DIVISION B:

TECHNICAL SPECIFICATION, CIVIL AND MECHANICAL WORKS

CONSTRUCTION OF THE JATIBARANG MULTIPURPOSE DAM

PACKAGE 1: JATIBARANG MULTIPURPOSE DAM INCLUDING APPURTENANT STRUCTURES

SPECIFICATION

SECTION 2. WATER CONTROL

TABLE OF CONTENTS

SECTION 2. WATER CONTROL

2.1 DIVERSION AND CONTROL OF WATER DURING CONSTRUCTION

2.1.1 General

a. The Contractor shall design, construct and maintain all temporary diversion and all protective works which are necessary for the prevention of surface drainage and groundwater entering the various parts of the Works.

b. Diversion and protective works shall comprise, but are not necessarily limited to cofferdams, levee banks, channels, flumes, conduits, drains, pumps and, when required, settling ponds. The location of these works shall be such that there is no encroachment on to any area required for construction of the Permanent Works.

c. On completion of the Works all temporary diversion and protective works shall be removed and disposed of or shall be levelled in an approved manner to give a slightly appearance and so as not to interfere in any way with the operation or usefulness of the Permanent Works.

d. Notwithstanding the Contractor's obligations for design stated in clause 2.1.1.a the upstream cofferdam shall be constructed in accordance with the Drawings.

2.1.2 Dewatering

a. The Contractor shall design dewatering system and shall furnish, install, maintain and operate all necessary pumping, piping and other equipment and temporary structures for dewatering and maintaining the various parts of the Works free from the water during construction and, as required, for inspection and safety.

b. The Contractor's method of removal of water from the excavation work shall be subject to the approval of the Engineer. The dewatering shall be accomplished in a manner that will prevent loss of fines from the foundation, maintain stability of the excavated slopes and bottom of the excavation and results in all construction operation being performed in dry conditions.

2.1.3 Pollution

a. The Contractor shall construct, maintain and operate in accordance with his proposals as approved in the Letter of Acceptance, suitable settling ponds, separating plants or other works necessary to prevent any discharge of water containing polluting matter or visible suspended materials into rivers, streams or existing drainage systems.

b. All diverted and pumped water shall be discharge at locations on the surface from which it cannot re-enter the Works and in a manner which does not cause erosion, pollution or nuisance to landholders, other contractors employed by the Employer or other persons within or adjacent to the Site.

c. Disposal of waste oil from workshops and other areas shall not cause pollution of rivers and streams and shall be in accordance with methods approved by the Engineer.

2.1.4 Interference with Rivers and Streams

The Contractor shall not interfere with the natural flow of rivers or streams on the Site for any purpose without prior approval.

2.1.5 Responsibility for Works

a. The Contractor shall be fully responsible for any damage or delay to the Works caused by failure of the diversion and protective works and/or dewatering installations constructed by him in accordance with this Clause and shall indemnify the Employer against claims by other contractors employed by the Employer working on the Site or by landholders or other persons, arising out of any such failure.

b. The Contractor shall be responsible for, and shall repair or reinstate at his expense, any damage to foundations, excavated slopes or any other parts of the Works caused by the failure of the diversion and protective works and/or dewatering installations constructed in accordance with this Clause.

2.1.6 Payment

Separate payment will not be made for complying with the requirements of this Clause 2.1 and all costs shall be deemed to be included in the various rates and lump sums in the Bill of Quantities for the items for which the diversion and control of water is required.

2.2 DIVERSION AND CONTROL OF RIVERS AND STREAMS

2.2.1 Water Control Plan

The Contractor's method of diversion and control of rivers and streams during construction shall be in accordance with the proposals, which shall include the upstream temporary main cofferdam and the diversion tunnel as shown in the Drawings, approved by the Employer in the Letter of Acceptance.

At least 30 days before commencing any work on the diversion and control works the Contractor shall submit, for approval, a detailed Water Control Plan describing the proposed sequence of work. The plan shall include the location, type, size quantity and capacity of the diversion equipment, the computation and drawings, the source of materials, the schedule of constructions, and other information directed by the Engineer. The plan shall be placed in operation upon approval, but nothing in this Clause shall relieve the Contractor from full responsibility for the adequacy of the diversion measures, removal of water and protective works. Should the Contractor consider special circumstances have arisen after commencement of the Works which warrant a deviation from the Tender proposals he shall submit, for approval, full details of these circumstances together with the detailed Water Control Plan at least 30 days before commencing any work on the diversion and control works.

