, research and development or any other mark up that is not a direct cost to the Contractor. The quoted lump sum cost shall include the following details as a minimum:

- (a) Engineering hours and rates
- (b) Drafting hours and rates
- (c) Project management hours and rates
- (d) Material quantity and cost by type
- (e) Manufacturing and processing cost
- (f) Delivery cost
- (g) Travel, meals, and accommodations
- (h) labour by trade
- (i) Equipment, Tools, and Plant

In respect of travel, airfare shall be limited to economy class, receipts shall be required.

(the “Quoted Cost”).

The Quoted Cost shall be reviewed and either approved by the Engineer or returned to the Contractor with an explanation as to why the Quoted Cost was not accepted. Within the next 5 days, the Contractor will be entitled to submit a revised Quoted Cost.

Following such 5 day period, the Engineer may either:

- i) accept the latest Quoted Cost of the Contractor within 28 days of its receipt as documented by issuance of an Extra Work Order or Change Order; or,
- ii) advise the Contractor as to the Engineer's determination, acting reasonably, of the Quoted Cost of the addition or Claim as documented by issuance of an Extra Work Order; or,
- iii) direct the Contractor to provide a time and materials estimate in accordance with Subsection 13.1.2 Time and Materials of the General Conditions.

The payment to the Contractor of the additional work or Claim on a lump sum basis will be calculated in accordance with the following equation using the Quoted Cost set out in the Extra Work Order or Change Order:

$$\text{Payment} = \text{Quoted Cost} + (\text{Quoted Cost}) * (\text{Mark Up})$$

The Mark Up, as defined below, will be fixed at 15% for a Contractor initiated lump sum Proposal for Extra Work and Claims. For changes initiated by the Engineer, the Mark Up shall vary based upon the response time of the Contractor as follows:

Mark Up	Submission of Quoted Cost after receipt of Proposal for Extra Work
15%	Less than 29 days
12%	≥ 29 days < 45 days
10%	≥ 45 days < 60 days
5%	≥ 60 days

13.1.2 Time and Materials

At any time where the Engineer has directed that an addition to the Work or Claim be dealt with on a time and material basis, the Contractor shall prepare and submit a detailed reasonable estimated time and materials cost of the requested addition or Claim. The estimate shall not include any mark-up for overhead, profit, research and development or any other mark up that is not a direct cost to the Contractor. The estimated time and materials cost shall include the following details as a minimum:

- (a) Engineering hours and rates
- (b) Drafting hours and rates

- (c) Project management hours and rates
- (d) Material quantity and cost by type
- (e) Manufacturing and processing hours and rates for specific processes
- (f) Delivery cost
- (g) Travel, meals, and accommodations
- (h) labour by trade
- (i) Equipment, Tools, and Plant

Travel, meals, and accommodations shall be limited by the following conditions:

Travel	Airfare shall be limited to economy class, receipts shall be required
	Land transportation shall be estimated, receipts shall be required
Meals	A per diem of \$100 per day shall be applied for meals and all incidental expenses other than accommodations and transportation, receipts not required
Accommodations	The hotel chosen must be specified in the estimate with a quoted rate from the vendor identified, receipts shall be required

(the “Estimated Actual Cost”)

The Estimated Actual Cost shall be reviewed and either approved by the Engineer or returned to the Contractor with an explanation as to why the Estimated Actual Cost was not accepted. Within the next 5 days, the Contractor will be entitled to submit a revised Estimated Actual Cost.

Following such 5 day period, the Engineer may either:

- i) accept the latest Estimated Actual Cost submitted by the Contractor within 28 days of its receipt as documented by issuance of an Extra Work Order or Change Order; or,
- ii) advise the Contractor as to the Engineer’s determination, acting reasonably, of the Estimated Actual Cost of the addition or Claim as documented by issuance of an Extra Work Order.

The Contractor shall daily and within 48 hours submit to the Engineer for the Engineer's written approval, vouchers, certificates, and time sheets showing the total Actual Cost of all labour and material expended or used each day on such addition to the Work or Claim for approval of the Engineer.

At completion of the additional work or Claim, the Contractor will submit a progress statement setting out the Actual Cost for the agreed upon additional work or Claim on a time and material basis. Detailed billings of the Actual Cost of the

additional work or Claim shall be provided with the progress statement. The payment to the Contractor of the additional work or Claim on a time and materials basis will be calculated in accordance with the following equation using the Estimated Actual Cost set out in the Extra Work Order or Change Order and the Actual Costs of the addition or Claim submitted by the Contractor in accordance with this Section and approved by the Engineer:

$$\begin{aligned} \text{Payment} &= (\text{Actual Cost}) \\ &+ (\text{Estimated Actual Cost} - \text{Actual Cost}) * 0.50 \\ &+ (\text{Actual Cost}) * (\text{Mark Up}) \end{aligned}$$

The Mark Up, as defined below, will be fixed at 15% for Contractor initiated time and material Proposals for Extra Work and Claims. For changes initiated by the Engineer, the Mark Up shall vary based upon the response time of the Contractor as follows:

Mark Up	Submission of Estimated Actual Cost after receipt of Proposal for Extra Work
15%	Less than 29 days
12%	≥ 29 days < 45 days
10%	≥ 45 days < 60 days
5%	≥ 60 days

13.2 Deductions from the Work

13.2.1 Credit for Deduction from the Work

Where a deduction from the Work is proposed by the Purchaser through issuance by the Engineer of a Proposal for Extra Work to the Contractor setting out such deduction, the Contractor prepare and submit to the Engineer a detailed quoted credit for the requested deduction. The quoted credit shall represent the cost to the Contractor to perform the Work to be deducted and shall not include any mark up for overhead, profit, research and development or any other mark up that is not a direct cost to the Contractor. The Contractor shall submit a detailed breakdown of the proposed credit and at a minimum include the following:

- (a) Engineering hours and rates
- (b) Drafting hours and rates
- (c) Project management hours and rates
- (d) Material quantity and cost by type
- (e) Manufacturing and processing hours and rates for specific processes
- (f) Delivery cost
- (g) Travel, meals, and accommodations
- (h) Equipment rental cost
- (i) Site labour by trade
- (j) Equipment, Tools, and Plant

(the "Deduction Credit")

The Deduction Credit shall be reviewed and either approved by the Engineer or returned to the Contractor with an explanation as to why the Deduction Credit was not accepted. Within the next five (5) days, the Contractor will be entitled to submit a revised Deduction Credit.

Following such 5 day period, the Engineer may either:

- i) accept the latest Deduction Credit of the Contractor within 28 days of its receipt as documented by issuance of an Extra Work Order; or,
- ii) advise the Contractor as to the Engineer's determination, acting reasonably, of the Deduction Credit as documented by issuance of an Extra Work Order.

The credit in favour of the Purchaser to be deducted from the cost of the applicable Performance Based Payment Milestone will be calculated in accordance with the following equation using the Deduction Credit set out in the Extra Work Order:

$$\text{Credit} = \text{Deduction Credit} + (\text{Deduction Credit}) * 15\% \text{ mark up}$$

14 CONTRACTOR CLAIMS

14.1 Notice of Intent to Claim

If the Contractor deems himself to be entitled to additional costs to perform the Work or for an extension of the time required to perform the Work under any provision of the Contract, the Contractor shall give written Notice of Intent to Claim in the form *attached as Appendix Y* to the Engineer, describing the event or circumstance and provision of the Contract giving rise to the claim. The written notice shall be given as soon as practicable, and no later than seven (7) days after the Contractor became aware, or should have become aware, of the event or circumstance. If the Contractor fails to give written notice of a claim within such period of seven (7) days, the Contractor shall not be entitled to any adjustment to the Contract Price or to any adjustment to the Contract Schedule, and the Purchaser shall be discharged from all liability in connection with the claim.

The Contractor's Notice of Intent to Claim shall include all of the following information with respect to the event or circumstance giving rise to the claim:

- (a) a full and detailed description of the event or circumstance

- (b) the date upon which or the dates during which the event or circumstance is said to have occurred;
- (c) the date upon which the event or circumstance first came to the attention of the Contractor;
- (d) the claimed impact of the event or circumstance on the Contractor with all substantiating and supporting documentation available;
- (e) the clauses of the Contract relied upon by the Contractor; and
- (f) any proposed resolution

The Contractor shall also provide the Engineer with such further information and records as the Engineer may request.

All subsequent communications with the Engineer respecting a claim or potential claim shall reference the description and date of the original Notice of Intent to Claim or such other identifier as the Engineer may subsequently require.

The Contractor shall control, track and fully document all claimed matters and alleged impacts on performance from first notice. All such documentation shall be submitted daily to the Engineer for review, or at such other periodic interval as the Engineer may direct.

Each party shall take reasonable steps to mitigate their losses.

14.2 Determination of Claim

The Engineer shall proceed in accordance with this Section **14.2** of the General Conditions to determine:

- i) the extension (if any) of the time for completion of the Work in accordance with Section 15 REQUESTS FOR EXTENSION OF TIME of the General Conditions; and,
- ii) the adjustment (if any) to the Contract Price to which the Contractor is entitled to pursuant to the Contract.

Whenever a provision of the Contract provides that the Engineer shall proceed in accordance with this Subsection 14.2 to determine any matter, the Engineer shall employ collaborative claim resolution practices to jointly seek to cap unintended Contractor costs or other impacts and to jointly seek resolution of all potential claims with minimal negative consequences for the Work. The Engineer shall consult with each party in an effort to reach agreement. If for any reason agreement is not achieved, the Engineer shall make a fair determination on a timely basis in accordance with the Contract, taking due regard of all relevant circumstances.

The Engineer shall give written notice to both parties of each determination of a claim, with supporting particulars and if an extension of time or an adjustment to

the Contract Price, or both, are warranted in the opinion of the Engineer, the Engineer shall document such changes in an Extra Work Order. The Contractor and the Purchaser shall give effect to each such determination unless and until revised pursuant to Section 44 ARBITRATION of the General Conditions.

For any claims made in accordance with this Section that are unable to be resolved by agreement of the parties, either party shall have the right to refer the determination of the Engineer to arbitration in accordance with Section 44 ARBITRATION of the General Conditions.

The Contractor shall have no further recourse or claim against the Purchaser, nor shall it have any right of action against the Purchaser for loss or damage suffered by reason of a claim other than that set out in this Section **14** CONTRACTOR CLAIMS of the General Conditions.

The Contractor shall not delay or hold up performance of the Work during resolution of a claim pursuant to this Section **14** CONTRACTOR CLAIMS of the General Conditions or originating pursuant to Section 15 REQUEST FOR EXTENSION OF TIME *or* Section **16** PURCHASER CAUSED DELAY of the General Conditions or during referral of any such claim to arbitration as permitted above.

15 REQUESTS FOR EXTENSIONS OF TIME

The Contractor shall be entitled, subject to Section 14 CONTRACTOR CLAIMS of the General Conditions, to an extension of time for completion of the Work if completion of the whole of the Work is or will be delayed by any of the following causes:

- (a) legal strikes or walkouts;
- (b) any peril insured against pursuant to Section 26 INSURANCE of the General Conditions;
- (c) unpreventable accident;
- (d) terrorism, war or delay caused by war;
- (e) vandalism or malicious mischief not reasonably preventable by the Contractor;
- (f) riot or civil commotion;
- (g) acts of God;
- (h) lawful orders of civil or military authorities; *or*
- (i) a cause of delay giving an entitlement to extension of time under a provision of the Contract

If the Contractor considers himself to be entitled to an extension of time for completion of the Work in accordance with the preceding paragraph, the

Contractor shall give written notice to the Engineer in accordance with Subsection **14.1** Notice of Intent to Claim of the General Conditions.

After receiving this notice, the Engineer shall proceed in accordance with Subsection **14.2** Determination of Claim of the General Conditions to determine:

- i) whether, and (if so) to what extent the factors described in (a), (b), (c), (d), (e), (f), (g), (h), **and** (i) above resulted in a delay to the completion of the Work; and,
- ii) the resulting extension of time, if any, to be granted to the Contractor, as a result of such delay (if any) to the completion of the Work.

The Contractor shall have no further recourse or claim against the Purchaser, nor shall it have any right of action against the Purchaser for loss or damage suffered by reason of delay.

The Contractor shall act promptly and diligently to give notice of, mitigate and, where possible, remove entirely all causes of interruption and delay affecting performance of the Work.

16 PURCHASER CAUSED DELAY

If the Contractor suffers delay and/or incurs additional costs in relation to the Work as a result of:

- (a) negligence or default on the part of the Purchaser;
- (b) negligence or default on the part of another contractor for whom the Purchaser is responsible;
- (c) deviation from the Contract or temporary suspension of the Work by direction of the Engineer;
- (d) ***any changes in applicable laws or regulations occurring after the date of the Contract, except for any changes in law impacting the payment of taxes by the Contractor which may in future be imposed by lawful authority within or outside of Canada.***

then the Contractor shall give notice to the Engineer in accordance with Subsection 14.1 Notice of Intent to Claim of the General Conditions.

After receiving this notice, the Engineer shall proceed in accordance with Subsection 14.2 Determination of Claim of the General Conditions to determine:

- i) whether, and (if so) to what extent the factors described in (a), (b) (c) *and* (d) above resulted in a delay to the completion of the Work and/or a change in the cost to the Contractor to complete the Work;
- ii) the resulting extension of time, if any, to be granted to the Contractor, as a result of such delay (if any) to the completion of the Work; and,
- iii) the resulting adjustment, if any, to the Contract Price for the substantiated amount of resulting additional costs to the Contractor.

17 CONFLICTS

For the entire duration of the Contract, the Contractor and its agents and Subcontractors shall not provide personnel, equipment or services to any other persons or entities in a manner which conflicts with the Contract, including but not limited to, the complete and timely performance of the Work.

18 SUBCONTRACTS

The Contractor shall bind each Subcontractor to carry out all the provisions of the Contract insofar as they can be applied to the part or parts of the Work sublet, and each Subcontractor shall agree with the Contractor that all work done by the Subcontractor shall be subject in all respects to the provisions of the Contract.

The Contractor shall not, without the prior approval in writing of the Purchaser, make a subcontract with any person, firm or corporation for the execution of any portion of the Work, except for Subcontractors included in the Contractor's Proposal and the Contractor shall further not remove a Subcontractor designated in the Contractor's Proposal without the Purchaser's prior written approval.

If the Contractor wishes to sublet any part of the Work, the Contractor shall first submit to the Purchaser for approval, a description of the part of the Work which the Contractor wishes to sublet and the name or names of the Subcontractor or Subcontractors it wishes to employ.

Under no circumstances whatsoever shall any approval of any Subcontractor, whether express or implied, relieve the Contractor from any obligation or liability for the full and complete performance of the Work, all in accordance with the Contract.

All work done by a Subcontractor shall, for the purposes of the Contract, be deemed to be done by the Contractor and payment therefor shall be made to the Contractor. All employees of a Subcontractor and all persons operating or working in connection with rented Plant being used on the Work shall be deemed to be part of the Contractor's work force and the Contractor shall be responsible

therefor. Claims against the Subcontractor, whether for wages, materials, damages, or otherwise howsoever shall, for the purposes of the Contract, be deemed to be claims against the Contractor.

If the Purchaser so requests, the Contractor shall furnish the Purchaser with duplicate copies of all contracts/subcontracts placed by the Contractor with Subcontractors.

19 MATERIALS, PLANT AND LABOUR

Unless otherwise specified in the Contract, the Contractor shall furnish all Plant and materials and shall perform all labour necessary for the due, proper and safe design, execution and completion of the Work.

All materials necessary for the Work shall be new and all work done and materials supplied pursuant to the Contract shall be of specified quality, if specified, otherwise of suitable quality as determined by the Engineer.

In all cases where work or material of “approved” type or make is specified, the Engineer’s approval thereof in writing must be obtained before such work is begun or material ordered.

For the protection of all persons and property on or about the Site, the Contractor shall observe proper and adequate safety precautions in the execution of the Work.

Ownership of and title to all Contractor’s Plant, Tools and surplus materials shall vest in and become the property of the Purchaser immediately after the same has been brought on the Site by the Contractor, but shall nevertheless remain at the sole risk of the Contractor. Ownership of and title to Plant, Tools and surplus materials shall not revert to the Contractor unless and until the Purchaser has accepted and taken over the completed Work in accordance with the terms of the Contract, and has made final settlement of all claims which the Purchaser may have against the Contractor by reason of the Contractor’s default under the terms of the Contract, or in respect of payments made by the Purchaser on the Contractor’s behalf. Failing final settlement as aforesaid, the Purchaser may, in its discretion, sell or otherwise dispose of the Contractor’s Plant, Tools and surplus materials, or any portion thereof, and apply the proceeds towards the satisfaction of such claims.

Materials and Plant may not be removed by the Contractor from the Site without the permission of the Engineer until the Work has been fully completed in accordance with the Contract and accepted by the Purchaser, but the Engineer

may, in his discretion, give permission at any time for the removal of any portion thereof.

If the Engineer is of the opinion that the labour force or the quantity of Plant supplied for the performance of the Work is insufficient, or that the methods, Plant or Tools being employed are unsafe, unsuitable or inefficient, or are not such as to assure that the Work will be completed within the time specified in the Contract, the Engineer may so notify the Contractor in writing and the Contractor shall, without cost to the Purchaser, forthwith take steps to increase the number of persons employed on the Work make the required additions and/or improvements to its Plant, and conform to the methods or procedures, and use such Plant and/or Tools as are directed by the Engineer. The Engineer may notify the Contractor in writing to remove unsafe, unsuitable or inefficient Plant from the Site, and if the same is not removed within three (3) days thereafter, the Engineer may cause it to be removed at the Contractor's risk and expense.

If the Engineer is of the opinion that the material required for the Work, other than that supplied by the Purchaser, is not arriving at such a rate or within such a time as to indicate that the entire Work will be completed within the time specified in the Contract, the Engineer may so notify the Contractor in writing and the Contractor, without cost to the Purchaser, shall obtain such material at the rate or within the time directed by the Engineer.

If the Contractor makes use of material which, in the opinion of the Engineer is unsafe, unsuitable, inefficient or which will not permit the execution of the Work to his satisfaction, or the completion thereof within the time specified in the Contract, the Engineer may give the Contractor notice in writing to alter and/or improve the material, and the Contractor, without cost to the Purchaser, shall comply with the requirements of the Engineer without delay.

20 SEQUENCE AND METHODS

The Contractor shall be responsible for determining the proper sequence to be followed, and the methods, Plant and Tools to be used in the execution of the Work, so as to fully and effectually carry out the intent and purpose of the Contract, subject however, to the paramount right and authority of the Engineer to direct and control the sequence to be followed and the methods, Plant and Tools to be used so as to promote the safety, economy and proper scheduling of the Work, harmony and co operation with other contractors, and to cause as little interference as possible with ordinary traffic and public business.

If any part of the Work depends for its proper execution upon work to be done by another contractor, the Contractor shall give notice in accordance with Section 14 CONTRACTOR CLAIMS of the General Conditions, in writing, to the Engineer

of any errors, omissions or defects in the work of such other contractor which interfere with or are likely to interfere with or prevent the proper execution of the Work and the Contract. Should the Contractor fail to give such notice, the Contractor shall have no claim against the Purchaser by reason of the impact on the Work of such erroneous, omitted or defective work.

21 EMERGENCIES

In an emergency or threatened emergency affecting or liable to affect the safety of life or property, the Engineer shall have the right and authority to stop the Work and/or order and direct such changes therein or in the methods, Plant and Tools used by the Contractor, as the Engineer deems necessary in the circumstances.

22 INSPECTION AND TESTING

All Plant to be provided, Work to be performed, and materials and equipment to be supplied pursuant to the Contract shall at all times be subject to inspection and testing by the Engineer, the Purchaser, or QAR. Any special tests which the Purchaser requires are set forth in the Contract. The Contractor shall cooperate with the Engineer, the Purchaser and/or QAR and shall make available every facility in which Work is or may be performed at for inspecting and testing.

All Work, materials and equipment condemned by the Engineer or QAR shall be removed and rebuilt or replaced in accordance with the Contract at the Contractor's expense and in a manner satisfactory to the Purchaser. All Work and other property of the Purchaser which is disturbed, injured, damaged or destroyed in the course of removal of the condemned Work shall be promptly repaired and made good at the Contractor's own cost and expense.

If the Purchaser shall waive its right of inspecting and testing as herein provided, it shall in no way relieve the Contractor of full liability for the quality, character, proper operation and performance of the completed Work, and every part of it, nor shall it prejudice or affect the rights of the Purchaser set forth in Sections 23 USE OF FAULTY OR DEFECTIVE WORK, 25 CONTRACTOR'S LIABILITY, 32 CONTRACTOR'S DEFAULT, 33 TERMINATION FOR BREACH OF CONTRACT, and 38 WARRANTY of the General Conditions.

23 FAULTY OR DEFECTIVE WORK

If, in the opinion of the Engineer, the Work, or any portion thereof fails to comply with the requirements of the Contract, or if any tests prove or indicate the existence of any fault or defect in the Work, or any part thereof, the Engineer

shall give the Contractor notice as herein provided, together with particulars of such failure, fault or defect, and the Contractor shall, at the Contractor's expense, forthwith re-execute or make good the faulty or defective Work or alter the same to make it comply with requirements of the Contract. Thereafter, completely new tests shall, if required by the Engineer, or requested by the Contractor, be carried out in the manner provided by Section 22 INSPECTION AND TESTING of the General Conditions.

If after such notification, the Contractor shall make default or delay in diligently commencing, continuing and completing the making good of the faulty or defective Work so as to make it comply with the requirements of the Contract, then the Purchaser may do so or cause the same to be done by any person, firm or corporation, in any manner and by any means which the Engineer considers expedient or advisable. The Contractor shall be liable for all costs, charges and expenses incurred by the Purchaser in connection therewith, and shall pay to the Purchaser an amount equal to such costs, charges and expenses upon receipt of invoice therefore certified correct by the Purchaser. The Purchaser may, at the Purchaser's option, apply monies due or to become due from the Purchaser to the Contractor in or towards payment of such costs, charges and expenses, in which event the Contractor shall remain liable for any deficiency.

24 USE OF FAULTY OR DEFECTIVE WORK

Until all faulty or defective Work has been made good or altered as provided by Sections 23 FAULTY OR DEFECTIVE WORK and 38 WARRANTY of the General Conditions, the Purchaser shall have the right to use any such faulty or defective Work at the Contractor's sole risk, and without thereby in any way affecting the Purchaser's rights under Sections 23 FAULTY OR DEFECTIVE WORK and 38 WARRANTY of the General Conditions unless the Contractor shall have notified the Purchaser in writing that, in the opinion of the Contractor, the faulty or defective Work cannot be so used without undue risk to the Work or to persons in the vicinity of the Work.

25 CONTRACTOR'S LIABILITY

25.1 The Work

The Contractor shall indemnify and save the Purchaser harmless from and against any and all losses, costs, damages or expenses, which the Purchaser may suffer or be put to or arising from any manners of action, causes of action, suits, claims, liabilities, debts and demands which may be brought or made against the Purchaser by any third party, in respect of:

- (a) bodily injury, sickness, disease or death, of any person whatsoever, and

(b) damage to or loss of any property, real or personal, including the Work, to the extent attributable to or arising out of any breach of the Contract by the Contractor, or any negligent acts, errors or omissions or wilful misconduct of the Contractor, its officers, agents, employees and Subcontractors in the performance of the Work, including during any Work pursuant to Section 38 WARRANTY of the General Conditions.

25.2 Labour and Materials

The Contractor shall assume the defence of and shall indemnify and save harmless the Purchaser from and against all suits, claims and demands which may be brought or made by any person, firm or corporation against the Purchaser for the value or price of labour performed or materials furnished to or by the Contractor for the Work.

25.3 Total Liability

The total liability of the Contractor to the Purchaser on all claims of any kind whether in contract or tort (including negligence) arising from the Contract or performance of the Work shall not exceed one hundred (100%) percent of the Contract Price.

25.4 Indirect Damages

Save and except as specifically provided for in the Contract, including without limitation, for liquidated damages as provided in the Contract, in no event shall the Contractor be liable to the Purchaser for loss of profit or revenues or for any indirect or consequential damages.

26 INSURANCE

26.1 Purchaser's Insurance

The Purchaser shall provide the following insurance during the Keeyask Project. On request, the Purchaser shall supply the Contractor with a certified copy of the required policy of insurance and all renewals thereof. A Certificate of Insurance may be submitted in place of the policy provided that all terms and conditions of required coverage are specified therein.

26.1.1 Builder's Risk Insurance

"All Risk" – Course of Construction Insurance covering all risks, (subject to policy terms, conditions and exclusions) of physical loss or damage to all materials, structures, property and equipment intended for incorporation in the

Keeyask Project and at the Keeyask Project site during or pending construction, erection, and installation, naming the Contractor and its Subcontractors connected with the performance of the Work at the Keeyask Project site as additional insureds. The sum insured by this policy will be the replacement value of the insured property, subject to a deductible amount. The Contractor shall be responsible for any deductible amounts (per occurrence) up to \$10,000.00 (Cdn) under the policy.

26.1.2 Wrap-up Liability Insurance

“Comprehensive Wrap-up Liability Insurance” covering all-insurable risk of liability for death or injury to persons or loss, damage or injury to property arising out of or connected with the performance of work at the Keeyask Project site naming Contractor and its Subcontractors as additional insured. The sum insured by this policy will be an amount not less than \$50,000,000.00 (Cdn) for any loss or losses arising out of the same occurrence or related occurrences. The Contractor shall be responsible for any deductible amounts (per occurrence) up to \$25,000.00 (Cdn) under the policy.

26.2 Contractor’s Insurance

The Contractor shall, without limiting its obligation or liabilities herein, maintain and keep in force during the term of the Contract at its own expense and cost the following insurance with limits not less than indicated for the respective items.

- (a) Insurance for the full insurable value of the Work at the Contractor’s facilities, including property of others and work in progress and for which the Contractor is legally liable and for which the Purchaser has an insurable interest.
- (b) For work outside the scope of coverage of the Wrap-up Liability Policy, Comprehensive General Liability insurance for an inclusive limit of not less than \$10,000,000.00 (Cdn) per occurrence for bodily injury, death and damage to property. This insurance will have the following extensions of coverage:
 - i) Premises Property and Operations
 - ii) Products and Completed Operations Liability
 - iii) Blanket Contractual Liability
 - iv) Employer’s Liability
 - v) Cross Liability
 - vi) Non-Owned Automobile Liability
 - vii) Broad Form Property Damage
 - viii) Manitoba Hydro added as Additional Insured
 - ix) Owners and Contractors Protective

- (c) Automobile liability insurance, including contractual liability, covering all motor vehicles owned, hired or used in the performance of the Work at the Site, with limits not less than \$2,000,000.00 (Cdn) bodily injury and property damage combined single limit each occurrence.
- (d) Property insurance covering all loss of or damage to Tools, property and equipment of the Contractor or for which the Contractor is legally liable or responsible used in performance of the Work at the Site. The policy shall include waiver of subrogation against the Purchaser.

The Contractor shall supply the Purchaser with a certified copy of the required policies of insurance and all renewals thereof. A Certificate of Insurance may be submitted in place of the policy provided that all terms and conditions of required coverage are specified therein. All documentation must be submitted to the Purchaser within 30 days of the execution of the Contract.

The policies shall provide the Purchaser with not less than 30 days written notice in advance of cancellation, change or amendment restricting coverage, and to show the Purchaser as an additional insured. All such policies of insurance shall provide by endorsement or otherwise that the Contractor and its insurers waive their rights of subrogation against the Purchaser.

26.3 Subcontractor's Insurance

The Contractor shall be responsible for ensuring all of its Subcontractors comply with or secure and maintain the insurance coverage as set forth above as applicable, and any deficiencies in the coverage or policy limits of such Subcontractor's insurance coverage shall be the responsibility of the Contractor.

26.4 Supplementary Insurance

Should the Contractor deem the insurance arranged by the Purchaser to be inadequate in any way, the Contractor may supplement the All Risks Course of Construction insurance and/or the Comprehensive Liability Insurance by the purchase of additional insurance, but any supplementary insurance so purchased shall be at the expense of the Contractor.

27 WORKERS COMPENSATION

If required, the Contractor shall at all times pay, or cause to be paid, any assessment or compensation required to be paid pursuant to The Workers Compensation Act, R.S.M. 1987, c. W200.

Upon failure to do so, the Purchaser may pay such assessment or compensation to The Workers Compensation Board, and may deduct the amount thereof from

monies due or to become due to the Contractor pursuant to the Contract. The Purchaser may, at any time during the performance and upon the completion of the Work, require a declaration from The Workers Compensation Board that such assessments or compensation have been paid in full, and may withhold final payment to the Contractor until such declaration has been received.

28 CLEANUP AND REMOVAL OF PLANT, SURPLUS MATERIALS AND DEBRIS

The Contractor shall at all times during the course of the Work, keep the Site clean and free from fire hazards and other hazards, and accumulations of waste materials, rubbish and debris caused by its employees or Work. Before a WORK RELEASE CERTIFICATE will be issued by the Purchaser in respect of a turbine and generator, the Contractor shall, at its own expense, remove from the Site and dispose of all the Contractor's Tools, Plant, surplus and waste materials, rubbish and debris, in, upon and about the Site, and shall leave the Work and the Site in a clean and tidy condition to the satisfaction of the Engineer. When the Work involves the construction of a building or other structure(s), the building/structure(s) shall be left "broom clean" or its equivalent, unless the Contractor is expressly directed or permitted in writing by the Purchaser to do otherwise.

If the Contractor fails to maintain or leave the Site in a clean and tidy condition within a reasonable time after written notice from the Engineer, the Purchaser may remedy this default, or cause the same to be remedied, and the Contractor shall be liable for all costs, charges and expenses incurred by the Purchaser in so doing which may be deducted by the Purchaser from any monies due and payable to the Contractor pursuant to the Contract.

29 PAYMENTS BY THE CONTRACTOR

The Contractor shall promptly pay all assessments, premiums, levies, taxes, permit and licence fees and shall promptly pay for all materials, labour, and services obtained or required by the Contractor in the execution of the Contract. If the Contractor fails to pay the same, or unduly delays payment, the Purchaser may, at the Purchaser's option, make such payment or payments for and on behalf of the Contractor, and thereafter the Contractor shall on demand, pay the Purchaser an amount equal to the aggregate of all the sums so paid by the Purchaser, plus interest on the sums so paid at an interest rate equal to the Prime Rate of interest charged by the Purchaser's bank plus 3% per annum calculated from the date of payment by the Purchaser to the date when moneys are next due and payable by the Purchaser to the Contractor under the Contract, plus the sum of \$10.00 (Cdn) as a service charge in respect of each cheque issued by the

Purchaser for or on behalf of the Contractor pursuant to this section of the General Conditions, or the Purchaser may, at its option, deduct the aforesaid sums, interest and service charge from any moneys due or to become due to the Contractor from the Purchaser, provided that no payment by the Purchaser as aforesaid shall be held to relieve the Contractor from the Contractor's liabilities and obligations under the Contract.

As applicable, the Contractor shall keep a record of the pro rata share of accrued interest on holdbacks due all Subcontractors.

30 WORK RELEASE CERTIFICATE

Subject to the provisions of Section 38 WARRANTY of the General Conditions, as soon as the installation and pre-commissioning for each turbine and generator is complete to the satisfaction of the Purchaser, the Purchaser shall issue a WORK RELEASE CERTIFICATE (a SAMPLE ONLY WORK RELEASE CERTIFICATE is included as **Appendix G**), and from and after the date of said certificate, the Purchaser shall be deemed to have accepted and taken over the Work and the risk of the Work in relation to such turbine and generator for Manitoba Hydro Unit commissioning and subsequent commercial service.

31 COMPLETION CERTIFICATE

As soon as the final inspection and/or performance tests shall have shown that the Work has been completed and fulfilled all the requirements of the Contract, the Purchaser shall issue a COMPLETION CERTIFICATE (a SAMPLE ONLY COMPLETION CERTIFICATE is included as **Appendix E**).

32 CONTRACTOR'S DEFAULT

If the Contractor:

- a) abandons the Work;
- b) fails to perform the Work in accordance with the terms and provisions specified in the Contract;
- c) fails to perform the Work within the time or times specified in the Contract;
- d) becomes bankrupt or insolvent, or makes an assignment for the general benefits of creditors;
- e) permits any execution to be levied on the Contractor's real or personal property or on any portion of the Work;
- f) assigns or sublets the Contract other than in accordance with the requirements of the Contract;

- g) loses control of the Work for any cause whatsoever, except by reason of circumstances enumerated in *Section 15 REQUESTS FOR EXTENSION OF TIME or Section 16 PURCHASER CAUSED DELAY of the General Conditions.*
- h) refuses or neglects to follow the instructions of the Engineer;
- i) fails to meet the Purchaser's requirements for material, Plant, methods and/or labour within a reasonable time, or as the case may be, within the time(s) required, or that may be required, pursuant to the terms and conditions of the Contract;
- j) refuses or neglects to use measures to protect the Work from damage;
- k) is carelessness or incompetent in the execution of the Work;
- l) delays the Work or any part thereof unnecessarily or unreasonably;
- m) is in default of any other of its covenants or obligations in, or arising from, the Contract;

then the Purchaser may, at its option, and without prejudice to any other rights or remedies:

- i) at the Contractor's expense, employ additional labour and/or purchase, lease or otherwise obtain additional or suitable material, Plant, and Tools at such price or prices as the Purchaser deems proper; and/or
- ii) at the Contractor's risk and expense, remove unsuitable or inefficient material, Plant and Tools from the Site; and/or
- iii) at the Contractor's expense, take over and carry on the Work to the extent necessary to avoid loss or waste or damage to the Work already performed; and/or
- iv) give notice of intention to terminate the Contract as provided in Section 33 TERMINATION FOR BREACH OF CONTRACT of the General Conditions, and
- v) recover against the Contractor and be fully indemnified and saved harmless by the Contractor for any and all losses, costs, damages, expenses, suits, claims and damages which the Purchaser may itself suffer or be put to, or which may be brought or made against the Purchaser by third parties, including other contractors or suppliers whose performance on the Keeyask Project is adversely affected by default of the Contractor, its officers, agents, employees or Subcontractors.

33 TERMINATION FOR BREACH OF CONTRACT

If the Contractor makes default in any manner set forth in Section 32 CONTRACTOR'S DEFAULT paragraphs (b), (c), (h), (i), (j), (k), (l) or (m) of the General Conditions, or as set forth in Section 33 COMPLIANCE WITH BURNTWOOD/NELSON AGREEMENT of the General Requirements or Paragraph 6.27(c) of the Technical Requirements, the Purchaser may give written notice to the Contractor of intention to terminate the Contract, stating the reasons

therefor. If the Contractor does not remedy or take steps to remedy the default to the satisfaction of the Purchaser, within ten (10) days of receipt of such notice, the Purchaser, may, without prejudice to any other rights or remedies, by further written notice to the Contractor, forthwith terminate the Contract. If the Contractor makes default in any manner set forth in Section 32 CONTRACTOR'S DEFAULT paragraphs (a), (d), (e), (f), or (g) of the General Conditions, the Purchaser may, without prejudice to any other rights or remedies, by written notice to the Contractor, immediately terminate the Contract. In the event of any termination of the Contract as provided herein, the Contractor shall thereupon discontinue the Work and shall have no claim for payment for Work done or material furnished thereafter. The Purchaser may, at its own option, enter into possession of all or any part of the uncompleted Work, and prosecute the same to completion by contract or otherwise as the Purchaser may deem fit.

At any time after the Purchaser has terminated the Contract, the Purchaser, with such assistance or resort to legal process as it deems necessary, may break and force open any doors, locks, bars, bolts, fastenings, hinges, gates, fences, buildings, enclosures and places for the purpose of seizing and taking possession of the Work, and of the material, Plant and Tools pertaining to the Work. The Contractor's material, Plant, and Tools at the Site may be utilized by the Purchaser, without payment, for the purpose of completing the Work. The Contractor hereby grants the Purchaser a free and unimpeded right of access to the Contractor's facilities which shall survive any termination of the Contract, for the purpose of permitting the Purchaser to take control of and remove any Work, including but not limited to any Work for which title has vested in the Purchaser pursuant to Section 55 TITLE AND RISK OF LOSS of the General Requirements, and the Contractor shall cooperate and facilitate the Purchaser's removal in such circumstances.

Upon any termination of the Contract, as provided herein, the Purchaser shall not be bound to make any further payment to the Contractor until the Work has been completed. The Contractor shall be liable to the Purchaser for all losses, costs, damages, and expenses which the Purchaser may incur, suffer or be put to, for, or by reason, or on account of the Contractor's default and the subsequent termination of the Contract. When the Work has been completed, the Purchaser shall certify the amount of all losses, costs, damages and expenses incurred by the Purchaser as aforesaid. If the total of such losses, costs, damages and expenses when added to the moneys paid to the Contractor before the termination of the Contract exceeds the total amount which would have been payable to the Contractor upon due completion of the Work in accordance with the Contract, the difference shall be a debt payable to the Purchaser by the Contractor and the Purchaser may deduct the same from any monies due or to become due to the Contractor or the same may be otherwise recovered by the Purchaser from the Contractor as liquidated damages. The Purchaser shall not be liable for any losses,

costs, damages, or expenses suffered or incurred by the Contractor by reason of any termination of the Contract.

34 RESPONSIBILITY AS TO PATENTS

The Contractor shall pay all royalties payable under or in respect of, and shall fully indemnify and save harmless the Purchaser from and against any and all actions, claims, demands, costs, charges and expenses arising from or incurred by reason of any infringement or alleged infringement of, any and all letters patent, registered design, trade mark or copyright of any apparatus or component part thereof forming part of or used in connection with the Work and in the subsequent use and operation thereof protected in the country in which the Work is to be used as stipulated in the Contract, but such indemnity shall not cover any use of the Work otherwise than for the purpose indicated by or reasonably to be inferred from the Contract.

