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SPEC. NO. TCE.7784A-3057- 01	Khutani Hydroelectric Project (21MW), Uttarakhand	SHEET i OF ii

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14 METALWORKS (WHEREEVER APPLICABLE)

14.1 SCOPE OF WORK

- i) The work under this Chapter includes all labour, materials and equipment required for the supply, fabrication, and installation of various metalworks as shown on the Construction Drawings or as directed by the Project Manager. The specifications contained in this Chapter are applicable for all metal works to be carried out by the Contractor under this Contract.
- ii) This Chapter covers the following items:
 - a) Steel pipes,
 - b) Cast iron pipes,
 - c) Miscellaneous steel sections,
 - d) Watertight steel covers,
 - e) Hatch covers for light loads, covers for cable channels, frames, and gratings,
 - f) Grating
 - g) Floor Plate covers
 - h) Handrails,
 - i) Railing,
 - j) Ladders, handles, and climbing irons,
 - k) Erection hooks,
 - l) Steel anchoring,
 - m) Metalworks supplied by others.
- iii) Unless otherwise stated or shown, all miscellaneous metalwork shall be fabricated from steel sections, plates and bars. All miscellaneous metalwork shall be painted as specified hereinafter. Where specifically so stated, steelwork shall be hot-dip galvanised.
- iv) The Contractor shall be responsible for material quality control and shall ensure compliance of the metalworks to the pertinent standards and these Specifications.

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14.2 STANDARDS


Metal work shall conform to the latest editions of the following Indian Standards:


IS: 432	Mild steel and medium tensile steel bars and hard drawn steel wire for concrete reinforcement.
IS: 456	Code of practice for plain and reinforced concrete.
IS: 800	Code of practice for general constructions in steel.
IS: 1477	Code of practice for painting ferrous metals in buildings
IS: 2062	Code for structural steel (fusion welding quality)
IS: 4736	Hot-dip zinc coatings on mild steel tubes.
IS: 4759	Hot-dip zinc coatings on structural steel and other allied products.
IS: 6631	Steel pipes for hydraulic purposes.


14.3 SUBMITTALS


- i) The Contractor shall supply certificates of compliance with specified Indian Standards or other relevant standards for all materials supplied to the Works. Manufacturers catalogues and samples of materials proposed for incorporation in the Works shall be submitted for approval, if requested by the Project Manager.
- ii) From the information given in the Tender and on the Construction Drawings, the Contractor shall prepare, prior to the manufacture, his own shop drawings showing sections and plans of all parts, assemblies, connections and supports for all metalwork shown on the Construction Drawings. Two copies of each drawing, calculation sheet and schedule of materials shall be submitted to the Project Manager for comments and approval. Within 28 days from the submission, the Project Manager will return such drawings either as approved or with requests for modifications. Within 7 days the Contractor shall revise the drawings, calculations and schedules accordingly and return a new set (two copies) of these for the final approval.