2.2.2 Data Supplied to Contractor

Stream flow data for the Kreo River are included in the data made available to Tenderers in pursuant to Clause 11 of the General Conditions of Contract. The Employer does not guarantee the reliability of accuracy of these data and will not be responsible for any deduction, conclusions or interpretations which may be made by the Contractor from these data.

2.3 Diversion and Protective Works

a. The construction of the diversion tunnel and the upstream main cofferdam which comprise the main diversion works and shall be constructed in accordance with the Drawings and as specified in other Sections of the Specification are not be included in the Contractor's obligations under this Section 2.

b. The Contractor shall provide all other diversion and protection works proposed in his Water Control Plan and approved by the Engineer.

2.4 Payment

Payment for water control will be made at the lump sum price tendered therefore in the priced Bill of Quantities (Item B.1). This lump sum price shall include the design, construction, operation and maintenance of all diversion works and the removing and levelling of such works where required.

Payment for the upstream temporary main cofferdam, the upstream and downstream portals and the diversion tunnel are not included in this payment item and their payment is allowed for under other payment items.

CONSTRUCTION OF THE JATIBARANG MULTIPURPOSE DAM

PACKAGE 1: JATIBARANG MULTIPURPOSE DAM INCLUDING APPURTENANT STRUCTURES

SPECIFICATION

SECTION 3. SURFACE EARTHWORKS

TABLE OF CONTENTS

SECTION 3. SURFACE EARTHWORKS

3.1 GENERAL

This section covers the requirement for all surface earthworks (as opposed to underground works) required to be carried out for the Works and includes clearing and grubbing, stripping of topsoil, surface excavation, exploratory trench excavation, fill and backfill and specific earthworks described herein.

Underground Earthworks (tunnelling) are specified in Section 4 and Embankment Construction is specified in Section 6.

3.2 CLEARING AND GRUBBING

3.2.1 Areas to be Cleared

The Contractor shall clear the areas to be occupied by the Works of all trees, stumps, roots, brush, rubbish and other objectionable matter. Areas to be cleared shall include, but not be restricted to

a. borrow areas and quarries;

b. surfaces of stockpile areas;

c. disposal areas;

d. areas to be filled; and

e. areas of permanent and temporary construction

3.2.2 Areas to be Cleared and Grubbed

In areas from which stripping of topsoil is required in accordance with Clause 3.3 the Contractor shall clear then grub all tree stumps, roots, rubbish and vegetable matter from all surfaces such that clearing shall be effected in such a manner as to prevent, as far as practicable, the loss of top soil.

3.2.3 Method of Clearing and Grubbing

a. The limits of the areas to be cleared or grubbed shall be within the limits of surface excavation and for a distance 10 m beyond those limits; within the right-of-way for embankment construction; and for other areas as shown on the Drawings or directed.

b. No tree shall be cut down outside the limits specified in paragraph a. of this Sub-Clause unless otherwise directed by the Engineer. Felling or removal of trees with explosives will not be permitted.

c. Clearing shall be completed as early as possible to permit the maximum drying out period during the driest months of the year before burning.

d. The areas to be grubbed shall be scarified to a depth of 300 mm and the area raked to remove all large organic material, rubbish and objectionable matter. Small-sized organic material shall be retained in the top soil as much as possible.

e. Valuable trees shall be cut and stockpiled separately prior to the commencement of clearing works. Valuable trees shall be identified by the Engineer following setting out of the area to be cleared. After felling the cut trees shall be pruned and trimmed of all branches and the main

trunk retained in one length unless otherwise approved. The valuable trees shall be stockpiled in locations directed by the Engineer.

3.2.4 Disposal of Material

a. All materials from clearing and grubbing operations shall be burned or removed from the site of the work before the date of completion or otherwise disposed of as approved by the Engineer. All materials to be burned shall be burned completely. Piling for burning shall be done in such manner and location so as to cause the least risk of fire.

b. Burning shall be done at such times as approved by the Engineer in accordance with the applicable laws and regulations. All burning shall reduce the materials to ashes. The Contractor shall at all times take special precautions to prevent fire from spreading to areas beyond the limits of the cleared areas and shall have available at all times suitable equipment and water supplies for use in preventing and suppressing fires.