In the event of any claim being made or action brought against the Purchaser arising out of the matters referred to in this section of the General Conditions, the Contractor shall be promptly notified thereof and may at its own expense conduct all negotiations for the settlement of the same, and any litigation that may arise therefrom. The Purchaser shall not, unless and until the Contractor shall have failed to take over the conduct of the negotiations or litigation, make any admission which might be prejudicial thereto. The conduct by the Contractor of such negotiations or litigation shall be conditional upon the Contractor having first given to the Purchaser such reasonable security as shall from time to time be required by the Purchaser to cover the amount ascertained, or agreed, or estimated, as the case may be, of any compensation, damages, expenses, and costs for which the Purchaser may become liable in respect of such infringement or alleged infringement as aforesaid. The Purchaser shall, at the request of the Contractor, provide reasonable assistance for the purpose of contesting any such claim or action, and shall be repaid any expenses incurred in so doing.

In case any Work is in such claim or action held to constitute an infringement and its use enjoined, the Contractor shall either secure for the Purchaser the right to continue using such Work by suspension of the injunction, by procuring for the Purchaser a licence, or otherwise, or shall at the Contractor's own expense, replace such Work with a non infringing Work or modify it so that it becomes non infringing or remove the said enjoined Work and refund all monies previously paid therefore by the Purchaser to the Contractor pursuant to the Contract.

35 RECORDS

The Contractor shall:

- (a) keep full and detailed records, reports, schedules, books, accounts, correspondence, instructions, drawings, receipts, vouchers, memoranda, and records of labour force, Plant, Tools, equipment, hours worked and rates required to properly appraise the progress of the Work, (herein "Records") necessary for the proper administration of the Contract and the Work.
- (b) provide to the Engineer and/or the Purchaser with copies of any Records when requested, provided such rights of review shall not extend to the audit of profits, expenses, or costs associated with sums payable on a lump sum basis under the Contract or the compositions of such lump sum amounts.
- (c) provide the Engineer and/or the Purchaser with reasonable access to any premises and to inspect and/or audit Records, and permit copies to be made of same, provided such rights of review shall not extend to the audit of profits, expenses or costs associated with sums payable on a lump sum basis under the Contract or the compositions of such lump sum amounts.
- (d) preserve Records for a period of not less than three (3) years from the date of the Completion Certificate provided for in Section 31 COMPLETION CERTIFICATE of the General Conditions.

36 INTELLECTUAL PROPERTY

36.1 Drawings

Drawings, reports, manuals, documents, and other and/or similar materials (herein "Drawings") produced or provided by the Contractor or on behalf of the Contractor in the course of the Work shall become the exclusive property of the Purchaser. Ownership of any proprietary information or intellectual property contained in the Drawings shall remain with the Contractor. The Contractor grants the Purchaser a perpetual, royalty free, non-transferable, limited licence to use, copy, and to allow third parties to use the Drawings and all proprietary information in the Drawings as may be required for the purpose of tendering, installing, operating, repairing, maintaining, modifying, reconstructing, replacing and/or upgrading the Work, or any part thereof. The Contractor agrees to include the following notation on all Drawings either directly or by reference:

"[Contractor Name] hereby licenses Manitoba Hydro to use, copy and to allow third parties to use the Drawings, and all proprietary information in the Drawings as may be required for the sole purpose of tendering, installing, operating, repairing, maintaining, modifying, reconstructing, replacing and/or upgrading the Work, or any part thereof."

36.2 Software

The Contractor shall deliver to the Purchaser all such software (in object code format only) that is required for the installation, operation and maintenance of the Work. The Contractor hereby grants to the Purchaser (and transferable to the Keeyask Hydropower Limited Partnership) a perpetual, fully paid-up, non-exclusive, transferable, royalty free, limited license to use and copy such software for the Purchaser and/or the Keeyask Hydropower Limited Partnership's internal business purposes in respect of the installation, operation and maintenance of the Work.

37 CONFIDENTIALITY

The Contractor and its agents shall:

- a) treat as confidential all Work, including Drawings and Hydro Property (collectively "Information"),
- b) not disclose or use, or permit to be disclosed or used, to or by any person any Information without prior written permission from the Purchaser, and
- c) comply with any reasonable directions given by the Purchaser with respect to safeguarding or ensuring the confidentiality of the Information; and
- d) not directly or indirectly destroy, invalidate, or otherwise harm, or attempt or threaten to destroy, invalidate, or otherwise harm, any Information or other property owned or controlled by the Purchaser.
- e) ensure that any and all equipment, materials and procedures, that will, or may, be used to store, access and/or use any Information and/or other property owned or controlled by the Purchaser are, and shall continue to be, sufficiently secured to protect against unauthorized or accidental access, use, modification, damage, destruction, theft, intrusion, disclosure, transfer, disposal, copying, or reproduction, of any of the same;
- f) notify the Purchaser in writing immediately upon discovery or otherwise becoming aware of any unauthorized or accidental access, use, modification, damage, destruction, theft, intrusion, disclosure, transfer, disposal, copying, or reproduction, of any Information or other property owned or controlled by the Purchaser, or threat or attempt thereof, and in any such event, shall cooperate fully with the Purchaser in connection with any and all preventive and/or remedial actions that the Purchaser may require;
- g) from time to time perform any acts as may be requested by the Purchaser, acting reasonably, which are required to be performed by the Contractor and/or its agents to ensure compliance with this section of the General Conditions.

38 WARRANTY

A 36 month warranty period for each turbine and generator shall commence on the date of the Work Release Certificate issued in respect of such turbine and generator as referred to in Section 30 WORK RELEASE CERTIFICATE of the General Conditions. For the balance of the Work, the 36 month warranty shall commence on the date of the Completion Certificate issued as referred to in Section 31 COMPLETION CERTIFICATE of the General Conditions.

If within such turbine and generator warranty period or Work warranty period as applicable, the turbine and generator or any part thereof becomes broken or defective or fails for any reason whatsoever, including faulty or improper design, materials, workmanship, manufacture, fabrication, shipment or delivery, or if the Work or any part thereof fails for any reason whatsoever, including faulty or improper erection or installation, or if the turbine and generator or Work or any part thereof fails to meet the requirements of the Contract, then the Contractor shall, upon notification in writing from the Purchaser, as soon as possible thereafter make good every such breakage, defect or failure without cost (including, without limitation, transportation, removal and installation costs) to the Purchaser; provided further that the turbine and generator or Work or any part thereof made good under this section shall be subject to all the provisions of this section for a further period of 36 months from the date when the same has been made good as aforesaid. Furthermore, the warranty period for the turbine and generator in question shall be extended for the period such turbine and generator was out of commercial service as advised by the Purchaser, acting reasonably.

If, after such notification as provided in the immediate preceding paragraph, the Contractor shall make default or delay in diligently commencing, continuing and completing the making good of such breakage, defect or failure in a manner satisfactory to the Purchaser, then the Purchaser may proceed to do so and to place the turbine and generator or Work or any part thereof in good operating condition in accordance with the Contract, and the Contractor shall be liable for all costs, charges and expenses incurred by the Purchaser in connection therewith and shall forthwith pay to the Purchaser an amount equal to such costs, charges and expenses, upon receipt of invoices therefore certified correct by the Purchaser.

In addition to the foregoing warranty, the Work shall be subject to a warranty against excessive cavitation pitting, and the Contractor shall be liable for same as set forth in Subsection 5.8.1 Cavitation Warranty of the Technical Requirements.

39 IMPORTS

The Contractor shall be the importer of all non-Canadian goods and services.

40 ASSIGNMENT OF RIGHTS AND OBLIGATIONS

The Contractor shall not, without the prior written consent of the Purchaser in writing, which consent may be withheld by the Purchaser for any reason in its sole discretion, assign the Contract or any of its rights or obligations thereunder, to any other person or entity; and provided further that any such assignment for which consent has been granted shall not relieve the Contractor of any obligation under or in respect of the Contract and/or the Work save and except to the extent same has been effectually performed or fulfilled by the assignee.

The Purchaser shall have the right at any time to assign the Contract, in whole or in part and any and all rights thereunder, including with respect to warranties for the Work, to any third party without the prior consent and without prior notice to the Contractor for which purpose the Contractor hereby expressly consents to same. The Purchaser shall advise the Contractor in writing within ten (10) days of the occurrence of such assignment, as to the particulars thereof.

41 INTENTIONALLY LEFT BLANK

42 NON-WAIVER OF THE PURCHASER'S RIGHTS

No action nor want of action on the part of the Purchaser or the Contractor, as the case may be, at any time to exercise any right or remedy conferred upon either of them under the Contract shall be deemed to be a waiver on the part of the Purchaser or the Contractor, as the case may be, of any right or remedy, except as may be expressly agreed in writing by such party.

No failure by the Purchaser or the Contractor, as the case may be, at any time or from time to time to enforce or require the strict keeping and performance by the other party of any term or condition of the Contract shall constitute either an estoppel against or waiver by the Purchaser or the Contractor, and shall not affect nor impair that term or condition in any way, nor the right of the Purchaser or the Contractor, as the case may be, at any time to avail itself of any remedy existing hereunder except as may be expressly agreed in writing by such party.

43 APPLICABLE LAW

The Contract shall be subject to, interpreted, performed, and enforced in accordance with the laws of Manitoba and the applicable laws of Canada without

regard to Manitoba or Federal Canadian Law governing conflicts of law, even if one or more of the parties to the Contract may be resident of, or domiciled in another province or country. Subject to Section 44 ARBITRATION of the General Conditions, the parties to the Contract hereby irrevocably attorn to the exclusive jurisdiction of the Court of Queen's Bench of Manitoba, Winnipeg Centre.

44 ARBITRATION

44.1 *Notice of Dissatisfaction*

A party shall be conclusively deemed to have accepted a determination by the Engineer issued under any provision of the Contract, and to have expressly waived and released the other party from any claims in respect of the particular matter dealt with in that determination unless, within ten (10) days after receipt of that determination, the party sends a notice of dissatisfaction to the other party and to the Engineer which contains the particulars of the matter in dispute and of the relevant provisions of the Contract.

44.2 *Reply*

The responding party shall send a notice in reply within fifteen (15) days after receipt of the notice of dissatisfaction setting out the particulars of its response and any relevant provisions of the Contract.

44.3 *Amicable Settlement*

The Purchaser and the Contractor shall make all reasonable efforts to resolve any dispute by amicable negotiations and each party agrees to provide, without prejudice, frank, candid and timely disclosure of relevant facts, information and documents to facilitate the negotiations.

In the event that the *responding party* and the dissatisfied party fail to resolve the dispute *within thirty (30) days from the date of the notice of dissatisfaction*, the matter shall next be considered by the Purchaser and the appropriate member of the Contractor's executive, and if they fail to resolve the matter, the last attempt at amicable negotiations shall involve the Vice President, Power Supply for *the Purchaser* and the equivalent senior executive of the Contractor.

44.4 *Final and Binding Arbitration*

If the dispute has not been resolved within a reasonable time *following the steps set out in Subsection 44.3 Amicable Settlement of the General Conditions*, or such period of time as the Purchaser and the Contractor may have agreed, the dispute shall be finally resolved by binding arbitration before a single arbitrator.

Arbitration proceedings shall be commenced by either party serving upon the other a written notice to arbitrate, together with a concise statement of the matters in dispute.

44.5 *Appointment of Arbitrator*

The Contractor and the Purchaser shall attempt to agree upon the appointment of a single arbitrator. If the Contractor and the Purchaser are unable to agree on the choice of a single arbitrator within twenty five days of commencing arbitration proceedings, either the Contractor or the Purchaser may apply to a Judge of the Court of Queen's Bench of Manitoba to appoint a single arbitrator.

44.6 *Authority of the Arbitrator*

The arbitrator shall not have the authority to modify, amend, add to or delete any provision of the Contract or to make any award contrary to the provisions of the Contract.

44.7 *Venue*

Arbitration proceedings shall be conducted at Winnipeg, Manitoba.

44.8 *Proceedings*

The arbitrator shall, as soon as possible, examine the matters in dispute, hear evidence and argument from both the Contractor and the Purchaser, and issue an award in writing. An award by the arbitrator shall be final and binding upon the Purchaser and the Contractor *and shall not be subject to appeal to a court of law..*

44.9 *Rules and Statutes to Apply*

The Rules for Arbitration of Construction Disputes set out in the Canadian Construction Documents Committee Standard Construction Document CCDC 40 - 2005, as updated from time to time, shall apply and all referenced therein to "the Agreement" shall mean the Contract.

To the extent and in the manner provided in CCDC 40, provisions of The Arbitration Act (Manitoba) shall apply.

44.10 *Costs*

The costs of arbitration shall be assessed and apportioned between the Contractor and the Purchaser in such manner as the arbitrator may determine.

44.11 Work to Continue

The Contractor shall not suspend, delay or interfere with the progress of the Work because of dissatisfaction with a determination of the Engineer or because of any dispute, nor during any of the notice or negotiation periods *set out in this Section 44* above, nor during any arbitration proceedings.

44.12 Equitable Relief

Nothing in this Section 44 shall prevent, or be deemed to prevent, either party from seeking and/or obtaining *interlocutory or permanent injunctive* relief from any court of competent jurisdiction *as permitted pursuant to Section 43APPLICABLE LAW of the General Conditions to restrain any anticipated, present or continuing breach of a provision of the Contract with respect to confidentiality, intellectual property, patent, or other similar breach where such party, acting reasonably, is of the view that such breach will cause irreparable harm to it which cannot be adequately compensated for in damages.*

45 NOTICES

Every notice or communication required or permitted to be given or served pursuant to the Contract shall be in writing, and shall be delivered *via the Purchaser's collaboration website at https://<address to be determined>*, by *delivery* or by fax:

To Purchaser: [to be completed]

To Contractor: [to be completed]

To the Engineer: [to be completed]

In addition to and notwithstanding the above, the Purchaser may effectually give notice to the Contractor by serving same on the Superintendent, whether *via the Purchaser's collaboration website, by delivery*, or by fax to the Superintendent's designated Manitoba office.

Notice given or served by *delivery* shall be deemed effectually given and received upon such *delivery*, and notice given or served by fax shall be deemed effectually given and received on the first calendar day after the day of successful transmission.

46 SET OFFS

Notwithstanding any other provision in the Contract, any and all costs, losses, damages, credits, other liabilities or payments due or to become due from the Contractor to the Purchaser, may be set-off against any payment due or to become due from the Purchaser to the Contractor, and the Purchaser shall have a discretion in respect of selection of the time or times for effecting the set-off or recovery of part or all of any such amount, provided that a written accounting for each such deduction or set-off exercised is provided forthwith to the Contractor. Such set-offs need not be accumulated or delayed to completion of the Work.

END OF GENERAL CONDITIONS



TERMS AND CONDITIONS OF PAYMENT

KEYYASK GENERATING STATION DESIGN, MANUFACTURE, SUPPLY AND INSTALLATION OF HYDROELECTRIC TURBINES & GENERATORS

TERMS AND CONDITIONS OF PAYMENT

1 PRICES

Prices in the Contract shall include all customs duties, surcharges, insurance premiums, permit and licence fees, transportation and delivery costs, workers compensation and vacation pay assessments, and all other payroll benefits. Canadian Goods and Services Tax (GST) and Manitoba provincial retail sales tax (PST) shall be treated as specified in the Contractor's Proposal for each ITEM. All other applicable taxes shall be included and shall not be subject to any adjustment.

No payment shall be made to the Contractor for sales tax (if any) which may be imposed by Canada or Manitoba in respect of the Contractor's Plant, Tools and any other items not included in the Work.

Except as specifically provided for in the Contract, prices in the Contract shall be firm and not subject to adjustment for changes or unexpected contingencies of any kind whatsoever, including without restricting the generality of the foregoing, changes in wages, material costs, or taxes which may in future be imposed by lawful authority within or outside of Canada.

2 GOODS AND SERVICES TAX (GST)

GST applies to the Work. Where the Contractor is carrying on business in Canada and therefore required to register under the Excise Tax Act of Canada, the Contractor shall show the GST as a separate amount on each invoice and any invoice issued shall also include the Contractor's GST registration number.

3 OUT OF PROVINCE CONTRACTOR

If the Contractor is based outside of Manitoba and has no permanent place of business in Manitoba, it must comply with Section 14 of The Tax Administration and Miscellaneous Taxes Act (Manitoba) and The Retail Sales Tax Act (Manitoba) when operating in Manitoba.

The provisions under The Tax Administration and Miscellaneous Taxes Act (Manitoba) outline the extra-provincial Contractor's responsibilities with respect

to reporting business activity in Manitoba and the need, if applicable, for the Contractor to provide security to the Province of Manitoba.

The Retail Sales Tax Act (Manitoba) imposes Manitoba provincial retail sales tax (PST) on the temporary use of equipment by a non-resident Contractor who brings such equipment into Manitoba to perform work in the province. Additional information with respect to the application of the PST to the equipment of a non-resident Contractor can be found in Information Bulletin No. 005 – Information for Contractors as issued by Manitoba Finance.

Information with respect to the Contractor's responsibilities under The Tax Administration and Miscellaneous Taxes Act, The Retail Sales Tax Act or any other tax related provincial legislation can be obtained from:

Manitoba Finance, Taxation Division
Telephone: (204) 945-5603
FAX: (204) 945-0896
Email: MBTax@gov.mb.ca

4 WITHHOLDING TAX

If the Contractor is a non resident of Canada, withholding tax may be deducted from payments made to the Contractor in accordance with the Income Tax Act (Canada), R.S.C. 1985, c. 1 (5th supplement), Regulation 105(1), as amended from time to time, the Income Tax Regulations, and any applicable tax treaties.

For further information concerning the withholding tax, contact Canada Customs & Revenue Agency at:

Canada Customs & Revenue Agency
Winnipeg Tax Services Office
International Tax Unit
325 Broadway Avenue
Winnipeg, Manitoba R3C 4T4
Canada
Telephone: (204) 983-3969
FAX: (204) 984-6746

5 THE BUILDERS LIENS ACT

Section 3(3) of The Builders Liens Act (Manitoba) R.S.M. 1987, c. B91, excludes contracts with Manitoba Hydro respecting hydro-electric generating stations from

the application of that Act. Accordingly, the Purchaser will not retain a builder's lien holdback from payments made under the Contract.

6 ESCALATION

The Contract Price may be subject to upward or downward adjustment to reflect the changes in market pricing for certain ITEMS or portions of the Work as reflected in identified Performance Based Payment Milestones in accordance with the Contract Schedule ("Escalation"). Cost relating to alterations, additions and deductions to the Work, if any, shall not be subject to Escalation except by prior written agreement of the Purchaser. The Contractor must supply all calculations and supporting documents to be paid for any Escalation to be added to or deducted from the Contract Price in accordance with this Section 6 ESCALATION.

6.1 Limitation With Respect to Performance Based Payments

The Contract Schedule shall govern the application of Escalation for all ITEMS of the Work as follows.

Escalation shall be calculated on an annual basis for each applicable Performance Based Payment Milestone approved during the prior calendar year. When calculating the Escalation on an annual basis for individual Performance Based Payment Milestones, the amount calculated shall be based upon the month in which the Performance Based Payment Milestone was approved as per the Terms and Conditions of Payment Section 6.3 Approval of Milestones. When the approval date is later than the associated date in the Contract Schedule (current at the time that the applicable Performance Based Payment Milestone was approved), the Contract Schedule date shall be used to calculate the Escalation. When the approval date is earlier than the associated date in the Contract Schedule (current at the time that the applicable Performance Based Payment Milestone was approved), the Milestone approval date shall be used to calculate the Escalation.

Escalation shall be calculated in relation to each ITEM of the Work as follows:

6.2 Escalation for ITEM 1 - Model Test

No Escalation shall apply to ITEM 1 - Model Test

6.3 Escalation for ITEM 2 - Supply and Delivery of Turbine Generators

That portion of the Contract Price, applicable to ITEM 2, shall be subject to Escalation calculated as follows:

A. Definitions

The Steel Index shall mean one hundred percent (100%) of the published CANSIM industrial product price index series from Steel Index: Table 329-0063 Sheet, strip and plate, alloy steel (V53433780) (the “Steel Index”).

The Copper Index shall mean one hundred percent (100%) of the published CANSIM industrial product price index series from Copper Index: Table 329-0063 Manufactured Copper Products (V53433832) (the “Copper Index”).

2. The base reference month shall be August 2012 (the “Base Reference Month”)
3. The Escalation percentage shall be calculated and rounded off to the nearest one tenth of one percent. Each last significant figure shall be rounded to the next higher figure if the succeeding figure is five (5) or more. If the succeeding figure is less than five it shall be reduced to the next lower figure.

B. Method of Adjustment Calculation

$$PA1 = Pm (Sa/Sb-1)$$

$$PA2 = Pm (Ca /Cb-1)$$

Where;

PA = Price adjustment

Pm = Performance Based Payment Milestone for material supply as listed in **Appendix T** Performance Based Payments Table in Excel Format

Sa = Three point average of the latest available final published Steel Index at the time of the approval of the applicable Performance Based Payment Milestone and such Index for the preceding and following month.

Sb = Base Steel Index composed of the three point average of such Index for the Base Reference Month and the preceding and following month.

Ca = Three point average of the latest available final published Copper Index at the time of the approval of the applicable Performance Based Payment Milestone and such Index for the preceding and following month.

Cb = Base Copper Index composed of the three point average of such Index for the Base Reference Month and the preceding and following month.

The indices above shall be taken 6 months after the end of the applicable calendar year to account for any adjustments made by the index publisher. For ITEM 2, the Contractor shall provide an Escalation Report for each calendar year reflecting

Escalation calculations made in accordance with the requirements of this Section ESCALATION in July of each following year for review by the Engineer. The total of all ITEM 2 Escalation for the applicable calendar year shall be included in the Contractor's July progress statement with the Escalation Report attached.

In the event that the indices specified herein are discontinued, or the basis of their calculations is modified, equivalent indices shall be substituted by mutual agreement of the parties.

6.4 Escalation for Work ITEM 3 - Installation of Turbine Generators

That portion of the Contract Price, applicable to ITEM 3, shall be subject to Escalation calculated as follows:

$$PA3 = 0.8 Pi (La / Lb - 1)$$

PA = Price Adjustment

Pi = Performance Based Payment Milestone for installation as listed in **Appendix T** Performance Based Payments Table in Excel Format

La = the current labour index for Keeyask Generating Station Turbine Generators installation which shall be the arithmetic average of the indices computed as hereinafter defined for the 15th day of each month of the preceding six months prior to the Performance Based Payment Milestone approval date.

Lb = the base labour index for Keeyask Generating Station Turbine Generators Installation computed as in Subsection 6.5 Labour Index of the Terms and Conditions of Payment.

6.5 Labour Index

The base labour index (Lb) and the monthly indices used to determine the current labour index for installation of Turbine Generators for Keeyask Generating Station (La) shall be the average hourly labour cost for an identical composite group of tradesmen determined exclusively in accordance with the provision set forth herein. Calculations of such average hourly labour costs shall be based on wages and benefits payable under the terms of the BNA, and on the assumption of a 60-hour work week. No change shall be made on account of variation of the composition of the labour force, the duration of the work week, or by reason of any changes of labour-related costs not covered by the BNA, or included in the definitions herein.

For purpose of such calculations the composite group of tradesman shall be comprised of the following:

18	Only Journeyman Millwrights
9	Only Journeyman Electricians
4	Only Journeyman Pipefitters
4	Only Journeyman Ironworkers
5	Only Labourers
40	Total

The base labour index (Lb) shall be determined for August 2012. A sample base labour index has been computed as illustrated below:

Base Labour Index Calculation for 60 hour work week.			
MILLWRIGHT, JOURNEYMAN (18)			
SALARY AND BENEFIT			
1	Labour		\$ 2,236.50
	Base Rate (\$/hr)	\$ 29.82	
	Regular Salary (Base Rate x 40)	\$ 1,192.80	
	OT (Base Rate x 10 hrs x 1.5 + Base Rate x 10 hrs x 2)	\$ 1,043.70	
2	Vacation Pay @6% of Labour		\$ 134.19
3	Statutory Holiday Pay @4.5% of Labour		\$ 100.64
4	Trade Improvement Plan @\$.3 / hr x 60 hr		\$ 18.00
5	Welfare Trust Fund @ \$1.71 / hr x 75hr		\$ 128.25
6	Pension Plan @ 5.00 hr x 75 hr		\$ 375.00
7	Sub Total Salary and Benefit		\$ 2,992.58
TRANSPORTATION			
8	Transportation Cost every 35 days		\$ 1,610.00
	Air Fare - Thompson to Winnipeg & return	\$ 1,386.35	
	Travel Time (7.5 hrs x base rate) estimate for Keeyask	\$ 223.65	
9	Sub Total Transportation for 60 hours work week (Transportation cost x 7 / 35)		\$ 322.00
10	Total cost of 1 Millwright 60 hours week		\$ 3,314.58
11	Total cost of 18 Millwright 60 hours week		\$ 59,662.49
ELECTRICIAN, JOURNEYMAN (9)			
SALARY AND BENEFIT			
1	Labour (Regular + OT)		\$ 2,446.50
	Base Rate (\$/hr)	\$ 32.62	

	Regular Salary (Base Rate x 40)	\$	1,304.80	
	OT (Base Rate x 10 hrs x 1.5 + Base Rate x 10 hrs x 2)	\$	1,141.70	
2	Vacation Pay: 6% on gross earnings			\$ 146.79
3	Statutory Holiday Pay: 4.5% on gross earnings			\$ 110.09
4	Trade Improvement Plan @\$.2 / hr x 60 hr			\$ 12.00
5	Welfare Trust Fund @ \$1 / hr x 60hr			\$ 60.00
6	Pension Plan @3.15 hr x 60 hr			\$ 189.00
7	Sub Total Salary and Benefit (9 Electrician)			\$ 2,964.38
TRANSPORTATION				
8	Transportation Cost every 35 days			\$ 1,631.00
	Air Fare - Thompson to Winnipeg & return	\$	1,386.35	
	Travel Time (7.5 hrs x base rate) estimate for Keeyask	\$	244.65	
9	Total cost of transportation for 60 hours work week (Transportation cost x 7 / 35)			\$ 326.20
10	Total cost of 1 Electrician 60 hours week			\$ 3,290.58
11	Total cost of 9 Electrician 60 hours week			\$ 29,615.24
PIPEFITTER, JOURNEYMAN (4)				
SALARY AND BENEFIT				
1	Labour			\$ 2,447.25
	Base Rate (\$/hr)	\$	32.63	
	Regular Salary (Base Rate x 40)	\$	1,305.20	
	OT (Base Rate x 10 hrs x 1.5 + Base Rate x 10 hrs x 2)	\$	1,142.05	
2	Vacation Pay: 6% x Base rate earnings			\$ 78.31
3	Statutory Holiday Pay @ 4% of (base rate earnings + vacation Pay)			\$ 55.34
4	Trade Improvement Plan @\$.12 / hr on hours worked			\$ 7.20
5	Welfare Trust Fund @ \$.91 / hr x 75hr			\$ 68.25
6	Pension Plan @\$4 /hr x 75 hr			\$ 300.00
7	Industrial Promotion Fund @\$.44 /hr x 60 hr			\$ 26.40
8	Sub Total Salary and Benefit (4 Pipefitter)			\$ 2,982.75
TRANSPORTATION				
9	Transportation Cost every 35 days			\$ 1,631.08
	Air Fare - Thompson to Winnipeg & return	\$	1,386.35	
	Travel Time (7.5 hrs x base rate) estimate for Keeyask	\$	244.73	

10	Total cost of transportation for 60 hours work week (Transportation cost x 7 / 35)		\$ 326.22
11	Total cost of 1 Pipefitter 60 hours week		\$ 3,308.97
12	Total cost of 4 Pipefitter 60 hours week		\$ 13,235.87
STRUCTURAL IRONWORKER (4)			
SALARY AND BENEFIT			
1	Labour		\$ 2,253.75
	Base Rate (\$/hr)	\$ 30.05	
	Regular Salary (Base Rate x 40)	\$ 1,202.00	
	OT (Base Rate x 10 hrs x 1.5 + Base Rate x 10 hrs x 2)	\$ 1,051.75	
2	Vacation Pay @ 10% x Labour		\$ 225.38
3	Welfare Trust Fund @ \$1.66 / hr x 60hr		\$ 99.60
4	Pension Plan @\$5.55 /hr x 60 hr		\$ 333.00
5	Trade Improvement Plan @\$.2 / hr x 60 hr		\$ 12.00
6	Sub Total Salary and Benefit (4 Pipefitter)		\$ 2,923.73
TRANSPORTATION			
7	Transportation Cost every 35 days		\$ 1,611.73
	Air Fare - Thompson to Winnipeg & return	\$ 1,386.35	
	Travel Time (7.5 hrs x base rate) estimate for Keeyask	\$ 225.38	
8	Total cost of transportation for 60 hours work week (Transportation cost x 7 / 35)		\$ 322.35
9	Total cost of 1 Structural Ironworker 60 hours week		\$ 3,246.07
10	Total cost of 4 Structural Ironworker 60 hours week		\$ 12,984.28
LABOURER (5)			
SALARY AND BENEFIT			
1	Labour		\$ 1,449.08
	Base Rate (\$/hr)	\$ 21.31	
	Regular Salary (Base Rate x 44 hrs / week)	\$ 937.64	
	OT (Base Rate x 16 hrs / week x 1.5)	\$ 511.44	
2	Vacation Pay @ 6% x Base Rate x 60 hr / week		\$ 76.72
3	Statutory Holiday Pay @ 4.5% x Base Rate x 60		\$ 57.54
4	Welfare Trust Fund @ \$.4 / hr x 60hr		\$ 24.00

5	Pension Plan @ \$1.99 /hr x 60 hr		\$	119.40
6	Training Fund @ \$0.25 /hr x hours worked		\$	15.00
7	Sub Total Salary and Benefit (1 Labourer)		\$	1,741.73
TRANSPORTATION				
8	Transportation Cost every 40 days		\$	1,546.18
	Air Fare - Thompson to Winnipeg & return	\$	1,386.35	
	Travel Time (7.5 hrs x base rate) estimate for Keeyask	\$	159.83	
9	Total cost of transportation for 60 hours work week (Transportation cost x 7 / 40)		\$	270.58
10	Total cost of 1 Labourer 60 hours week		\$	2,012.31
11	Total cost of 5 Labourer 60 hours week		\$	10,061.57
SUMMARY				
1	Total cost of 18 Millwright 60 hours week		\$	59,662.49
2	Total cost of 9 Electrician 60 hours week		\$	29,615.24
3	Total cost of 4 Pipefitter 60 hours week		\$	13,235.87
4	Total cost of 4 Structural Ironworker 60 hours week		\$	12,984.28
5	Total cost of 5 Labourer 60 hours week		\$	10,061.57
6	SUB TOTAL (40 PEOPLE COST 60 HOUR WORK WEEK)		\$	125,559.45
7	AVERAGE COST / HR (SUBTOTAL / 60 / 40)		\$	52.32
	BASE LABOUR INDEX (Lo)		\$	52.32

Average hourly labour cost for the composite group (Base labour index for Keeyask Generating Station Turbine Generators): **\$52.32**

In determining the current labour index (*La*), the method of computation shall be the same as illustrated in the foregoing computation of the base labour index (*Lb*). Hourly rate of pay, overtime provision and fringe benefits shall be inserted at the actual values and on the basis of prescribed in the BNA and applicable appendices for the date of the index required. Changes of the reference appendices directed by the Appendix Review Committee and / or a mediator concerning adjustment of fringe benefit items (including additional of new benefits), wage and transportation costs, shall be incorporated in the computations in accordance with the method illustrated. Cost of transportation shall be the effect on the corresponding date.

For ITEM 3, the Contractor shall provide an escalation report for each applicable calendar year in January of each following year for review by the Engineer. The

total of all ITEM 3 Escalation for the applicable calendar year shall be included in the Contractor's January (of the following year) progress statement with the escalation report attached.

6.6 Escalation for Work ITEM 4 - Generator Efficiency Test

No Escalation shall apply to ITEM 4 - Generator Efficiency Test.

6.7 Escalation for Work ITEM 5 - Supply of Miscellaneous Items

No Escalation shall apply to Work ITEM 5 - Supply of Miscellaneous Items.

6.8 Escalation for Work ITEM 6 - Supply and Delivery of Spare Parts

No Escalation shall apply to Work ITEM 6 - Supply and Delivery of Spare Parts.

6.9 Escalation for Work ITEM 7 - Accelerated Installation Schedule

Any premium paid for ITEM 7 shall be applied to ITEM 3 Performance Based Payment Milestones and escalation for said ITEM shall apply.

6.10 Escalation for Work ITEM 8 - Consultation During Station Design

No Escalation shall apply to ITEM 8 - Consultation During Station Design

6.11 Escalation for Work ITEM 9 – Shop Test Assemblies

No Escalation shall apply to ITEM 9 – Shop Test Assemblies

6.12 Escalation for Work ITEM 10 – Commissioning Support

No Escalation shall apply to ITEM 10 – Commissioning Support

7 TERMS OF PAYMENT

Subject to certification by the Engineer, the Purchaser shall pay the Contractor the cost of the Work and all services of the Contractor in connection therewith, in Canadian currency, as follows:

7.1 Performance Based Payments (ITEMS 1 to 6, & 9)

The purpose of Performance Based Payments is to compensate the Contractor for Work that has actually been completed.

For the purposes of the Contract, a performance based payment milestone is defined as a specific milestone in performance of the Work by the Contractor that,

upon completion, will authorize the Contractor to request payment using the Purchaser's Monthly Progress Statement form (a "Performance Based Payment Milestone"). The Purchaser has included a complete distribution of all Performance Based Payment Milestones in **Appendix T** Performance Based Payment Table in Excel Format. Payments for each ITEM of the Work shall be determined based upon completion of the related Performance Based Payment Milestones set out in such table. Each Performance Based Payment Milestone is assigned a unique alphanumeric identifier for use in identification and documentation of the milestone completion. The Contractor must reference this number in all correspondence related to payment of such Performance Based Payment Milestone.

7.2 Approval of Milestones

Before any Performance Based Payment Milestone may be included for payment in the Contractor's Monthly Progress Statement, the Contractor shall obtain certification of such milestone by the Engineer. To obtain such certification, the Contractor must submit a completed "Performance Based Payment – Milestone Completion" form as set out in **Appendix S**. A separate form is required and shall be submitted for each individual numbered Performance Based Payment Milestone. This form shall be completed, including all necessary background information substantiating that the milestone has been completed, and submitted for signature to the Engineer, or assigned delegate. ***The Engineer shall review and return approval or comment requesting additional information within 10 days of receipt of the Milestone Completion.*** Once certified, the Contractor must attach the signed form(s) to the applicable Monthly Progress Statement. Only those Performance Based Payment Milestones that have been certified as complete by the Engineer shall be processed for payment by the Purchaser.

Approval of a Performance Based Payment Milestone will be given only if all of the defined work for such milestone is complete. If, in the opinion of the Engineer, the work has not been completed, or the completed work is in any way deficient, certification shall not be provided. The Contractor may request partial payment of a Performance Based Payment Milestone ; however, the Purchaser is under no obligation to make any partial payment until all of the work in relation to the applicable milestone is completed to the satisfaction of the Engineer.

In addition, the Purchaser is not obligated to make payment for any Performance Based Payment Milestone certified as completed in advance of the current Contract Schedule dates associated with such milestone. The Contractor may request early payment of any such certified Performance Based Payment Milestone; however, the Purchaser is under no obligation to make any payment of the applicable Performance Based Payment Milestone until the Contract Date identified in the Contract Schedule for such milestone.

7.3 Work Performed as Extra Work

In addition, included in the Monthly Progress Statements shall be a detailed breakdown of:

- (a) any extra work performed by the Contractor; or
- (b) any deduction to the Work,

directed by the Engineer pursuant to an Extra Work Order or Change Order during that month.

Extra work so approved, shall be subject to the requirements of Subsection 7.1 Performance Based Payments of these Terms and Conditions of Payment and new Performance Based Payment Milestones will be added as required by the Engineer to accommodate the extra work under the appropriate ITEM of the Work.

7.4 Monthly Progress Statement

At the end of each month, the Contractor shall submit to the Engineer for certification a Monthly Progress Statement requesting payment of all the Performance Based Payment Milestones which have been certified as complete in the current month in accordance with Subsection 7.2 Approval of Milestones of these Terms and Conditions of Payment as well as requesting payment for any extra work performed in the month and/or providing credit for any deductions to the Work in accordance with Subsection 7.3 Work Performed as Extra Work of these Terms and Conditions of Payment.

Monthly Progress Statements shall be in the form provided by the Purchaser and shall be satisfactory to the Purchaser in both form and content. Monthly Progress Statements shall include all applicable Performance Based Payment - Milestone Completion Forms as certified by the Engineer and any other information requested by the Engineer to assist the Engineer in evaluating the Monthly Progress Statement and verifying the amounts claimed to be paid in respect of the Work.

The Contractor shall deliver to the Engineer any books, records, receipts, vouchers, memoranda and any other information that the Engineer may reasonably require in relation to an invoice.

7.5 Certification of Monthly Progress Statement

The Engineer may refuse to certify payment for all or part of the cost of any matter under any Monthly Progress Statement where the matter in question is

unsuitable, unnecessary, or the cost was otherwise improperly incurred in the performance of the Work.

The Engineer will issue to the Purchaser, no later than 10 days after receipt of a Monthly Progress Statement accompanied with any requested information, a certificate for payment in the amount set out in the Monthly Progress Statement or in such other amount as the Engineer certifies to be properly due. If the Engineer amends a Monthly Progress Statement, the Engineer will advise the Contractor providing the reason for the amendment.

Any certificate for payment made in respect of a Contractor's Monthly Progress Statement shall not be deemed to be the Engineer's final verification of quantities or quality or acceptance of any Work completed or matters under consideration in respect of the Work.

7.6 Payment

Subject to the terms and conditions of the Contract, the Purchaser will make payment to the Contractor within 30 days after receipt of a certificate for payment issued by the Engineer in respect of a Monthly Progress Statement.