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<div> <div> iii) </div> <div> After the final approval, the Contractor shall deliver one transparency and two copies of the documents to the Project Manager for his files. </div> </div> <div> <div> iv) </div> <div> The approval of shop drawings and calculations shall not in any way relieve the Contractor of his responsibility and obligations under this Contract, particularly those relating to the adequacy and accuracy of the final product. Any materials ordered, or fabrication work performed, before the Contractor's drawings are approved will be at his own risk. </div> </div> <div> <div> v) </div> <div> The Contractor shall not be entitled to any time extension based upon the rejection of his designs or detail drawings if these fail to conform to sound engineering practices or to the stipulations contained in these Specifications or as directed by the Project Manager. </div> </div> <div> <div> 14.4 </div> <div> <u>FABRICATION</u> </div> </div> <div> <div> i) </div> <div> Tolerances for fabrication of steel structures shall conform to the latest version of IS: 7215. </div> </div> <div> <div> ii) </div> <div> The work shall be shop fitted and shop assembled where possible, and shall conform to the details on approved Contractor's shop drawings. </div> </div> <div> <div> iii) </div> <div> Workmanship shall conform to the best modern shop and field practice. All joints and intersecting members shall be accurately fitted and all work shall be fabricated in true planes (to tolerances as provided on drawings) with adequate fastenings. </div> </div> <div> <div> iv) </div> <div> Plates and steel sections shall be perfectly straight with smooth surfaces. Edges shall be sharp, clean and without burrs after the cutting. Thick plates may be flame cut, provided that the material is not damaged and that the edges of the cut are ground clean or machined. Plates shall be cold-rolled. Correction of bent members by heavy blows shall be avoided. Special care shall be taken when hot-rolling becomes necessary. </div> </div> <div> <div> v) </div> <div> All members shall be carefully and accurately assembled by welding, screws, bolts or rivets as approved. The joints shall be filled, milled, or machined as necessary to provide closed and perfect connections. All frames shall be provided with suitable bracing to maintain alignment during transport. Units shall not be subject to overstressing during transportation </div> </div>		
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<p>and erection. Hammering which would injure or distort the members shall not be allowed.</p> <p>vi) All fastenings, anchors and accessories required for fabrication and erection of the work shall be provided. Exposed fastenings shall be kept to an absolute minimum, evenly spaced and neatly set out. Wood plugs shall not be permitted.</p> <p>vii) The Contractor shall check the actual dimensions and shapes of existing concrete openings before fabricating steel frames and metal supporting parts of steel covers and gratings.</p> <p>14.5 <u>WELDING</u></p> <p>i) All welding shall be carried out by experienced welders using the shielded-arc method as described in the SP12 ISI Handbook for Gas Welders and ISI Handbook of Metal Arc Welding for Welders.</p> <p>ii) Welding rods shall be of the heavily coated type designed for all position welding, and the size, type and manufacture of the rods shall require the consent of the Project Manager.</p> <p>iii) All welding shall be continuous along the entire line of contact, except where tack welding is permitted. Bevelling of the materials shall be done as shown on the approved shop drawings and shall be finished to a smooth and true finish with an automatic gas cutter or grinder. The use of manual gas cutters shall require the consent of the Project Manager.</p> <p>iv) The surface of the working materials shall be free from slag, moisture, rust, oil, paint or other impurities. Mill scale, which cannot be removed with a stiff wire brush, will be allowed to remain.</p> <p>v) The face of welds shall be smooth and form a uniform bead. The size and thickness of weld shall neither be less than specified, nor shall there be an excessive build-up or marked irregularities in the surface appearance.</p> <p>vi) Blow holes, slag, overlap, undercut and unsatisfactory melting of welded joints shall be removed with grinders or by other means and then rewelded. Due care shall be taken to protect the surrounding part from any injury or</p>		