3.2.5 Clearing of Reservoir Area

a. The Contractor shall clear portions of the reservoir area below EL. 157. The boundaries of the areas to be cleared will be set out by the Contractor and approved by the Engineer prior to clearing. The clearing includes the removal of all trees, saplings, bushes and undergrowth.

b. All Trees, saplings, bushes and undergrowth shall be felled in such a manner that the height of the stumps above the ground measured on the uphill side of the stump does not exceed 30 cm. Felling or removal of trees with explosives will not be permitted. Trees stumps and roots shall be left firm in the ground.

c. All fallen timber and all branches, saplings, bushes, brush, undergrowth and rubbish shall be stocked for burning in heaps of not more than 5 cubic meter with gaps of not less than 10 m between heaps.

d. Clearing shall be completed at such a time to permit the maximum drying period during the dry season prior to burning. All cleared materials described in paragraph c. of this Sub-Clause shall be disposed of by burning.

e. The Contractor shall conduct his clearing operations in such a manner that any disturbance of the original surface conditions in the cleared areas shall be avoided or kept to a minimum. The use of tracked or wheeled vehicles will be permitted in the areas only a long roads and tracks which are approved for this purpose.

f. The Contractor shall programme to do the reservoir clearing at a suitable time that does not permit excessive re-growth to occur, as determined by the Engineer, before impounding of the reservoir. If excessive re-growth occurs before impounding it shall be removed as directed by the Engineer at the expense of the Contractor.

3.2.6 Measurement

a. Measurement, for payment, for clearing and grubbing shall be made only for such areas as are actually cleared and grubbed within the limits specified in this Clause for required excavation for permanent construction, foundation for embankments for Permanent Works, areas to be backfilled as part of the Permanent Works, disposal areas

designated on the Drawings or other areas as shown on the Drawings or as directed by the Engineer.

b. Measurement, for payment, of clearing of the reservoir area shall be made of the horizontal projection of the area approved to be cleared by the Engineer in accordance with Sub-Clause 3.2.5.

3.2.7 Payment

a. Payment for clearing and grubbing will be made at the rate per square meter tendered therefor in the Bill of Quantities (Item C.1.1) which rate shall include the cost of all labour, materials, equipment and incidentals for clearing, grubbing, piling and burning of the cleared materials, and any other necessary works connected therewith. Direct payment will not be made for clearing and grubbing of borrow areas, quarries, surfaces of stockpile areas and other areas of temporary construction referred to in this Clause and the cost of all such clearing and grubbing shall be deemed to be included in the rates and lump sum prices for the relevant items in the Bill of Quantities.

b. Payment for clearing of portion of the reservoir will be made at the rate per hectare tendered therefor in the Bill of Quantities (Item C.1.2) which rate shall include all costs of cutting, pruning and trimming, transporting, heaping and burning.

3.3 STRIPPING OF TOPSOIL

3.3.1 General

Immediately after clearing and grubbing operations and before excavation commences topsoil shall be removed from the surface of areas to be excavated for diversion facilities, dam embankment and spillway, inclined intake structure, access road, dam management complex, approved borrow areas and quarries disposal areas designated on the Drawings and in all other areas shown on the Drawings or referred to in Clause 3.2 to a minimum depth of 300 mm. Topsoil shall be removed within 300 mm outside the limits of required excavation and embankment construction shown on the Drawings and the surface shall not be disturbed beyond these limits.

Topsoil is defined as the surface or top layer of soil containing fine roots, herbaceous vegetation and overlaying grass and is characterised by the presence of organic matter.

3.3.2 Disposal and Stockpiling

Where topsoil is required for other activities (e.g. sodding, reinstatement of borrow areas etc.) it shall be stockpiled at convenient approved locations on or adjoining the area from which such topsoil was removed.

All topsoil surplus to requirements for other activities shall be disposed of in approved disposal areas.

3.3.3 Measurement

Measurement, for payment, of stripping of topsoil shall be made of the area of topsoil actually stripped within the limits of the areas directed or approved by the Engineer and to the specified depth.