7.7 Final Payment

Upon completion of the Work and certification of all remaining Performance Based Payment Milestones, the Contractor shall prepare a final statement showing the total value of Work completed. The final Progress Statement shall be forwarded to the Engineer for certification including all remaining and required Milestone Completion forms. The certified amount shown on the final Progress Statement, less an amount equal to the aggregate of all previous payments made to the Contractor pursuant to the Contract and less the total amount, if any, deductible under the terms of the Contract, shall be paid to the Contractor 30 days after the date of the Completion Certificate issued in respect of the Work, subject to the following:

- (a) If the issue of the Completion Certificate is delayed by the Purchaser beyond 30 days from the date of the completion of the Work in accordance with the Contract, the Purchaser shall have the option of extending the time for payment of the said balance and shall pay the Contractor interest on said balance at the annual rate of interest equivalent to that charged to preferred borrowers by the Purchaser's bank ('prime lending rate') in Winnipeg, calculated from the 30th day after the date of the completion of the Work. If payment is delayed by reason of any defect in the Work or any portion thereof, or any failure to meet this Request or the requirements of the Contract, so that the Work or any portion thereof is rejected by the Purchaser, and if such defect or failure is attributable to the Contractor, then interest on said balance shall be payable by the Purchaser

as aforesaid up to the date on which the Work or the portion thereof was rejected by the Purchaser, and thereafter no interest shall be payable.

- (b) Prior to payment of the balance of the cost of the Work to the Contractor as aforesaid, the Purchaser may require the Contractor to furnish the Purchaser with an Affidavit sworn by the Contractor, in the form set out in Schedule 'A' (see SAMPLE ONLY) to these Terms and Conditions of Payment.

7.8 Overdue Payments

Should either party fail to make payments as they become due under the terms of the Contract or in an award by an arbitrator or court, interest at one and a half percent (1.5%) per annum above the prime rate on such unpaid amounts shall also become due and payable until payment. Such interest shall be compounded on a monthly basis. The prime rate shall be the lowest rate of interest quoted by the Royal Bank of Canada for prime business loans.

Interest shall apply at the rate and in the manner prescribed above on the amount of any claim for which either party is entitled to payment pursuant to the Contract upon resolution of any dispute, 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.

7.9 Consultation During Station Design (ITEM 8 ONLY)

The Contractor shall invoice Manitoba Hydro on a monthly basis, as part of the Contractor's Monthly Progress Statement for the actual cost of hours spent during the month in consultations with Manitoba Hydro's designers at the rate set out in the Contractor's Proposal. Expenses for travel and accommodations will be reimbursed on a time & materials basis in accordance with Section 13 PRICING AND PAYMENT METHODS FOR CHANGES TO THE WORK of the General Conditions.

Payments by the Purchaser for ITEM 8 of the Work shall be made in accordance with Subsection 7.6 Payment of the Terms and Conditions of Payment.

This consultation will take place around the time that ITEM 1 is completed. Upon receipt of a Notice to Proceed for ITEMS 2 to 10 the Contractor shall reimburse the Purchaser for 50% of all costs previously paid by the Purchaser to the Contractor for ITEM 8.

7.10 Commissioning Support (ITEM 10 ONLY)

The Contractor shall invoice Manitoba Hydro on a monthly basis, as part of the Contractor's Monthly Progress Statement for the actual cost of hours spent during the month in support of commissioning activities at the rate set out in the

Contractor's Proposal. Expenses for airfare and vehicle lease/rental only will be reimbursed on a time & materials basis in accordance with Section 14 PRICING AND PAYMENT METHODS FOR CHANGES TO THE WORK of the General Conditions. Accommodations at the site (room and board) will be provided by the Purchaser. Offsite accommodations and expenses are the responsibility of the Contractor.

Payments by the Purchaser for ITEM 10 of the Work shall be made in accordance with Subsection 7.6 Payment of the Terms and Conditions of Payment.

8 CONTRACT SECURITY

For each irrevocable letter of credit required by Section 3 PERFORMANCE SECURITY of the General Requirements, the Purchaser shall pay the Contractor the cost of the applicable irrevocable letter of credit rate as set out in the Contractor's Proposal or the actual rate as invoiced by the Contractor's bank. A copy of the applicable irrevocable letter of credit invoice from the Contractor's bank must accompany the Contractor's invoice. Payment will be forwarded to the Contractor within 30 days after the date of the Contractor's invoice following the receipt of the applicable letter of credit by the Purchaser.

9 LIQUIDATED DAMAGES

Liquidated damages, if any, payable pursuant to Section 56 LIQUIDATED DAMAGES AND PERFORMANCE BONUSES of the General Requirements, shall be applied as a credit against the balance of the cost of ITEMS 2 to 10 payable to the Contractor or other monies payable by the Purchaser to the Contractor pursuant to the Contract at the Purchaser's discretion. In addition, the Purchaser shall be entitled to call upon any irrevocable letter of credit delivered by the Contractor to the Purchaser pursuant to Section 3 PERFORMANCE SECURITY of the General Requirements to recover any liquidated damages payable by the Contractor pursuant to Section 56 LIQUIDATED DAMAGES AND PERFORMANCE BONUSES of the General Requirements where the Contractor has failed to make payment of such amounts within 5 days of the Purchaser's written demand therefor. If there are insufficient monies payable by the Purchaser to the Contractor or recovered pursuant to such irrevocable letter of credits to cover the amount of such liquidated damages, then the difference shall be debt due and payable by the Contractor to the Purchaser within 30 days of receipt of the Purchaser's invoice by the Contractor.

10 PERFORMANCE BONUS

A performance bonus, if any, payable pursuant to Section 56 LIQUIDATED DAMAGES AND PERFORMANCE BONUS of the General Requirements, shall be paid by the Purchaser to the Contractor, subject to Section 9 LIQUIDATED DAMAGES of the Terms and Conditions of Payment, within 30 days of the date of the calculation set out in Section 56 LIQUIDATED DAMAGES AND PERFORMANCE BONUS of the General Requirements of the showing that a bonus is payable to the Contractor.

11 ON-THE JOB TRAINING

If exercised, the cost of the on-the-job training shall be applied as a proportional increase to the installation Performance Based Milestone Payments for ITEM 3.

END OF TERMS AND CONDITIONS OF PAYMENT

Terms and Conditions of Payment Schedule 'A'

CANADA) I, _____
)
 PROVINCE OF MANITOBA) of the _____ of _____ in the
)
 TO WIT: Province of Manitoba,

MAKE OATH AND SAY:

1. THAT I am the _____
 of _____
 and as such have personal knowledge of the facts and matters herein deposed to.

2. THAT by agreement in writing dated _____ 200__
 undertook the following work for Manitoba Hydro, namely:

3. THAT all work or services required to be performed and all materials
 required to be furnished or placed, pursuant to said Agreement, have been performed,
 furnished or placed and that all wages, accounts, claims, and demands in connection
 therewith, and in connection with any subcontract for the doing of work, provision of
 services and supply of materials, have been fully paid and satisfied, other than:

NAME	PARTICULARS	AMOUNT

4. THAT all assessments and levies by the Workers Compensation Board against

 have been paid in full.

SWORN before me at the _____ of _____, in the
 Province of Manitoba, this _____ day of _____, 200__.

 A Commissioner for Oaths in and for the Province of Manitoba.

My Commission expires _____, 200__



**REQUEST FOR PROPOSAL 016321
WITH ADDENDA 1 TO 6**

**TECHNICAL REQUIREMENTS
VOLUME 2 OF 3**

KEYYASK GENERATING STATION PROJECT

**DESIGN, MANUFACTURE, SUPPLY AND
INSTALLATION OF HYDROELECTRIC
TURBINES & GENERATORS**

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SEPTEMBER 22, 2011

ADDENDA 1 TO 6

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**KEYYASK GENERATING STATION PROJECT
DESIGN, MANUFACTURE, SUPPLY AND INSTALLATION OF
HYDROELECTRIC TURBINES & GENERATORS
REQUEST FOR PROPOSAL 016321**

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KEYYASK GENERATING STATION PROJECT DESIGN, MANUFACTURE, SUPPLY AND INSTALLATION OF HYDROELECTRIC TURBINES & GENERATORS REQUEST FOR PROPOSAL 016321

TECHNICAL REQUIREMENTS

1 GENERAL

1.1 Acronyms

The following acronyms are used throughout this document:

AC	Alternating Current
ANSI	American National Standards Institute
ASTM	American Society for Testing and Materials
BHN	Brinell Hardness Number
NBCC	National Building Code of Canada
CSA	Canadian Standards Association
CT	Current Transformer
DC	Direct Current
EEMAC	Electrical and Electronic Manufacturers Association of Canada
FEA	Finite Element Analysis
FM	Factory Mutual
HMI	Human Machine Interface
HPOIS	High Pressure Oil Injection System
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronic Engineers
ISO	International Organization for Standards
I/O	Input/Output
NEMA	National Electrical Manufacturer's Association
NERC	North American Electric Reliability Corporation
NFPA	National Fire Protection Association
NPT	National Pipe Thread
OD	Outer Diameter
PLC	Programmable Logic Controller
PT	Potential Transformer
PTFE	Polytetrafluoroethylene
QAR	Quality Assurance Representative
RTD	Resistance Temperature Detector
SAE	Society of Automotive Engineers
UCMS	Unit Control and Monitoring System
ULC	Underwriters' Laboratories of Canada

UL Underwriters' Laboratories

1.2 Standards

Wherever a specific standard is mentioned in the Technical Requirements, it shall be understood that the latest revision, current at the time and the date of the execution of the Contract for ITEM 1 and the issuance of the Notice to Proceed for ITEMS 2 to 10, shall apply, as applicable.

1.3 Deviations from Technical Requirements

Where the Contractor wishes to deviate from the Technical Requirements, the Contractor shall follow the procedure outlined in Section 16 EQUAL ARTICLES, MATERIALS OR EQUIPMENT of the General Requirements.

2 DESIGN AND CONSTRUCTION

2.1 General

The Contractor shall be responsible for the complete design of the Work so that it will fully meet all requirements with respect to fabrication, manufacture, installation, tests and operation, all as specified in and required by the Technical Requirements.

Electrical and mechanical equipment shall comply with applicable CSA standards.

Additional standards are included in the applicable equipment sections.

Deflections and stress levels in all components shall be determined by the Contractor. Structural and mechanical design calculations shall be submitted to the Engineer for review, when requested.

Data for flux density, current density and electro-mechanical loads shall be submitted to the Engineer for review, when requested.

A finite element analysis (FEA) will be performed and a design report, including all constraints, proof of grid independence, loads, deflections and stresses prepared and submitted to the Engineer for the following components:

- 1) Runner (blade and hub assembly)
- 2) Stay ring
- 3) Head cover assembly
- 4) Wicket gates

- 5) Rotor spider
- 6) Rotor pole
- 7) Stator frame
- 8) Thrust bearing support structure
- 9) Discharge ring
- 10) Bottom ring
- 11) Draft tube liner

Upon request, the Contractor shall forward to the Engineer its finite element model for review.

The Contractor shall perform a transient analysis of the pressure rise in the water passages due to the full opening or closing of the wicket gates in order to determine the required gate opening and closing times to respect the maximum allowable pressure in the water passages. A report summarizing the analysis and the results of the analysis shall be submitted to the Engineer for review.

The following design requirements shall be incorporated:

- 12) The prototype turbine runner and water passage components shall be a reproduction of the model turbine shape and profile within one half of the tolerances permitted in IEC Publication 60193 (2nd Edition, 1999-11), except as otherwise specified herein.
- 13) The Contractor shall design bolted joints with fasteners 25 mm and larger in such a way that the fasteners may be disassembled and reassembled using a hydraulic torque wrench. Fasteners that do not have a mechanical means of locking shall be installed with loctite.
- 14) When performing an FEA, grid independence is achieved when halving the size of the elements changes the results of the analysis by 5% or less.
- 15) A minimum design metal temperature (MDMT) of 0°C shall be applied for all materials and weld metal.
- 16) Wicket gate bushing clearances shall be in accordance with ISO 286-2 fit NJSE7/e7. Note NJS stands for nominal journal size, the E7 fit applies to the installed bushing bore and e7 applies to the installed stainless steel sleeve OD.
- 17) Wicket gate linkage bushing clearances shall be in accordance with ISO 286-2 fit NJSE7/h7. The E7 fit applies to the installed bushing bore and h7 applies to the stainless steel pin OD.
- 18) Self-lubricating bushings and sliders shall be designed to prevent external particles from entering the bushing clearances.
- 19) All “below the hook lifting devices” shall be designed in accordance with ASME BTH-1-2008. However, a minimum factor of safety of 5.0 shall be maintained for all lifting devices per the Manitoba Safety and Health Act W210 - Regulation 217/2006.

- 20) Hooks, slings, hoists, and other lifting devices components shall be designed and constructed as per applicable ASME B 30 Standards.
- 21) The Purchaser shall construct concrete in accordance with CSA A23.1 Concrete Materials and Methods of Concrete Construction. The Contractor shall design the turbines and generators to accommodate the tolerances specified in CSA A23.1.
- 22) All joints that depend upon bearing contact for transfer of load shall have the bearing surfaces machined to a common plane.
- 23) The draft tube liner shall be designed assuming that there is no contact between the outer diameter of the shell and the secondary concrete.

2.2 Loading Conditions

2.2.1 Normal Loading Conditions

The Contractor shall design the turbine and generator components for the most adverse combination of the loading conditions listed below and in the various sections of the Technical Requirements, plus any other loading conditions which the Contractor considers necessary, all without exceeding the allowable stresses specified in Subsection 2.3.3 Under Normal Loading Conditions of the Technical Requirements.

- 1) Hydraulic pressures at maximum head.
- 2) Loads imposed by maximum Unit output at maximum head.
- 3) Loads imposed by the Unit's rotational synchronous speed.
- 4) Loads imposed by operating the wicket gates from full closed to full open at maximum head.
- 5) Loads imposed by operating the wicket gates full open to full closed at maximum head.
- 6) The maximum pressure in the water passage due to Unit load rejection and shut down as calculated by the Contractor.
- 7) Thermal loads including cyclic.
- 8) Loads due to forced vibration.
- 9) Weight of the concrete structures.
- 10) Weight of the Unit parts.
- 11) Electro magnetic loads.
- 12) Hydraulic thrust, calculated at maximum head.
- 13) Maximum headwater pressure at the interface between embedded components and the concrete.
- 14) A 144 kPa pressure due to the weight of the concrete (hydraulic load) during placement.
- 15) A 210 kPa pressure due to grouting.

2.2.2 Extreme Loading Conditions

The Contractor shall design the turbine and generator components for the most adverse combination of the loading conditions listed below and in the various sections of the Technical Requirements, plus any other loading conditions which the Contractor considers necessary, all without exceeding the allowable stresses specified in Subsection 2.3.4 Under Extreme Loading Conditions of the Technical Requirements.

- 1) The maximum runaway speed at maximum gross head.
- 2) Loads imposed by closing the wicket gates at the full runaway speed at maximum head.
- 3) A short circuit of half the poles.
- 4) A single phase short circuit.
- 5) A phase to phase short circuit.
- 6) A three phase short circuit.
- 7) The worst case faulty synchronization.

2.3 Allowable Stresses

2.3.1 General

Stress for the purpose of the design of the Work shall be defined as:

$$\sigma := \sqrt{\frac{(\sigma_x - \sigma_y)^2 + (\sigma_y - \sigma_z)^2 + (\sigma_z - \sigma_x)^2 + 6(\tau_{xy}^2 + \tau_{yz}^2 + \tau_{zx}^2)}{2}}$$

Where:

σ is stress

$\sigma_x, \sigma_y, \sigma_z$ are normal stresses

$\tau_{xy}, \tau_{yz}, \tau_{zx}$ are shear stresses

2.3.2 Events for Fatigue Analysis

The Contractor shall design the turbine and generators to operate without any cracking or other failure mechanisms. At a minimum, the following events shall be considered when performing a fatigue analysis:

- 1) 50000 start/stop cycles
- 2) 200000 best gate to full gate cycles
- 3) 600 full gate load rejections

2.3.3 Under Normal Loading Conditions

In the design of the turbine and generator components, the allowable stresses for Normal Loading Conditions set out in Subsection 2.2.1 Normal Loading Conditions of the Technical Requirements shall not exceed the following:

- 1) The maximum stresses shall not exceed 33% of the minimum published specified yield strength of the material*.
- 2) The maximum stresses for bolts and studs, shall not exceed 67% of the published minimum specified yield strength of the material.
- 3) Bolted joints shall be pre-tensioned to prevent joint separation under all operating loads including prying action. The ratio of the per fastener force required to separate the joint to the maximum load on the highest loaded fastener shall be greater than or equal to 2.
- 4) Bearing pressures on self-lubricating bushings shall not exceed 66% of the bushing manufacturer's recommended allowable pressure.
- 5) Bearing pressure on bronze bushings shall not exceed 20,000 kPa.
- 6) Bearing pressures on babbitt shall not exceed 3,300 kPa.
- 7) Bearing pressures on PTFE bearings shall not exceed 3,500 kPa.
- 8) Bearing pressures on concrete shall not exceed 4,200 kPa.
- 9) Static and dynamic loads on cast in place anchors and sole plates shall not exceed loads permitted in ACI Standard 318. Complete information regarding the design of these features shall be supplied to the Engineer in accordance with Subsection 8.4 Contract Dates of the General Requirements.
- 10) The maximum allowable pressure in the scroll case during the worst case load rejection shall be less than or equal to 130 % of the maximum steady state operating pressure at maximum head.

* If the Contractor performs a FEA stress analysis it may apply the Elastic Stress Analysis Method described in the 2010 ASME Boiler and Pressure Vessel Code Section VIII Division 2 Appendix 5 Design by Analysis Requirements with the following modifications:

- 11) The allowable stress S is equal to one third of the minimum published yield strength of the material.
- 12) The allowable limit on the primary plus secondary stress range SPS is equal to the minimum published yield strength of the material.
- 13) The distance used to determine if a stress is a Local Primary Membrane Equivalent Stress is equal to the thickness of the material.
- 14) A fatigue analysis shall be performed.
- 15) The values of S_a shall be reduced, before any application of stress concentration factors, by a factor of 1.33.

2.3.4 Under Extreme Loading Conditions

In the design of the turbine and generator components, the allowable stresses for Extreme Loading Conditions set out in Subsection 2.2.2 Extreme Loading Conditions of the Technical Requirements shall not exceed the following:

- 1) The maximum stresses shall not exceed 67% of the minimum published yield strength of the material*.
- 2) The maximum stresses for bolts and studs, shall not exceed 80% of the minimum published yield strength of the material.

* If the Contractor performs a FEA stress analysis it may apply the Elastic Stress Analysis Method described in the 2010 ASME Boiler and Pressure Vessel Code Section VIII Division 2 Appendix 5 Design by Analysis Requirements with the following modifications:

- 3) The allowable stress S is equal to two thirds of the minimum published yield strength of the material.
- 4) The allowable limit on the primary plus secondary stress range SPS is equal to twice the published yield strength of the material.
- 5) The distance used to determine if a stress is a Local Primary Membrane Equivalent Stress is equal to the thickness of the material.

The rotating parts shall be designed to operate continuously at maximum runaway speed at maximum head.

The thrust, generator guide and turbine bearings shall be designed to operate for 15 minutes at maximum runaway speed at maximum head.

2.4 Allowable Stiffness

Stiffness for the purpose of the design of the Work shall be defined as the ratio of the force required to deflect a component a unit length. The units of stiffness shall be N/m or N/mm.

For components where the stiffness is the governing factor in design the Contractor shall either:

- 1) Provide calculations of the deflection of the component and any components that it interacts with and show that the deflections cause no binding or adverse affects, or
- 2) Provide calculations of the stiffness of the component and the details of design (including drawings) and stiffness of five reference components that are within 20% of the size of the component in question. The reference components shall have a stiffness that is equal to or less than the component in question. The references shall include the name of the

facility, the owner of the facility and the contact information of an owner's representative.

At a minimum, the design of the following components is governed by stiffness:

- 3) Head cover assembly,
- 4) Wicket gates,
- 5) Bearing support structures.

There are requirements for the stator and rotor stiffness in Subsection 6.20 Combined Stator and Rotor Stiffness of the Technical Requirements.

2.5 Allowable Vibration

The Contractor shall design the hydraulic water passages and the turbine and generator components such that the fundamental natural frequencies of the turbine and generator components are at least 20% less than or 20% greater than the frequencies of harmonics of the forced vibrations to avoid a resonance.

The Contractor shall undertake a FEA, and provide a summary report, for the following components, plus any other components which the Contractor considers necessary, to determine their fundamental natural frequencies;

- 1) *Runner (blade and hub assembly)*
- 2) *Turbine and generator shaft(s)*
- 3) *Bearing support structures*
- 4) *Wicket Gates*
- 5) *Stay Vanes*
- 6) *Discharge Ring*

The Contractor shall consider the following forced vibrations plus any forced vibrations which the Contractor considers necessary;

- 7) *Rotations per second (RPS) x No. of runner blades.*
- 8) *RPS x No. of wicket gates*
- 9) *RPS x No. of runner blades x No. of wicket gates/(No. of runner blades - No. of wicket gates)*
- 10) *RPS x No. of generator poles*
- 11) *RPS x No. of stator slots*

The Contractor shall submit to the Purchaser for review, a design report detailing the results of the analysis prior to beginning any fabrication.

After final machining of the runner the Contractor shall measure the natural frequencies of all the blades, with the blades still attached to the runner hub, and provide this information to the Engineer.

Where a 20% deviation is not possible, the Contractor shall demonstrate how they will ensure the stresses of the component in question are within the allowable stresses as defined in Subsection 2.3 Allowable Stresses of the Technical Requirements.

2.6 Sizing of Welds

The Contractor shall perform a stress analysis to check the size of all welds.

The yield strength and ultimate strength used to size the weld shall be the lesser of the yield and ultimate strengths of the joint member material or the weld deposit.

The size of each weld shall be the greater of the minimum weld size in accordance with CSA W59-03, Clauses 4.3.4.1 and 4.3.4.2 or the minimum weld size as determined by the procedures outlined in Subsection 2.6.1 Design by Analysis or Subsection 2.6.2 Otherwise.

It is assumed that, if a finite element analysis is performed, that the weld geometry will not be included in the finite element model.

2.6.1 Design by Analysis

If the stress analysis is conducted in accordance with the ASME Boiler and Pressure Vessel Code, Section VIII, Division 2, Part 5, Design by Analysis Requirements, the modifications listed in Subsection 2.3.3 Under Normal Loading Conditions shall apply.

- 1) Evaluate the stress categories at planes normal to the joint members at the toe of the weld.*
- 2) Multiply the stresses by the area ratio $A_{member} / A_{weld\ throat}$ where A_{member} is the cross sectional area of the member where the stresses were evaluated in step (1) and $A_{weld\ throat}$ is the cross sectional area of the weld throat (the shortest distance through the weld).*

2.6.2 Otherwise

- 1) Evaluate the average stress, σ_{avg} , at planes normal to the joint members at the toe of the weld.*
- 2) Calculate the cross sectional area of the member, A_{member} .*
- 3) Calculate the average force in the joint, $F_{avg} = \sigma_{avg} \times A_{member}$.*

- 4) Calculate the cross sectional area of the weld throat (the shortest distance through the weld), A_{weld} .
- 5) Calculate the stress in the weld, $\sigma_{weld} = K_f \times F_{avg} / A_{weld}$, where K_f is in accordance with Tables 5.11 and 5.12 from ASME Boiler and Pressure Vessel Code Section VIII, Division 2, Part 5.

3 MATERIALS AND WORKMANSHIP

3.1 Turbine and Generator Materials

The turbine and generator components shall be manufactured from the materials listed in the following table or from equivalent materials as approved in writing by the Engineer.

Material Specifications for Hydraulic Turbines and Generators Systems

Component	Material	Standard
Discharge ring assembly	Stainless steel plate	ASTM A240 Type 304(L)
Runner blades	Stainless steel	ASTM A743 Grade CA-6NM
Wicket gate stem sleeves Operating mechanism pins	Stainless steel	ASTM A747 Grade CB7Cu-1 H900
Main shaft seal sleeve	Stainless steel	Centrifugally Cast ASTM A743 Grade CA6NM
Turbine guide bearing	Shell - cast steel Shell - steel plate Lining - babbitt	ASTM A27 ASTM A516 ASTM B23 Alloy No. 2
Wicket gate bushings	Self-lubricating	DEVA Metal (Must be used on lower wicket gate bushings) DEVA BM
Operating mechanism bushings, servomotor bushings, head cover sliders (for operating ring)	Self-lubricating	DEVA BM, Orkot TLMM Orkot TXMM
Draft Tube Bulkhead Dome, Runner & Main Shaft Supports, Sump tank and miscellaneous fabrications	Plate steel/bar	ASTM A36
Operating ring sliders	Stainless Steel	ASTM A693 type 630

Component	Material	Standard
		Condition H900
Draft tube liner	Steel Plate Stainless steel plate	ASTM A36 ASTM A240 Type 304(L)
Stay ring assembly Bottom ring Outer head cover Inner head cover Wicket gates Runner hub Operating Ring Accumulator tanks and wicket gate servomotors	Cast steel Steel Plate	ASTM A216 ASTM A516
Main Shaft and Miscellaneous, forgings	Forged steel	ASTM A668 Class D
Generator Structural Components: Less than 4 inches thick Greater than or equal to 4 inches thick	Steel Plate Steel Plate	ASTM A36 ASTM A516
Core Steel	Laminations	ASTM A677
Generator Bearing Oil Cooler Tubes: Inner Tube	Copper Nickel Tubing	UNS C70600
Surface Air Cooler Tubes	Copper Nickel Tubing	UNS C70600
Surface Air Cooler Tube Sheet	Stainless Steel Plate	ASTM A240 Type 316
Surface Air Cooler Water Box	Steel Plate	ASTM A516
Surface Air Cooler External Frames and Supports	Steel Structural Shapes	ASTM A36
Generator Brake Air/Oil and Shaft Seal Water Supply Piping	Stainless Steel Tubing	ASTM A 269
Piezometric Piping	Stainless Steel Tubing	ASTM A 269
Oil Piping: 50 mm and smaller Larger than 50 mm	Stainless steel Piping Steel Piping	ASTM A 312 ASTM A53 Grade B
Compressed Air Piping: Less than 25 mm 25 mm and Above	Stainless Steel Tubing Steel Piping	ASTM A 269 ASTM A53 Grade B
Water Piping:		

Component	Material	Standard
Surface air cooler Bearing Cooling Water, Fire Protection water, Head cover Dewatering	Steel Piping	ASTM A53 Grade B
Field Coil, Rotor pole to pole connections, Rotor bus bar	Copper	UNS C11000 (ETP), H04 (Hard) as per ASTM B-187
Bearing Babbitt	Babbitt	ASTM B23, Alloy 2
Thrust and Guide Bearing Backing Plates	Steel	ASTM A516
Rotor Pole Keys	Steel	Annealed AISI 1018 or 1020
Fasteners for copper-to- copper connections: e.g. main and neutral leads, excitation leads, rotor bus and horseshoes, amortisseur links	Silicon bronze or stainless steel	

3.2 Material Requirements

The Contractor shall supply mill test certificates for *all components listed in Subsection 3.1 Turbine and Generator Materials, except piping*, to the Engineer. *The requirements for documenting the material properties of the piping are covered in the Manitoba Department of Labour Technical Bulletin 96-001 and ANSI B31.1 Power Piping Code.*

Materials *for all components listed in Subsection 3.1 Turbine and Generator Materials, except piping*, shall demonstrate notch toughness according to the following table:

Allowable Charpy Impact Values					
Carbon Steel, Austenitic Stainless Steel			Martensitic Stainless Steel (CA6-NM Only)		
T < 19.1mm	19.1mm ≤ T < 38.1 mm	T ≤ 38.1 mm	T < 19.1 mm	19.1mm ≤ T < 38.1 mm	T ≤ 38.1 mm
27	27	40	27	40	40

Note: In the above table, T is the material thickness.

Values specified in the above table are the average of 3 Charpy Impact tests. Where 27 Joules is specified, the minimum value for one specimen shall be 21.6 Joules. Where 40 Joules is specified, the minimum value for one specimen shall be 34 Joules.

All Charpy V-Notch toughness testing shall be in accordance with ASTM A370. All toughness testing documentation shall be in metric units, referenced to 0°C.

Materials and products shall not contain environmentally hazardous substances such as mercury, cadmium, asbestos, or PCBs and shall be tested to ensure they are not radioactive.

All austenitic stainless steels shall have less than 3% (maximum reading) delta ferrite measured at the surface of the plate, and less than 6% delta ferrite measured at the mid-plane (center of thickness) of the plate. The tests shall be conducted using a Fischer Ferrite Scope, Model MP30. A minimum of ten measurements shall be taken on each side of the plate and three measurements taken at the mid-plane. The mid-plane sample must be taken a minimum of 50mm from any edge. Test results shall be provided to the Engineer for each batch (heat run) of austenitic stainless steel used.

3.3 Additional Material Testing Program

3.3.1 General

For each turbine and generator, the Contractor shall provide sample coupons of the raw materials to the Engineer for independent lab testing by the Purchaser to verify the material properties.

3.3.2 Materials Laboratory

The Purchaser shall retain the services of an independent materials laboratory that is mutually acceptable to both the Purchaser and the Contractor.

3.3.3 Required Tests

The following table lists the tests to be performed, on each thickness of plate to be used to fabricate the components listed in Subsection 3.3.4 Components to be Tested of the Technical Requirements, along with the number of samples and the dimensions of the coupons.

Test	Number of Coupons	Coupon Size
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Chemical Analysis	1	25 mm by 25 mm
Tensile	2	230 mm by 50 mm
Charpy Impact	3	55 mm by 10 mm
Radiographic Contamination	1	25 mm by 25 mm

The equipment used to test the coupons shall have been calibrated within one year of the testing.

The test coupons shall be marked with the rolling direction and the component it was to be used in at the time of the coupon collection. The coupon shall be oriented so the rolling direction is along the longest axis.

3.3.4 Components to be Tested

The following components will be tested:

- 1) Bottom ring
- 2) Discharge ring
- 3) Stay vanes
- 4) Stay ring
- 5) Outer and inner head covers
- 6) Wicket gates
- 7) Lower bracket
- 8) Upper bracket
- 9) Stator frame
- 10) Rotor spider
- 11) Guide and thrust bearings pads
- 12) Bearing housings (if not on one of the above components)

The following fasteners shall be supplied for testing:

- 13) One runner to turbine shaft fastener
- 14) One turbine to generator shaft fastener
- 15) One generator shaft to thrust block/rotor fastener
- 16) Five outer head cover to stay ring flange fasteners
- 17) Five intermediate to outer head cover fasteners
- 18) Five runner blade to hub fasteners (if applicable).

3.3.5 Results of Test

Any material that does not meet the material requirements set out in the Technical Requirements shall not be used. The Contractor shall supply additional test samples in accordance with the Technical Requirements for any replacement material.

3.4 Material & Workmanship Standards

The Engineer will be the sole judge of materials and workmanship furnished and supplied by the Contractor. No patching, plugging, shimming or other such means to overcome defects, discrepancies or errors shall be employed without the prior written approval of the Engineer. Failure to comply with this requirement shall constitute grounds for rejection of the part or component in question.

The design, fabrication, heat treatment, inspection and certification shall comply with the requirements of the applicable ASTM standards, design codes and specifications referenced herein and where applicable, those of the Province of Manitoba Department of Labour.

As a minimum requirement, the Work shall be carried out in accordance with CSA Standards B97.1 "Standard Tolerances for Linear Dimensions"; B97.2 "Interpretation of Limits and Tolerances"; and B97.3 "Standard Fits for Mating Parts", or approved equivalent series of standards.

Screws, bolts, studs, nuts and other fasteners shall be in accordance with ANSI/ASME *B1.13M* or approved equivalent.

Pressure vessels shall be to AMSE Section VIII Division I - Rules for Construction of Pressure Vessels.

Equipment shall be the most recent proven design and no products shall be supplied that are at the end of their useful product life cycle.

3.5 Castings

3.5.1 General

All castings shall be tested for chemical composition and physical properties. The chemical analysis shall be taken at 6 mm beneath the casting surface.

All joints shall be machined; all bolt head and nut locations shall be spot or back faced and castings shall be machined on any part which acts as a bearing surface. The surfaces of castings which do not undergo machining shall be free from foundry irregularities, such as projections, ridges, hollows, honeycombing, pock marks, chip marks or entrapped sand.

The moulds and casting practice shall provide proper ventilation and shall be designed to minimize the occurrence of high stresses and defects caused by air entrapment in the mould or the adverse effect of chills.

Test coupons from which test specimens are prepared shall be attached to all castings weighing 250 kg or more. The number, size and location of the test coupons shall be made acceptable to the Engineer. Heat numbers shall be permanently applied to all castings for reference.

All castings require physical tests and Charpy V notch impact tests as specified in ASTM A370 and Subsection 3.2 Material Requirements of the Technical Requirements. Before proceeding with the first casting pour, the location and number of coupons to be used for testing shall be specified by the Contractor on its casting drawings and approved by the Engineer. Coupons for Charpy V notch impact testing shall be supplied in the normalized or normalized and tempered condition. Where special heat treatment cycles are required to maintain mechanical properties, the applicable ASTM specification shall be followed.

All castings shall conform to the general requirements of ASTM 703 and the applicable material specification, including supplements S5 Radiographic Inspection, S12 "Prior approval of major weld repairs", S18 "Additional tension tests when applicable" and S20 "Weld repair charts".

ASTM A216 castings shall:

- 1) Have a carbon equivalent less than 0.45%.
- 2) Receive a 150 °C preheat, for weld repairs, when the material carbon equivalent exceeds 0.37%.

3.5.2 Repair of Castings

Ferrous castings may be repaired by welding. *All casting weld repairs shall be in accordance with the Technical Requirements.*

A defect shall be defined as injurious if:

- 1) *It is classified as major as defined by the applicable ASTM material stand, or*
- 2) *Its presence impairs the resulting stress concentration factor causes the stress to exceed 80% of the stress allowed in Subsection 2.3 Allowable Stresses of the Technical Requirements, or*
- 3) *Its presence affects machinability or causes a contour variation on the turbine runner greater than that specified in Subsection 5.11.4 Waviness of the Technical Requirements, or*
- 4) *It is linear*

All injurious defects shall be completely removed to sound metal and repairs carried out.

Bridging of unsuitable material will not be accepted. If the Contractor submits proof in writing for the Engineer's review that such defects may be acceptable as is, or successfully repaired, then due consideration will be given.

Major defects shall be repaired in the foundry prior to final stress relieving of the casting. *For carbon steel castings, weld repairs* in excess of those permitted by the applicable ASTM *material* standard **shall be completed prior to the final** stress relieving.

All indications shall be mapped and a report presented to the Engineer for review. Repairs shall be in accordance with the applicable ASTM specification. All repairs in critical areas, regardless of size, shall receive post weld heat treatment. The Purchaser defines critical areas as those where the stress is equal to or greater than 80% of the normal load stress defined in Subsection 2.3 Allowable Stresses of the Technical Requirements.

Removal of *defects* by thermal methods (arc air gouging for example) is only permitted with approval of the Engineer. This consideration shall only be with a detailed procedure that includes:

- 1) Preheating of the materials, and
- 2) Grinding technique of the removed areas to assure removal of carbon residue.

3.5.3 Non-Destructive Testing (NDT)

Castings shall be inspected by the following non-destructive testing methods as specified herein or whenever the QAR considers the quality of a casting to be questionable.

Prior to non-destructive testing, the surfaces to be inspected shall be cleaned and prepared to ensure that the non-destructive testing inspection is thorough and permits precise interpretation.

Castings showing evidence of injurious defects ***which cannot be repaired or which may create a significant risk to the project if a repair is attempted*** may be rejected by the Engineer.

a) For Surface Defects

A magnetic particle examination shall be conducted in accordance with ASTM E709. ***A casting shall be acceptable if it is*** free from injurious defects as defined in Subsection 3.5.2 Repair of Castings of the Technical Requirements.

An inspection shall be performed on the full runner blade and hub surfaces. Before inspection, the fillet area between the hub and blade shall be ***machined***.

The limit of this *machined* area shall be the tangent point of the fillet radius with the blade and hub.

b) For Subsurface Defects

All castings shall be Radiographic Inspected (RT) in the areas where the stresses exceed 80% of the stress allowed in Subsection 2.3 Allowable Stresses of the Technical Requirements. Only high contrast fine-grained film shall be used. RT operators shall be qualified to CSA W178.2 Level II.

The acceptance criteria for indications found during the radiographic inspection are summarized in the following table, *referenced to the applicable ASTM standard (E446, E186 or E280)*:

Category	Severity Level
A (Gas Porosity)	2
B (Sand and Slag Inclusions)	2
C (Shrinkage)	Type 1 : 3 Type 2 : 3 Type 3 : 3
D (Crack)	Not Permitted
E (Hot Tear)	Not Permitted
F (Insert)	Not Permitted

All repairs of injurious subsurface defects shall be inspected by RT.

Other methods of testing may be used only with the written approval of the Engineer.

3.6 Forgings

Forgings shall be free from all defects affecting their strength and durability, including seams, pipes, flaws, cracks, scales, fins, porosity, hard spots, excessive non-metallic inclusions and segregation.

Large fillets compatible with the design shall be incorporated wherever a change in section occurs. Tool marks or tearing of the metal by the finishing tool will not be permitted on the surface of fillets. All finished surfaces of forgings shall be smooth and free from tool marks.

The forgings shall be clearly stamped with the heat number. The forging for highly stressed shafts shall be examined by ultrasonic inspection.

3.7 Plate and Structural Steel

Plates and structural steel subject to tensile stress and/or fatigue and greater than 19 mm thick shall be normalized.

These material suppliers shall have material identification/verification programs registered to CAN/SCA-ISO 9001-08 or Engineer's approved equivalent.