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<div> <div>v)</div> <div>After priming, steelwork shall receive a further two coats of two component epoxy based paint, each of dry film thickness 0.08 mm. The total theoretical thickness of paint applied, including prime coats, shall be 0.26 mm, but in no case less than 0.22 mm.</div> </div> <div> <div>vi)</div> <div>All painting work shall be carried out in accordance with the manufacturers recommendations in a clean dust-free environment with temperature and humidity controlled to comply with these specifications and the recommendations of the paint manufacturer. All the surrounding works shall be protected in a suitable manner from paint drops and overspray. All smeared and damaged surfaces shall be cleaned or repaired.</div> </div> <div> <div>vii)</div> <div>After erection of painted miscellaneous metalwork the Contractor shall make good any damage to the paint coating in accordance with the manufacturers recommendations. The Project Manager may require items, which are badly damaged to be removed, returned to the shop and repainted.</div> </div> <div> <div>viii)</div> <div>In the case of surfaces to be welded, the steel shall not be painted or metal coated within a suitable distance of any edges to be welded if the paint specified or the metal coating would be harmful to welders or impair the quality of welds.</div> </div> <div> <div>ix)</div> <div>Parts to be encased in concrete shall not be painted or oiled.</div> </div> <div> <div>14.6.2</div> <div><u>GALVANISED STEELWORK</u></div> </div> <div> <div>i)</div> <div>All steel assemblies required to be galvanised shall, after the steel has been thoroughly cleaned of rust and scale, be galvanised in accordance with IS: 4759. The zinc coating shall not be less than 350 g/m². Any galvanised parts that become warped during the galvanising operation shall be straightened. Bolts, nuts and similar threaded fasteners, after being properly cleaned, shall be galvanised in accordance with ASTM Specification A 153 "Spec, for Zinc Coating (Hot-Dip) on Iron and Steel Hardware". Threads on galvanised bolts and nuts shall be formed with suitable taps and dies such that they retain their normal clearance after hot-dip galvanising.</div> </div>		
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<div> <div> ii) </div> <div> After installation on the final place all areas of damage to the galvanised coating shall be sandblasted and prepared and given 2 coats of approved zinc rich paint. The preparation of the steelwork surface and application of the paint shall be in accordance with the paint manufacturers instructions. </div> </div> <div> <div> iii) </div> <div> The Contractor shall supply certificates of compliance with the above standards for all galvanised material delivered to the Site. </div> </div> <div> 14.6.3 <u>FASTENERS</u> </div> <div> <div> i) </div> <div> Fasteners for miscellaneous metalwork including bolts, anchor bolts, cap screws and nuts shall be of stainless steel unless otherwise stated or shown. </div> </div> <div> <div> ii) </div> <div> Studs and anchors for fixing metalwork to concrete shall be of stainless steel and shall be of the expanding anchor type of approved quality unless otherwise stated. Grouted or resin types shall require the consent of the Project Manager. </div> </div> <div> 14.6.4 <u>ANODISING</u> </div> <div> <div> i) </div> <div> All aluminium parts exposed to view shall have an anodising finish of uniform appearance and shall be free from marks and blemishes. </div> </div> <div> <div> ii) </div> <div> Sulphuric acid shall be employed as electrolyte for anodising unless otherwise directed. The coating thickness shall be 0.02 mm or as specified by the Project Manager. </div> </div> <div> 14.7 <u>INSTALLATION</u> </div> <div> <div> i) </div> <div> All items of the miscellaneous metalwork shall be installed in correct position and alignment. Damaged or defective materials shall not be installed. Damaged or defective areas of paint or galvanising shall be cleaned and repaired as directed by the Project Manager. </div> </div> <div> <div> ii) </div> <div> Metalwork to be embedded in concrete shall be located accurately and shall be held in correct position and alignment during concrete placing and setting of the concrete. </div> </div> <div> <div> <div>ISSUE</div> <div>R1</div> </div> </div>		


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<div><div><div>iii)</div><div>Unless otherwise provided, the anchor bolts shall be set and held in position before concrete is placed. Where it is impractical to embed anchor bolts or anchors for the comparatively light metalwork before the concrete is placed, and where it is necessary to anchor parts but inserts or anchor bolts have not been provided, holes shall be drilled in the concrete and approved expansion anchors shall be installed. All holes for the anchors shall be straight and true to the diameter recommended by the manufacturer of the expansion anchors. If necessary, the Contractor shall use diamond bits to achieve true, fitting holes. When drilling water is used, surfaces of concrete permanently exposed shall be cleaned immediately to prevent discoloration by the drilling water and cuttings.</div></div><div><div>iv)</div><div>Supports and base plates shall be levelled or aligned accurately and rigidly secured in place. Adjustment with steel shims shall be done as necessary. All spaces under the supports or base plates shall be filled with concrete or shall be grouted as specified in the Chapter "Concrete".</div></div><div><div>v)</div><div>Each complete unit shall be serviced and tested after installation. The servicing shall include lubricating, adjusting, cleaning all parts, and all other work and material required for operation. After each unit has been serviced, it shall be given an operation test, and adjustments shall be made until the operation of the unit is approved by the Project Manager.</div></div></div> <div><div><div>14.8</div><div><u>METALWORKS SUPPLIED AND INSTALLED BY THE CONTRACTOR</u></div></div><div><div><div>14.8.1</div><div><u>STEEL PIPES</u></div></div><div><div><div>i)</div><div>The Contractor shall supply and install galvanised steel pipes of approved quality of various diameters and fittings conforming to IS: 4736 in the positions shown on the Drawings or as directed by the Project Manager. Material for steel pipes and fittings shall be of first class quality, shall be of standard weight conforming to IS: 6631.</div></div><div><div>ii)</div><div>Pipes shall be carefully fastened and supported within the shuttering, in order to avoid any movement when pouring concrete.</div></div></div></div></div> <div><div>ISSUE</div><div>R1</div></div>		