3.3.4 Payment

a. Payment for stripping of topsoil from the surface of all permanent embankment foundations, the surface of all required excavation and any other areas to be covered by the Permanent Works shall be made at the rate per square meter tendered therefor in the Bill of Quantities (Item C.2) which rate shall include the cost of all labour, materials, equipment and incidentals necessary for stripping, hauling, disposal, and where required, stockpiling, of topsoil materials.

b. Separate payment will not be made for stripping and stockpiling of topsoil from borrow areas, quarries, stockpile areas and areas for Temporary Works and all costs shall be deemed to be included in the rates and lump sum prices for the relevant items in the price Bill of Quantities.

c. If, by reason of the Contractor not using all topsoil from required excavation which is suitable and required for the Permanent Works, it is necessary to obtain topsoil from other sources, the Contractor shall obtain, at his own expense, a quantity of topsoil equal to the quantity of suitable topsoil from required excavation wasted by him, as determined by the Engineer.

d. The Contractor shall provide, at his own expense, all topsoil required to reinstate all borrow areas, quarries, stockpile and disposal areas and all other areas of temporary construction and Temporary Works to the same standard specified in Clause 7.10.

3.4 SURFACE EXCAVATION

3.4.1 General

3.4.1.1 General Requirements

a. All surface excavation covered by Clause 3.4 shall comply with the general requirements specified in this Sub-Clause 3.4.1, 3.4.2 and 3.4.3 and with the appropriate clauses related to the specific items of work specified hereunder.

b. Surface excavation includes all surface excavation for the following parts of the Works:
   - Diversion Facilities
   - Embankment Dam
   - Gallery
   - Spillway
   - Inclined Intake Structure
   - Hydropower Station (below EL. 80.00m)
   - Dam Management Complex
   - Roadworks
   - Minor works

c. The Contractor shall perform all surface excavation in whatever material and in whatever conditions may be encountered and, pursuant to Sub-Clause of 11.1 of the General Conditions of Contract, he shall be deemed to have allowed for the cost of such in the unit rates and lump sums in the Bill of Quantities.

d. For payment purposes no distinction shall be made between surface excavation of materials of different hardness, different character or differing degrees of difficulty in excavation.

e. The Contractor shall perform all surface excavations in accordance with the proposals submitted by the Contractor in his Tender and approved in the Letter of Acceptance or with such modifications as may be approved by the Engineer from time to time.

f. Suitable material from surface excavation shall be used in the Works. The Contractor shall perform surface excavation such that it will yield sufficient required suitable material for use in the construction of the impervious zone of the dam embankment or for other fill purposes as practicable and shall be subject to approval. Where practicable, material suitable for use in the Works shall be excavated separately from materials to be wasted. Approved material shall be segregated by loads during the excavation and shall be placed in the designated final locations or shall be placed in stockpiles and later placed, or processed and placed, in the designated final locations in accordance with the provisions of this Specification.

g. The suitability of material obtained from the required excavations for use in the Works will be determined by the Engineer.

h. If, by reason of the Contractor's not using all material from required excavation which is suitable and required for the Works, it is necessary to obtain material from other sources, the Contractor shall obtain, at his own expense, a quantity of material equal to the quantity of suitable material from required excavation wasted by him, as determined by the Engineer.

i. Any and all over-excavation performed by the Contractor for any purpose or reason, except as may be directed, shall be at the expense of the Contractor. All such over-excavation shall be backfilled with approved material from required excavations or concrete, as directed, and the cost of furnishing and placing this backfill shall be at the expense of the Contractor. The Engineer may approve alternative measures to backfilling and the cost of such measures shall be at the expense of the Contractor.

j. Excavated materials to be wasted from all surface excavations shall be disposed of in accordance with Clause 3.4.2

3.4.1.2 Shape of Excavation

a. All surface excavations shall be made to the lines, grades and dimensions shown on the Drawings or directed. During the progress of the work the Engineer may direct that the slopes or dimensions of the excavations be varied from those shown on the Drawings and the Contractor shall not be entitled to any additional allowance above the various rates tendered in the Bill of Quantities for surface excavations by reason of such changes.

b. Any other surface excavation performed at the option of the Contractor to secure access to required work, for disposal of material excavated, or for any other purpose, shall be kept within approved limits and shall be at the expense of the Contractor.

c. The Engineer may direct excavations to be performed in successive stages until a suitable foundation or surface is reached as determined by the Engineer. The Contractor shall not be entitled to any additional

payment above the applicable rates tendered in the Bill of Quantities for these excavations by reason of such successive stages in the excavation procedure. Each successive stage shall include clean off of foundations or surfaces for inspection in accordance with Sub-Clause 3.4.1.9 except that if the Engineer approves the excavated surface as being a suitable foundation surface or final batter the clean off will be regarded as part of clean up as required in Sections 6, 9 and 10 of the Specification. The cost of all work required for the preparation of a suitable foundation or surface shall be included in the applicable rates tendered in the Bill of Quantities, for surface excavation.