3.8 Welding

Welding shall be in accordance with the Purchaser's welding standard included in Appendix K.

3.9 Stress Relief

All cast and fabricated components that require machining, after casting or fabricating, shall be stress relieved. ***The Purchaser may waive this requirement on components where the Contractor demonstrates that:***

- a) ***Features have been designed into the component that prevents the distortion that occurs during machining from negatively impacting the performance of the component, or***
- b) ***The distortion that occurs will not be detrimental to the performance of the component.***

The performance of the component includes its ability to be assembled with other components.

Stress relief cycles shall be in accordance with ASME Section VIII Division I UCS 56.

Vibratory stress relief (VSR), shall not be used without the written approval of Manitoba Hydro. The Contractor shall follow the procedures recommended by the VSR equipment manufacturer.

All fabrications containing butt weld thicknesses or fillet weld leg lengths greater than 50 mm shall be stress relieved.

Copies of the stress relief time versus temperature plots ***shall*** be submitted to the Engineer for review.

3.10 Piping and Tubing

The Contractor shall design, supply and install all piping systems for the generator and turbine. All piping systems shall be designed, supplied and installed

in accordance with the Manitoba Department of Labour Technical Bulletin 96-001 and ANSI B31.1 Power Piping Code.

All piping shall have either welded fittings with SAE o-ring flanges or mechanical groove type couplings, “Victaulic” or Purchaser’s approved equivalent, to provide ease of installation and removal for maintenance. Connections relying on the threads for sealing shall not be used.

All tube fittings shall be double ferrule, compression type, “Swagelok” or Purchaser’s approved equivalent. Workers installing tube fittings will have successfully completed installation training provided by the tube fitting manufacturer.

Tube and pipe fittings to be used on stainless steel pipe or tube shall be stainless steel. Tube and pipe fittings to be used on copper pipe or tube shall be brass. Tube and pipe fittings to be used on steel pipe or tube shall be steel.

All isolation valves on lines less than or equal to 102 mm in diameter shall be ball type. All isolation valves on lines greater than 102 mm shall be flanged butterfly type.

All liquid piping runs shall be sized so that the maximum flow velocity is 3 m/s or less unless otherwise noted.

All water piping lines shall include a galvanic insulator fitting at any point where there is a change in the piping material.

Piping systems shall include vent valves at high points as necessary for air purging.

The interior of all piping assemblies shall be cleaned of all foreign material prior to installation.

3.11 Babbitt Bearings

The babbitt material requirements are listed in subsection 2.1 Turbine and Generator Materials of the Technical Requirements. Only virgin babbitt shall be used. The babbitt shall be metallurgically bonded to the steel shells or pads.

Babbitt surfaces shall be machined to have a surface finish of **0.8** µm or better.

3.11.1 Inspection

- 1) The babbitt bond and surface shall be 100% inspected to verify that the acceptance criteria as defined in Subsection 3.11.2 Acceptance Criteria of the Technical Requirements have been met.
- 2) The babbitt surfaces shall be fully machined prior to inspection.
- 3) The babbitt bond shall be tested by ultrasonic inspection and the babbitt surface shall be tested by liquid penetrant inspection.
- 4) The results of the tests, including a map of each bearing surface showing areas of lack of bond and/or surface porosity, shall be reported to the Engineer for review and acceptance prior to shipping the bearings.
- 5) Testing inspectors shall be certified in accordance with CGSB 48.9712, or ISO 9712, Level II or III.
- 6) Ultrasonic bond inspection shall be conducted with a single crystal probe, 10 to 30 mm in diameter at a frequency of 2 to 5 MHz and in accordance with ISO 4386-1, class 3.
- 7) Liquid penetrant surface inspection shall be conducted in accordance with ISO 4386-3.
- 8) The Purchaser reserves the right to witness any testing performed by the Contractor's inspector, or to perform independent testing at the Contractor's facility. Any independent testing inspector will be qualified to CGSB 48.9712, or ISO 9712, Level II or III, and shall determine acceptance or rejection.

3.11.2 Acceptance Criteria

a) **Babbitt Bond**

The babbitt bond shall be acceptable if the following two (2) criteria are satisfied:

- 1) A 40 mm zone from any exposed babbitt-to-shell shall conform to ISO 4386-1 Defect Group A. This includes holes, ports, grooves, etc.
- 2) The remainder of the babbitt area shall conform to ISO 4386-1 Defect Group B1.

b) **Babbitt Surface**

The babbitt surface shall be acceptable if the entire surface conforms to ISO 4386-3, Class C.

3.12 Protective Coatings

3.12.1 General

The generator and turbine shall be prepared and coated as per the following:

Machined steel surfaces shall be protected from corrosion during transport and handling with a liberal coat of Valvoline TECTYL #506 or Houghton Rust Veto 344 rust preventative coatings or Purchaser's approved equivalent.

The Contractor shall provide the Purchaser with three 4 litre cans of each colour and type of paint for touch ups after the Work is complete. The paint shall be fully mixed and include all the necessary tints.

3.12.2 Surface Preparation

a) General

Surfaces to be painted shall be properly prepared by the Contractor and shall be dry and suitable for finishing before painting is commenced.

Care shall be taken to protect machined surfaces, machinery, bearings and other equipment from sand, paint solvent, dust, rust and grit.

Prepared surfaces shall be kept under cover in a heated area and shall not under any circumstances be exposed to the weather. If rusting has occurred on any prepared surface prior to application of the coating, the Contractor shall re-clean the surface.

Prepared surfaces shall be coated within 24 hours of cleaning.

b) Blast Cleaning

Heavy deposits of oil or grease shall be removed by solvent prior to blast cleaning. Small quantities of oil or grease may be removed by the blasting process, in which case, however, the abrasive shall not be re-used.

c) Power Tool Cleaning

The Contractor shall prepare metal surfaces for coating systems which require power tool cleaning, in accordance with the following requirements:

All deposits of oil, grease, welding flux residues and salts, shall first be removed in accordance with Steel Structures Painting Council Specification SP1 "Solvent Cleaning". Power tool cleaning shall be carried out in accordance with SSPC Specification SP3 "Power Tool Cleaning".

Edges of existing coated surfaces shall be feathered into the prepared surfaces. All welds, torch-cut surfaces, or other mechanical damage shall be ground smooth and weld splatter removed before surface preparation commences.

d) Hand Tool Cleaning

The Contractor may omit power tool cleaning on certain metal surfaces where, in the Engineer's opinion, power tool cleaning is not warranted or cannot be effectively performed. In such areas scale, flux, rust, burnt or damaged paint and other foreign matter shall be completely removed by hand tool cleaning in accordance with SSPC-SP2.

The Contractor shall clean previously coated surfaces of oil, debris and other foreign matter prior to applying subsequent coats.

3.12.3 Protection

Masking shall be used to prevent over-spray and to protect finished surfaces adjacent to areas being prepared or coated.

The Contractor shall remove surface fittings, hardware, electrical fixtures, door knobs, labels and electrical cover plates, during surface preparation and shall store and reinstall such items at the completion of the Work.

Machined metal surfaces shall be protected with a light coat of TECTYL #506 Rust Preventive prior to long-term storage or shipping.

3.12.4 Application and Workmanship

a) General

Surfaces to be coated shall be completely dry and shall be at a minimum temperature of 10°C and at least 3°C above the dew point of the surrounding air.

Newly cleaned or coated surfaces shall be protected from moisture, condensation, contamination and freezing temperatures until the coating is thoroughly cured. Care shall be taken to prevent contamination of surfaces between coats.

Written instructions from the coating manufacturer shall be submitted to the Engineer for review and shall be followed in conjunction with the requirements specified herein. Thinners shall not be added to any coating except as recommended by the coating manufacturer. Each coat shall be thoroughly cured in accordance with the manufacturer's instructions before application of subsequent coats.

Galvanized surface coatings that are damaged or modified during the course of the Work shall be repaired with two coats of a high zinc content spray paint.

b) Curing and Film Thickness

Curing schedules as recommended by the coating manufacturers shall be followed for each coating.

Parts shall be cured to "Hard Dry" before handling. If parts must be removed before they are fully cured, care shall be taken to ensure the coating is not damaged.

No portion of the coating film shall be less than the design film thicknesses. Film thickness shall not be so great that either the appearance, curing or service life of the paint will be detrimentally affected. In order to ensure that proper dry film thickness is being attained, the wet film thickness shall be checked at the time the coating is being applied.

c) Inspection

Coatings shall not be applied until the surface preparation has been inspected and approved by the Engineer.

The coated surface will be rejected if any of the following defects are apparent to the Engineer:

- 1) Runs, sags, holidays or shadowing caused by inefficient application methods,
- 2) Evidence of poor coverage at plate lap joints, crevices, pockets, corners and re-entrant angles, and
- 3) Damage to coating because of handling before the paint is sufficiently cured, or any other contributory causes.

Cleaned and/or coated surfaces rejected by the Engineer shall be re-cleaned and/or re-coated by the Contractor. Small affected areas may be touched up. Large affected areas shall require the application of another complete coat. Runs, sags, or coating damaged in handling shall be removed prior to further applications.

d) Field Coating

If the Contractor does not exercise sufficient care in protecting coated surfaces during shipment, and damage to the coating is considered by the Engineer to be excessive, the Contractor shall bear the cost of repairing the coatings.

e) Workmanship

Material shall be evenly applied, well brushed out, so as to be uniform, free of runs, sags, crawls, with clean corners and minimum of brush marks. Finishes shall be uniform as to sheen, colour and texture, even and smooth.

Factory finished materials such as baked enamel, chrome plating, stainless steel, bronze, copper, brass, aluminum, door and cabinet hardware, pre-finished metals, laminated plastics, acrylics, latex rubber, fiberglass, open or louvered electrical cable trays, labels, nameplates, faying surfaces or spotfaces for fasteners, shall not be painted unless otherwise directed by the Engineer.

3.12.5 Colour Schedule

Colours of all paints and materials used shall conform to the Colour Schedule below. All piping shall be colour coded as per the list appearing at the end of Table P2. In addition, insulated pipes shall have a 100 mm wide colour band applied at intervals not greater than 3m or as otherwise directed by the Engineer. In the event that an item requiring paint is not listed in Table P2, the Contractor shall request clarification from the Engineer.

3.12.6 Paint and Materials

- a) Coating Systems
Coating systems shall be in accordance with Table P-1.

Table P-1-Coating Systems

Coating System	S - 1	S - 2	S - 3
Coating System Type	Industrial Equipment Enamel	2-Part Epoxy (Water Immersion)	2-Part Epoxy (Oil Immersion)
Service Type	Indoor exposure, generator components, etc.	All turbine components and embedded parts not subject to oil immersion	Tank and gearbox interior linings, etc. subject to oil immersion
Surface Preparation	Blast cleaning to SSPC SP-6 "Commercial Blast Cleaning"	Blast cleaning to SSPC SP-10 "Near White Metal"	Blast cleaning to SSPC SP-10 "Near White Metal"
Re-Preparation, If Coating Delayed	Blast cleaning to SSPC SP-6 "Commercial Blast Cleaning" or Solvent Cleaning to SSPC SP-1 or Power Tool Cleaning to SSPC SP-2 or SP-3 as directed	Blast cleaning to SSPC SP-10 "Near White Metal" or Solvent Cleaning to SSPC SP-1 or Power Tool Cleaning to SSPC SP-2 or SP-3 as directed	Blast cleaning to SSPC SP-10 "Near White Metal" or Solvent Cleaning to SSPC SP-1 or Power Tool Cleaning to SSPC SP-2 or SP-3 as directed

Coating System	S - 1	S - 2	S - 3
Approved Primers	One coat, minimum dry film thickness 1.5 - 2.0 mils Cloverdale Paint Grey Rustex Primer No. 71024. General Paint Universal Grey Primer 06164 International Paint Grey Primer Interprime 198 CPA098	None	None
Approved Finish Coats	Two coats, minimum dry film thickness 1.25 - 1.75 mils / coat Cloverdale Paint Industrial Enamel No. 74 General Paint Industrial Enamel No. 16 International Paint Interlac 665FD Industrial Enamel	Two coats, minimum dry film thickness 5.0 - 8.0 mils / coat Cloverdale Paint ClovaMastic Epoxy 83110 Ameron Amerlock 2 Epoxy International Paint Interseal 670HS Epoxy	Two coats, minimum dry film thickness 5.0 - 7.0 mils / coat Cloverdale Paint Enviroline 375 Ameron Amercoat 90HS Epoxy International Paint Interline 850 Epoxy

Table P-2: Color Schedule

Item	Coating System	Finish Color Coat
Generator Covers	S-1	Grey
Air Intake Baffles	S-1	Grey
Generator Brackets	S-1	Grey
Exciter Housing	S-1	Grey
Exciter Cone	S-1	Grey
SAC Supports	S-1	Grey
Rotor Spider	S-1	Grey
Stator Frame & Supports	S-1	Grey
Stator Air Box Covers	S-1	Grey
PMG	S-1	Grey
Brush Gear Support	S-1	Grey
Bearing Oil Sump Interior	S-3	White
Stay Ring (Dry Side)	S-2	Grey
Stay Ring (Wet Side)	S-2	White

Item	Coating System	Finish Color Coat
Head Covers (Dry Side)	S-2	Grey
Head Covers (Wet Side)	S-2	White
Runner Hub & Cone	S-2	White
Operating Ring	S-2	Yellow
Links & Levers	S-2	Yellow
Servomotors	S-2	Yellow
Connecting Links	S-2	Yellow
Bearing Shell Exterior	S-2	Grey
Governor Tanks (Air, Exterior)	S-1	Grey
Governor Tanks (Air, Interior)	S-2	White
Governor Tanks (Oil, Exterior)	S-1	Grey
Governor Tanks (Oil, Interior)	S-3	White
Water Passage Doors	S-2	Grey
Wicket Gates	S-2	White
Special Tools	S-1	Yellow
Air Piping Systems	S-1	Blue
Water Piping Systems	S-1	Green
Fire Protection Piping Systems	S-1	Red
Oil Piping Systems	S-1	Purple

* COLOR CODES:

White	– RAL 9003
Green	– RAL 6032
Grey	– RAL 7042
Blue	– RAL 5015
Red	– RAL 3020
Purple	– RAL 4006
Yellow	– RAL 1023

3.12.7 Control Panels

Control panels shall be powder coated ANSI 61 Grey.

3.12.8 Stator Winding and Rotor Pole Painting

The stator circuit ring bus, upper and lower end windings and jumpers shall be painted with *two coats of* buff epoxy paint, Glyptal #74004 and catalyst #74010

or Purchaser approved equal. The air gap face of the stator core shall remain unpainted.

The entire completed rotor field pole assembly shall be painted with one light coat of buff epoxy paint, Glyptal #74004 and Catalyst #74010 or Purchaser approved equal. The rear of the pole body and dovetail/key area shall not be painted.

4 GENERAL TURBINE AND GENERATOR REQUIREMENTS

4.1 General

The Keeyask Generating Station shall be designed to operate unmanned from the Purchaser's System Control Centre but shall be capable of local control.

Each Unit shall be capable of operation as a synchronous condenser with the wicket gates closed and the water in the draft tube depressed past the bottom of the runner cone. This capability may be required in the future if a tailwater depression system is installed.

4.2 Powerhouse Crane

The Purchaser desires to limit the overall height of the powerhouse and the capacity of the crane. Headroom required for erecting or dismantling the generator shall not exceed the headroom required for erecting or dismantling the turbine runner and shaft.

4.3 Turbine and Generator Shafts

The turbine and generator shafts shall be forged and shall come complete with, at a minimum, the following features:

- 1) Designed to operate continuously at any speed, up to and including full runaway speed, without detrimental vibration or distortion, and to withstand full load when operating at full gate output without exceeding normal design stresses.
- 2) Designed in accordance ANSI/IEEE Standard 810-1987 (R 2001).
- 3) Have a fully machined outer surface and hollow bored (not honed) to at least a 150 mm diameter and finished to allow a thorough inspection of the shafts to be performed.
- 4) A stainless steel shaft seal sleeve on the turbine shaft with a minimum thickness of 35 mm which is bolted and doweled to prevent movement between the two halves of the sleeve. Material requirements for the shaft sleeve are set out in Subsection 3.1 Turbine and Generator Materials of the Technical Requirements.

- 5) Two sets of nut guards for coupling between the generator and turbine shafts.
- 6) Jacking screws in the flanges for breaking the joints between the runner and turbine shaft and the generator and turbine shafts.
- 7) Integrally-forged coupling flanges for connection of the shafts and runner.

Material requirements for the turbine and generator shaft are set out in Subsection 3.1 Turbine and Generator Materials of the Technical Requirements.

The turbine shaft shall incorporate an accurately machined integral boss from which to support the generator shaft, turbine shaft and runner on the head cover during initial erection and subsequent maintenance.

Positive locking methods shall be used for locking the coupling bolts and nuts in position.

The generator shaft shall be equipped with a target that facilitates “keyphasor” measurement compatible with the Purchaser’s vibration monitoring equipment

4.4 Lubricating Oil

Oil for the generator guide bearing(s), turbine guide bearing, thrust bearing and governor shall be the same brand, type, grade and viscosity. The brand shall be Esso. The Contractor shall recommend the lubricating oil type, grade and viscosity. The Contractor shall supply the lubricating oil.

4.5 Self Lubricating Material

Where the application of self lubricating materials is required, said materials shall not be glued. All self lubricating sliders shall be secured via mechanical fasteners. Self lubricating bushings shall be installed with an interference fit, as specified by the bushing supplier, for the given application.

4.6 Auxiliary Electric Motors

Auxiliary electric motors shall be unmodified and according to EEMAC Standard M1. Auxiliary motor insulation shall be Class F but operated at Class B temperature rise according to NEMA standard MG 1 for a maximum 40°C ambient temperature. Motors shall be rated for 1.15 service factor and continuous duty. Unless otherwise specified, motors shall be totally-enclosed fan-cooled frame type.

Motors shall have factory sealed and lubricated, anti-friction type bearings designed for horizontal installation with direct coupling to the shaft. The insulation shall be of the sealed type using non-hygroscopic materials unaffected

by moisture or petroleum products. The internal parts shall be protected with a double application of an epoxy coating.

Motor systems that reduce energy consumption without compromising reliability or increasing maintenance costs shall be used.

During load rejection the motors will be subjected to line frequencies up to 140% of rated. Motors and their connected loads shall safely withstand the overspeed. Overheat trip protection shall be provided.

All auxiliary electric motors greater than $\frac{3}{4}$ hp shall be 600 V, 3 phase.

4.7 Vibration Monitoring and Air Gap Monitoring Detectors

The Contractor shall make provision for the mounting of the following items:

- 1) Four proximity probes, 90° apart, on each guide bearing
- 2) One accelerometer, mounted axially, on the headcover
- 3) One accelerometer, mounted axially, on the thrust bearing (absolute vibration)
- 4) One proximity probe on the thrust bearing (axial displacement)
- 5) One keyphasor sensor mounted against generator shaft
- 6) One velocimeter for stator core vibration
- 7) Eight air gap sensors

The Purchaser shall supply:

- 8) Sensors and intermediate converters (linearization modules)
- 9) Cables
- 10) Vibration monitoring equipment located outside of the generator enclosure.
- 11) Air gap monitoring equipment located outside of the generator enclosure.

The Contractor shall:

- 12) Install the sensors and associated intermediate converters (linearization modules)
- 13) Supply and install a termination panel on the exterior wall of the generator enclosure at a point convenient for the Purchaser to route cables to its vibration monitoring cubicle.
- 14) Supply and install the conduit system from the sensors to the termination panel on the exterior wall of the generator enclosure.
- 15) Connect and route the cables from the sensors to the termination panel.

- 16) Show all cable routing and conduit system details for vibration and air gap monitoring cables inside the generator enclosure on the Contractor's drawings.

4.8 Lighting, Convenience Receptacles and Panelboards

The Contractor shall supply and install lighting, convenience receptacles and panelboards.

Lighting fixtures shall be:

- 1) Compact fluorescent type
- 2) Cast aluminum base suitable for vertical or horizontal mounting.
- 3) Lenses shall be clear, smooth exterior, polycarbonate or tempered glass.
- 4) Rated vapour-tight for damp location (includes gaskets) even if in dry location. This is necessary to prevent insects from getting behind the lenses.
- 5) CSA rated
- 6) Medium base 120 V screw type

Light switches shall be commercial specification grade.

There shall be sufficient lighting fixtures to achieve the illuminance levels listed below:

Location	Illuminance (Lux)
Generator enclosure floor	50
Generator pit walls (under rotor)	50
Turbine pit floor <i>and stairwell</i>	200
Turbine bearing well	200
Collector housing brushgear	300

The Purchaser shall provide recesses in the concrete so that the light fixtures are flush with the concrete wall. The top, bottom and sides of the recesses shall be at 45 degrees to reflect and diffuse the light.

The turbine bearing well and collector housing light fixtures shall be the "Jam Jar" type with clear, prismatic, smooth exterior, tempered glass lenses and protective metal grilles. Fixtures shall include a heavy cast aluminum base with a gasket to prevent moisture and dirt ingress. Bulb sockets shall be porcelain. The fixtures shall be CSA rated for a minimum 150 W incandescent bulb and shall be suitable for vertical or horizontal mounting.

Convenience receptacles shall be as follows:

- 7) Commercial specification grade
- 8) Duplex receptacles 20A, GFCI type with a metal cover plate.
- 9) Not less than four (4) duplex receptacles on two (2) separate circuits in the generator enclosure.
- 10) Not less than eight (8) duplex receptacles on four (4) separate circuits in the turbine pit.
- 11) Not less than two (2) duplex receptacles on one circuit in the collector housing.
- 12) Not less than two (2) duplex receptacles on one circuit in the turbine bearing well.
- 13) One receptacle in each of the turbine instrumentation panel and generator instrumentation panel.

Each turbine and generator shall have a panelboard to supply lighting and receptacles. The panel board shall be:

- 14) Three-phase, 4-wire, 208/120 V ac
- 15) Bolt-in type circuit breakers
- 16) 22,000 A interrupting capacity.
- 17) Mains sized to provide additional 20% load capacity for future use.
- 18) Include provision for 20% additional space.

4.9 Special Tools and Lifting Devices

The Contractor shall provide a complete set of special tools, jacks, lifting devices, special slings, and other necessary equipment to dismantle and assemble the turbines and generators for maintenance.

All “below the hook lifting devices shall be constructed in accordance with CSA S16.1-01 and welded in accordance with CSA W59-03 by a shop certified in accordance with CSA W47.1 division 1 or 2.

The following information will be included on all lifting device drawings:

- 1) Rated load
- 2) Factor of safety
- 3) Workmanship requirements
- 4) Material requirements
- 5) Paint requirements
- 6) Marking requirements
- 7) Inspection requirements
- 8) Operation/Lifting instructions

The lifting device for the rotor poles shall:

- 9) be designed to lift the poles from the horizontal position on the floor to a vertical position to be installed in the rotor and vice versa.
- 10) be designed to prevent contact with adjacent poles when installing between two poles.
- 11) Incorporate soft materials to prevent damage to the pole being lifted and any adjacent poles.

In addition the Contractor shall provide the lifting procedures for major turbine and generator components i.e. turbine shaft and runner, generator rotor, head cover, operating ring, bottom ring, stay ring, thrust bearing, rotor poles etc. The lifting procedures will include all required details including, but not limited rating, quantity and length of all slings and hardware.

4.10 Turbine Pit Hoist

The Contractor shall provide a permanent hoisting and conveyance arrangement, capable of accessing and lifting and removing at least the following items from the turbine pit to an area accessible by the powerhouse crane:

- 1) Turbo vent valve
- 2) Wicket gate links and levers
- 3) Servomotors
- 4) Servomotor connecting links
- 5) Turbine bearing
- 6) Head cover dewatering pumps
- 7) Shaft seal components
- 8) All thrust bearing components that can be removed without complete disassembly of the Unit (if the thrust bearing is located on the head cover)

4.11 Walkways, Catwalks, Platforms, Stairs and Ladders

All walkways, stairs, catwalks and platforms shall:

- 1) Be constructed from safety non-slip plank gratings, FISHER & LUDLOW “GripSpan” or Purchaser’s approved equivalent
- 2) Be designed for a minimum live load of 4.8 kPa in combination with any point load that could be expected during regular maintenance and operations.
- 3) Include kick plates that are a minimum 125 mm high.

Walkways and catwalks shall have a minimum width of 800 mm.

Stairs shall be designed in accordance with the NBCC.

Ladders shall:

- 4) be the vertical type.
- 5) treads shall be FISHER & LUDLOW "GripSpan" or Purchaser's approved equivalent.
- 6) have vertical grab bars, painted with non-slip paint, separate from the rails.

4.12 Temperature Detection

All resistance temperature detectors shall be three-wire, spring loaded, 100 ohms at 0°C platinum, DIN Class B, with temperature coefficient of 0.00385.

Resistance temperature detectors measuring the temperature of liquids shall be installed in drywells.

Detectors for bearing metal temperature measurement shall be located as close to the babbitt material at the anticipated hot spots as good practice and design will permit.

4.13 Unit Control and Monitoring System

All equipment Input/Output (I/O) shall communicate with the Purchaser's Unit Control and Monitoring System (UCMS).

The UCMS consists of Programmable Logic Controllers (PLCs) and Human Machine Interfaces (HMIs). The PLCs interface with the generating station and Units to gather information and present it to the operator via the HMI on graphical displays. The operator interacts with the displays to monitor and control the generating station. The UCMS provides annunciation, operating & information displays, real-time and historical trending, and HMI, PLC & I/O fault diagnostics.

Communication from the Contractor's equipment to UCMS shall be Ethernet, Modbus, or Purchaser's approved alternative. All communication delays shall be strictly less than 200 milliseconds for all operating conditions with no exceptions. Individual control systems shall be fail-safe and fully functional with loss of UCMS.

Exact communication protocols and medium shall be determined when drawings are submitted for review.

4.14 Power Supply, Fuses and Circuit Breakers

The Purchaser will provide station service electrical power supplies as follows:

4.14.1 ac

- 1) 347/600 Vac, 3 phase 4 wire, 60 Hz, ac, Range $\pm 10\%$
- 2) 120/240 Vac, 1 phase, 60 Hz, ac, Range $\pm 10\%$

The frequency is normally 60 Hz with a range of 50 to 85 Hz under load rejection conditions.

It should be noted that the above ac power supplies may be interrupted momentarily due to automatic transfer of sources. The momentary interruption of the ac supply shall not cause any false operation or indications in the system.

4.14.2 dc

- 1) 125 Vdc (Nominal)
- 2) 104 to 140 Vdc (Range)

Grounding of either terminal of the batteries will not be permitted and filtering shall be provided to prevent any spurious voltage spikes returning to the battery.

Circuit breakers or fuses shall be included in the Contractors equipment to isolate the line side of the Purchaser's ac or dc supplies. Fuses and fuseholders shall be:

- 3) High rupturing capacity (HRC)
- 4) Compact rail-mounted holders
- 5) Finger safe

4.15 Instrument Transformers Supplied by the Purchaser

Instrument transformers supplied by the Purchaser will typically be located in the Purchaser's equipment such as the 13.8kV generator breaker. The voltage transformers will have nominal 120 Vac at 60 Hz, 3-phase, connected in a wye-wye configuration. The current transformers will have a nominal 5 A secondary at full rated input. The current transformers will be connected in a wye configuration with the neutral grounded.

4.16 Contractor's Nameplates

The Contractor shall supply turbine and generator nameplates fabricated from stainless steel plate engraved with black lettering. The plate will give the name and address of the manufacturer, the date of manufacture, and the rating data.

Lamacoid plastic plaques shall identify each cubicle, panel, and terminal box, and each device within. Plaques shall have white letters on a black background, and shall be fastened with screws.

The nameplate and lamacoid information will be finalized by the Purchaser during the drawing review stage.

4.17 Instrumentation Cubicles

Separate instrumentation cubicles shall be provided for the generator system and the turbine system for each Unit.

The generator and turbine instrumentation cubicles shall include a CSA certification label.

The instrumentation cubicles shall be:

- 1) NEMA 12
- 2) 14 gauge steel minimum
- 3) Designed for bottom entry of the Purchaser's cables. Terminal blocks shall be located in such a way that these incoming cables can be terminated neatly and conveniently
- 4) 2300 mm high
- 5) Include doors for convenient access to equipment. Doors shall have 3-point latching mechanism with industrial duty handles with provision for padlocking.
- 6) Include ventilation openings if required to dissipate heat and the ventilation openings shall include filters. Use of fans for ventilation of the cubicles is not acceptable unless approved by the Purchaser.
- 7) Include external ground lug and internal ground bar as listed Subection 4.23 Grounding of the Technical Requirements.
- 8) Include space for the Purchaser's I/O modules to interface signals to the UCMS. Details will be finalized when drawings are submitted for review. Purchaser's supplied I/O modules shall be mounted and wired by the Purchaser.
- 9) Include unused space for the Purchaser to mount future equipment if required. Amount of space shall be 300 mm x 300 mm x 600 mm per cubicle and subject to the Purchaser's approval.
- 10) Include vapor-tight lighting fixture that is 120 V ac and automatically lighted when the cubicle door is opened.
- 11) Include 120 V ac convenience receptacle

All the local controls, displays, gauges, etc. for each system shall be installed into its respective cubicle. The indicating and control devices shall be mounted on the front panels of the cubicles in a symmetrical and convenient manner. The size and type (e.g. digital or analog, etc) of gauges and displays shall be approved by the Purchaser.

PLCs in the control equipment shall be the same brand as the PLCs that the Purchaser is using in the UCMS system (e.g. GE Fanuc at time of execution of the contract).

Instruments within the cubicle shall be readily accessible for adjustment and maintenance through the inspection doors. All devices shall be mounted so as to be readily accessible for maintenance and easily removable should they have to be replaced. Wherever possible, unused areas of the panels shall be kept free of wiring to facilitate the installation of equipment.

The Contractor shall supply all interconnecting cabling, wiring, and piping between the equipment and the instrumentation cubicles.

Wiring for internal lighting and receptacles shall be kept separate from all control wiring in the cubicle. 600Vac circuits shall not be allowed in the instrumentation cubicles.

Instrumentation panels that are located in the turbine pit shall be stainless steel.

4.18 Wire & Cable

a) Wire and Cable Conductor Colour coding:

3-phase power:

A phase – red
B phase – black
C phase – blue

1-phase power:

Line – black
Neutral – white

dc power:

positive – black
negative – white

current transformers:

cable conductors - grey with numbers

b) Wiring in Cubicles and Terminal Boxes

- 1) Wire shall be SIS 600 V, XLPE insulated, FT2 rated, stranded copper equipment wire, colour grey.

- 2) Wire size shall be minimum No. 12 AWG for current transformer circuits, No. 14 AWG for control circuits, and No. 16 AWG for PLC input/output circuits.
- 3) Wiring between devices shall be point-to-point, with no splices or tee connections.
- 4) Not more than two wires shall be connected at any device terminal or terminal block point.
- 5) Wire runs shall be trunked in wiring ducts, or neatly bound in groups and secured to the panel. Anchoring of wiring ducts and wire bundles shall be with mechanical fasteners. Adhesive fasteners are not acceptable.
- 6) The shield drain wire of analog circuit cables shall be routed through its own feed-through terminal block connecting external and internal wiring shields.
- 7) Spare un-used conductors of cables shall be left long enough to reach any terminal block or device in the enclosure
- 8) Unused areas of panels shall be kept free of wiring to facilitate the installation of future equipment.
- 9) Wiring to swing panels and doors shall be extra flexible fine stranded conductor and shall be arranged so that a twisting rather than bending motion is imparted on the conductors when the door is opened.
- 10) Wires shall be marked at both ends according to the wiring diagrams. Markers shall be clearly visible after conductors are terminated.
- 11) Wire markers shall be heat shrink type or approved equal.
- 12) All wiring connections shall be readily accessible and removable for test or other purposes.

c) Terminal Lugs

- 1) All wires shall have crimp-on lugs with only one wire in each lug.
- 2) Ring lugs shall be Burndy Hylug type YAV or approved equal
- 3) Lip-blade (bent tongue) lugs shall be AMP type PIDG or approved equal
- 4) Fork lugs are not permitted
- 5) Screw-down terminals on relays and devices shall use ring lugs.

d) Cables

The Contractor will install the inter-connecting cables and wiring between all supplied equipment.

All cable shall be:

- 1) FT-4 rated
- 2) Armoured if not installed in conduit or tray
- 3) CSA tray-rated if installed in tray.
- 4) Shielded cable shall include drain wires

The following table describes the cable requirements for different circuit uses.

Circuit Use	Description
Lighting, receptacles, heaters, and pumps.	Teck 90 cable or RW90 wire in rigid conduit
Instrumentation, small signals (4-20mA), and PLC digital I/O.	#16 AWG, 600V, 90C, single or multi twisted pairs, instrumentation cable with individual and overall shields, PVC jacket
RTDs	#16 AWG, 600V, 90C, single or multi twisted triad instrumentation cable with individual and overall shields, PVC jacket
Control cable (e.g. 125VDC)	#14 AWG, 600V, 90C, control cable with overall shield, PVC jacket
Current transformers	#12 AWG, 600V, 90C, control cable with overall shield, PVC jacket

4.19 Conduit System

Rigid conduit systems shall be rigid galvanized steel with NPT thread. Short lengths (1 meter) of flexible conduit are permitted to route sensor cable into the rigid conduit system or tray. Cable tray shall be galvanized ventilated type and ladder tray is not allowed. Trays shall include a cover where routed outside the generator enclosure. Armoured cables and rigid conduits shall be mounted using galvanized framing channel and clips. Armoured cables shall be supported at 450mm intervals. Where there are more than 5 cables routed along the same path, the cables shall be routed in cable tray.

4.20 Terminals & Boxes

Terminal and junction boxes shall have:

- 1) NEMA 12 rating
- 2) a hinged door with T-handle or 1/4 turn fasteners
- 3) a inner mounting panel
- 4) an external ground lug for minimum #6 AWG ground wire
- 5) an internal ground bar for shielded cable drain wires
- 6) be stainless steel if located in the turbine pit
- 7) terminal blocks for the connection of the Purchaser's incoming cables.

Terminal blocks shall be:

- 8) Weidmuller type ST5 terminal blocks for all current circuits and include three nuts per stud. The bottom nut tightens against the fixed link, the top two nuts tighten against the ring lug and act as a locking nut. The ST5 blocks shall include a clear plastic cover.
- 9) All terminal blocks other than ST5 shall be specifically designed to hold two lip-blade lugs back to back.
- 10) Spring-loaded screw-clamp terminal block, Entrelec M10/10RS or approved equal, for ac and dc control circuits above 24 V,.
- 11) Test/disconnect type terminal block, Entrelec M6/8/STP or approved equal, for analog and digital circuits.
- 12) Screw-clamp feed-through terminal block, Entrelec M6/8/STP3 or approved equal, for feed-through circuits,.
- 13) Arranged and located for the Purchaser's connections such that the Purchaser's incoming cables can be adequately supported and the individual wires conveniently connected to the terminal blocks.
- 14) Parallel rows of terminal blocks shall be spaced at least 200 mm apart.
- 15) Include terminal block marker labels as shown on wiring drawings using the terminal block manufacturer's labels.
- 16) Include 20% spare terminal blocks suitably distributed throughout the installation

As much as reasonably possible, circuits shall be arranged to avoid groups of ac and dc circuits terminated in the same terminal box. There shall be 50 mm separation on the rail between groups of terminal blocks with different voltages (i.e. 120Vac, 125Vdc, 24Vdc). Low voltage digital and analog circuits and communication circuits shall be adequately separated from control or power circuits in order to avoid interference.

4.21 Control of Hazardous Energy - Lockout and Other Methods

All equipment must follow the CSA standard Z460, "Control of Hazardous Energy - Lockout and Other Methods". Any equipment which is deemed to contain hazardous energy shall be lockable to prevent the unwanted release of that energy during times of maintenance.

The isolation points on such equipment shall incorporate a device which will allow the installation of a key operated padlock to lock the device in the safe condition. The locking device shall be substantial enough to prevent operation of the energy-isolating device without excessive force, unusual measures, or destructive techniques, e.g., bolt cutters or other metal-cutting tools.

The hazardous energy types may include, but are not limited to electrical (30 volts or higher), thermal, chemical, pneumatic, hydraulic, mechanical and gravitational

energy. On some equipment it may be necessary to construct attachments to which locks can be applied.

Drawings provided by the Contractor should clearly show where the equipment isolation points are and the device that will be used to lock them. The Engineer will review the drawings and comment on a per system basis.

4.22 Fire Protection Requirements

The Contractor shall provide a water sprinkler system capable of providing fire protection to the generator.

All equipment comprising the sprinkler system shall be compatible, UL, ULC listed and FM approved as an assembled unit and shall comply with the latest editions of the following codes and standards:

MBC	Manitoba Building Code
MFC	Manitoba Fire Code
M.R. # 29/2003	Trade of Sprinkler System Installer Regulation
NBC	National Building Code of Canada, Volume I & II
NFC	National Fire Code of Canada
NFPA	National Fire Protection Association
NFPA 13	Standard for the Installation of Sprinkler System
NFPA 15	Standard for Water Spray Fixed systems for Fire Protection
NFPA 25	Inspection, Testing, and Maintenance of Water-Based Sprinkler Systems
NFPA 72	National Fire Alarm and Signaling Code
NFPA 851	Recommended Practice for Fire Protection for Hydroelectric Generating Plants, 2010 Edition.
CAN/ULC S524	Standard for the Installation of Fire Alarm Systems
CAN/ULC S537	Standard for Verification of Fire Alarm Systems
CAN/ULC S548	Alarm Initiating and Supervisory Device for Water type Extinguisher Systems

4.23 Grounding

Equipment and control cubicles shall be fitted with a Burndy Type QA-B ground connector or equivalent suitable for connection of a 4/0 AWG – 500 MCM stranded bare copper conductor for connection to the Purchaser's ground grid. A copper ground bar shall be provided in each cubicle for connection of all external cable grounds. The ground bar shall be 6 mm x 25 mm copper, with M5 screws at 12 mm spacing. The exact location will be identified when panel layout drawings are submitted for review.