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<div data-bbox="236 387 1358 526"> <p>iii) Pipes where not cast into concrete shall be adequately supported by galvanised mild steel holderbats or other approved means. The distance between pipe supports shall not exceed 2.0 meters.</p> </div> <div data-bbox="236 568 612 607"> <p>14.8.2 <u>CAST IRON PIPES</u></p> </div> <div data-bbox="236 651 1358 1059"> <p>i) The Contractor shall supply and install cast iron pipes and fittings of approved quality, as shown on the Construction Drawings or as directed by the Project Manager.</p> <p>ii) Material shall be of first class quality grey cast iron subject to the approval of the Project Manager.</p> <p>iii) Cast iron pipes and fittings shall be treated with bituminous paint at the manufacturer's plant. Any damage to this coat shall be thoroughly cleaned and repainted to the satisfaction of the Project Manager.</p> </div> <div data-bbox="236 1102 868 1140"> <p>14.8.3 <u>MISCELLANEOUS STEEL SECTIONS</u></p> </div> <div data-bbox="349 1184 1358 1373"> <p>The Contractor shall supply and install all small galvanised steel sections such as edge protection, angles, frames, bearing plates, brackets, beads at plastered corners, etc., of various dimensions, bolts, screws, anchors and other accessories for interior or exterior purposes.</p> </div> <div data-bbox="236 1417 1353 1456"> <p>14.8.4 <u>WATERTIGHT STEEL COVERS AND HATCH COVERS FOR LIGHT LOAD</u></p> </div> <div data-bbox="236 1500 1358 1951"> <p>i) The Contractor shall supply and install watertight pressure covers as shown on the Construction Drawings and as specified herein. These covers are designed to resist an internal pressure of approximately 5 bars. All items shall be fabricated according to shop drawings prepared by the Contractor in the course of Works.</p> <p>ii) The pressure covers shall be manufactured from steel plates fastened to support frames with high strength bolts. Supporting frames shall consist of steel angles and welded steel flats provided with continuous watertight rubber seal. Frames shall be adjusted during installation to ensure a good fit</p> </div> <div data-bbox="1393 2033 1493 2123"> <div>ISSUE</div> <div>R1</div> </div>		