3.4.1.3 Seams, Cavities and Other Defects in Rock

a. The exploratory investigations of the foundations, slopes and other areas to be excavated are not sufficiently complete to disclose all seams and other defects that may exist in the rock. It is anticipated that there may be depressions, fissures, faults, seams and bands of soft disintegrating rock running in various directions in the materials to be excavated and in the foundations, slopes and other areas. The assumed lines of excavation shown on the Drawings shall therefore not be interpreted as indicating with any degree of accuracy the final or actual excavation lines or that no defects exists.

b. Where such seams or defects occur they shall be corrected by local surface excavations below the general surface of excavation, to the lines, depths and dimensions directed. These local surface excavations shall be solidly backfilled with concrete or approved materials or covered by shotcrete.

c. The Engineer may direct that certain surfaces be protected and/or supported in accordance with the relevant Clauses of Section 7 of the Technical Specification.

d. Payment for such excavations will be made at the applicable rate tendered in the Bill of Quantities for the excavation for the relevant structure and payment for backfill concrete will be made in accordance with Sub-Clause 9.30.3.

3.4.1.4 Excavation Precautions

a. All necessary precautions shall be taken to preserve, in the soundest possible condition, the material below and beyond the lines of all excavation. Unless otherwise directed or approved the Contractor shall use the pre-splitting technique. Blasting operations that might damage the Works will not be approved. Any damage done to the Works by blasting, including the shattering or loosening of the material beyond the required excavation lines, shall be repaired by and at the expense of the Contractor.

b. The Contractor shall exercise special care to avoid damage to concrete, shotcrete or pressure grouting already completed. Delay-blasting shall be used to reduce shock waves. The Engineer may require that blasting shock wave intensity as measured by peak particle velocity at any location shall be kept within limits to be determined by the Engineer to ensure that no damage or disturbance to any part of the Works is caused by blasting operations. The Contractor shall provide the instrument to measure the peak particle velocity during blasting operations, if required. Unless otherwise approved, the Contractor shall not fire any charges within 60 m of concrete or shotcrete already placed.

The entire costs of complying with the requirements of this Sub-Clause shall be deemed to be included in the various rates in the Bill of Quantities for excavation.

c. The Contractor shall periodically remove loose material from excavated batters to maintain them in a safe condition. All berms shall be maintained with the clear width of passageway shown on the Drawings.

d. All planking, strutting and supports necessary to retain the sides of the excavations shall be provided, erected and maintained in a safe condition by the Contractor. No payment will be made for planking, strutting or temporary supports. Permanent support shown on the Drawings or directed shall be installed in accordance with Section 7 of the Specification and will be paid for as provided therein.

3.4.1.5 Pre-Splitting Technique

a. Where blasting is required to produce excavated surfaces to the lines and grades shown on the Drawings or directed, the Contractor shall use the pre-splitting technique to ensure that a fracture plane is established along the required final excavation surfaces before excavation of the main body of rock, thus minimising damage to the rock beyond the required final excavation surface.

b. The Contractor shall submit, for approval, a description of his proposed method and procedures of excavation at least 30 days before starting excavation in any section of the work requiring the use of the pre-splitting technique specified in this Sub-Clause. The spacing and diameter of pre-splitting holes and the arrangement of the explosives in each hole shall be varied to suit the hardness of the rock and be chosen to provide the best practical excavated surface after blasting.

c. The Contractor shall establish, by field trials in an approved area, his blasting technique to produce a minimum of overbreak and fracturing of the rock outside the excavation lines of the areas required to be pre-split. These trials shall be performed by varying the diameter, depth and pattern of holes, the type and quantity of explosive, the blasting sequence and delay pattern. The cost of developing this technique shall be included in the rates tendered in the Bill of Quantities for the excavation of the relevant structures.

d. Unless otherwise approved by the Engineer the Contractor shall not fire any charges within 30 m of concrete or shotcrete already placed.