4.24 Contacts and Sensors

Sufficient electrical contacts and elements for connection to the Purchaser’s UCMS shall be provided. Electrical contacts in sensors (e.g. level switches) shall be suitable for 125 Vdc pilot duty and suitable for connection to UCMS inputs.

If by virtue of the Contractor’s system design maintained contacts are required, these shall be supplied by the Contractor. The Contractor shall assume that all control contacts supplied by the Purchaser will have momentary action.

The Contractor shall install sensing devices so that calibration tests may be readily done over the life of the generator.

4.25 Electrical Grid Interconnection

The generators driven by the hydraulic turbines will be synchronized at generator voltage and the power output will be transformed from the generator voltage up to 138 kV.

All equipment specified shall operate continuously with a voltage unbalance of up to 2% measured at the generator transformer high side. The net result of all installed equipment shall not contribute to voltage unbalance.

All equipment specified shall operate with an expected maximum individual harmonic or interharmonic voltage distortion measured at the generator transformer high side equal to 1.0% and total voltage distortion equal to 1.0%. Calculations and design with respect to harmonic voltage distortion and harmonic currents shall consider a fundamental frequency of 58.0 Hz to 63.5 Hz. The net result of all installed equipment shall not contribute to voltage distortion.

4.26 Spare Parts

Spare parts shall be electrically and mechanically identical to corresponding parts of the Units. Spares shall be securely packed and clearly marked for long term storage at the Purchaser’s plant. Delivery of the spare parts shall be made with the shipment to Site of the stationary and rotating parts for Unit 1. All controls shall include 20% spare I/O.

The Contractor shall provide the following spare parts. Quantities shown are the total for all seven Units.

4.26.1 Generator

Item	Quantity	Description
1	15	Stator laminations of each type.

Item	Quantity	Description
2	100	Stator bars - Top
3	100	Stator bars - Bottom
4	200	Stator bar caps
5	1 set	Flexible links for main and neutral leads
6	10	Stator winding pole jumpers of each type
7	10	Stator bar taps
8		Extra wedges, ripple springs, depth packing and centre separator sufficient for 25% of the stator slots of one generator
9	3	Stator core resistance temperature detectors
10	3	Stator winding resistance temperature detectors
11	2	Neutral CTs - relaying type
12	1	Neutral CTs - metering type
13	1	Interneutral CT
14	2	Wound field poles
15	5	Field pole collar - inner
16	5	Field pole collar - outer
17	5	Field pole horseshoe connectors of each type
18	1 set	Flexible links for rotor bus
19	50	Amortisseur winding flexible links
20	1 set	Guide bearing pads
21	1 set	Thrust bearing pads
22	1	Generator bearing cooling coil
23	1	Bearing cooling water valve
24	1 set	Complete (positive and negative) collector brush rigging assembly including brushgear connection rings, mounting hardware, insulators, brushes and brush holders
25	1	Collector ring assembly with both positive and negative rings, mounting hardware and insulators
26	1	Thrust bearing high pressure oil pump and ac motor assembly and associated oil flow and oil pressure sensors (If Contractor chooses to supply a Babbitt thrust bearing.)
27	1	Surface air cooler water valve
28	1	Each type of surface air cooler resistance temperature detectors for inlet and discharge air and inlet and outlet water
29	1	Water flowmeter for each of the surface air cooler and bearing cooling water systems
30	1	Bearing metal and bearing oil resistance temperature detector of each type

Item	Quantity	Description
31	1	Bearing water-in-oil detector
32	1	Bearing oil level sensor
33	1	Rotor jacking position sensor
34	2	Brake position sensor
35	2	Brake shoe wear sensor
36	1	Sprinkler solenoid valve
37	1	24Vdc, 125Vdc, 120Vac, 600Vac Auxiliary relays and contactors of each type (including alarm relays) used in the generator and turbine instrumentation panels and auxiliary panels including braking, jacking, HPOIS, heating and lighting.
38	1	Fuse, fuseholder, circuit breaker of each type used in the generator and turbine instrumentation panels and auxiliary panels including braking, jacking, HPOIS, heating and lighting.
39	1	Electronic power supply module of each type used in the generator and turbine instrumentation panels and auxiliary panels including braking, jacking, HPOIS, heating and lighting
40	1	Digital and analog display and gauge of each type used in the generator and turbine instrumentation panels and auxiliary panels including braking, jacking, HPOIS, heating and lighting.

4.26.2 Turbine

Item	Quantity	Description
1	1	Complete turbine main shaft guide bearing (a complete set of segments or a complete bearing shell)
2	1 set	Wicket gate shear pins and shear pin failure detection devices
3	2 sets	Carbon seal rings and springs for the turbine shaft seal
4	1	Head cover main pump and motor for ac power supply
5	1	Head cover stand-by pump and motor for dc power supply
6	1	Air admission check valve
7	25% of 1 set	Bushings for one turbine
8	1	Wicket gate angle transducer
9	2	Wicket gate position switches
10	1	Wicket gate position magnetostrictive position sensor (LVDT)
11	1	Vacuum breaker valve for air admission complete With position switch
12	1	Oil level transducer with sight glass, 4-20ma output and switches (2) levels for turbine main guide bearing assembly
13	1 each	Each type of pressure gauges for air supply to maintenance

Item	Quantity	Description
		seal, shaft seal, smp pump, draft tube liner
14	1	Pressure switch for air supply to maintenance seal
15	1	Flow transducer for shaft seal
16	1	Shaft seal cooling solenoid valve
17	1each	Each type of float switches for sump pump
18	1	Sump pump level transmitter

4.27 Work Platforms

The Contractor shall design, supply and remove any temporary work platforms required to perform the Work. The temporary work platform shall be designed in accordance with Manitoba Regulation 189-95 pursuant to The Workplace Safety and Health Act, C.S.S.M. Chapter W210.

4.28 Gasket Templates

The Contractor shall supply templates for every gasket used in the turbine and generator.

The templates shall be:

- 1) Fabricated from 1/8" thick aluminum plate.
- 2) Be clearly labelled with the component, location and applicable drawing number.

5 TURBINES

5.1 General

The turbines will be of the vertical, fixed blade propeller installed in concrete semi-spiral cases and elbow type draft tubes and will be directly connected to a vertical shaft synchronous type generator. Water for the turbines will be supplied through an intake structure, with three openings leading to the semispiral case. The draft tube will incorporate two water passages in the horizontal portion.

The turbines selected by the Contractor shall be within the range of experience for turbines of this type presently installed and in service.

5.2 Turbine Data

The hydraulic turbines shall be designed for the following conditions

Type	Fixed Blade Propeller or Kaplan
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Shaft configuration	Vertical
Shaft rotation (viewed from above)	Clockwise
Number of Units	7

5.3 Hydraulic Conditions

The turbines will be designed based on the following hydraulic data:

Discharge	
Rated plant discharge (7 Units at full gate) at a gross head of 18.3 m	4070 m ³ /s +/- 140 m ³ /s
Headwater Elevations	
Normal Maximum	159.0 m
Normal Minimum	158.0 m
Tailwater Elevations	
Normal Maximum	141.3 m
Normal Minimum	139.4 m
Extreme Minimum	138.3 m

5.4 Operating Conditions and Requirements

The turbines and generators shall:

- 1) Be capable of continuous operation, without restrictions *due to cavitation*, at any gate opening *above* 70% for all gross heads with a tailwater elevation greater than or equal to 139.4 m. *The generator limit or the maximum wicket gate opening are the only acceptable restrictions, to continuous operation, at gross heads with a tailwater greater than or equal to 139.4m.*
- 2) Be capable of continuous operation, with power limits to prevent damage due to cavitation, at tailwater elevations greater than or equal to 138.3 m and less than 139.4 m.

5.5 Fish Friendly Features

The Purchaser desires to minimize the impact of the turbine on fish (e.g., mortality and/or injury due to mechanical strike) passing through the generating station. At a minimum the Contractor shall include the following fish friendly features in its turbine design:

- 1) Maximize the thickness of the runner blade leading edges without negatively impacting the turbine performance.

- 2) Minimize the thickness of the runner blade trailing edges without negatively impacting the turbine performance or compromising the structural integrity of the blade.
- 3) Minimize the gaps between the runner blade tips and discharge ring and runner blades and hub.
- 4) Minimize the gaps between the head cover and wicket gates and the wicket gates and bottom ring.
- 5) Minimize the bottom ring radius without negatively impacting the turbine performance.
- 6) Minimize the hub diameter without compromising the runner structural integrity.
- 7) *Have a rotational speed less than or equal to 90 rpm.*

5.6 Model Test

5.6.1 General

The Contractor shall perform tests on a turbine model fully homologous with the prototype turbine. The model shall be fully homologous with the prototype and its water passages, including the draft tube, semi-spiral case, and the complete intake structure up to the intake trashracks.

The Model Test Report of Record is defined as the final model test report whose results will be used for the calculations pursuant to Section 56 LIQUIDATED DAMAGES AND PERFORMANCE BONUSES of the General Requirements. The Model Test Report described in this Subsection 5.6.1 will be considered the Model Test of Report of Record unless independent verification, as described in Subsection 5.6.5 Independent Verification of the Technical Requirements, is required.

The Contractor shall prepare and submit to the Engineer a detailed test schedule and test procedure outlining the method of discharge, head and power output measurements.

The final Model Test Report shall be submitted to the Engineer in accordance with Subsection 8.4 Contract Dates of the General Requirements. The Contractor shall notify the Engineer at least 14 calendar days in advance of final tests such as those performed to prove guaranteed performance, determining cavitation limits and confirming runaway speed, to enable the Engineer to make necessary plans to witness the final tests.

Upon the Engineer's review of the draft report six paper copies and one electronic copy of the finalized Model Test Report shall be submitted to the Engineer. The Model Test Report shall include the following:

- 1) Description of test equipment.
- 2) Sample calculations for all calculated parameters including efficiency, cavitation and runaway speed for the model and step-up for the prototype.
- 3) Comparison of test results with the performance guarantees as stated in the Contractor's Proposal.
- 4) Hill Chart for the head range.
- 5) Model test curves for:
 - i) Unit power, Unit discharge and efficiency versus speed for various gate openings.
 - ii) relationship of power output, efficiency and discharge to the cavitation coefficient "sigma" for various gate openings and speeds corresponding to the head range to be encountered in service.
 - iii) relationship of runaway speed to wicket gate opening over the range of net heads.
- 6) Prototype turbine curves showing:
 - i) relationship of efficiency and turbine output with respect to discharge with cavitation limits indicated.
 - ii) Relationship of efficiency and turbine output with respect to wicket gate position, shown in percentage.
 - iii) relationship to the turbine discharge with wicket gate opening, in 10% increments, for the head range to be encountered in service.
 - iv) wicket gate torque relationship to head and opening.
 - v) relationship of hydraulic thrust to head and wicket gate opening.
 - vi) relationship of runaway speed to wicket gate opening for the maximum head.
- 7) Photographs and video recordings showing appearance of cavitation during cavitation tests.
- 8) An estimate of the turbine discharge at speed no load (this will be used by the Purchaser to size the spillway).
- 9) Detailed dimensional drawings of the model turbine, including the runner, guide vane, spiral case and draft tube used for tests.
- 10) The required values for use in calculations pursuant to Section 56 Liquidated Damages and Performance Bonuses of the General Requirements. The values shall be presented in a separate section, in table format using the same variable names.

After completion of the model tests the Contractor shall retain the turbine model for a minimum period of 15 years. During the 15 year period the Contractor shall provide the model at no cost to the Purchaser for testing in an independent hydraulic test facility at the Purchaser's request.

5.6.2 Test Requirements

The tests shall be performed in accordance with IEC 60193 “Hydraulic turbines, storage pumps and pump-turbine – Model acceptance tests” except as otherwise specified herein.

The high pressure measuring section will be located at the same position as the intake gate seal face (see Figure 5.). The intake gate slots do not have to be modeled. The low pressure measuring section will be located at the Upstream end of the tailrace log slots. The tailrace log slots do not have to be modeled.

The Contractor shall be responsible for the accurate calibration of all laboratory test facilities. Following any instrument failure or incorrect measurement resulting from faulty calibration, the Contractor shall repair and recalibrate the instruments and repeat any and all test runs at its own expense.

The step-up formula shall be as specified in IEC 60193 “Hydraulic turbines, storage pumps and pump-turbine – Model acceptance tests”. *The prototype values of gravity and density used for the step-up calculation shall be 9.816 m/s² and 998.7 kg/m³ respectively. The prototype water temperature shall be assumed to be 18 °C.*

5.6.3 Inspection

The Engineer reserves the right to be present at the Contractor’s model test facility for the duration of the model test.

5.6.4 Model Accuracy

The maximum allowable model test error shall be as follows.

Efficiency Error = plus or minus 0.25%

Turbine Power Error= plus or minus 0.15%

5.6.5 Independent Verification

At the completion of the model test, the Contractor, upon the request of the Purchaser shall make available the turbine model for shipment and testing at an independent laboratory, at the Purchaser’s expense.

If the Purchaser deems it necessary to have the turbine model tested at an independent laboratory, the final Model Test Report from the model test at the independent laboratory shall be the Model Test Report of Record.

5.7 Prototype Tests

After the prototype turbine runner has been installed and commissioned, the Purchaser will test the Unit for power and efficiency. The prototype will be tested in its normal operating condition. The prototype performance tests will be performed in accordance with IEC 60041 except as otherwise specified herein.

If there is dissatisfaction with the prototype performance test and the test does not agree with results from the model test, the dissatisfied party shall have the right to request that all or any part of the test be repeated. If the repeated prototype performance test confirms the results of original test, then, the party that requested that the test be repeated shall be responsible for all reasonable costs incurred by all parties, related to the repeated test.

The Chief of test will be the Purchaser's performance testing engineer.

Deviations from IEC 60041 for the prototype performance tests are as follows:

- 1) Unit inspections will be performed during commissioning of the Unit.
- 2) Aside from a servomotor stroke string transducer and pressure transducers, all instruments are calibrated off-site. Acoustic sensors for water level measurements are checked to ensure they are operating within specified accuracy. The timing of successive current meter calibrations will be based on hours of use as opposed to pre- and post-test calibrations. Current meters will be calibrated on the same type of mounting rod and main support member as used in the test, but not on the full carriage section. Meters will not be calibrated for oblique flow conditions.
- 3) Revolutions of current meter propellers will be counted over a two-minute period to determine flow velocities.
- 4) The discharge metering section will be located upstream of the intake stoplog gains and testing will be done with the intake in its existing configuration without any flow-straightening devices.
- 5) Data will be collected with a data acquisition system. Direct readings during test runs will only be taken if monitoring of instrumentation readings indicates suspicious results. Data summaries will be included in the final test report that will be signed by the Chief of test.
- 6) Generator efficiencies will be determined prior to test and results will be included in final test report.
- 7) Planned test runs will be completed without a preliminary test. If the peak efficiency operating region is not initially tested, additional runs will be made to adequately define the peak zone.
- 8) Rotational speed will be assumed to be the synchronous speed.
- 9) Instrument elevations will be tied-in by surveying structures adjacent to the instruments and then using a measuring tape to find the distance from the survey mark to the measuring surface of the instrument.

- 10) Water level measurements will be made at a single location in each gate chamber. Water levels in the tailrace downstream of the draft tube will be measured with a single instrument centered on each draft tube opening. Tailrace measurements are expected to be in an area with some flow disturbances.
- 11) The dimensions of measuring sections will be measured prior to testing.

Copies of the Purchaser's method for calculating the total error in the efficiency measurement is included in **Appendix N**.

The Chief of test has the right to replace or modify any of the methods or hardware components used for the testing or analysis, provided the changes or improvements maintain or improve upon the accuracy of the test, maintain or reduce the error bands of the data, and maintain or improve upon the level to which the testing complies with the pertinent test codes.

5.8 Cavitation

5.8.1 Cavitation Warranty

In addition to Section 38 WARRANTY of the General Conditions, the turbine shall be warranted against Excessive Cavitation Pitting for a period of 8000 operating hours or 24 months, whichever comes first (the "Cavitation Warranty"). The Cavitation Warranty shall commence upon issuance of the Commissioning Certificate.

"Excessive Cavitation Pitting" per Unit is defined to include all of the following:

- 1) increasing the stress in the turbine runner above those specified in Subsection 2.3 Allowable Stresses of the Technical Requirements, or,
- 2) removing more than the guaranteed amount of metal loss in the Cavitation Warranty page of the Contractor's Proposal from the turbine runner and stationary parts of the water passage, or,
- 3) reducing the thickness of the turbine runner blade by an average of 6.5 mm over any single continuous area of 930 cm² or greater.

During the Cavitation Warranty, the turbine runner will not be operated in generate mode:

- 4) for more than 500 hours at outputs less than 50% of the full gate output, or
- 5) for more than 100 hours at outputs greater than 10% above the guaranteed output at 19.2 m gross head in the "Performance Data" portion of the Contractor's Proposal.

The amount of metal lost due to cavitation is the weight of consumables used to repair the cavitation pitting. Note that prior to repair, the cavitated areas shall be gouged to sound metal.

At or near the end of the Cavitation Warranty (or extended Cavitation Warranty) period, the Contractor and the Engineer shall jointly inspect the turbine for any damage due to cavitation. Should Excessive Cavitation Pitting occur, as defined above, the Contractor shall repair the pitted areas and modify the hydraulic surface to eliminate or reduce subsequent cavitation pitting. The Contractor shall be prepared to commence repair of the pitted areas immediately after the inspection for damage due to cavitation has been completed. The Purchaser will, at its own expense, dewater the turbines, install inspection platforms and provide station power and compressed air to enable the Contractor to carry out required inspections and repairs. The Contractor may be required to work two 12 hour shifts per day (including weekends) until the Unit is returned to service to minimize the Unit outage time.

Should any repair be required as provided in the immediate preceding paragraph the Contractor shall extend the Cavitation Warranty for a further 8000 hours (or 24 calendar months, whichever comes first). If at the conclusion of the extended Cavitation Warranty, should Excessive Cavitation Pitting occur Cavitation Liquidated Damages will be assessed in accordance with Subsection 56.6 Cavitation Liquidated Damages of the General Requirements.

5.9 Embedded Parts

5.9.1 General

The embedded parts shall include the draft tube liner, discharge ring, bottom ring, and stay ring. The embedded parts shall be designed to provide a wicket gate service gallery which will allow for the replacement of the wicket gate bushings installed in the bottom ring, without dismantling the Unit.

All embedded components shall incorporate machined, bolted and doweled flanges with o-ring seals such that no structural welding of the embedded parts shall be required during installation at Site.

The transitions between all embedded parts shall be smooth and without a visible step.

All embedded parts shall include provision for bonding to the Purchaser's station grounding grid.

5.9.2 Draft Tube Liner

The draft tube liner shall come complete with at a minimum, the following features.

- 1) A minimum thickness of 30 mm.
- 2) The top 500 mm section of the liner shall be stainless steel plate (as specified in Subsection 3.1 Turbine and Generator Materials of the Technical Requirements) and shall have a minimum thickness of 50 mm.
- 3) Extend downward from the discharge ring and continue until the water velocity is less than 6 m/s.
- 4) Provided with anchor bolts and adjusting devices to maintain alignment during concreting operations.
- 5) Nelson Type H4L, or Purchaser's approved equal, studs installed on a grid pattern so that the liner and surrounding concrete act as a composite structure. The studs shall extend beyond the outside diameter of the rib flanges.
- 6) Reinforced pockets in the draft tube liner designed to support the runner maintenance platform.
- 7) A watertight and airtight access door for access to the draft tube and turbine runner. The door shall be not less than 750 mm clear width by 1100 mm clear height and shall be arranged flush with the inner surface of the liner. The hinge pins shall be of stainless steel construction. All bolts shall be stainless steel. The door shall be sealed with an O-ring located in a groove in the door. The hinges shall be equipped with self lubricating bushings. The doorframe, which forms part of the draft tube liner, shall be suitably reinforced with ribs to reduce and limit vibration of the door under all conditions of turbine operation.
- 8) A 25 mm test valve on the draft tube liner below the access door to check the water level during Unit dewatering.
- 9) A compound pressure and vacuum gauge together with shut-off and bleed valves, pressure snubber and necessary piping mounted on a galvanized steel frame fastened to the concrete wall adjacent to the access door.

5.9.3 Runner Maintenance Platform

The Contractor shall provide a removable runner maintenance platform for runner inspection and cavitation repair. At a minimum, the platform shall have the following features:

- 1) The platform shall be located between 1m and 1.5m below the bottom of the runner blades.
- 2) The platform shall cover the complete draft tube area at the installed elevation.
- 3) The platform shall be designed for a minimum distributed load of 4.8 kPa and a minimum point load of 1780 N.

- 4) The runner maintenance platform attachment points shall be incorporated into the draft tube liner and shall be flush with the water passage. The attachment points shall be designed so that no tools are required to install the platform supports.
- 5) Access to the platform shall be via the draft tube man door.
- 6) The maximum spacing between the platform support arms, at the draft tube liner, shall be 1.2 m.
- 7) The platform shall have appropriate kickplates & handrails and/or restraint/fall arrest system, including temporary & permanent anchors etc, to meet all current and applicable Manitoba Provincial Fall Protection/Retrieval Regulations & CSA Standards during assembly and as a final assembled platform.
- 8) The maximum weight of any component *that has to be installed or handled manually* shall not exceed 25 kg. The components shall be able to easily pass through the draft tube man door.
- 9) Access/retrieval systems such as a rescue ladder shall be provided from the platform for rescue of unconscious workers from the draft tube water below the platform. This system shall meet all current and applicable Manitoba Provincial Fall Protection/Retrieval Regulations & CSA Standards. The retrieval system shall be designed so that it is functional as soon as the first section of platform has been installed.
- 10) A temporary lighting system including lights, power supply and support mounts for both to be integrated into the platform structure.
- 11) The platform structure shall be constructed out of aluminum.
- 12) The platform surface shall be an assembly consisting of an aluminum frame and a plywood surface. The plywood surface shall be replaceable, *painted with fire retardant paint* and attached with flush mounted fasteners.
- 13) The load capacity of the platform shall be permanently and clearly marked on all components.

5.9.4 Draft Tube Bulk Head

Draft tube bulk head domes are required in order to keep the semi-spiral case dry during the construction, after flooding of the tailrace. Five domes are required. Two sets of draft tube gates shall be supplied by the Purchaser for the remaining two Units. The dome shall be welded to the draft tube liner below the stainless steel section and shall be designed for the following conditions:

- 1) Designed for maximum tailwater Elevation 141.1 m.
- 2) Be of welded design.
- 3) Have nozzles and valves to bleed air.
- 4) Be removed through the draft tube access door and the dewatering gallery after completion of its life.
- 5) Be designed for a one time use.

5.9.5 Discharge Ring

The discharge ring shall come complete with at a minimum, the following features:

- 1) A minimum wall thickness of 60 mm after final machining of the discharge ring
- 2) A maximum surface finish of 6.3 μm on the machined bore of the discharge ring.

5.9.6 Bottom Ring

The bottom ring shall come complete with at a minimum, the following features:

- 1) Designed to allow removal of the bottom wicket gate bushings, with the wicket gates installed, through the wicket gate service gallery.

5.9.7 Stay Ring

The stay ring shall come complete with at a minimum, the following features:

- 1) Consist of upper and lower shroud rings rigidly connected and spaced by stay vanes.
- 2) An o-ring seal between the stay ring and the outer head cover.
- 3) Provided with concrete placement holes not less than 200 mm in diameter and tapped air release and pressure grout holes not less than 25 mm in diameter in the lower shroud ring to facilitate concreting and pressure grouting by the Purchaser. Steel plates and pipe plugs shall be provided for subsequent plugging of the holes. The plates shall be welded and ground to the shroud contour by the Contractor after grouting.
- 4) Provided with Piezometer tappings with stainless steel orifices in the stay ring for Index Testing. The tappings shall be similar to those used for the Winter-Kennedy method of flow measurement. The details and location of the taps shall be in accordance with IEC Publication 60041 "International Code for the Field Acceptance Tests of Hydraulic Turbines".

The lower shroud ring shall be provided with anchors extending into the draft tube cone. The anchor and jack arrangement shall be designed to maintain alignment and to distribute loads from the stay vanes to the concrete below during concreting and subsequent turbine operation.

Steel plate cone liners shall extend 500 mm above and below, from the outer diameter of the stay ring, over the upper and lower cones of the semi-spiral case. The liners shall:

- 5) Be a minimum of 12mm thick.
- 6) Be equipped with Nelson Type H4L, or Purchaser's approved equal, studs on a 250 mm grid pattern.

5.9.8 Stay Vanes

The Contractor shall design permanent anchorage points in the stay vanes for the installation of a horizontal lifeline. At minimum, the anchor points shall:

- 1) Meet all current and applicable Manitoba Provincial Fall Protection/Retrieval Regulations and CSA Standards.
- 2) Allow for the safe installation of a horizontal lifeline around the stay vanes.
- 3) Not impact the hydraulic profile of the stay vanes.
- 4) Not impact the performance of the turbine.

5.9.9 Wicket Gate Gallery

A wicket gate gallery shall be provided and shall come complete with at a minimum, the following features:

- 1) Allow for the replacement of the bottom wicket gate bushings without the removal of the wicket gates.
- 2) Be 2m from the floor to the bottom of the wicket gate pockets.

5.9.10 Turbine Pit Access

The Contractor shall supply a turbine pit entrance stairway and walkways.

The entrance stairway and walkways shall be designed with the following features:

- 1) A fabricated stairway for access from the passageway to the walkway on the turbine head cover.
- 2) A minimum width of the stairway of 1100 mm or 50% wider than the largest component, excluding the operating ring, in the turbine pit, whichever is wider.

5.10 Head Cover Assembly

5.10.1 General

The head cover assembly shall consist of the outer head cover, inner head cover, turbine guide bearing, shaft seal, and walkways, all as described in the following sections.

The head cover assembly shall be arranged so that the turbine runner may be removed through the turbine pit by removing the inner head cover and without dismantling the outer head cover or wicket gates.

The arrangement shall provide good access, without hazards, for the operation, repair and maintenance of the turbine.

The head cover shall be supplied with a flanged fitting to permit future installation of tailwater depression piping. *Alternatively, air for dewatering could be delivered through the draft tube liner. In this case the Contractor shall supply an embedded pipe connected to the draft tube liner and run to the draft tube gallery. The end of the pipe in the draft tube gallery would have to be supplied with a flange and blanked off.*

5.10.2 Assembly

The head cover assembly shall be designed so that:

- 1) Turbine pit leakage will be directed to the head cover sumps.

5.10.3 Outer Head Cover

The outer head cover shall come complete with at a minimum, the following features:

- 1) Incorporate machined, bolted and doweled flanges in order to facilitate shipping and connection to the stay ring and inner head cover.
- 2) Incorporate removable bushing housings to allow for the replacement of the wicket gate bushings without the removal of the wicket gates.

Drainage around the outer head cover shall be directed to the gutter drain at the stay ring baffle vane. The Contractor shall provide an arrangement so that water from the wicket gate packing glands has positive drainage to this drain without accumulation.

5.10.4 Inner Head Cover

The inner head cover shall come complete with at a minimum, the following features:

- 1) Incorporate machined, bolted and doweled flanges in order to facilitate shipping and connection to the outer head cover, turbine bearing, and shaft seal.
- 2) A removable bronze wearing ring installed on the lower face of the inner head cover above the runner hub to distribute up-thrust loads from the hub when the runner is subjected to uplift forces during operation and to limit upward travel of the turbine and generator rotating parts to 12.5 mm for dismantling of the generator thrust bearing.
- 3) Be capable of supporting the generator shaft, turbine shaft and runner during assembly and disassembly.
- 4) Include a sump for collecting shaft seal water leakage. The sump covers shall be held in place by their own weight and not require fasteners.

The inner head cover may be arranged with intermediate and lower sections to facilitate fabrication, shipping and Site installation.

5.10.5 Turbine Guide Bearing

The turbine guide bearing shall be of the babbitted, oil bath, self-lubricated and self-cooled type and shall come complete with at a minimum, the following features:

- 1) ***Shell or*** segmented design ***with the ability to adjust the center of the bearing within the headcover a minimum of 6 mm.***
- 2) A removable top cover plate with visual inspection windows to permit examination of the bearing during operation
- 3) A brush seal around the shaft to prevent dirt or foreign matter from entering the bearing.
- 4) The oil reservoir shall have sufficient capacity to hold all the oil in the entire bearing system and to provide cool oil to the bearing under all conditions of operation.
- 5) Suitable drain and fill points with valves and plugs shall be provided in the bearing reservoir.
- 6) A maximum normal operating temperature of 60°C.

The turbine bearing shall be equipped with at a minimum, the following sensors:

- 7) A minimum of four RTDs in the bearing babbitt.
- 8) A minimum of one RTD in the bearing oil.
- 9) Four mounting points for Purchaser supplied proximity probes.

- 10) One oil level site glass with graduated plaque showing the normal operating oil levels.
- 11) One oil level sensor which can be connected to the Purchaser's UCMS for monitoring.
- 12) One low oil level switch which can be connected to the Purchaser's UCMS for monitoring.

5.10.6 Turbine Shaft Water Seal

The turbine shaft seal shall be either a radial carbon ring or a packing box type.

a) **Radial Carbon Ring Shaft Seal**

A radial type carbon ring shaft seal shall include the following features:

- 1) All components constructed from stainless steel.
- 2) A wear indicator for each of the carbon rings which can be connected to the Purchaser's UCMS for monitoring of seal wear.
- 3) A differential pressure regulating water control system.
- 4) An inflatable rubber bladder below the shaft seal to close the void between the shaft and the seal when the Unit is not in motion. This will allow for maintenance on the seal without draining the draft tube.

The Contractor shall provide a differential pressure regulated water system with the following features:

- 5) Deliver a constant flow of filtered water to the sealing rings for cooling and lubrication.
- 6) Include a controller that varies the flow to each ring to maintain the desired differential pressure.
- 7) Measure the water pressure below the head cover and entering the carbon seals.
- 8) Measure water flow to each cooling ring.
- 9) Have an automated bypass to allow raw water to feed the seal in the event that the filtered water source is not working or fails.

b) **Packing Box Shaft Seal**

A packing box shaft seal shall include the following features:

- 1) All components constructed from stainless steel.
- 2) An inflatable rubber bladder below the shaft seal to close the void between the shaft and the seal when the Unit is stopped. This will allow for maintenance of the seal without draining the water passages.
- 3) A spring loaded self-adjusting gland ring.

- 4) A lantern ring to create a void between the packing rings for injecting cooling/lubricating water.
- 5) A water supply header ring which injects cooling/lubricating water into the seal at a minimum of three locations evenly spaced around the seal.
- 6) Measure water flow to the seal.

The Contractor shall identify the flow, pressure and filtration requirements for the shaft seal in accordance with subsection 8.4 Contract Dates of the General Requirements.

5.10.7 Drainage Pumps

The inner head cover shall incorporate a sump to which drainage water shall be directed for removal by one of each 600 V ac and 125 V dc automatically controlled sump pumps provided by the Contractor. The pumps shall be of the vertical, centrifugal turbine. Each pump shall be capable of handling all normal leakage without exceeding 25% of its rated capacity.

The sump pumps shall be controlled by a guided wave radar level transducer, Magnetrol Eclipse 705 or Purchaser's approved equivalent. The level transducer shall communicate with the Purchaser's UCMS system. The level transducer shall control the motor starters through interface relays supplied by the Contractor.

As a backup, the Contractor shall also provide mechanical float type switches to provide an alarm on extreme high water level and to run both sump pumps. In addition, a head cover flood alarm shall be provided. These float switches shall have one normally open contact and one normally closed contact which will interface into the 120V ac and 125V dc pump controls.

In addition, another float switch shall be provided to provide a head cover flood alarm and unit trip

The drainage system shall:

- 1) Have the pumps located 1.3m above and within 0.3m laterally of a platform so that when they are being maintained the worker can carry out the task while standing.
- 2) Have foot valves and check valves on the pump inlet line.
- 3) Have a check valve on the pump discharge line.
- 4) Have shut-off valves and pressure gauges on the discharge lines.
- 5) Connect to the Purchaser's embedded pipe which will be connected to the station oil water separator.

Drainage pumps controls shall be self-contained with communication to the Purchaser's UCMS. Alarms shall include power failure, pump run, high water level and extreme high water level.

A pump control panel shall be provided for each pump located within view of the pumps. Each panel shall contain a motor disconnect switch, an On-Off-Auto switch, and indicating lamps for power and pump run status. The Purchaser has specific requirements for the pump controls requiring auxiliary relays in these control panels. The Purchaser will provide detailed design requirements at the design stage.

A test run button shall be located by each pump that will allow manual testing of the pumps when the switch on the pump control panel is in the Auto position.

The Purchaser shall supply and install motor starters in its Motor Control Centre (MCC) for the 600 V ac drainage pumps. The Purchaser shall supply and install motor starters in its DC MCC or alternatively local motor starters in the turbine pit for the 125V dc pumps.

The Contractor shall specify the size of the required embedded line, and details on AC and DC pump size in accordance with Subsection 8.4 Contract Dates of the General Requirements.

5.10.8 Turbine Vacuum Breaker System

The Contractor shall provide the necessary valves, piping and fittings for admission of air to the runner chamber to relieve excessive vacuum created in the turbine water passages and to ensure smooth operation of the turbine.

The vacuum breaker valve shall operate automatically and shall incorporate a check valve, Hoerbiger Type B "Compact-A-Check" Valve or Purchaser's approved equivalent. A manual butterfly valve shall be provided below the vacuum breaker valve to permit repairs without dewatering the Unit. The Contractor shall furnish all piping and fittings between the head cover flange to the edge of the concrete corbel in the turbine pit. The Purchaser will provide and install the remaining piping to atmosphere.

The Contractor shall provide one form C 125 Vdc dry contact indicating valve position for the Purchaser's use.

5.10.9 Wicket Gate Bushing Housings

The upper, intermediate and lower wicket gate bushing housing bores shall be concentric within 0.04 mm and their axis shall be plumb to 0.0625 mm/m.

5.11 Runner

5.11.1 General

The runner coupling flange shall be machined flat. To ensure that the outer portion of the coupling face makes contact first, the runner coupling face shall be machined to the tolerances outlined in IEEE 810, Standard for Hydraulic Turbine and Generator Integrally Forged Shaft Couplings and Shaft Runout Tolerances (R1994).

The turbine runner blades shall be numbered, both above and below the blades on the hub, in sequence with 5 inch high permanent markings so that each blade is readily identifiable when viewed from the scroll case or draft tube.

The runner cone shall be of sufficient strength to support the weight of the turbine shaft and the runner assembly on the powerhouse floor during erection and maintenance and shall have a spigot fit with the runner hub. The clearance in the spigot fit shall not exceed 0.25 mm.

5.11.2 Balancing

The turbine runner assembly shall be accurately balanced to Grade G2.5 in accordance with ANSI S2.19-1999 "Mechanical Vibration - Balance Quality Requirements of Rigid Rotors" at the Contractor's factory.

Where possible, it is preferable to remove material from the runner, as opposed to the addition of balance weights, to achieve the required balance. If balance weights are used, they shall be installed in a manner not detrimental to the performance of the runner and shall be securely attached so as not to come loose during operation.

The use of lead for balance weights is not permitted.

5.11.3 Surface Roughness

Surface roughness shall not exceed half the values specified in IEC 60193.

5.11.4 Waviness

Waviness, as defined in IEC 60193, tolerances shall not exceed half the values specified IEC 60193.

5.12 Wicket Gate Operating Mechanism

5.12.1 General

The wicket gate operating mechanism shall include but not be limited to the servomotors, operating ring and sliders, wicket gate links, levers and bushings, wicket gate bushings, wicket gates and locking device.

5.12.2 Servomotors

The wicket gates shall be operated by a minimum of four double-acting, oil filled, hydraulic cylinders having a combined capacity to move the wicket gates through a full stroke, either open or closed at a pressure no greater than 60% of the nominal operating pressure of the governor pumping system. The design shall be such that the force required to move the wicket gates shall be shared equally between the servomotors and applied tangentially in equal magnitude to the wicket gate operating ring.

The nominal operating pressure for the governor system shall be 16 MPa.

When sizing the servomotors the Contractor shall use maximum head when considering the worst case of:

- 1) the sum of the friction in the wicket gate bushings, linkage bushings, servomotor bushings and operating ring due to the reactions at each bushing and the moment required to open the wicket gates from the closed position,
- 2) the sum of the friction in the wicket gate bushings, linkage bushings, servomotor bushings and operating ring due to the reactions at each bushing and the hydraulic moment acting on the wicket gates when they are being opened,
- 3) the sum of the friction in the wicket gate bushings, linkage bushings, servomotor bushings and operating ring due to the reactions at each bushing and the hydraulic moment acting on the wicket gates when they are being closed, or
- 4) the sum of the friction in the wicket gate bushings, linkage bushings, servomotor bushings and operating ring due to the reactions at each bushing and the hydraulic moment acting on the wicket gates when they are being closed during a Unit runaway.

A coefficient of friction of 0.22 shall be assumed for the wicket gate and wicket gate linkage bushings when sizing the servo motor.

The servomotors shall:

- 5) Be mounted on the head cover so that they may be aligned to the operating ring.
- 6) Have two double acting piston seals.
- 7) Have piston rods plated with chrome over their entire length (minimum thickness of 0.04 mm) or Purchaser approved equivalent.
- 8) Have wrench flats on the free end of the piston rod to allow rotating of the rod.
- 9) Have piston rods equipped with an adjustable connection at the gate operating ring end.
- 10) Have minimum 25 mm drains with ball valves on each of the cylinders.
- 11) Each servomotor shall be shop-tested to a pressure of 1.5 times the maximum allowable working pressure of the governor pumping system.
- 12) Be filled with oil for shipment and storage at Site.
- 13) Have by-pass connections, with adjustable needle valves to retard the rate of closure of the wicket gates between 10% or slightly below the speed-no-load position and the fully closed position. The by-pass connections shall be fitted with check valves and shall be designed to allow unrestricted opening of the gates from the fully closed position.