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<p>the component encountered. After trimming, a binding strip shall be provided on the grating to suit the profile so obtained.</p> <ul style="list-style-type: none"> vi) Openings in gratings for pipes or ducts that are 150 mm in size or diameter or larger shall be provided with steel bar toe plates of not less than 5 mm thickness and 100 mm width, set flush with the bottom of the bearing bars. vii) Penetrations in gratings that are more than 50 mm but less than 150 mm in size or diameter shall be banded with plates of the size shown in the detailed drawings set flush with the bottom of the grating panel. viii) Penetration, in gratings that are less than 50 mm in size or diameter shall be cut on site. ix) Unless otherwise indicated on the drawings, grating unit at all penetrations shall be made up in split section, accurately fitted and neatly finished to provide for proper assembly and erection at the job site. x) Grating unit shall be provided with all necessary clips, bolts, units and lock washers required for proper assembly and rigid installation and fastening to abutting units and supporting structural steel framing members. xi) Gratings shall be hot-dip galvanized and shall be fixed to support platforms using stainless steel screws and fittings. <p>14.8.6 <u>FLOOR PLATE COVERS</u></p> <p>Floor plates for platforms, trench covers, pit covers, etc., shall be formed of raised pattern chequered steel plates of shape and size as shown on the drawings, complete with stiffener ribs, stop bars, anchors and necessary accessories. Maximum deviation in the linear dimensions of floor plate covers from approved dimensions shall not exceed 5 mm.</p> <p>14.8.7 <u>HANDRAILS</u></p> <ul style="list-style-type: none"> i) The Contractor shall supply and install in the buildings handrails fabricated from galvanised steel pipes supported on welded steel flats and steel plates as shown on the Construction Drawings and as specified herein. Material for steel pipes shall be of standard weight and shall conform to IS: 4736. All <div data-bbox="1398 2033 1487 2121" style="border: 1px solid black; padding: 5px; text-align: center;"> ISSUE R1 </div>		

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<p>conforming to IS: 2062. Erection hooks shall be hot bent and shall be firmly held during placing of concrete.</p> <p>ii) Erection hooks as required shall be galvanised as specified above in this Chapter.</p> <p>14.8.11 <u>STEEL ANCHORING</u></p> <p>i) The Contractor shall supply and cast into concrete steel anchoring as required by the Project Manager or when shown on the Construction Drawings. Anchoring shall consist of 150 mm long, 16 mm diameter anchors made of mild steel conforming to IS:432.</p> <p>ii) Steel anchoring shall require no surface treatment.</p> <p>iii) Where anchoring is to be done after concreting either for convenience or as per specification or drawings, same shall be grouted by cement grout.</p> <p>14.9 <u>METALWORKS SUPPLIED BY OTHERS</u></p> <p>i) Anchoring and conduits furnished by suppliers of hydro and electro-mechanical equipment shall be installed by the Contractor at the locations shown on the Construction Drawings or on the installation drawings prepared by others and approved by the Project Manager.</p> <p>ii) The pieces to be incorporated in the concrete shall be furnished and stored in the warehouse of the Contractor at the Site. Every piece handed over to the Contractor shall have a handover card on which the following is stated:</p> <p>a) Installation site,</p> <p>b) Number of pieces,</p> <p>c) Number of reference drawings,</p> <p>d) Weight of the pieces, without packing,</p> <p>e) Special connections for fixing if necessary.</p> <p>iii) The Contractor shall transport the pieces from the warehouse to the installation site and fix it properly and with due precision behind the formwork before concreting. It is the responsibility of the supplier to check the correct fixing of these pieces behind the formwork before concreting</p>		
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<p>takes place. In case of any dispute regarding the correctness of the fixing or otherwise, the decision by the Project Manager would be final and binding on both Contractors.</p> <p>iv) The Contractor shall provide unless otherwise specified any foundations, wall and roof openings, concrete floor filling and sleeves in foundations for metal works supplied by others.</p> <p>v) All adjustments to foundation levels, embedding, bedding and grouting works on foundations and cementing into walls and floors will be done by the civil contractor.</p> <p>vi) Grouting shall be done by the Contractor as instructed by the Project Manager.</p> <p>14.10 MEASUREMENT AND PAYMENT</p> <p>i) Supply and installation by the Contractor when used in this Chapter shall be deemed to include the provision of all labour, plant and materials necessary for:</p> <p>a) Preparation and submittal of the shop drawings, calculation sheets, schedule of materials, and providing catalogues about, and samples of the materials,</p> <p>b) Purchasing or manufacturing, including surface and corrosion protection,</p> <p>c) Transporting to Site, including loading and unloading,</p> <p>d) The provision of certificates of compliance with required standards, as specified,</p> <p>e) Storing and protecting,</p> <p>f) Transporting to point of incorporation into the Works,</p> <p>g) Incorporating into the Works, including all necessary fasteners, fittings and accessories, formation of concrete block outs, and casting into concrete or grouting,</p> <p>h) Assistance to third parties for checking of erected parts,</p> <p>i) Servicing and testing of completed units.</p> <div data-bbox="1396 2033 1485 2123"> ISSUE R1 </div>		

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- ii) For installation by the Contractor of items of miscellaneous metalwork supplied by others, only e) to h) shall apply.