3.4.1.6 Approval of Blasting Techniques

All blasting techniques, including the depth and size of holes and the size and characteristics of charges, shall be subject to approval. The explosives shall be of such quantity and moderate power and shall be used in such locations as will neither open seams nor crack nor damage rock outside the prescribed limits of excavation. As the excavation approaches its final lines, the depths of the holes for blasting and the amount of explosive used per hole shall be reduced progressively. Wherever further blasting may damage the rock, the Engineer may direct that the use of explosive shall be discontinued and the excavation shall be completed by wedging, barring, channelling and broaching, or by other approved means.

3.4.1.7 Inspection of Completed Excavation

When any excavation has been completed to the lines shown on the Drawings or directed and trimmed, the Engineer shall be informed

accordingly so that he may inspect the completed excavation. No excavation shall be filled in or covered with any material whatsoever until it has been inspected and the Contractor has been authorised to proceed with the work.

3.4.1.8 Surface Drains

Where required and when directed, the Contractor shall excavate surface drains to divert surface water away from surface excavations. The entire cost of such drains shall be included in the rates tendered in the Bill of Quantities for the various items of excavation except for excavation for surface drains along the upper side of the spillway shall be paid under item C.4.4 and excavation for roadside drains shall be paid under item J1.

3.4.1.9 Clean off Foundations for Inspection

3.4.1.9.1 General

The Contractor shall clean-off foundations for inspection with an air or a combined air and water jet under high pressure or vacuum where and when directed.

The Engineer may direct clean-off of foundation for inspection after each successive stage of excavation for foundations for concrete structures and embankments to determine whether any unsound or suitable material is present in the foundation.

Clean-off of foundations for inspection is separate and distinct from clean-up before placement of any embankment materials and concrete as required elsewhere in this Specification.

3.4.1.9.2 Measurement and Payment

a. Measurement, for payment, of clean-off of foundations for inspection shall be made of the horizontal projection of the areas of foundations actually cleaned off for inspection as directed.

b. Payment for clean-off of foundations for inspection will be made at the rate per square metre tendered therefor in the Bill of Quantities (Item C.8)

3.4.1.10 Classification of Excavated Materials

No classification of excavated materials from surface excavation will be made for payment purposes.

Solely for the purposes of determining batter slopes of excavations under sub-clause 3.4.1.11 the following definitions will apply.

a. Common

Common, shall include excavation of all common soil materials including boulders or detached pieces of solid rock less than one cubic meter in volume which can be removed without ripping by a Komatsu D85a bulldozer 228 rated H.P. or equivalent.

b. Unsound Rock

Unsound rock shall consist of excavation of rock other than sound rock as defined in paragraph c. of this Sub-Clause which can be removed by ripping with a Komatsu D85a bulldozer 228 rated H.P. or equivalent.

c. Sound Rock

Opencut excavation of sound rock shall include excavation of all solid rocks in place which can only be removed after they are loosened by blasting and all boulders or detached pieces of solid rock more than one cubic meter in volume. Sound rock shall be defined as any in-situ material which cannot be ripped by the tynes of a Komatsu D85a bulldozer 228 rated H.P. or equivalent.

d. Riverbed Material

Riverbed material shall include excavation of sand, gravel, cobble and boulder layers.

3.4.1.11 Measurement

a. Measurement, for payment, of surface excavation shall be made of the volume of material excavated to the lines, grades and dimensions shown on the Drawings or directed and shall be taken only in the presence of the Engineer. The Engineer shall be notified at least 24 hours before taking such measurements.

b. Before commencing and immediately after completion of surface excavation which is to be measured for payment, the Contractor shall take survey measurements sufficient to define the dimensions and elevations of the original and final surfaces.

c. Not less than 7 days before commencing such survey measurements, the Contractor shall submit to the Engineer, for approval, a plan showing the proposed layout of reference lines, cross-sections and method of survey.

d. Reference lines and points are to be set out on the ground and related to permanent marks. At least 24 hours before commencing setting out, the Engineer shall be notified. Original field notes of the setting out of these reference lines are to be submitted to the Engineer, together with the notes on actual quantity observations.

e. Except as shown the Drawings or as otherwise directed by the Engineer, the required open-cut excavation will be measured, for payment, to the slopes as shown in the following table.