The opening and closing piping for the servomotors shall be equipped with Swagelok quick connect type connections for installation of pressure gauges.

The Contractor shall provide the necessary oil pressure supply and return piping and valves between the servomotors and the governor actuator cubicle.

In accordance with subsection 8.4 Contract Dates of the General Requirements the Contractor shall supply the following information to allow for the design of the governor system:

- 14) Unit inertia factor H,
- 15) Full gate servomotor stroke,
- 16) Opening and closing volumes of the servomotors,
- 17) Opening and closing rate of servomotors.

5.12.3 Wicket Gate Operating Ring

The operating ring shall:

- 1) Be mounted on the inner head cover.
- 2) Be supported horizontally and vertically on self-lubricating surfaces mounted on the inner head cover.
- 3) Be restrained from lifting vertically by self-lubricating lined restraining supports mounted on the inner head cover.

- 4) Have stainless steel sliders bolted to the operating ring that will mate with the inner head cover self-lubricating sliders.
- 5) Be designed so that all self lubricating bushings can be easily removed with the operating ring in place.
- 6) Be designed to eliminate any tendency for binding during rotation.
- 7) Have connections for the operating links that are readily accessible.
- 8) Have all pin connections equipped with self-lubricating bushings and thrust washers.
- 9) Be equipped with an accurately machined brass scale with pointer, mounted on the head cover, for measurement of servomotor stroke. Graduations shall be in 1% divisions with major divisions every 5% and numbers every 10%. The scale shall be easily visible from the turbine pit walkway near the turbine pit entrance.

5.12.4 Shear Pins

The wicket gate operating mechanism shall be equipped with shear pins and friction devices to prevent the wicket gates from being over stressed in the case of an object jamming in the gates. The center 1/3 of the shear pin shall be drilled out.

A shear pin failure monitoring system of the resistance type shall provide individual condition monitoring for each shear pin. The monitoring system shall be designed to prevent faulty failure signals due to shear pin flexing. The system shall be arranged such that the pins can be monitored by the Purchaser's UCMS.

5.12.5 Wicket Gates

The wicket gates shall come complete with at a minimum, the following features:

- 1) Stainless steel sleeves at the wicket gate bushing locations.
- 2) Include 300 mm black painted numbers to allow for identification.

The leakage past the wicket gates shall not cause the Unit to creep or rotate when the brakes *and HPOIS, if applicable*, are off.

5.12.6 Locking Device

The wicket gate operating mechanism shall have a manually operated locking device. The locking device shall at a minimum:

- 1) Be capable of restraining and holding the wicket gates in the fully closed position with maximum allowable working pressure in the governor pressure system.
- 2) Include a suitable means of padlocking.
- 3) Be able to be installed by one person.

- 4) Be able to be installed while standing on the turbine pit walkway.
- 5) Be installed without having to perform any lifting.

5.13 Shop Test Assemblies (Purchaser's Option)

To help ensure all components can be assembled at Site without issue, the Contractor shall couple the draft tube liner, discharge and bottom ring in its shop. ***The Purchaser may waive this requirement if the Contractor can demonstrate an alternative method, such as templates that replicate the bolted connections between components, that proves that the components can be assembled at Site without issue.***

To help ensure all components can be assembled at Site without issue, the Contractor shall perform a shop test assembly of the turbine including but not limited to the following components:

- 1) Bottom ring
- 2) Stay Ring
- 3) Outer head cover
- 4) Inner head cover
- 5) Wicket gates
- 6) Operating Ring
- 7) Wicket gate links
- 8) Wicket gate levers
- 9) Servomotors

The Purchaser may waive the requirement to have the stay ring in the shop test assembly if the Contractor can demonstrate an alternative method which ensures that the Purchaser can verify that the components can be assembled at Site without issue.

6 GENERATOR

6.1 General

The generator shall be a vertical axis, salient pole, rotating field, air-cooled, self-ventilating type. The generator shall be installed in a totally enclosed housing. An amortisseur winding shall provide the largest damping torque possible, consistent with a balanced design. Except where noted, the generator shall be built to IEEE standard C50.12.

6.2 Rating

The rating of the generator shall be as follows.

Rated for Maximum Turbine Output at maximum rated head	Continuous
Power Factor (overexcited)	0.85
Frequency	60 Hz
Voltage Between Phases	13.8 kV
Phases and Connection	3-phase wye
Rotation	Clockwise
Inertia (H factor) for the combined turbine and generator at rated speed and rated MVA base	3.4 MW-s per MVA

6.3 Generator Nameplate

The nameplate shall be in accordance with the requirements of IEEE C50.12.

6.4 Function and Mode of Operation

A generator circuit breaker and Unit step-up transformer will connect the generator to the Purchaser's 138 kV network.

6.5 Voltage and Frequency

The generator shall be rated at 13.8 kV, 60 Hz balanced 3-phase voltage. All tests and guarantees shall be based on this voltage. The generator shall have the following capability:

- 1) Limit inherent phase voltage unbalance to not more than 1% while Units are operating unsynchronized.
- 2) Be suitable for continuous operation with a phase voltage unbalance of up to 2% while connected to the Purchaser's 138 kV network.
- 3) Operate satisfactorily at any terminal voltage between 95% and 105% of rated voltage, at rated capacity, frequency, and power factor, according to IEEE standard C50.12.
- 4) Operate 10% below and 15% above rated voltage when synchronizing and under emergency conditions. Not exceeding one hour per emergency event.

6.6 Harmonic Currents Withstand Capability

The proximity of the generators to the D.C. conversion system results in a requirement for harmonic absorption for the generators. Each generator shall continuously withstand the heating effect due to the total of the harmonic currents

listed in **Appendix U**: Keyask Generation Harmonic Profiles at 13.8 kV, while operating at rated load.

6.7 Temperature Guarantee

Based on a maximum cooling water inlet temperature *of 25°C*, temperatures at the generator nameplate rating shall not exceed the following:

Component	Temperature
Armature Winding <i>including end-arms</i>	110°C
<i>Pole Jumpers</i> Circuit ring bus and generator leads	115°C
Field Winding	120°C
Core	95°C

Based on a maximum ambient air temperature of *30°C*, the temperature, at the generator nameplate rating, of the collector rings shall not exceed *105°C at 80% of the nominal collector ring airflow*.

Method of temperature measurement:

- 1) *Armature* winding temperature shall be measured by embedded resistance temperature detectors located between the bars *in the slot*. *The temperature of the end-arms shall be measured within temporary fibre-optic sensors attached to the side of the end-arms at various elevations in the stress control region*.
- 2) Circuit ring bus, *pole jumpers* and generator leads temperature shall be measured with fibre optic temperature sensors and infrared thermography.
- 3) Field winding temperature shall be determined by the change of resistance method measured according to IEEE Standard 115.
- 4) Cooling water temperature and cooling air temperature shall be measured by resistance temperature detectors.
- 5) Collector ring temperature shall be measured by temperature sensitive tape.

6.8 Wave Shape and Telephone Influence Factor and I²T Characteristic

The open-circuit wave shape and telephone influence factor and the capacity of the generator for negative sequence current I²T shall be within the limits stated by IEEE Standard C50.12

6.9 Flywheel Effect

Flywheel effect (MR2) of the generator rotating parts shall provide the specified H value at synchronous speed.

6.10 Reactances

The generator shall be designed with the following reactances based on rated kVA at rated current:

- 1) Direct-axis subtransient reactance $0.15 \leq X''_d \leq 0.35$ per Unit.
- 2) The ratio of the quadrature-axis to direct-axis subtransient reactances (X''_q/X''_d) at rated current shall be as near to unity as possible and shall be between 0.9 and 1.1.

6.11 Auxiliary Devices and Equipment

For ready reference, the minimum auxiliary devices for each generator are listed below:

12	Stator winding embedded RTDs
12	Stator core RTDs
1	Collector housing air temperature RTD
4	Thrust Bearing RTDs
1	Bearing Oil RTD (per reservoir, if applicable)
4	Guide Bearing RTDs (per bearing, if applicable)
1	Bearing oil cooler inlet water RTD
1	Bearing oil cooler outlet water RTD
1	Bearing Cooling Outlet Water Flowmeter
1	Bearing Cooling Water Valve
1	Ultrasonic thrust bearing oil pot oil level monitor with stilling well
1	Mechanical oil level switch with stilling well (extreme low level alarm and Unit trip)
1	Pressure switch to detect oil or water in the void between the inner and outer tubes for the generator bearing cooling coils
1	Thrust Bearing High Pressure Start System including pressure gauge and pressure switch
1	Bearing water cooler solenoid valve
1 per radiator	Surface Air Cooler air inlet RTD
1 per radiator	Surface Air Cooler air outlet RTD
2	Surface Air Cooler inlet water RTDs
1	Surface Air Cooler outlet water RTD
2	Surface Air Cooler Flowmeters
1	Surface Air Cooler Main Water Outlet Valve

12	Addressable Fire Detectors (generator housing)
1	High Pressure Oil Injection System (If Applicable)
1	Brake Control and Wear Monitoring System
1	Rotor Jacking system and position sensor
1	Neutral grounding transformer and resistor
3 per circuit	Neutral end Current Transformer
1	Inter-neutral current transformer

6.12 Isolated Phase Bus Terminations

The Contractor shall provide flexible lead terminals and associated connecting hardware suitable for connection to the Purchaser’s isolated phase bus.

6.13 General Mechanical Construction

The generator shall be enclosed in a pit with concrete walls built up to the elevation of the powerhouse floor. *The Contractor shall determine the shape of the generator pit. There shall be a minimum of 1 m of clearance between the stator frame, with the surface air coolers installed, and the walls of the generator pit.*

The turbine and generator shall withstand a vertical lift of 18.0 mm of the rotating parts above normal position, under hydraulic disturbances, without damage while operating.

Each turbine and generator will be assembled at Site. The stator bore shall be large enough to permit withdrawal of the turbine runner through the stator. Rotor field poles shall be designed to permit easy removal with the rotor in place, to allow access for repairs to the stator or rotor windings.

All turbine and generator valves that must be operated to start or stop the Unit shall be supplied by the Contractor. Valves shall be electrically controlled and operated to allow for remote start and stop of the generator. Local manual start and stop control shall also be provided.

Bolted electrical connections shall use “Fujilock” self locking nuts.

6.14 Generator Shaft Grounding Brush

The Contractor shall supply and install a shaft grounding brush. The grounding brush shall be in a dry, clean location that is easily and safely accessible for inspection.

6.15 Generator Speed Switch

The Contractor shall make provision for the mounting of the following items:

- 1) A speed switch wheel on the collector or generator or turbine shaft.
- 2) Three probes mounted against the toothed wheel.
- 3) The speed switch wheel shall be in a dry, clean location that is easily and safely accessible for inspection.

The Purchaser shall supply:

- 4) Toothed speed switch wheel and three probes
- 5) Speed switch cables
- 6) Speed switch monitoring equipment located in a cubicle outside of the generator enclosure.

The Contractor shall:

- 7) Install the speed switch toothed wheel.
- 8) Supply and install brackets to hold the three probes.
- 9) Install the three probes.
- 10) Supply and install a termination panel on the exterior wall of the generator enclosure at a point convenient for the Purchaser to route cables to its governor cubicle.
- 11) Supply and install the conduit system from the probes to the termination panel on the exterior wall of the generator enclosure.
- 12) Connect and route the cables from the probes to the termination panel.
- 13) Show all cable routing and conduit system details for speed switch cables inside the generator enclosure on the Contractor's drawings.

6.16 Brakes and Jacks

The brake system shall be capable of bringing the rotating parts to a stop from 50% of synchronous speed in less than 5 minutes without injurious heating. Braking effect shall be sufficient for the inertia of the rotating parts and wicket gate leakage that would produce, at standstill, 2% of rated full load torque.

Brake shoes shall bear against a brake track. The brake track shall be renewable in segments. The brake pads shall be made from ROBCO Scan-Pac RF-38 non-asbestos friction material.

The Purchaser will supply air for brakes at a nominal pressure of 700 kPa. A solenoid valve furnished by the Contractor will control the brakes. For normal operation the brakes will be applied at the coasting speed of the Unit and will be applied continuously until 5 minutes after the Unit is stopped. A pressure switch

shall supervise the brake air pressure supply and shall be wired to the Purchaser's control system.

The Contractor shall also supply two manually operated valves to bypasses the solenoid valve. One valve shall be located adjacent to the Purchaser's governor cubicle and the other valve should be located in the generator pit near the entrance.

Each brake shoe shall have a brake position switch with two electrically separate contacts, one normally closed and one normally open. Alternatively, proximity probes can be used for brake position indication. The Contractor shall wire these switches to the Purchaser's 125 Vdc control and alarm circuits.

A hydraulic oil pump and piping with manual control valves shall allow the brakes to be used as jacks. The vertical lift will be limited by turbine clearances. Safety blocks shall be provided by the Contractor for supporting the turbine and generator assembly during maintenance. The system shall be designed to allow compressed air to be applied at the dead end of the system to blow any oil out of the brake lines.

6.17 Bearings

6.17.1 General

The generator bearing(s) shall be designed to include the following features:

- 1) Fittings in the bearing oil reservoir(s) shall allow filling, draining or recirculating oil for conditioning.
- 2) Oil level monitor with adjustable high, low and extreme low alarm contacts and visual sight glass complete with a graduated plaque showing the normal operating range, high, low and extreme low oil levels.
- 3) Extreme low level mechanical alarm switch
- 4) Stationary wearing parts can be replaced without removing the bearing brackets or rotor.
- 5) The bearing(s) shall be designed to be free from oil throwing or emission of oil vapor.
- 6) Direct-reading water flow indicator with calibrated scale and adjustable alarm and trip contacts.
- 7) Drilled and tapped holes to accept proximity sensors in (each of) the guide bearing(s). The proximity sensors shall be located such that no bearing disassembly is required to replace faulty sensors.
- 8) Provision to mount accelerometers on the main generator bracket, adjacent to the thrust bearing housing.
- 9) Resistance temperature detectors measuring bearing oil temperature.

- 10) A lip on the access openings to prevent the oil that is left in the bearing after it is drained from spilling out when the access covers are removed.
- 11) Permanent platforms, if required, to allow maintenance of the bearings.
- 12) A handling system that allows, all removable, bearing components to be removed to an area that can be accessed by the powerhouse crane.

6.17.2 Cooling

The oil coolers shall be designed with the following features:

- 1) Material requirements for the coolers are listed in Subsection 3.1 Turbine and Generator Materials of the Technical Requirements.
- 2) To operate with strained cooling water to be supplied between 180 kPa and 210 kPa and 25°C at Elevation 150.0 m.
- 3) Pressure tested at test pressure of 315 kPa.

The Contractor shall supply all necessary valves and piping. The piping will be designed to include the following features:

- 4) Suitably insulated to prevent condensation from forming and dripping on the Unit.
- 5) The main shut-off valve for cooling water shall be an electrically controlled and operated valve located downstream of the oil coolers.
- 6) The solenoid shall be rated 125 Vdc and de-energized to open the cooling water valve. Auxiliary contacts on the valve shall indicate its position and shall be wired to the Purchaser's UCMS.
- 7) Allow each cooler to be individually pressurized to test for leaks.

In accordance with Subsection 8.4 Contract Dates of the General Requirements, the Contractor shall supply the volumetric flow rate of cooling water required and the size of the supply piping for each bearing cooler to allow for the design of the generator cooling water system.

6.17.3 Thrust Bearing

The Contractor shall supply either a babbitted thrust bearing or a PTFE thrust bearing.

If the Contractor chooses to supply a babbitted thrust bearing, the thrust bearing shall be designed to include the following features:

- 1) The material requirements for the steel for the thrust pads are listed in Subsection 3.1 Turbine and Generator Materials of the Technical Requirements.

- 2) Capable of carrying the weight of all the rotating parts of the turbine and generator, and the maximum unbalanced hydraulic thrust under all operating conditions of starting, running, and stopping.
- 3) The number of starts and stops under normal operating conditions shall not be restricted.
- 4) A High Pressure Oil Injection System (HPOIS), including the necessary oil pump, filters, piping and measuring instruments, complete with oil spill containment. The oil system shall have an ac motor driven pump.
- 5) Normal starting and stopping shall not damage the bearing if the bearing is at normal operating temperature and the HPOIS fails to operate.
- 6) The rotating ring shall be a single piece and constructed so that it may be removed and replaced by the spare rotating ring.
- 7) Thrust bearing shoes shall be positively restrained from lifting should the Unit rotating parts lift. The turbine shall limit the lift of the rotating parts to 12.5 mm and the Contractor shall confirm the adequacy of this clearance for removal of the bearing parts.
- 8) Four equally spaced resistance temperature detectors measuring bearing metal temperatures.
- 9) Each pad shall be stamped with its number on its inner and outer diameter of the steel base. Numbering shall be a minimum of 12 mm high. i.e. if there are 14 thrust pads the pads will be stamped numbers 1 through 14.
- 10) The Units shall be able to be rotated manually without the use of chain falls, winches etc.

The bearing HPOIS shall be designed to include the following features:

- 11) The oil pump will turn on automatically on a generator start signal or creep detection and turn off automatically when the Unit reaches 80% of synchronous speed.*
- 12) On shutdown, the oil pump will turn on at 80% of synchronous speed and will turn off automatically after the stopping sequence is complete. Manual controls shall be provided for maintenance and testing.*
- 13) Oil pressure gauge and pressure switch for high pressure start system.

****Signals to start and stop the HPOIS will be provided by the Purchaser's UCMS.***

The thrust bearing housing will be drilled, tapped and spot faced, for SAE style o-ring fittings, on each side of the housing where the supply and drain tubing enters and exits.

In accordance with subsection 8.4 Contract Dates of the General Requirements, the Contractor shall supply the details of the HPOIS pumps.

The Purchaser will supply motor starters in its MCC for the thrust bearing oil pumps.

If the Contractor chooses to supply a PTFE thrust bearing, the thrust bearing shall be designed to include the following features:

- 14) The material requirements for the steel for the thrust pads are listed in Subsection 2.1 Turbine and Generator Materials of the Technical Requirements.
- 15) Have a running surface composed of either pure Polytetrafluoroethylene PTFE or PTFE combined with glass fibre and molybdenum disulfide.
- 16) Have steps machined into the outer diameter of the PTFE surface in order to facilitate visual inspection of wear.
- 17) Each pad shall be stamped with its number on the inner and outer diameter of the steel backing plate. Numbering shall be a minimum of 12 mm high. i.e. if there are 14 thrust pads the pads will be stamped numbers 1 through 14.
- 18) The Units shall be able to be rotated manually without the use of chain falls, winches etc.

6.17.4 Guide Bearing(s)

The bearings shall be designed to include the following features:

- 1) The material requirements for the steel for the guide pads are listed in Subsection 2.1 Turbine and Generator Materials of this Technical Specification. The plates are to be free from cracks, delaminations, rolling defects, inclusions, or blemishes.
- 2) The number of starts and stops under normal operating conditions shall not be restricted.
- 3) Four equally spaced resistance temperature detectors measuring bearing metal temperatures.
- 4) Each pad shall be stamped with its number on the top and bottom of the steel backing plate. Numbering shall be a minimum of 12 mm high.

6.18 Lower Bracket

The lower bracket shall be designed to include the following features:

- 1) Transmit all axial rotational component loads to the powerhouse structure.
- 2) Transmit, in conjunction with the turbine guide bearing, all radial Unit rotational component loads to the powerhouse structure.
- 3) Be adjustable in both the vertical and horizontal directions to facilitate Unit alignments.
- 4) House the thrust bearing and generator guide bearing.

6.19 Ventilation, Cooling, Heating

Air, driven by the rotor spider, will circulate radially through ventilation slots in the rotor rim and stator core. Hot air will be cooled in surface air cooler heat exchangers outside the stator frame, before being redirected toward the rotor hub. The generator frame will have vanes to direct the ventilation airflow, and seals to maintain it as a closed-circuit system.

The cooling system *design* shall *include adjustable baffles to control total cooling air flow and cooling air distribution*.

The generator shall be designed to supply hot air for heating the powerhouse. The Contractor shall:

- 1) Supply and install manually operated louvers, in the U/S, Service Bay and Spillway sides of the generator enclosure, to extract the heated air from the generator. The Contractor shall supply the dimensions of the louvers and amount of heat available to heat the powerhouse in accordance with Subsection 8.4 Contract Dates of the General Requirements.
- 2) Supply and install gratings in the corners of the generator enclosure to allow air to return to the generator.

Collector ring cooling and the collector enclosure shall include the following features:

- 3) The collector rings shall be cooled with ambient powerhouse air drawn into the collector ring enclosure by a mechanical fan mounted on the shaft that is driving the collector rings.
- 4) The fan shall include a guard.
- 5) Provide sufficient cooling to meet the collector ring temperature requirement stated in Subsection 6.7 Temperature Guarantee of the Technical Requirements.
- 6) The design shall ensure that generator cooling air is entirely separated from collector ring cooling air.
- 7) The collector ring enclosure shall include filters for the outlet air. Filters shall be fire retardant material. Filters shall be sized to operate continuously for a minimum of one year without replacement. Filters shall have a maximum 5 micron size rating with a 99% particle capture efficiency, or higher.
- 8) The collector enclosure shall include ample size access doors to provide easy access to all the brushes. The doors shall be sealed with gaskets.
- 9) The cooling system components shall not hinder access for brush maintenance and any baffles that need to be removed for maintenance shall have quick release, captive type fasteners.

- 10) The collector enclosure shall include an RTD to measure outlet air temperature.
- 11) In order to facilitate removal of the collector enclosure, all wiring to the collector enclosure shall terminate at an intermediate junction box located on the generator cover support bracket.

6.19.1 Cooling Water Piping

The cooling water piping shall be designed to allow long enough straight runs for the proper installation of temporary flow meters and resistance temperature detectors that will be used during generator efficiency testing.

All cooling water piping shall be insulated to prevent condensation dripping inside the generator.

If cooling water piping is installed in pipe trenches, the Contractor shall supply support angle brackets to be embedded in the concrete and covers for the trenches. The covers shall use a manual T handle for removal and shall be held in place by their own weight.

6.19.2 Surface Air Coolers

a) General

Surface air coolers shall be grouped in two separate water circuits. Manual throttling valves on the discharge side shall control flow in each circuit. Each surface air cooler shall have all the necessary valves for balancing the flows in the system and for isolation of the main components. Direct reading flow gauges shall measure water flow in each circuit. Gauges shall have calibrated scales and shall be of a type approved by the Purchaser. Each flow gauge shall have two sets of adjustable low flow alarm contacts. These two gauges shall be supplied and installed by the Contractor.

The two surface air cooler water circuits shall be joined on the discharge side and emerge as a common flow. The Contractor shall supply and install a main control valve in the common discharge line. The valve shall be electrically operated and controlled, remotely operated, 125 Vdc solenoid, and shall be connected to the start chain.

Surface air coolers shall be constructed so that the water box covers may be easily removed and access gained for inspection and cleaning.

In accordance with subsection 8.4 Contract Dates of the General Requirements, the Contractor shall supply the volumetric flow rate of

cooling water required and the size of the supply piping for each surface air cooler to allow for the design of the generator cooling water system.

b) Operating Conditions

The following operating conditions and performance requirements for the surface air coolers are as follows:

- 1) Maximum air flow pressure drop: 0.2 kPa
- 2) Maximum water flow pressure drop: 34.5 kPa / cooler
- 3) Design water pressure: 180 to 210 kPa at elevation 150 m
- 4) Maximum inlet water temperature: 25 °C
- 5) Minimum inlet water temperature: 0 °C

c) Design

The design of the new surface air coolers shall:

- 1) Be in accordance with ASME Boiler and Pressure Vessel Code, Section VIII.
- 2) Have sufficient heat exchange capacity to meet the operating conditions with ***a 25% loss in cooling capacity due to plugged tubes and or removed coolers. The unit will never be operated with more than one cooler removed at a time.***
- 3) Include magnesium anodes of sufficient size to protect the coolers for a period of five (5) years.
- 4) Include lifting lugs designed to carry the dry weight of each cooler with a minimum factor of safety of 5.0.
- 5) Include water header box drain and vent ports with plugs.
- 6) Be such that the tubes are adequately supported along their length to prevent damage due to vibration, movement, etc.
- 7) Have a wet side tube velocity of 1 m/s to 2 m/s.
- 8) Surface air coolers shall have two easily accessible tap connections for connection of a manometer.
- 9) Include ***Resistance Temperature Detectors (RTDs) mounted on a bracket centered across the downstream face of the coolers to measure the outlet air temperatures.***

d) Materials

The material requirements for the surface air coolers are defined in Subsection 3.1 Turbine and Generator Materials of the Technical Requirements. All materials shall be in accordance with ASME Boiler and Pressure Vessel Code, Section II and:

- 1) Tubes shall be straight, seamless, minimum 19 mm OD x minimum 1.25 mm wall thickness. Tubes shall be stress relieved following any straightening and/or sizing operations.
 - 2) Fins shall be aluminum, minimum 0.25 mm thick, permanently attached to the tubing. Fins shall withstand pressure washing at 3.5 MPa from a distance of 150 mm at a 45 degree angle without damage.
 - 3) Water header box seals shall be Buna-N Nitrile rubber.
- e) Fabrication
All welding and welder qualifications shall be in accordance with ASME Boiler and Pressure Vessel Code Section IX. Prior to commencing fabrication, the Contractor shall submit its welding procedures and welder qualifications to the Engineer for review and acceptance.
- f) Coatings
External side frames and supports shall be hot dip galvanized.

Internal and external surfaces of the water header boxes shall be coated to coating system S-2 in Subsection 3.12.6(b) Coating Systems and Color Schedule of the Technical Requirements.
- g) Pressure Testing
Each new cooler shall be pressure tested at 315 kPa for 1 hour. The test shall be considered a success if there is no evidence of leakage at the end of the test period. If the test is unsuccessful, the leak shall be repaired and the test repeated.
- h) Technical Information Included on the Drawings
At a minimum, the Contractor shall include the following information on the surface air cooler drawings:
- 1) Heat transfer rate
 - 2) Heat transfer coefficient
 - 3) Effective surface area
 - 4) Effective tube length
 - 5) Water inlet temperature
 - 6) Water outlet temperature
 - 7) Water flow rate
 - 8) Maximum water flow pressure drop
 - 9) Maximum air flow pressure drop
 - 10) Number of tube-side passes
 - 11) Number of fins per inch
 - 12) Fin thickness

- 13) Fin material
- 14) Tube wall thickness
- 15) Tube outside diameter
- 16) Tube material
- 17) Tubesheet material
- 18) Tubesheet thickness
- 19) Water box material
- 20) Magnesium anode weight
- 21) Percent excess capacity
- 22) Estimated dry weight

i) Shipping

The new coolers shall be completely drained in preparation for shipping.

6.20 Combined Stator and Rotor Stiffness

The combined stator and rotor stiffness shall be 20% greater than the maximum air gap magnetic stiffness. The combined stator and rotor stiffness shall be calculated by:

$$K_{\text{statorandrotor}} := \frac{1}{\frac{1}{K_{\text{stator}}} + \frac{1}{K_{\text{rotor}}}}$$

Where:

- $K_{\text{statorandrotor}}$ is the combined stiffness of the stator and rotor
 K_{stator} is the stiffness of the stator frame and core assembly
 K_{rotor} is the stiffness of the rotor spider and rim assembly.

As part of the stator and rotor design, the Contractor shall submit calculations, to the Engineer, of the stiffness of the rotor, the stator, the stator and rotor assembly and the magnetic stiffness of the air gap.

6.21 Stator

6.21.1 General

Accidental operation of the fire protection sprinklers shall not injure the stator. The Contractor shall supply a procedure for drying the stator.

The Contractor shall take the necessary measures to prevent dust, dirt and other contaminants, from the powerhouse, ancillary systems and Unit construction, from contaminating the stator core and winding during installation.

6.21.2 Soleplates

The Contractor shall supply radial key soleplates. The soleplates shall:

- 1) be designed for ease of installation and ease of adjustment after installation is complete,
- 2) allow for 7 mm total (3.5 mm up and down) of future adjustment of the stator level,
- 3) allow for 10 mm total (5 mm in each direction) of future adjustment of the stator alignment relative to the Unit centerline,
- 4) allow free expansion of the stator in the radial direction while maintaining the alignment of the stator to the Unit centerline,
- 5) utilize DEVA BM self-lubricating bearing material coupled with a hardened stainless steel sliding surface for both the vertical and horizontal sliding interfaces.

The Contractor shall supply a detailed procedure outlining all steps necessary to align and inspect the soleplates.

6.21.3 Frame and Core Assembly

The stator frame and core assembly shall:

- 1) Have a sufficient radial and ovalizing stiffness to maintain a stable air gap at all normal and abnormal operating conditions.
- 2) Meet all CEA erection tolerances.
- 3) In order to minimize the force that the stator frame imparts on the core, the minimum temperature of the stator frame shall be within 10 °C of the maximum temperature of the back of the stator core.

6.21.4 Frame

The stator frame shall:

- 1) Support the core.
- 2) Transmit the tangential loads from the core to the soleplates.
- 3) Thermally expand and contract equally at the top and bottom.
- 4) Provide adequate stiffness and strength to permit lifting of the *fully assembled*, piled and wound stator *from a minimum of four and maximum of eight points. Each point shall be designed and fabricated to accommodate a removable lifting lug attached with bolts to the frame. A drawing shall be prepared showing the designed lifting procedure identifying reaction loads on the lifting lugs, allowable deflections, safety factors and assumptions made regarding the lift procedure and device.*

- 5) Direct air and connect to the louvers in the generator enclosure.
- 6) Include brackets centered across the openings for the surface air coolers for the Purchaser to mount Resistance Temperature Detectors (RTDs) to measure the surface air cooler inlet air temperatures.

The stator frame shall have provision for grounding to the station ground system. Ground connections shall be two conductors 500 MCM copper at two opposite corners of the stator frame.

6.22 Core

6.22.1 General

Before core stacking begins, the surface that the core will be stacked on shall be level within 0.25 mm between the highest and lowest points.

The stator core shall:

- 1) Be stacked at Site in one integrated operation with the stator frame fully assembled and leveled.
- 2) Be designed such that the overlap of laminations is not equal to 1/2 a lamination.
- 3) During stacking, the core shall be subjected to intermediate presses two times spaced equally, or at every horizontal stiffener in the stator frame, whichever is greater.
- 4) Permit partial or complete field replacement of the stator windings without requiring major cutting, welding, heating or rework of the stator core or frame.
- 5) Permit partial or complete field replacement of the stator core laminations without requiring major cutting, welding or heating of the stator frame.
- 6) Have a maximum steady state temperature gradient in the core, from top to bottom of 5°C at rated output.

In order to verify the temperature requirement above, the temperature of the back of the core will be measured using the stator core RTDs embedded in the core.

Before starting manufacture, the Contractor shall submit the quality control methods for grading the core laminations for the Engineer's review.

a) Laminations

The core Laminations shall:

- 1) Be nominally 0.5mm thick.
- 2) Have losses not exceeding 3.2W/kg at 1.5 Tesla, 60 Hz

- 3) The depth of the core yoke shall be greater than or equal to the depth of the core slots.
 - 4) Lamination material requirements are listed in Subsection 3.1 Turbine and Generator Materials of the Technical Requirements.
 - 5) Have a C-5, C-6 or C-3 coating or equal, to ASTM A976, on both sides to insulate laminations from each other and minimize eddy current losses.
 - 6) The laminations insulation coating shall be of uniform thickness and finish, without visual or hidden defects and thermally stable and unaffected by moisture.
 - 7) Be de-burred after punching and reinsulated. Burrs shall not to exceed 15% of lamination thickness
 - 8) Adequately keyed to the stator frame.
 - 9) Designed and assembled to minimize noise from excitation and to offer minimum resistance to airflow
- b) Air Duct Space Blocks
The inside air ducts spacers shall:
- 1) Be constructed from non-magnetic stainless steel.
 - 2) Have an I-beam or rectangular cross section.
 - 3) Provide sufficient support for adjacent laminations to prevent edge collapse of the laminations.
- c) Core Clamping System
The core clamping system shall:
- 1) Have a minimum core clamping pressure of 1.5 MPa.
 - 2) Clamping fingers shall be non-magnetic stainless steel and shall not be welded to adjacent laminations. Cast metal finger supports for the teeth of the laminations will not be accepted.
 - 3) Allow access to the clamping bolts after the stator is completely wound and the circuit ring bus has been installed.
 - 4) Have one piece core clamping studs that are long enough to extend past the top and bottom of the core.

The Contractor shall provide the Engineer with a recommended core clamping bolt stretching/torquing program to ensure that the core clamping is maintained as the core settles. The program will contain:

- 5) Details on how the clamping bolts are to be stretched or torqued.
- 6) A schedule for the stretching or torquing.
- 7) Acceptance criteria for when the program is over.

- d) **Slot Varnish and Penetrating Epoxy**
Semi-conducting varnish shall be applied to the stator slots. The Contractor may submit other methods for maintaining low slot contact resistance for review of the Engineer.

The air gap face of the stator teeth shall be coated with penetrating epoxy. To reduce vibration the two uppermost lamination packets and the two lowermost lamination packets shall receive two coats of penetrating epoxy.

- e) **Core Temperature Monitoring**
The Contractor shall supply and install at least twelve resistance temperature detectors embedded in the stator core. The RTDs shall be installed at each of 3, equally spaced, elevations at 4, equally spaced, stator sole plate locations.

The RTDs shall be:

- 1) 3-lead type, platinum DIN, 100 ohms at 0°C, 0.00385 ohm/ohm/°C
- 2) Class F body

The RTD connections, cables and conduit shall include the following:

- 3) A Western Union splice with 63/37 Eutectic solder shall be used to connect the RTD lead wire to the RTD extension cable.
- 4) Supply and install a grounded rigid galvanized steel conduit to route the RTD extension cables around the circumference of the stator and to the terminal board.
- 5) RTD cables shall be shielded twisted triad cables.
- 6) Supply and install RTD terminal board and junction box.

6.22.2 Shrouding

The generator shrouding shall:

- 1) Be constructed from fibre glass that conforms to ASTM E84 class 1 with stiffeners that conform to either FAR 25.583 or UL94-V0 or Purchaser approved equivalent.
- 2) Have a maximum per piece weight of 40 lbs.
- 3) Allow for any individual piece of shrouding to be removed with out having to remove any of the adjacent pieces.
- 4) Use a fastening system including “Fujilock” self locking nuts.
- 5) Any seals shall be attached using a non-metallic fastening system.

6.22.3 Stator Winding Configuration

The generator stator winding shall:

- 1) Be wye-connected
- 2) Have parallel circuits per phase
- 3) Be wound with single turn Roebel bars.

6.22.4 Stator Insulation

The stator bars and stator bar insulation system shall be designed with the following requirements:

- 1) Stator bar insulation system shall be Class F.
- 2) Groundwall insulation shall be mica based.
- 3) Each stator bar shall be consistent in shape and dimensions to the following tolerances:
- 4) Bars slot section width within ± 0.25 mm
- 5) End head drop back within ± 5.0 mm in both the radial and tangential directions.
- 6) Stator bars shall be identified with stamped numbers on the strands.
- 7) Stator bars shall be taped to prevent discontinuities between the straight and overhung portions.
- 8) The insulation thickness on the corners of the stator bar is not less than the minimum thickness shown on the design drawings.
- 9) Stator bar insulation shall be bonded with a thermo-setting resin. The Purchaser prefers that a vacuum and pressure process be used to cure the resin, to eliminate void formation and to ensure uniformity of the slot portion of the bars. Pre-impregnated resin-rich mica tape heated in a press is also acceptable.
- 10) The surface of the bar insulation in the slot sections shall be provided with an armour tape saturated and coated with a semi-conducting material. Over the armour tape, the Contractor may elect to apply a formulation of CRTV/RTV so as to provide an interference fit of the bar in the slot.
- 11) The bar ends shall have a stress control system, which shall effectively eliminate surface discharge at normal operating voltage. Where the stress control system consists of a non-linear resistive tape and/or coating on the surface of the bar, it shall not be covered by insulating varnish before installation, so as to facilitate power factor tip-up tests at Site (out of stator) on selected bars for each generator.
- 12) Exposure to a humid atmosphere shall not damage the bar insulation.

The functional durability of all of the above coatings shall be demonstrated by accelerated aging tests. As described in Subsection 5.22.3(c) Thermal Cycle and Voltage Endurance Tests of the Technical Requirements, voltage endurance tests

will be made by the Purchaser on selected bars at 35 kV 120°C. During these tests there shall be no visible loss (exposing the fibres of the armour tape) of either semi-conducting or stress control coating in less than 250 hours.

6.22.5 Stator Bar Wedging and Side Packing

The wedging system shall maintain the slot contents under a compressive load, radially towards the bottom of the slot under conditions of cycling between no load and maximum machine rating and shall include the following:

- 1) Two-piece milled NEMA G11 wedges with tapered tightener or selectable widths of non-tapered tightener.
- 2) At least 3 wedges per slot with gauge holes to check ripple spring compression.
- 3) Krempel radial ripple spring, Class F. The radial ripple spring shall be one-piece, the full height of the core.
- 4) The wedges shall extend 3mm further than the wedge groove at each end of the core.
- 5) If the bottom wedge is to be installed last (and has a tapered slide) then this wedge shall be designed for the slide to enter from the bottom.
- 6) Designed to prevent axial movement of the wedges in the slot and to prevent migration of the wedge material out of the slot.
- 7) Depth packing shall be Class F material.
- 8) The depth packing strip adjacent to the bar shall be a minimum of 0.5 mm thick and not less than the gross length of the core. Thinner and shorter lengths, not less than 300 mm, of packing material may be used immediately adjacent to the tightener of the wedge.
- 9) The center separator between top and bottom bars shall be semi-conductive laminate, class F material, and one piece.
- 10) The bottom filler shall be semi-conductive and class F material.
- 11) Slot liners are not allowed.