14.10.2 PIPES

- i) Measurement for payment for the supply and installation of steel or cast iron pipes will be of the length of pipework installed as shown on the Construction Drawings or as directed by the Project Manager.
- ii) Payment will be made at the appropriate Unit Price per linear meter entered in the Bill of Quantities.

14.10.3 MISCELLANEOUS STEEL SECTIONS

Measurement for payment for the supply and installation of steel sections of various dimensions will be of the weight installed as per relevant IS standards. Payment will be made at the Unit Price per kilogram entered in the Bill of Quantities.


14.10.4 WATERTIGHT STEEL COVERS

- i) Measurement for payment for the supply and installation of steel covers will be of the weight as per relevant IS standards of steel cover, including frames, installed as shown on the Construction Drawings or as directed by the Project Manager. Payment will be made at the Unit Price per kilogram entered in the Bill of Quantities, which shall include the supply and installation of suitable steel frames and all required accessories.

14.10.5 STEEL GRATINGS AND FLOOR PLATE COVERS

- i) Measurement for payment for the supply and installation of steel gratings will be of the weight of gratings, including frames, installed. Payment will be made at the Unit Price per kilogram entered in the Bill of Quantities.

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14.10.6 HANDRAILS AND RAILINGS

- i) Measurement for payment for supply and installation of handrails, railings will be of the length installed.
- ii) Payment will be made at the appropriate Unit Price per linear meter entered in the Bill of Quantities.

14.10.7 LADDERS AND CLIMBING IRONS

- i) Measurement for payment for supply and installation of ladders, handles and climbing irons, as shown on the Construction Drawings will be of:
 - a) The length in meters for ladder composition with protection cage installed, measured vertically from the top to the base of ladder,
 - b) The number of climbing irons installed.
- ii) Payment will be made at the appropriate Unit Price entered in the Bill of Quantities.


14.10.8 ERECTION HOOKS

- i) Measurement for payment for the supply and installation of erection hooks will be of the weight of erection hooks installed as per relevant IS standards and as shown on the Construction Drawings.
- ii) Payment will be made at the Unit Price per kilogram entered in the Bill of Quantities.

14.10.9 STEEL ANCHORING

- i) Measurement for payment for the supply and installation of steel anchoring will be of the total weight of anchoring in kilograms installed as per relevant IS standards and as shown on the Construction Drawings or as required by the Project Manager.
- ii) Payment will be made at the Unit Price per kilogram entered in the Bill of Quantities.

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<div data-bbox="234 387 681 423"> 14.10.10 <u>CABLE CHANNEL</u> </div> <div data-bbox="234 470 1358 763"> <ul style="list-style-type: none"> i) Measurement for payment for the supply and installation of steel plates for cable channels shall be of the total weight of installed steel plate in kilograms as per relevant IS standards, including the weight of frames, if any. ii) Payment will be made at the Unit Price per kilogram entered in the Bill of Quantities. </div> <div data-bbox="234 795 979 831"> 14.10.11 <u>METALWORKS SUPPLIED BY OTHERS</u> </div> <div data-bbox="234 846 1358 1081"> <ul style="list-style-type: none"> i) Measurement for payment for the installation will be of the weight as indicated by the supplier or in absence of such, the metalworks will be weighed at the Site in accordance with the relevant IS standards. ii) Payment will be made at the Unit Price per kilogram entered in the Bill of Quantities </div> <div data-bbox="234 1108 442 1144"> End of Chapter </div> <div data-bbox="1394 2033 1485 2123"> <div>ISSUE</div> <div>R1</div> </div>		