Particular	Slope to be Permanently Exposed	Slope to be Backfilled Later
Sound Rock	0.5(H) : 1.0 (V)	0.3(H) : 1.0 (V)
Unsound Rock	0.8 : 1.0	0.5 : 1.0
Common	1.0 : 1.0	0.8 : 1.0
Riverbed Material	1.5 : 1.0	1.0 : 1.0

f. Except as shown on the Drawings or as otherwise directed by the Engineer, where the depth of the excavation exceeds 7.5 m, a berm of 1.5 m width shall be provided.

g. In the case of excavation where backfill is to be made after excavation, the lines of slope for measurement shall be drawn at the slopes prescribed above from the point 0.6 m outside of the bottom of foundation concrete of the structures unless direct concreting on or

against a rock surface is shown on the Drawings or specified in which case measurement for payment will be in accordance with paragraph a. of this Sub-Clause. This line of slope is only for measurement for payment and not for the construction, even if shown on the Drawings.

3.4.1.12 Payment

Payment for the various items of required surface excavation will be made at the applicable rates per cubic meter tendered therefor in the Bill of Quantities. These rates shall include the cost of all labour, materials, temporary construction, pumping, bailing, draining and all other work necessary to maintain the surface excavations in good order during construction, and of removing such temporary works, if so directed. These rates shall also include the entire cost of excavating and transporting the materials from the excavation to the point of final use or to disposal and, where stockpiles are used, the cost of transporting the material to the stockpiles, of re-handling and of transporting such material to the point of final use and the entire cost of cleaning up excavated surfaces.

3.4.2 Stockpile and Disposal of Excavated Material

3.4.2.1 General

a. Insofar as practicable and as determined by the Engineer, suitable materials from excavation shall be used in permanent constructions required under the Specification such as in embankments or as backfill.

b. Where practicable suitable materials for embankments or common fill or backfill or random fill shall be excavated separately from the materials to be wasted. The suitable materials shall be segregated by loads during the excavation operations and placed in the designated final locations directly from the excavation, or may be placed in temporary stockpiles and later placed in the designated locations, as directed by the Engineer.

c. The excavated materials suitable for embankment or backfill after drying out but too wet for immediate compaction when excavated shall be placed temporarily in a stockpile approved by the Engineer until the moisture content is reduced sufficiently to permit them to be placed in the embankment or backfill.

d. Excavated materials unsuitable for or in excess of permanent construction requirements shall be wasted. The disposal of all excavated materials to be wasted shall be subject to the approval of the Engineer.

3.4.2.2 Location of Disposal Areas

Disposal areas shall be located where they will not harmfully interfere with the natural flow of streams or with the operation of the future reservoir or with the flow of water to or from the outlet works and spillway. They will not interfere with the accessibility of the structures for operation requirements nor detract from the appearance or recreational attractiveness of the completed Project. Areas for disposal of waste materials from excavation shall be as shown on the Drawings, or as directed or approved by the Engineer.

3.4.2.3 Treatment of Surfaces

a. The Contractor shall grade the top surfaces of all material placed within disposal and stockpile areas and, where shown on the Drawings, shall construct permanent drains and other protective works sufficient to

ensure that surface run-off will not erode the surfaces of stockpiles and/or disposal areas or the material placed therein.

b. Unless otherwise approved, the finished outer slopes of the disposal areas shall not be steeper than 1 vertical to 3 horizontal or as otherwise shown on the Drawings or directed by the Engineer.

c. Unless otherwise directed, the finished surfaces of disposal areas, other than within the reservoir area, shall be covered with 100 mm of topsoil and protected in accordance with Sub-Clause 7.10.

3.4.2.4 Approval

At least 30 days before disposing of material in any area, the Contractor shall submit for approval details of his proposals for disposal of materials in the area and the protection of these materials from erosion.

3.4.2.5 Payment

a. The entire cost of hauling and of disposing of the materials removed in excavation, including stockpiling separately materials for use as, embankment material, backfill, roadway material or any other material required for the Works, shall be included in the rates tendered in the Bill of Quantities for the various items of excavation.

b. Separate payment will not be made for treatment of surfaces of material in stockpiles or disposal areas as specified herein and all costs shall be deemed to be included in the applicable rates tendered in the Bill of Quantities for the various items of excavation.

c. Permanent surface drains, constructed in designated disposal areas in accordance with the Drawings shall be paid in accordance with Clause 8.3.