Where bars have not been furnished with a coating of CRTV/RTV to provide an interference fit in the slot, a side packing system shall be installed between the left hand side of each bar and the slot (as viewed from the rotor) and shall include the following:

- 12) Krempel ripple spring, Class F.
- 13) Semi-conducting material impregnated throughout.
- 14) Bar maximum vertical gap of 15 mm between pieces of side packing.

6.22.6 Air Clearance for Energized Stator Winding Components

The stator winding shall be designed and installed to provide the following:

- 1) Minimum of 13 mm air clearance between energized stator winding components including end-arms, pole jumpers, circuit taps and circuit ring bus.
- 2) Minimum of 65 mm air clearance between ground and energized stator winding components including end-arms, pole jumpers, circuit taps and circuit ring bus.
- 3) Consistent spacing between end-arms. To verify clearance between adjacent stator bars, the Contractor shall place the stator bars in a mock partial stator assembly at the Contractor's shop and check clearance between bar end-arms and check the pole jumper fit for each type of pole jumper.

The Contractor shall indicate air clearance between all stator winding components on the drawings including, but not limited to, clearance between endarms, between pole jumpers, between stator bar and finger plates, spacing between circuit ring bus conductors.

For the stator winding, circuit ring bus, and leads, sufficient clearance shall be maintained between phases and from phases to grounded metal to ensure that there will be no ultraviolet emissions at operating voltage as detected by the Forsyth Corona Scope or equivalent instrument. For un-insulated terminals, clearances shall be maintained as listed in Table 8.1 of CAN3-C308-M85 "The Principles and Practice of Insulation Coordination"

6.22.7 Winding and Circuit Ring Bus Supports, Connections and Leads

The completed stator winding and ring bus shall be adequately supported and braced to withstand the full stresses due to electrical fault conditions, including faults at the 13.8 kV generator terminals.

Generator leads from the circuit ring bus to the generator main and neutral terminals shall include:

- 1) Removable links at the line and neutral end of each stator circuit to allow for testing of each individual stator circuit.
- 2) Copper bus with Class F insulation.
- 3) Flexible links connecting the stator winding to the generator bus where it is held rigidly on the stator frame or generator enclosure.
- 4) Phase isolators of NEMA GPO-3 or Purchaser's approved equivalent at connections where the bus is uninsulated.
- 5) Exposed high voltage bus and connections shall be protected with insulated barriers (Strongwell Duragrate or Purchaser's approved equivalent) from personnel contact.
- 6) Neutral leads shall be insulated for full terminal voltage.

- 7) Bolted connections shall be silver plated. Soldered connections shall not be permitted on generator lead connections that the Purchaser requires to be removable.
- 8) Permanent identification labels for each stator winding circuit at the main and neutral leads.
- 9) Bus supports fabricated from NEMA GPO-3 material or Purchaser approved equivalent.

Circuit rings shall include:

- 10) Silver plated terminals brazed to the ends of the line and neutral of each circuit suitable for connection to the generator leads.
- 11) Circuit rings shall be insulated with Class F material.
- 12) If the winding includes an equalizer connection between circuits, this connection shall include a removeable bolted link with removeable insulating boot so that the stator winding circuits can be individually isolated for testing.

Circuit ring bus supports shall be:

- 13) Fabricated from NEMA GPO-3 material or Purchaser approved equivalent.
- 14) Clamps used to support circuit ring bus shall be chamfered to protect insulation from damage during thermal cycling.
- 15) The circuit ring bus clamping system shall be designed to accommodate radial expansion of the circuit ring bus.

Surge rings shall be:

- 16) Fabricated from non-magnetic stainless steel
- 17) Insulated with minimum Class B material.
- 18) Supports shall be GPO-3 material or Purchaser approved equivalent.

Connections involving bars, jumpers, and circuit ring bus shall be:

- 19) Brazed with silver solder (Silfos). The Purchaser prefers induction type brazing. The Contractor shall prepare a complete schedule of brazing procedure consisting of detailed procedure specifications for each joint to be brazed for review by the Engineer. Brazing shall not be performed without an approved brazing procedure.
- 20) The Contractor shall supply two examples of brazed connections for the Engineer to use for brazing quality control of coil series connections and pole jumper connections.
- 21) Insulated throughout with Class F insulation.

All materials used in lashings shall be Class B or better.

For fully insulated ring bus and leads, sufficient clearance shall be maintained between phases and from phases to grounded metal to ensure that there will be no ultraviolet emissions at operating voltage as detected by the Forsyth Electro-Optics Corona Scope, or equivalent device. For uninsulated terminals, the minimum clearance shall be maintained as listed in Table 8.1 of CAN3-C308-M85 "The Principles and Practice of Insulation Coordination".

6.22.8 Winding Temperature Detectors

The Contractor shall supply and install at least twelve resistance temperature detectors embedded in the stator winding as follows:

- 1) RTDs shall be located in slots where both bars operate at no more than 50% of the terminal voltage.
- 2) RTDs shall be evenly distributed amongst three phases and located with equidistant spacing around the stator.
- 3) In accordance with IEEE Standard C50.12.
- 4) Locations of the RTDs shall be shown on the stator winding diagram.

The RTDs shall be:

- 5) 3-lead type, platinum DIN, 100 ohms at 0°C, 0.00385 ohm/ohm/°C
- 6) Class F material for the laminate body

The Contractor shall supply and install the following:

- 7) RTD leads shall be routed from the stator slot to the stator frame to prevent interaction with the stator bar stress control system.
- 8) A Western Union splice with 63/37 Eutectic solder shall be used to connect the RTD lead wire to the RTD extension cable.
- 9) A grounded rigid galvanized steel conduit to route the RTD extension cables around the circumference of the stator to the RTD junction box.
- 10) RTD cables shall be shielded twisted triad cables.
- 11) A RTD junction box with gas-diode terminal blocks.
- 12) Show all cable routing and conduit system details for RTD cables inside the generator enclosure on the Contractor's drawings instead of repeating this line everywhere, just make a bullet list of all items that have to be on this drawing.

6.22.9 Partial Discharge Couplers

The Purchaser will:

- 1) Supply the required number of 80 pF \pm 3 pF epoxy-mica 15 kV couplers (Iris or equal) for on-line partial discharge monitoring. The required number is typically one coupler per stator winding circuit.
- 2) Supply a ground isolation circuit, triaxial signal cable, and a termination panel to be installed on the outside of the generator enclosure.
- 3) Make the necessary measurements for adjusting the length of the triaxial signal cable and will terminate the cables at the panel.

The Contractor shall:

- 4) Provide a detailed installation drawing of the coupler HV connection to the circuit ring.
- 5) Provide a suitable means of attaching the coupler to the high voltage conductor. The flexible high voltage leads must be 65 mm from any grounded structure and other phases.
- 6) Install one coupler per circuit at the interface between the circuit ring bus and a line end bar.
- 7) Supply and install a grounded rigid galvanized steel conduit to route signal cables around the circumference of the stator and to the termination panel.
- 8) Route the signal cables to the termination panel. There must be 75 mm air clearance between the base of the coupler or triaxial cable to any insulated high voltage component.
- 9) Supply and install one 24inch x 24inch enclosure to store excess signal cables. The excess cable should be formed into an open loop not a coil, as a coil can increase the inductance of the cable and may distort the partial discharge pulses.
- 10) Show all cable routing and conduit system details for partial discharge signal cables inside the generator enclosure on the Contractor's drawings.

6.22.10 Stator Bar Servicing

The design and installation of the stator bars shall be such that it will be possible at any time in the future to lift or remove fully installed and wedged stator bars without extensive dismantling of the rotor. If during installation, it is necessary for the Contractor to lift or remove bars from the stator slots once they have been installed, the Contractor shall obtain the Engineer's approval prior to any lifting or removal.

6.22.11 Current Transformers

The Contractor shall supply and install the following current transformers and related equipment:

- 1) Two relaying accuracy (C400) current transformers per circuit at each of the neutral leads.
- 2) One metering accuracy (0.2B1.8) current transformer per circuit at each of the neutral leads.
- 3) Nominal 5 A secondary for rated CT input current.
- 4) CT Ratios shall be reviewed by the Purchaser.
- 5) Current transformers shall be connected in a wye configuration with the neutral grounded.
- 6) One CT shall be connected in the leads between the neutrals to monitor inter-neutral current. This CT shall have taps at 300/200/100-5A ratio with a relaying accuracy class of C300.
- 7) CT shall have pigtail leads of six feet in length to reach the local CT junction box adjacent to the CTs without additional splices.
- 8) One local CT junction box at each neutral location
- 9) One Main CT junction box located on the outside of the generator location that is convenient for routing cables to the Purchaser's protection panels.
- 10) All current transformers shall be securely mounted and protected from mechanical damage.
- 11) The exposed high voltage conductor at each of the neutrals shall be shielded from accidental contact by personnel.

6.22.12 Neutral Grounding

The stator winding neutral shall be grounded through a transformer and resistor combination which shall be supplied by the Contractor. The Contractor shall determine the transformer and resistor rating in order to match the requirement of the stator winding. The Contractor shall supply a cubicle to house the neutral grounding transformer and resistor for mounting outside of the generator enclosure. The neutral grounding cubicle shall include a separate control panel (1m height x 0.6m width x 0.4m depth complete with back panel) to contain Purchaser's generator protection equipment. There shall be provision on the neutral grounding transformer secondary side cable to mount a Purchaser supplied current transformer.

The neutral grounding cubicle is typically located adjacent to the outside wall of the generator enclosure. If the neutral grounding cubicle is not located directly against the generator enclosure wall, the Contractor shall supply and install a short section of ventilated covered cable tray to route the neutral grounding cable from the generator enclosure to the neutral grounding cubicle. Inside the generator enclosure, the neutral grounding cable shall either be armoured or routed in rigid conduit or cable tray.

6.23 Rotor

6.23.1 General

Fasteners on rotating parts shall use “Fujilock” self locking nuts with a suitable thread locking compound, and non-removable nuts shall be welded. Tack welding is not acceptable.

Accidental operation of the fire protection sprinklers shall not injure the rotor. As part of the rotor design, the Contractor shall submit a procedure for drying the rotor to the Engineer for review.

The rotor top surface will have permanent numbered markings corresponding to the center of each runner blade to facilitate positioning the Unit for cavitation maintenance.

6.23.2 Spider and Rim Assembly

The rotor rim and spider assembly shall:

- 1) Be a shrunk design with a shrink fit that shall be maintained up to 110% of rated speed.
- 2) Meet all CEA erection tolerances.
- 3) Remain circular, within CEA erection tolerances, up to a minimum of 110% of rated speed. The Purchaser will use an air gap monitoring system to verify during Unit commissioning.
- 4) Where pairs of tapered keys are used between spider arms and the rim, one key of each pair shall extend beyond the joint between the spider and the rim. Shear forces shall be taken by the material of the key, not the joint between the keys.

The rotational speed when the rim starts to float shall be measured by the Contractor after the Purchaser’s overspeed trip test.

6.23.3 Spider

The rotor spider shall be designed to:

- 1) Keep the rotor rim concentric, within CEA erection tolerances, to the axis of rotation at all times. The Purchaser will use an air gap monitoring system to verify.

6.23.4 Rim

Spacers, if used in the rotor rim sections, shall be welded in place. Tack welding is not acceptable.

6.23.5 Field Winding and Poles

The field poles shall:

- 1) Be held to the rim with tapered keys.
- 2) Be removable with the rotor rim in place.
- 3) Include Class F pole body insulation material.
- 4) Include one-piece inner and outer pole collars fabricated from NEMA G11 material.
- 5) Include a suitable sealant to prevent dust and dirt from migrating between the winding and pole body insulation.

The field coils shall include:

- 6) Material requirements are given in Subsection 3.1 Turbine and Generator Materials in the Technical Requirements.
- 7) Silver plating where the field coil interconnection jumper bolts to the field coil.
- 8) Class F turn to turn insulation.

The rotor bus shall include:

- 9) Material requirements are given in Subsection *3.1 Turbine and Generator Materials* in the Technical Requirements.
- 10) Silver plating at all connections
- 11) 5kV Class F insulation with an outer layer of glass tape for protection.
- 12) G11 insulating blocks at rotor bus bar clamps
- 13) Be routed inside the rotor as much as possible.

The amortisseur winding shall:

- 14) Be continuous type design and adequately sized according to IEEE C50.12
- 15) Include flexible amortisseur interconnection jumpers. The jumpers shall be tinned copper braid with silver plated bolted pads on each end of the braid. The copper braid shall be crimped in the bolted pads with no brazing or soldering.
- 16) Include a fastener system for the interconnection jumpers that can be easily removed and installed with the rotor in place.

The tapered keys to connect the rotor poles to the rim shall:

- 17) Project above the rotor rim a minimum of 3” to allow use of a key puller or alternate arrangement of key removal approved by the Engineer.
- 18) Be designed to be removed without having to weld a key puller to the keys.
- 19) The tapered and opposite side of the driven keys shall be tinned.

6.23.6 Collector Rings and Brush Rigging

The collector rings and brush rigging shall be designed with the following features:

- 1) Collector rings shall be steel and installed in a ventilated enclosure above the rotor.
- 2) Rings shall be accessible for inspection during operation, and accessible for maintenance.
- 3) The brush surface of the rings shall have machined helical square thread grooves.
- 4) Collector brushes shall be National Electrical Carbon grade AY with twin pigtail leads.
- 5) Each collector brush shall have a maximum current of 55 A at rated load.
- 6) Brushholders shall be constant pressure type, National Electrical Carbon catalogue number GE505DUF.
- 7) Brushholder fasteners shall include split spring washers and Loctite to prevent loosening.
- 8) Carbon brush leads shall be fastened to the brush arm with fine thread machine screws. There shall be no quick-disconnect in the brush lead.
- 9) One additional brushholder and brush, insulated from the brush arm shall be supplied on each arm. The insulated brushes will be used by the Purchaser to measure collector ring voltage during commissioning.

6.23.7 Excitation Leads

The excitation leads shall include copper busbar from the brush rigging to the generator enclosure wall to connect to the Purchaser’s excitation system. The excitation lead busbar shall:

- 1) have Class F insulation, 5 kV class with an outer layer of glass tape for protection.
- 2) be UNS C11000 (EPT) copper bar with silver plated terminations and NEMA 4 hole connection.
- 3) include flexible links to connect to the Purchaser’s bus duct at the generator enclosure wall to compensate for any misalignment.
- 4) have GPO-3 insulating supports or approved equivalent.
- 5) have insulating cover plate at the hole in the generator enclosure wall.

6.24 Fire Protection

The generator shall have a water deluge sprinkler system with two sprinkler rings, one above and one below the stator and field windings. All piping, fittings, and other items associated with the sprinkler system, within the generator enclosure, shall be provided by the Contractor.

The generator sprinkler system shall comply with the following design parameters:

Ambient Conditions	Indoor Heated
Density of Coverage (Upper Ring)	12 L/min/m ²
Density of Coverage (Lower Ring)	20 L/min/m ²
System Design Pressure	950 kPa
System Operating Pressure	450 kPa
Capacity Per Unit	32 L/s (estimated)
Nozzles	Open
System	Dry Type

Pipe connections to the sprinkler rings shall extend outside the generator housing to a deluge valve (to be supplied by others).

In accordance with subsection 8.4 Contract Dates of the General Requirements, the Contractor shall supply the volumetric flow rate of fire water required and the size of the supply piping to allow for the design of the fire water system.

6.25 Enclosure and Structural Details

The generator shall have fabricated steel top covers and supporting bracket. The generator covers shall not require bolting in position, and shall have recessed lifting points. The top of the generator covers shall be flush with the concrete generator enclosure.

The Contractor shall supply a sheet steel enclosure houses the collector rings. The enclosure may also house the generator speed switch, described in subsection 6.15 Generator Speed Switch, and the overspeed device. The Purchaser shall supply the overspeed device. The enclosure shall have a temperature alarm wired to a terminal box. The enclosure shall be mounted proud of the generator covers.

Where headroom is less than 2300 mm, a screen shall be provided to protect personnel from contact with rotating parts. The Contractor shall supply a platform over the turbine pit opening in the generator enclosure.

6.26 Inspections and Tests

6.26.1 General

The Contractor shall perform the following tests, with the exception of tests indicated as to be performed by the Purchaser, furnishing all necessary labour, materials, procedures, test equipment and facilities.

6.26.2 Stator Core

Before starting manufacture, the Contractor shall submit the quality control methods for grading the core laminations. At the time of shipment of shop tested equipment and material, one copy of the test documentation shall be provided to the Engineer. The Contractor shall submit for review a Manufacturing Inspection and Test Plan identifying all material and equipment factory inspections and tests to be carried out on the stator core laminations in accordance with Section 48 QUALITY of the General Requirements.

The Contractor shall perform at least the following tests as part of its quality control:

- 1) Epstein core-loss test, as per ASTM A343 to determine the core loss at 1.0 and 1.5 T
 - 2) Franklin test, as per ASTM A717 to verify insulation quality
 - 3) Dimensional checks, shearing and burr tests
 - 4) Laminations staking factor test
 - 5) Insulation thickness as per ASTM E376 and B499
- a) Loop Test

The Contractor shall provide calculations and a procedure to specify the number of turns and voltage for the loop test. The Contractor shall provide a technical representative to witness that the requirements of the Contractor's procedure are respected during the loop test.

After completion of stacking of the stator core, the Purchaser will:

- 1) employ a temporary winding to establish rated flux density in the core (loop test),
- 2) energize the core until the temperature of the core has stabilized, but for not less than one hour,

- 3) conduct an infrared scanning to detect any localized hot-spots. Hot-spot temperatures in excess of 5°C above the average core temperature shall be repaired by the Contactor. The test will be repeated until no hot-spot temperatures exceeding 5°C above average core temperature are detected.

The Contractor shall:

- 4) allow time within its schedule for the loop test,
- 5) retorque the core bolts to the manufacturer's specifications at the conclusion of the test,
- 6) repair any hot-spot temperatures in excess of 5°C above the average core temperature.

6.26.3 Stator Bar

The Contractor shall perform, as a minimum, the tests listed below on each stator winding bar, including spares, after manufacture and immediately prior to shipment. Failure of any test shall be grounds for rejection of the bar.

a) Strand Insulation

During manufacture, strand to strand insulation shall be tested at a minimum of 110 V rms, 60 Hz.

b) Corona

Factory tests shall be made to ensure there is no corona on the stator bar end windings. A total of 5% of the stator bars shall be tested. The bars shall be supported with identical geometry as in the actual stator core and the slot portion of the bar shall be grounded. The bar shall be subjected to 115% rated line to line voltage, 60 Hz with adjacent bars grounded. There shall be no ultraviolet emissions as detected by the Forsyth Corona Scope or equivalent instrument.

c) Power Factor Tip Up

All stator bars shall be tested for power factor tip up according to the IEEE "Recommended Practice for the Measurement of the Power Factor Tip Up of Rotating Machinery Stator Coil Insulation" (IEEE Standard 286, edition current at the time of tests). The results of these tests shall be made available to the Engineer prior to delivery of the bars. After manufacture, 100% of all bars shall have a 0.2 Vn to 1.0 Vn power factor tip up equal to or less than 0.6% and 95% of all bars shall have a power factor tip up equal to or less than 0.5%, where Vn equals the generator rated phase to neutral voltage. Bars with tip up of 0.51% to 0.6% shall be suitably identified, and prior to the commencement of the rewind the Engineer may, at its option, direct the Contractor to install these bars in the neutral 35% of the winding.

In addition to the above, the Purchaser will conduct power factor tip up tests at the Site on 5% to 10% of the stator bars prior to their being installed in the stator. These bars may be subjected to tip up tests at voltages up to 20 kV using the method described in IEEE Standard 286-2000 Section 8.1.1. This work will be scheduled so as not to impede the installation of the winding. Stator bars subjected to tip up tests at Site will also be subjected to partial discharge screening tests as described in Subsection 6.26.3 (e) Partial Discharge Screening Tests of the Technical Requirements.

d) Corona

Factory tests shall be made to ensure there is no corona on the stator bar end windings. A total of 5% of the stator bars shall be tested. The bars shall be supported with identical geometry as in the actual stator core and the slot portion of the bar shall be grounded. The bar shall be subjected to 115% rated line to line voltage, 60 Hz with adjacent bars grounded. There shall be no ultraviolet emissions as detected by the Forsyth Corona Scope or equivalent instrument.

e) Partial Discharge Screening Tests

The same bars selected for the Purchaser's power factor tip up tests listed in Subsection 6.26.3 (c) Power Factor Tip Up of the Technical Requirements, plus others which the Purchaser wishes to include, will be subjected to partial discharge screening tests at voltages up to 30 kV using the method described in IEEE Standard 1434-2000 Guide to the Measurement of Partial Discharges in Rotating Machinery, Table 3 Case 3. The Engineer may, at its option, direct the Contractor to install bars with high partial discharge readings, in the neutral 35% of the winding. If evidence of internal delamination is found during these tests, corrective actions will be pursued after discussion between the Contractor and the Engineer.

6.26.4 Rotor Field Poles

a) Individual Poles in Shop

The field poles shall be tested at the Contractor's shop to ensure that no faults exist between coil turns or from the coil winding to the pole body.

b) Completed Winding following Installation on Rotor

Immediately following the completion of on-site installation of the field poles on the rotor by the Contractor, the complete rotor winding shall be tested by the Contractor to verify the integrity of the turn-to-turn and winding-to-ground insulations. The purpose of these tests is to demonstrate that no deterioration or injury has occurred during transportation to Site or during installation of the poles.

A final acceptance high-potential test on the rotor field winding at 5000 Vrms, 60 Hz will be performed by the Purchaser during generator commissioning, as described in the Technical Requirements.

6.27 Generator Tests by the Purchaser

The following tests will be performed by the Purchaser:

a) Thermal Cycle and Voltage Endurance Tests

The Contractor shall supply seven bars from the production run for accelerated aging test purposes. These seven bars shall be in addition to those required for the winding installation and the spare parts requirement. Bars from the production run shall be selected by the Engineer on a random basis, representative of all stages of production, unless otherwise specified by the Purchaser. If the stator bars for all generators are made in one continuous production run without interruption, then one thermal cycle and voltage endurance test will represent the entire production run. Otherwise, a thermal cycle and voltage endurance test will be performed for each separate production run.

The seven bars must all be delivered to the Purchaser's test facility in Winnipeg, Manitoba in accordance with subsection 8.4 Contract Dates of the General Requirements.

At the Purchaser's expense, testing will be performed at its laboratory on each of the seven bars selected from each production run as follows:

- 1) Two (2) bars, (1 bottom bar and 1 top bar) for voltage endurance test only
- 2) Four (4) bars, (2 bottom and 2 top) for thermal cycle test followed by voltage endurance test
- 3) One (1) bar for temperature reference during thermal cycle tests. This bar will not be subjected to the voltage endurance test.

b) Thermal Cycle Test

The thermal cycle testing will be carried out generally in accordance with IEEE Standard 1310 "Recommended Practice for Thermal Cycle Testing of Form Wound Stator Bars and Coils for Large Generators". During thermal cycle testing, the bars under test, together with the temperature reference bar, will be connected in series.

Heating will be accomplished by circulating an alternating current sufficient to achieve 130°C at the copper within 30 to 50 minutes. Cooling will be accomplished with forced air to achieve a 40°C conductor temperature within 30 to 50 minutes. A thermocouple located on the

copper of the temperature reference bar at mid slot will be used to determine the copper temperature. The temperature reference bar will be centrally located relative to the other bars. The thermal cycle test is comprised of 500 cycles of heating and cooling.

Diagnostic tests will be made initially and after thermal cycles 10, 50, 100, 250 and 500 consisting of:

- 1) dissipation factor measurements from 2 kV to 30 kV in increments of 2 kV using the method described in IEEE Standard 286-2000 Section 8.1.1.,
- 2) partial discharge measurements of the type listed in Subsection 6.26.3 (e) PARTIAL DISCHARGE SCREENING TESTS of the Technical Requirements at 30 kV followed by 16 kV, 12 kV and 8 kV,
- 3) physical measurements of the width and depth of each bar at five equally spaced locations in the slot section. Also, each bar will be tapped to determine evidence of delamination.

Following the thermal cycle test, the following conditions should be met:

- 4) Measurable dimensional changes shall not exceed 0.005 inch.
- 5) No delamination detectable by tapping, confirmed by dissection.
- 6) The predominance of negative polarity partial discharge pulses shall not exceed $(-NQN) / (+ NQN) > 2.0$ where NQN is defined in IEEE Standard 1434.

c) Voltage Endurance Test

i) Procedure

The voltage endurance tests will be made in accordance with IEEE Standard 1043 "Recommended Practice for Voltage Endurance Testing of Form Wound Bars and Coils". Complete stator bars will be tested for voltage endurance at 35 kV, 60 Hz, at a steady state temperature of 120°C continuously to breakdown.

ii) Voltage Endurance Test Pass/Fail Criteria

The minimum time to breakdown under these test conditions shall not be less than 250 hours in accordance with Table 1 Schedule B of IEEE Standard 1553-2002 "Trial Use Standard for Voltage-Endurance Testing of Form-Wound Bars and Coils for Hydrogenerators". The "pass/fail" criteria are specified in IEEE Standard 1553.

In accordance with IEEE Standard 1553, if any of the six bar legs fail on voltage endurance in less than 125 hours, or if two or more bar legs fail in less than 250 hours then the complete production batch associated with the bars under test is considered as not complying with the requirements.

Corrective actions will be pursued after discussion between the Contractor and the Engineer. If no corrective action can be achieved, the Purchaser reserves the right to note the Contractor in default in accordance with Section 33 TERMINATION of the General Conditions.

The Engineer reserves the right to suspend the commencement of stator bar installation until all thermal cycle and voltage endurance test results are obtained and are accepted by the Purchaser.

iii) Dissection

Following each failure on voltage endurance, the Contractor will be invited to participate in the dissection of failed bars at the Purchaser's laboratory.

d) Winding Hi-pot Test

The completed stator winding shall be subjected to twice the rated line to line voltage plus 1 kV rms, 60 Hz for one minute on each individual circuit, or phase, with all other circuits grounded. This may be done before or after a dryout, as desired by the Contractor. Prior to and following this high-potential test, the insulation resistance and polarization index shall be measured using a 5000 V insulation resistance tester. The minimum values recommended by IEEE Standard 43 shall be obtained before the high-potential test is carried out. The Purchaser will perform the final high-potential test following the completion of mechanical run(s) on the Unit.

NOTE: The Purchaser may choose to initially perform this test prior to installation of the rotor in the generator. The Purchaser may, at its option, repeat the test later in the commissioning process. The final overpotential test will normally be conducted following the completion of mechanical run(s) on the Unit.

The Purchaser may elect to make the overpotential test at an average RTD temperature which is representative of full load conditions.

i) Winding Resistance

If the resistance of any of the circuits is more than 1.5% above the average resistance of the circuits, the Contractor shall supply suitable test equipment and shall conduct a test to apply controlled current to the stator winding and identify high resistance connections with a thermal camera.

ii) Winding Partial Discharge

The Purchaser will make partial discharge measurements on the completed winding using the TVA Peak Pulse Meter and ferrite probe. Prior to placing a Unit in-service, all readings shall be less than 5 mA peak pulse, and at the end of the warranty period, all readings shall be less than 10 mA peak pulse. These measurements are to be made with each circuit energized at 8 kV rms, 60 Hz with respect to ground, and with all other circuits grounded.

Partial Discharge test results are included in Appendix DD.

iii) Corona Test

The completed stator winding shall be subjected to 115% rated line to ground voltage, 60 Hz, on each individual phase, with all other circuits grounded. There shall be no ultraviolet emissions as detected by the Forsyth Corona Scope or equivalent instrument.

iv) Rotor Hi-Pot Test

The rotor field winding shall be subjected to **5000 V rms, 60 Hz to ground for one minute. This test will be performed** before the rotor is placed into the generator pit. This test will be repeated with the test potential applied at the slip rings after the rotor fans have been installed following the overspeed test. Prior to and following the high-potential test, the insulation resistance and polarization index shall be measured using a 1000 V insulation resistance tester. The minimum values recommended by IEEE Standard 43 shall be obtained before the high-potential test is carried out.

6.28 Generator Efficiency (Purchaser's Option)

If this option is exercised by the Purchaser, the Contractor shall determine the generator efficiency by the calorimetric method in accordance with IEC 34-2A. The Contractor shall provide test procedures, test equipment, all required instrumentation and shall perform the tests.. The following losses shall be determined by the tests and shall be included in the computation of the generator efficiency:

- 1) Stator copper loss
- 2) Field copper losses
- 3) Stray load losses
- 4) Core losses
- 5) Windage and friction losses

6.29 Insulation System Pre-Production Verification

The Purchaser wishes to maximize the probability that the stator bars randomly chosen from the production run will pass the applicable tests described in Subsections 6.27 Generator Tests by the Purchaser of the Technical Requirements. Therefore, in advance of the production run, the Contractor shall supply a set of 7 stator bars that are representative of the production run bars for the Purchaser to test according to the same method used in Subsection 6.27 Generator Tests by the Purchaser of the Technical Requirements. Stator bars that are within the following tolerances of the production run bars will be considered as acceptable representatives of the production run bars:

- 1) Ampacity: +/- 20%
- 2) V/mil: +/- 10%
- 3) Length of bar: +/- 20%

The tests on the representative stator bars must meet the pass requirements of Subsection 6.27 (c) ii) Voltage Endurance Test Pass/Fail Criteria prior to the date listed in Subsection 8.4 Contract Dates of the General Requirements. The Contractor shall allow 10 weeks for a complete set of tests.

7 GOVERNOR AND STATIC EXCITATION SYSTEM

The supply of the governor and static excitation system are outside the scope of the Contract and will be provided by the Purchaser. The Contractor shall supply the Purchaser with all necessary information to insure the governor and static excitation system will fully integrate with the generator.

8 INSTALLATION

8.1 DESCRIPTION OF WORK

The Work includes but is not limited to:

- 1) Installation and pre-commissioning of all turbine and generator equipment supplied for the Keyask Project except where as noted in Subsection 8.3

- Turbines through Section 9 COMMISSIONING of the Technical Requirements
- 2) Supervision of the installation of the turbine and generator equipment supplied for the Keeyask Project as set out in Subsections 8.3 Turbines through 8.5 120/240 V AC Panels, Generator and Turbine Pit Lighting and Convenience Outlets of the Technical Requirements.
 - 3) Touch up painting of all turbine and generator equipment supplied for the Keeyask Project.
 - a) All equipment and tools necessary to carry out the Work.

8.2 General

The Contractor shall install and align turbines and generators in accordance with the most recent version of the following:

- 1) The CEA 'Hydroelectric Turbine-Generator Units Guide for Erection Tolerances and Shaft System Alignment', and
- 2) IEEE 1095 – 'Guide for Installation of Vertical Generators and Generator/Motors for Hydroelectric Applications

If the Technical Requirements conflicts in any way, or any discrepancies occur with the above standards, the Contractor shall refer to the Engineer for a decision.

The Contractor shall provide all jacks, supports and other items required to erect and align any embedded parts and to retain alignment during the placement of any concrete.

The Purchaser will supply power to all of the equipment control cubicles.

All piping systems shall be supplied and installed in accordance with the Manitoba Department of Labour Technical Bulletin 96-001. All turbine and generator piping shall be installed and pressure tested in accordance with ANSI B31.1 Power Piping Code.

All cables shall be identified at both ends using fibre tags stamped with the cable number or conductor identifier.

The Contractor shall fill all bearings with oil.

Space will be provided within the service bay for the Contractor to assemble some of the components. The elevation of the service bay will be the same elevation as the top of the generator enclosure. The service bay will be sized to be able to assemble one each of the following components, with a minimum of 1 m between components, at the same time:

- 3) Rotor,
- 4) Turbine Runner,
- 5) Lower Bracket (if it exists),
- 6) Discharge Ring and
- 7) Inner Head Cover.

The Contractor may request the Purchaser's approval to store unit components, equipment and tools in the spaces between the units. The spaces between the units will be designed for a floor live loading of 25kPa.

8.3 Turbines

The Contractor shall install and align all turbine equipment and components with the exception of all anchors for the draft tube liner, bottom ring and stay ring lower shroud that are to be installed in the primary concrete. The Purchaser will install all the anchors for the draft tube liner, bottom ring and stay ring lower shroud in the primary concrete. The Contractor shall ensure that the anchors are installed correctly and sign off in writing prior to the Purchaser placing the primary concrete around the anchors.

After the primary concrete is placed around the anchors the Contractor shall inspect the anchors to ensure that they did not move during placement. Any movement of the anchors during placing of the primary concrete shall be the responsibility of the Purchaser. If the anchors did not move during concrete placement then the Contractor shall sign off in writing. Any damage to the anchors after that point shall be the responsibility of the Contractor.

The Contractor shall install and align the draft tube liner and stay ring before any secondary concrete is placed. Once all above components have been installed and aligned, the Contractor shall forward its alignment measurements to the Engineer for review. The Engineer shall be given two working days to review the Contractor's measurements. When the alignment is reviewed and returned without comment, the Unit shall be deemed to be "Pit Free – Ready for Second Stage Concrete" and the Contractor shall vacate the Unit.

The Contractor shall be responsible for any deformation or movement of the embedments caused by insufficient rigidity, anchoring or bracing based on the agreed pour and grouting rates. Any movement or deformation resulting from any other cause during the installation of forms and placing the primary and secondary concrete shall be the responsibility of the Purchaser.

The Contractor shall install any embedded piping before the secondary concrete is poured.

The Purchaser will provide and install all forms required to place the secondary concrete around the draft tube liner, bottom ring and stay ring lower shroud. The Purchaser will incorporate the stay ring upper shroud into the form work for the pouring of the primary concrete that will make up the semi-scroll case roof. Once all the forms have been installed, the Contractor shall check the alignment of its components, and forward its alignment measurements to the Engineer for review to ensure that no movement occurred during the form installation. The Engineer shall be given two working days to review the Contractor's measurements.

The Contractor shall monitor the concrete placement to ensure that this operation meets the specified requirements and the Contractor shall report to the Engineer, in writing, immediately any problems which may influence subsequent placement.

The Purchaser, with the assistance (as far as monitoring and protecting the mechanical parts) of the Contractor, will place the secondary concrete around the draft tube liner, bottom ring and stay ring lower shroud. Concrete shall be placed at a maximum rate of 1.6 m of height per hour. The difference in height of the concrete around the circumference of the embedments, during placement, shall not exceed 300 mm at any time. The Unit will not be turned back over to the Contractor until 48 hours after the secondary concrete pour is complete. The Contractor shall not use the draft tube liner, bottom ring and stay ring lower shroud as references for aligning other components until 7 days after the concrete pour is complete.

The Purchaser, under the observation of the Contractor, will grout the draft tube liner, bottom ring and stay ring. The grout pressure shall not exceed 210 kPa. During the grouting, the Engineer, assisted by the Contractor shall monitor the components for movement. The grouting will not occur until the temperature of the secondary concrete is within 5 degrees C of the temperature of the primary concrete.

When the Unit is turned back over to the Contractor, the Contractor shall take post pour alignment measurements of the draft tube liner, bottom ring and stay ring and forward a copy to the Engineer for review. The Engineer shall map the draft tube liner for any voids in the concrete and forward a report to the Contractor for review. If any of the components are out of alignment, or the discharge ring has voids in the concrete, the Engineer shall discuss possible solutions with the Contractor. Any remedial action that is required resulting from factors outside the Contractor's control shall be considered extra work and a Proposal for Extra Work in accordance with Section 12 CLARIFICATIONS AND CHANGES TO THE WORK of the General Conditions shall be issued by the Engineer to the Contractor. The Contractor shall not begin to remedy the problem or install the remaining turbine components without written permission

from the Engineer in the form of a Work Instruction or Extra Work Order in accordance with Section 12 CLARIFICATIONS AND CHANGES TO THE WORK of the General Conditions.

Upon acceptance of the alignment measurements and soundness of the concrete, the Unit will be deemed to be "Pit Free – Ready for Installation of Turbine Non-Embedded Parts".

The Contractor shall install all piping systems from the turbine to the Purchaser's station header pipes including the connections to the headers with the exception of the head cover de-watering piping which shall be routed by the Contractor to the Purchaser's embedded drain pipe.

The Contractor shall install the servomotor piping up to the governor.

The Contractor shall wire all connections from the drainage pumps controls and motors to the MCC. The Purchaser will terminate the wiring in the MCC.

8.4 Generator

The Contractor shall install and align all generator equipment and components with the exception of all anchors for the lower bracket, brakes and stator sole plates that are to be installed in the primary concrete. The Purchaser will install all the anchors for the lower bracket, brakes and stator sole plates in the primary concrete. The Contractor shall ensure that the anchors are installed correctly and sign off in writing prior to the Purchaser placing the primary concrete around the anchors. The Contractor shall attach the lower bracket, brakes and stator sole plates to the primary concrete anchors.

The *Contractor is responsible to perform all work necessary to* place the secondary concrete around the lower bracket, brakes and stator sole plates. The Purchaser shall be notified at least two working days in advance of the Contractor's completion of its Work required prior to placement of the secondary concrete.

The Contractor shall be *solely* responsible for any deformation or movement of the sole plates, for the lower bracket (if it exists), brakes and stator.

The Contractor shall allow the secondary concrete to cure a minimum of seven days after placement before resuming work on the components embedded in the secondary concrete.

Once the Contractor has completed the alignment of the stationary and rotating turbine and generator components, it shall forward the alignment measurements to the Engineer for review. The alignment of all rotating and stationary components

shall be in accordance with the latest version of the CEA guidelines. The alignment of the brakes to the rotor shall be checked against the manufacturers recommended alignment tolerances. The Engineer shall be given two working days to review the Contractor's alignment measurements. The Contractor shall not continue with the assembly of the generator until the Engineer returns the alignment measurements without comment.

The Contractor shall install all brake air piping to the governor cubicle.

The Contractor shall install the piping systems from the generator to the Purchaser's station header pipes including the connections to the headers.

The Contractor shall wire all connections from the thrust bearing high pressure oil starting equipment controls and motors to the MCC. The Purchaser shall terminate the wiring in the MCC.

The Purchaser shall supply power to the Contractor's Control Cubicles.

The Contractor shall develop the Generator installation procedures using the latest version of the IEEE standard 1095 – ‘Guidelines for Installation of Vertical Generators and Generator Motors for Hydroelectric Applications’. The Contractor shall submit these procedures to the Engineer, for review, at least six months prior to commencing the installation work.

8.4.1 Stator Bar Installation

The Contractor shall conduct high potential tests of the bars during the winding process to reasonably assure that the bars will not fail the Winding High-Potential Tests as described in Subsection 6.27 (d) Winding Hi-pot Test of the Technical Requirements. The tests and test voltages shall be included in the installation procedure.

Based on random checks, the Contractor shall verify that the resistance between laminations at slots and the machine frame is less than 1 ohm before painting the slot. The Contractor shall verify that the resistance between laminations at slots and the machine frame is less than 20 ohms after application of semiconductive paint in the slots.

Regardless of whether the bar has a CRTV/RTV coating or not, side packing shall be tight within the slot so that a 0.05 mm feeler gauge will not enter any gap between the bar and slot sides. The 0.05 mm feeler gauge “no-go” standard shall apply to at least 90% of the stacked core length. The length along the slot of any area where the clearance exceeds 0.05 mm shall not exceed 75 mm.

Prior to wedging, to check the adequacy of grounding of the bars in the slot, the Contractor shall measure and record the resistance between each bar and ground. The measurement method shall include the use of 150 mm by 12.5 mm wide contact board with copper braid as the contact electrode or Purchaser approved alternate, and the maximum resistance shall be 3000 ohms.

Prior to wedging, the Contractor shall demonstrate that the bars have been adequately "bottomed" in the slot. It must not be possible to insert a 0.13 mm feeler gauge more than 75 mm between the bottom leg of the bar and the bottom of the slot at either the upper or lower ends of the core.

The Contractor shall demonstrate the wedge tightness by a Engineer approved method. The Engineer will verify the wedge tightness by a tap test.

The Contractor shall supply the Engineer with a record of in-stator resistance measurements between the air gap side of each bar and the machine frame and its measurements of wedge deflection and radial ripple spring compression.

8.5 120/240 V ac Panels, Generator and Turbine Pit Lighting and Convenience Outlets

The Contractor shall install the panels on the generator enclosure wall, exact locations to be determined during drawing review. The Contractor shall supply and install all wiring for the lighting and receptacles to the generator and turbine pit areas.

8.6 Interconnection of Equipment

The Contractor shall install all power, control, and indication/annunciation cable according to the following:

- 1) Cables and any required tray or conduit from Contractor supplied equipment within the turbine and generator pit to Contractor supplied equipment within the turbine and generator pit shall be supplied, installed, pre-commissioned, and terminated by the Contractor.*
- 2) Cables and any required tray or conduit from Contractor supplied equipment within the turbine and generator pit to Purchaser supplied equipment within the turbine and generator pit shall be supplied, installed and pre-commissioned by the Contractor. Termination at Contractor supplied equipment is by the Contractor. Termination at Purchaser supplied equipment is by the Purchaser.*
- 3) Cables and any required tray or conduit from Contractor supplied equipment within the turbine and generator pit to Contractor supplied equipment outside of the turbine and generator pit shall be supplied, installed, pre-commissioned, and terminated by the Contractor. The*

Contractor supplied equipment outside of the turbine and generator pit is typically an interface point between the Contractor's equipment and Purchaser's equipment such as the generator instrumentation panel or the turbine instrumentation panel or suitable junction boxes supplied by the Contractor. Typically these instrumentation panels and junction boxes are located on the outside wall of the generator enclosure but the exact location will be determined during design reviews. Termination and pre-commissioning of Contractor supplied cables at these interface points is by the Contractor. Termination and pre-commissioning of Purchaser supplied cables at these interface points is by the Purchaser.

- 4) *If a continuous run of cable from the Purchaser's supplied equipment to the Contractor's supplied equipment is required by the Purchaser, (for example the 600 VAC feeders from the Purchaser's MCC to the headcover pump) the cables shall be supplied and pre-commissioned by the Purchaser. The conduit or tray outside the generator enclosure shall be supplied and installed by the Purchaser. The conduit or tray required inside the generator enclosure shall be supplied and installed by the Contractor. Termination at Contractor supplied equipment is by the Contractor. Termination at Purchaser supplied equipment is by the Purchaser.*

9 COMMISSIONING

9.1 Pre-Commissioning

Pre-commissioning is defined as the act of verifying, through inspection and testing, that the individual installed part or assembly is complete and ready for service. Pre-commissioning shall be completed using Purchaser supplied services (water, air, oil, electricity) available at the time the Contractor plans to undertake the pre-commissioning activities. Once the pre-commissioning is complete, each part or assembly shall be deemed ready to be operated as part of the commissioning of the turbine and generator by the Purchaser. The Contractor is responsible to generate a pre-commissioning report for each part or assembly including a list of deficiencies for review by the Engineer. Pre-commissioning is not deemed to be complete until a Work Release Certificate has been issued, as described in General Conditions Section 30 WORK RELEASE CERTIFICATE and Section 50 CONDITIONS FOR WORK RELEASE CERTIFICATE.

The Contractor shall perform all pre-commissioning of the main and auxiliary equipment *supplied as part of the Work* to ensure the integrated generator and turbine are ready for commissioning by the Purchaser.

The Contractor shall provide an Inspection and Test Plan (ITP) for all the proposed pre-commissioning activities. The ITP shall be submitted to the Engineer, for review, at least 180 days prior to the installation work commencing in the accordance with Subsection 8.4 Contract Dates of the General Requirements.

Any special tooling or equipment required for the pre-commissioning tests shall be provided by the Contractor.

9.2 Unit Commissioning

Commissioning is defined as the act of verifying, through inspection and testing, that the turbine and generator Unit functions as specified. Commissioning includes all testing to verify the operation of the unit as a whole, with the Purchaser's control and monitoring systems. Commissioning shall be completed using Purchaser supplied services (water, air, oil, electricity). Once commissioning is complete, the Unit shall be deemed ready to be operated as part of the Purchaser's power system.

The Purchaser will be responsible for conducting all commissioning of the turbine and generator. The Contractor shall provide one mechanical and one electrical professional engineer to assist with commissioning of the turbine and generator.

The Contractor shall work together with the Purchaser for the tests that involve equipment supplied by others such as governor, exciter, generator transformer, generator circuit breaker, generator controls and protection to ensure coordinated commissioning of all equipment. Commissioning procedures for this equipment will be provided by the Purchaser. The Contractor shall make personnel available to assist in the commissioning as required.

Commissioning shall include additional Purchaser specific NERC ***and Mid-continent Area Power Pool (MAPP)*** tests. ***The Purchaser will supply procedures for these specific tests.***

The Unit commissioning shall include but not be limited to the following tests on one or more Units:

- 1) Governor calibration and tuning
- 2) Exciter tuning and setup
- 3) Mechanical run:
 - i) Monitoring bearing temperature and Unit vibration
 - ii) Overspeed tests
 - iii) Deceleration test
- 4) Generator tests according to subsection 6.26 Inspections and Tests of the Technical Requirements, IEEE 1095 and IEEE 115.

- 5) Open circuit saturation.
- 6) Rated current zero power factor saturation.
- 7) Sudden three phase short circuit at the generator terminals at rated voltage to determine the adequacy of the winding supports.
- 8) Waveform.
- 9) Telephone influence factor (balanced and residual).
- 10) Tests to determine reactances and time constants as defined in ANSI Standard C42.10, Section 31.
- 11) Load tests and generator heat run to confirm the Unit rating.
- 12) load rejection tests on the Unit up to maximum load to determine governor and excitation response and performance.(this test to be made on all Units)
- 13) Excitation tests in accordance with IEEE 421. For reactive capability verification, an over-excited test must be conducted at the highest rated stator and field current for at least two hours or until temperatures have stabilized. Measurement of the AVR open-circuit step response and power system stabilizer frequency response is required.
- 14) Governor tests in accordance with one of the following codes: IEEE 1207, IEC 60308 or ASME PTC 29-2005.
- 15) All electrical systems in accordance with IEEE 1248.
- 16) Prototype performance tests in accordance with the Purchaser's established test procedures.

For the sustained short circuit impedance tests, the excitation system shall be supplied from the Purchaser's 600 V ac supply. The Purchaser shall be responsible for supply and installation of a local disconnect switch and the cabling from the Purchaser's 600 V ac distribution panels to the excitation system.

During the full load heat run, any connections of coils, pole jumpers, circuit taps, main leads that are more than 5°C higher than adjacent similar connections shall be considered as high resistance connections and shall be repaired by the Contractor.

The Contractor shall supply the generator breaker to perform the sudden 3 phase short circuit test.

After the overspeed test, the Contractor shall re-drive the rotor pole keys.

Any revisions to drawings, manuals and procedures required as a result of Unit commissioning shall be made by the Contractor and submitted to the Engineer.

The Purchaser shall issue a Commissioning Certificate in the form included as **Appendix F**, upon successful completion of Unit Commissioning.

9.3 *Commissioning Procedures*

All pre-commissioning and commissioning procedures prepared by the Contractor for its own or the Purchaser's use shall include the following at a minimum;

- a) *Prerequisite conditions for commencing commissioning.*
- b) *Step by step instructions describing the state of breakers, valves, switches, etc. And how they are operated in the text. The instructions shall include sufficient detail to allow a person not intimately familiar with the equipment being commissioned to perform the tests in a safe and efficient manner.*
- c) *Datasheets to record the commissioning test results.*
- d) *A sign-off page to record who did the commissioning and when.*

The Contractor shall provide the Engineer with a complete set of procedures for the pre-commissioning checks to be performed by the Contractor and the commissioning checks to be performed by the Purchaser. These shall be provided to the Engineer, for review, at least 240 days prior to the installation work commencing in accordance with Subsection 8.4 Contract Dates of the General Requirements.

The Purchaser will integrate the commissioning procedures provided by the Contractor into the Purchaser's final commissioning procedures for review, by the Contractor, 240 days prior to the start of commissioning.

10 **CONTRACTOR'S DOCUMENTS**

10.1 **Document Submissions**

In accordance with Subsection 8.4 Contract Dates of the General Requirements, the Contractor shall provide a complete document submission list for the Engineer's review. The submission list shall include all documents required for the Work and indicate the scheduled dates of issue for each document. The submission list shall be used by the Engineer for tracking purposes and the Contractor shall maintain and update the submission list during the course of the Work. The Contractor shall prepare and submit documents as scheduled in its submission list. These items shall be signed and sealed as required by Subsection 10.2 Documents Requiring Professional Seals of the Technical Requirements

The Contractor shall submit and issue for review all documents in accordance with the Contract. Documents will fall into two categories: SCI Numbered and Non SCI Numbered. These include but are not limited to:

SCI Numbered

Drawings
 Specifications
 O&M Manuals
 Commissioning Procedures
 Installation Instructions
 Design Reports
 Model Test Report
 Inspection & Test Plan
 Quality Docket

Non SCI Numbered

QA Inspection Sheets
 Raw Material Certificates
 Certificates of Conformance
 Non-Destructive Test Reports
 Non-Conformance Reports
 Material Test Reports
 Electrical Test Reports
 Corrective Action Requests
 Welding Procedure Specifications
 Procedure Qualification Records
 Personnel Qualifications
 Other Reports as Required

The SCI system is defined in Subsection 10.5 System Classification Index of the Technical Requirements.

Documents shall fully describe the Work and all details contained therein including but not limited to:

- 1) three dimensional model of powerhouse and individual components
- 2) general arrangement, size, dimensions and details of all materials and components to be supplied as part of the Work,
- 3) specifications for the types of materials from which the parts are to be made, the methods used to test and validate the materials, the coatings to be used for all components, etc
- 4) all construction and fabrication details showing machining requirements, welding and material specifications and tolerances,
- 5) all design reports,
- 6) installation and assembly
- 7) a complete bill of materials, integral to each drawing, including mark numbers, quantities, descriptions, materials, references and specifications for each item shown on the drawing. The bill of materials shall be incorporated into the drawing itself. Separate A4 size sheets are unacceptable.

Any other information that demonstrates that the Work meets the requirements of the Contract shall be submitted.

10.2 Documents Requiring Professional Seals

All documents and drawings requiring an engineer's seal or signature for revisions by *The Engineering and Geoscientific Professions Act of Manitoba* (<http://web2.gov.mb.ca/laws/statutes/ccsm/e120e.php>) shall be submitted in hard

copy form as required by APEGM's (Association of Professional Engineers and Geoscientists of Manitoba) act, bylaws & guidelines.

Only drawings appropriately sealed (and signed noting revisions) will be accepted.

Drawings bearing seals (and signatures noting revisions) from out-of-Province professional jurisdictions shall also show applicable Manitoba professional association license number.

Electronic files of documents requiring a professional seal shall show the professional member's or licensee's name (with applicable professional suffix) that sealed the original drawing and applicable date of sealing within the seal box of the title block. Documents submitted as revisions shall additionally show the initials (with applicable professional suffix) of the member or licensee taking responsibility for the revision, in the revision approval box.

10.3 Document Submission & Transmittal Process

Documents are submitted, reviewed and revised throughout the course of the Work as required. SCI numbered documents have specific requirements for numbering and formatting outlined in the following table.

Description	Revision	Submission Format	Engineer's Seal	Engineer's Initials
Preliminary	A,B,C... X	PDF via eRoom	No	No
Issued for Manufacture	00	Hard Copy + PDF via eRoom	Yes	Yes
Changes at Manufacture and/or Installation	01, 02... NN	Hard Copy + PDF via eRoom	No	Yes
As-Built	NN + 1	Hard Copy + PDF via eRoom	No	Yes
Final	NN +2	Hard Copy + PDF via eRoom	No	Yes

The Engineer uses the Purchaser's collaboration website as a collaboration tool for review of submissions. The process outlined in **Appendix R** describes the requirements for the use of the Purchaser's collaboration website to transmit submissions.

The Contractor shall submit to the Engineer 'Document Review Sets' for each individual component of the Work. The Document Review Set shall include all relevant Drawings, Specifications, Data Sheets, Reference Documents and any other documents necessary to fully describe the component of the Work. The

Document Review Sets shall generally follow the breakdown of the Work into Performance Based Payment Milestones as described in the **Appendix T** Performance Based Payment Table in Excel Format.

Document Review Set Example

(This is an example only and the Engineer shall be the sole judge of the completeness of a Document Review Set)

Component:	Discharge Ring
Document Set:	- Fabrication Drawings - Machining Drawings - Material Specification - FEA Report - QA Inspection Sheets - Inspection and Test Plan - Welding Procedures - Shipping Drawings - Storage and Handling Procedures

The Engineer shall review the Contractor's Document Review Sets within 28 days of receipt and return to the Contractor an electronic copy with notation as per Subsection 10.7 Engineer's Review of the Technical Requirements. The review period is based upon the Contractor meeting the following criteria for the applicable Document Review Sets being met:

- 1) The Contractor has included all relevant reference documents in the Document Review Set and no missing information is required to complete a review,
- 2) All of the documents are legible and written in the English language,
- 3) The quantity of documents within the Document Review Set does not exceed thirty sheets,
- 4) The Contractor manages the Work such that in any 28 day period the number of individual Document Review Set under review with the Engineer is three or less.

If the above conditions are not met, the review period may take longer than 28 calendar days. The Engineer shall endeavour to meet the review period, however the quantity of Document Review Sets requiring review is under the control of the Contractor and the Contractor shall manage this work to prevent delays. However, any Engineer review having a greater duration than 28 days as a result of the above conditions not being satisfied shall not be considered a delay of the Contractor's work and the Purchaser shall not be liable for any loss, costs, damages or expenses incurred by the Contractor as a result of such delay.

All documents shall be considered "Preliminary" with alphanumeric revision numbers (A,B,C, etc) until the document has been returned as "Reviewed". Documents that are returned "Reviewed as Noted" or "Amend and Re-submit" shall be revised and returned for the Engineer's review.

The Contractor, upon receiving from the Engineer a *Preliminary* document marked "Reviewed," shall submit to the Engineer two hard copies via courier and an electronic copy of the document via the Purchaser's collaboration website. The revision block shall be marked "Issued for Manufacture" and the revision number shall be set to 00. If the document requires an engineer's seal as per Subsection 10.2 Documents Requiring Professional Seals of the Technical Requirements, the drawings shall be appropriately sealed. One of the two hard copies shall be the original signed and sealed copy.

All changes to the Work during manufacture or installation shall be recorded in revisions to the documents. The Contractor shall, within 28 days of any change to the Work, issue to the Purchaser 2 hard copies via courier and an electronic copy of the revised document via the Purchaser's collaboration website. The revision block and revision number shall be updated. If the document requires an engineer's seal as per Subsection 10.2 Documents Requiring Professional Seals of the Technical Requirements, the document shall be appropriately sealed. One of the two hard copies shall be the original signed and sealed copy.

Once installation of the Work has been completed, the Contractor shall submit to the Engineer for review, 2 hard copies via courier and an electronic copy of the document via the Purchaser's collaboration website, of the As-Built version of all documents. The revision block and revision number shall be updated. If the document requires an engineer's seal as per Subsection 10.2 Documents Requiring Professional Seals of the Technical Requirements, the documents shall be appropriately sealed. One of the two hard copies shall be the original signed and sealed copy.

At the conclusion of the Work the Contractor shall submit to the Engineer electronic copies of each final reviewed document in AutoCAD .dwg format, via the Purchaser's collaboration website as well as two hard copies, of which one is the original signed and sealed copy. Where applicable, 3-D models updated with the final geometry shall be included.

All hard copy submissions shall be made to Manitoba Hydro's Document Control Section complete with a transmittal.

All electronic submissions via the Purchaser's collaboration website shall be made complete with a transmittal.

The transmittal shall contain the following:

- 5) Contractor's transmittal number
- 6) Date sent
- 7) Contractor's contact information
- 8) Addressed to Project Services Department (PSD) Attn: Document Control
- 9) Contract or Specification Number and Project Name
- 10) MH System Classification Index (SCI) Drawing Number and Revision number (if applicable)
- 11) Document description (same as in title block)
- 12) Contractor's document number
- 13) Quantity (copies of each document if in hard copy)
- 14) Format of document (i.e. paper, PDF)
- 15) Space for acknowledgement of receipt

The following is an example of the Purchaser's transmittal requirements:

Transmittal Number:	Transmittal number shall contain work package number and a sequential number i.e. 0####-TR-001.	
Date:	YYYY MM DD	Either Manitoba Hydro's date standard or the date spelled .
From:	NAME OF CONTRACTOR MAILING or COURIER ADDRESS CITY PROVINCE (STATE) POSTAL CODE (ZIP) TELEPHONE: FAX:	Contractor's contact information shall appear somewhere on transmittal .
To:	PSD DOCUMENT CONTROL (17) MANITOBA HYDRO 360 PORTAGE AVE WINNIPEG MB R3C 0G8	Transmittal shall be addressed to PSD Document Control .
Regarding:	Work Package and Specification Number Project Name	Work package and Specification number and Project Name shall appear somewhere on transmittal.

MH SCI Drawing Number Rev ##	Drawing Title	Contractor Drawing Number Rev ##	Quantity	Format
MH Drawings : Drawing number shall adhere to Manitoba Hydro System Classification Index (CSI)	Drawing title shall be the same as description in drawing title block.	Contractor drawing number and revision number .	Required	Required

Recipients' Signature	Date Received yyyy mm dd	
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Transmittal may contain signing area for acknowledgement .

All document packages submitted via postal service or courier shall be addressed to PSD Document Control, and the work package and specification number shall be visible on the side packaging.

Example:

<p>Re: Work Package</p>	<p style="color: red;">Mailing Label or courier slip shall reference Work package number</p>
<p>PSD DOC CONTROL (17) MANITOBA HYDRO 360 PORTAGE AVE WINNIPEG MB R3C 0G8 CANADA</p>	<p style="color: red;">Package shall be mailed or sent by courier to PSD Document Control</p>

10.4 Standards

10.4.1 Document Standards

All documents shall be prepared in accordance with the best engineering practice and shall be of a high standard with respect to neatness, clarity and legibility. All documents shall be checked, approved, dated and certified correct by the Contractor prior to submission to the Engineer. Correction of spelling and grammatical errors is the responsibility of the Contractor. If bilingual documents are produced, the Contractor shall have an engineer on staff, whose first language is English, check the documents for spelling and grammatical errors and sign off on the document as part of an internal quality review process. Documents received by the Engineer that have not been signed off in this manner shall be rejected.

All SCI numbered documents (other than drawings) shall have a title page that includes a revision block and a space reserved for an engineer's seal.

All SCI numbered documents to which revisions are made shall have the changes clearly marked in the revision column and in the drawing SCI number. Drawings revised as a result of comments by the Engineer shall be so referenced in the revision column. The revision notes shall describe in sufficient detail the change that has been made to the document and reference a sheet/page number and the drawing coordinates.

10.4.2 Drawing Standards

All Purchaser drawings, including drawings submitted by contractors are microfilmed. The microfilm records are retained and used until the physical plant

items shown on the drawings are retired from service. The minimum standards specified below have been designed to ensure that drawings supplied by contractors can be microfilmed, and that the microprints or other enlargements obtained from the microfilm will be legible. At the Engineer's discretion, legibility of microfilm and microprints may determine whether a Contractor's drawing will be accepted or rejected.

a) Content

In general, each drawing shall deal with a single subject. If not detailed specifically in these standards, information shall be displayed in a manner consistent with accepted practice in the discipline for which the drawing is produced (e.g. electrical, mechanical, structural, etc.).

b) Sizes

Drawing sizes shall be selected from the following table. Minor deviations may be acceptable if they can be accommodated using the Purchaser's standard microfilm reduction ratios. The aspect ratio between the short and long sides of the drawing shall fall in the range between 1.29:1 and 1.55:1. Under no circumstances shall drawings exceed A0 size.

MANITOBA HYDRO DRAWING SHEET SIZES & PLOT SETTINGS FOR NEW BORDERS

E SIZE
Metric ISO A0 = 841mm, Border Size = 801mm
Imperial ISO A0 = 31.1", Border Size = 31.5"

D SIZE
Metric ISO A1 = 594mm x 841mm
Border Size = 554mm x 801mm
Imperial ISO A1 = 23.4" x 33.1"
Border Size = 21.8" x 31.5"

C SIZE
Metric ISO A2 = 420mm x 594mm
Border Size = 380mm x 554mm
Imperial ISO A2 = 16.5" x 23.4"
Border Size = 15.0" x 21.8"

B SIZE
Metric ISO A3 = 297mm x 420mm
Border Size = 257mm x 380mm
Imperial ISO A3 = 11.7" x 16.5"
Border Size = 10.2" x 15.0"

A SIZE
Metric ISO A4 = 210mm x 297mm
Border Size = 180mm x 244mm
Imperial ISO A4 = 8.3" x 11.7"
Border Size = 7.1" x 10.4"

PLOT SETTINGS FOR BORDERS IN MODEL SPACE
Note: N.T.S. (1:1) Scale

METRIC DRAWINGS			IMPERIAL DRAWINGS		
Border Size	Paper Size	Plot Scale	Border Size	Paper Size	Plot Scale
A SIZE	ISO A4 - 210 x 297	1:1, 1 mm = 1 unit	A SIZE	ISO A4 - 210 x 297	1:1, 1 inches = 1 unit
B SIZE	ISO A3 - 297 x 420	1:1, 1 mm = 1 unit	B SIZE	ISO A3 - 297 x 420	1:1, 1 inches = 1 unit
C SIZE	ISO A2 - 420 x 594	1:1, 1 mm = 1 unit	C SIZE	ISO A2 - 420 x 594	1:1, 1 inches = 1 unit
D SIZE	ISO A1 - 594 x 841	1:1, 1 mm = 1 unit	D SIZE	ISO A1 - 594 x 841	1:1, 1 inches = 1 unit
E SIZE	ISO A0 - 841 x 1189	1:1, 1 mm = 1 unit	E SIZE	ISO A0 - 841 x 1189	1:1, 1 inches = 1 unit

PLOT SETTINGS FOR BORDERS IN PAPER SPACE
Note: N.T.S. (1:1) Scale

METRIC DRAWINGS			IMPERIAL DRAWINGS		
Border Size	Paper Size	Plot Scale	Border Size	Paper Size	Plot Scale
A SIZE	ISO A4 - 210 x 297	1:1, 1 mm = 1 unit	A SIZE	ISO A4 - 210 x 297	1:1, 1 inches = 1 unit Custom, 1 mm = .03937 unit
B SIZE	ISO A3 - 297 x 420	1:1, 1 mm = 1 unit	B SIZE	ISO A3 - 297 x 420	1:1, 1 inches = 1 unit Custom, 1 mm = .03937 unit
C SIZE	ISO A2 - 420 x 594	1:1, 1 mm = 1 unit	C SIZE	ISO A2 - 420 x 594	1:1, 1 inches = 1 unit Custom, 1 mm = .03937 unit
D SIZE	ISO A1 - 594 x 841	1:1, 1 mm = 1 unit	D SIZE	ISO A1 - 594 x 841	1:1, 1 inches = 1 unit Custom, 1 mm = .03937 unit
E SIZE	ISO A0 - 841 x 1189	1:1, 1 mm = 1 unit	E SIZE	ISO A0 - 841 x 1189	1:1, 1 inches = 1 unit Custom, 1 mm = .03937 unit

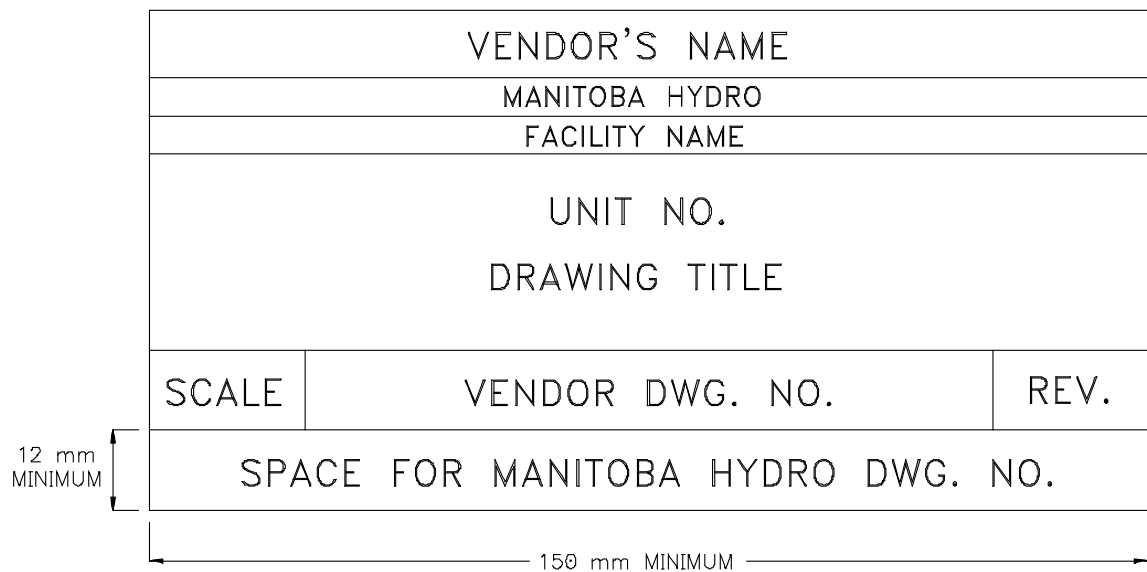
c) Title Block

The title block shall be located in the lower right hand corner of the drawing. The following shall be contained in the title block:

- 1) Vendor's name
- 2) MANITOBA HYDRO
- 3) Manitoba Hydro facility name
- 4) Drawing title
- 5) Drawing scale
- 6) Vendor's drawing number
- 7) Revision number
- 8) Manitoba Hydro drawing number

Lettering size and style shall be in accordance with Subsection 10.4.2 (e) Lettering of the Technical Requirements. Abbreviations in the title block are not acceptable.

Suggested minimum title block format:

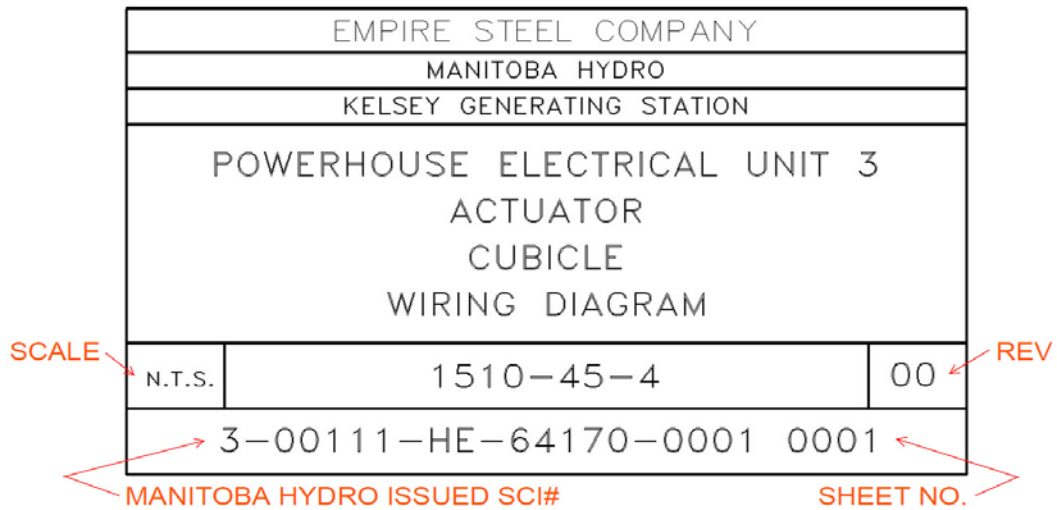


NOTE: Facility name denotes the generating station, transmission line, transmission station, etc. for which the Contractor's product will be used.

All drawing titles shall be reviewed by the Engineer. They shall be descriptive and short. The composition of a drawing title shall run from the general to the specific and will usually occupy three lines, but never more than four lines, in the title block. All text in the drawing title area shall be center justified.

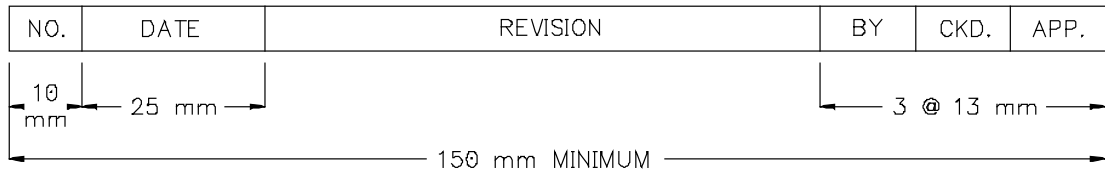
- Line 1 ... Area of the work or Unit No.
- Line 2 ... Specific subject
- Line 3 ... Name of equipment or system (if necessary)
- Line 4 ... Type of drawing

Example:



d) Revision Block

A revision block shall be located either directly above or to the immediate left of the title block. The format shall be as follows:



A clear space at least 50 mm in height shall be left above this block. An additional clear space at least 80 mm square shall be left in close proximity to the title block to accommodate a Manitoba Hydro "APPROVED" stamp.

e) Lettering

The lettering on the drawing is of particular importance due to the Purchaser's microfilming requirements and shall conform to the following standards:

- 1) Lettering shall be vertical, uppercase, single stroke
- 2) Font shall be ROMAN-D
- 3) Lettering height shall be 0.100 inches.

f) Lines

The weight of all lines shall be minimum 0.015 inches.

g) Scale

In general, all dimensioned drawings shall be drawn to scale. The scale shall be noted in the title block. If views are drawn to a scale other than that shown in the title block, the scale for those views shall be placed immediately under the view title.

h) Hatching

Hatching may be used to identify items in section and shall be in accordance with ISO standards.

i) Drawing Medium

Hard copies of drawings shall be submitted on 20 pound, bond, and brilliant white paper.

Electronic Preliminary drawings shall be submitted in PDF format.

Electronic Final drawings shall be submitted in .DWG and PDF format.

j) Drawing Limits

Drawing limits shall be set as follows. The lower limit shall be set to 0,0 and the upper limits to the plotting scale factor multiplied by the coordinates shown below for the particular drawing border size and by a metric conversion factor (25.4), if applicable.

- 1) A (A4) - 8.3, 11.7
- 2) B (A3) - 11.7, 16.5
- 3) C (A2) - 16.5, 23.4
- 4) D (A1) - 23.4, 33.1
- 5) E (A0) - 33.1, 46.8

All information in the drawing shall be within these limits.

10.5 System Classification Index (SCI)

The Purchaser uses SCI to identify specific drawings and documents pertaining to the Work. Each applicable drawing and document generated and submitted by the Contractor will be assigned a supplier SCI number by the Purchaser on the initial drawing or document submission, and that number shall appear on all subsequent issues of that drawing or document. All additional documents or drawings will be assigned their own unique SCI number.

The SCI number will be marked in the space reserved for the Purchaser.

10.6 Engineer's Review

In all instances in the Contract where there is a requirement for the Engineer's review, such review shall be conducted in accordance with the following.

The Engineer will review the Contractor's documents and return to the Contractor an electronic drawing with one of the following notations:

a) "Reviewed"

Meaning that there are no comments to the technical and/or drafting aspects of the document and the applicable Work may proceed.

b) "Reviewed As Noted"

Meaning that the applicable Work may proceed with the noted changes incorporated, and that the documents shall be resubmitted for the Engineer's review.

c) "Amend and Resubmit"

Meaning that the document is technically unacceptable and the applicable Work shall not begin, and that the document shall be resubmitted for the Engineer's review.

Upon receipt of documents marked "Amend and Resubmit" or "Reviewed as Noted", the Contractor shall modify the document and any other documents affected by such modifications and, within 14 calendar days, resubmit to the Engineer for review. Resubmission of documents for the Engineer's review shall in no way affect the Contract Dates of the Work.

All drawings on which revisions are made shall have the changes clearly identified on the drawing with a revision number (or letter) directly adjacent to

the change and the location of the revision shall be identified by reference to a grid system on the drawing. A brief description of the revision, including the grid location, shall be listed in the revision column.

11 CONTRACTOR'S MODELS

The Contractor shall provide to the Engineer all 3-D models used to produce engineering, shop and fabrication drawings. Models shall be submitted via eRoom, packaged with the associated drawings. All models shall be made to reflect exactly the “As-built” issue drawings as specified in 10.3 Document Submission & Transmittal Process in the Technical Requirements.

Additionally, 3-D models shall be supplied for the following components if they have not been created previously to produce engineering, shop and fabrication drawings:

- 1) Runner and hub
- 2) Bottom ring
- 3) Discharge ring
- 4) Draft tube liner
- 5) Wicket gate
- 6) Head cover(s)
- 7) Stay ring
- 8) Stay vane(s)
- 9) Operating ring
- 10) Link and lever
- 11) Rotor spider
- 12) Lower bracket
- 13) Upper bracket

If the 3-D technology used for the Work is Autodesk® Inventor, all modelled parts (.ipt), assemblies (.iam), drawings (.idw), and the work file (.ipj) are required.

If the 3-D technology used for the Work is not Autodesk® Inventor, the model will be supplied using STEP AP 203 format and will include all parts and assemblies.

12 OPERATION AND MAINTENANCE (O & M) MANUALS

For guidance during installation and testing of the Work and subsequently for the Purchaser’s use during operation, maintenance, disassembling and reassembling

of the Work, the Contractor shall provide an operation and maintenance manual describing in detail the construction and recommended procedure for assembling, disassembling, maintaining and operating the equipment and the completed Work.

The manual shall be printed on standard 216 mm by 279 mm sheets (8 1/2 inch by 11 inch) and all drawings shall be reduced to 217 mm x 432 mm high (11 inch by 17 inch) and z-folded for binding as necessary. In addition, 2 CD copies of an electronic version (PDF) of the manual must accompany the O&M manual submission.

Each manual shall be clearly titled to show the ITEM of the Work concerned, generating station name, Purchase Order number, the name and address of the Contractor and the issue date.

The manual shall include the following sections:

- 1) Index of Manual
- 2) General Description
- 3) Technical and design data including weights and dimensions of major components of the Work.
- 4) Maintenance Instructions
- 5) Complete details for maintenance including frequency of lubrication and recommended lubricants; dismantling and reassembling instructions; details of protective coatings, paint materials and application instructions; and a list of spare parts.
- 6) Contractor's Drawing List
- 7) Complete list of drawings issued.
- 8) Reduced Drawings
- 9) General arrangement drawings, fabrication drawings and other selected drawings, all reduced as described above.
- 10) Manufacturer's Bulletins.
- 11) All pertinent bulletins and instruction manuals prepared by the various manufacturers of component parts of the Work.

The Contractor shall submit three draft copies of the manual to the Engineer for review.

Once the draft manual is stamped "Reviewed", the Contractor shall forward seven (7) final paper copies and two (2) electronic copies on separate CDs of the complete manual to the Engineer.

13 RELIABILITY CENTERED MAINTENANCE (RCM)

The Purchaser uses classic RCM philosophy to determine the appropriate preventive maintenance schedule and tasks for its assets. A typical RCM process looks at the functions and desired standards of performance of an asset, examines functional failures and failure modes, analyses effects and consequences of failures, and develops proactive maintenance tasks and procedures to improve the reliability of that asset. The intent is to provide an optimal level of maintenance support that provides reliable operation and long equipment life in a cost-effective manner.

Prior to the completion of the detailed designs, the Contractor shall participate in a Purchaser led, five day RCM analysis of the proposed equipment and provide technical experts for each of the following two areas:

- 1) Turbine
- 2) Generator