3.4.3 Structural Foundations - General

a. All excavations for structure foundations shall be performed in dry conditions in accordance with clause 2.1.2. No additional allowance above the unit rates tendered in the Bill of Quantities for excavation will be made on account of any of the materials being wet.

b. The bottom and side slopes of excavation upon or against which concrete or stone masonry work is to be placed shall be excavated to the dimensions shown on the Drawings or as directed by the Engineer. No material will be permitted to extend within the neat lines of the structure. If, at any point in excavation material is excavated, at the direction of the Engineer beyond the lines shown on the Drawings the additional excavation shall be filled solidly with concrete. Subject to the provisions of Sub-Clause 3.4.1.2 for equitable adjustment of the Contract Price, payment for such additional excavation will be made at the unit price per cubic meter tendered in the Bill of Quantities for excavation for the relevant structure. Payment for the concrete placed in such additional excavation will be made at the applicable rate per cubic meter tendered in the Bill of Quantities for the concrete in the adjacent structure. Excess excavation and over-excavation performed by the Contractor for any purpose or reason without written order of the Engineer shall be refilled with concrete backfill furnished and placed by and at the expense of the Contractor.

c. When excavation precedes the scheduled time for subsequent backfilling of structure foundations, the Contractor shall leave a residual

depth of unexcavated material above the final cut line(s) to protect the final surface against weathering. Removal of the final thickness of material shall be made sufficiently close in time to backfilling or concrete placement so as to ensure that the effects of weathering are minimal. The timing of removal of the final layer shall be subject to the approval of the Engineer.

3.4.4 Surface Excavation for Diversion Facilities

3.4.4.1 General

Surface excavation for diversion facilities includes the excavation for the cofferdam (i.e. the cofferdam as shown in the Drawings as opposed to any other temporary cofferdam provided by the Contractor) and for the upstream and downstream portals of the diversion tunnel.

The excavations shall be to the lines grades and profiles as shown on the Drawings and shall be of sufficient depth so as to obtain a suitable foundation as determined by the Engineer.

3.4.4.2 Measurement and Payment

a. Measurement, for payment, shall be in accordance with Sub-Clause 3.4.1.11.

b. Payment for surface excavation for diversion facilities will be made at the rate per cubic metre tendered therefor in the Bill of Quantities (Item C.3.1) in accordance with Sub-Clause 3.4.1.12.

3.4.5 Surface Excavation for Dam Embankment

3.4.5.1 General

Excavation for the foundation for dam embankment includes:

a. The removal of partially and completely weathered material from the foundation area of the impervious zone, the removal of materials which might interfere with the proper bonding of that zone, and the removal of materials of inadequate strength. The extent and depth of the excavation to reach a suitable foundation shall be as directed.

b. The excavation for the dam embankment for the pervious zone shall be to a sufficient depth to obtain a foundation area of slightly to moderately weathered rock as determined by the Engineer which foundation area shall be essentially free from weathered materials, open seams or other objectionable material.

c. The removal of completely weathered material from the foundation area of the semi-pervious zone of materials which might permit unacceptable settlement of that zone or which might interfere with the proper compacting of these zones of the embankment and the removal of materials of inadequate strength. The extent and depth of the excavation to reach a suitable foundation shall be as directed by the Engineer.

d. The Engineer may direct that the excavation be performed in successive stages until suitable foundation conditions are reached.

3.4.5.2 Co-ordination with Grouting Works

Surface excavation of the region under the impervious zone of the embankment shall be left unexcavated to the extent that there remains a 1 m depth of unexcavated rock above the design surface of the foundation as

shown in the Drawings. The unexcavated portion shall be left in place until the completion of blanket grouting as describe in Section 5.

3.4.5.3 Required Quality of Foundation

a. The excavation for the dam embankment, for impervious and semi-pervious zones, shall be to a sufficient depth to obtain a foundation area of fresh to slightly weathered rock as determined by the Engineer which foundation area shall be essentially free from weathered materials, open seams or other objectionable defects.

b. The excavation for the Dam embankments for the pervious zone shall be to a sufficient depth to obtain a foundation area of slightly to moderately weathered rock as determined by the Engineer which foundation areas shall be essentially free from weathered materials, open seams or other objectionable material.

c. The alignment and cross-sectional dimensions of the foundations will be subject to changes considered necessary to adapt the foundation to the conditions disclosed by the excavation.

d. Steep or overhanging rock faces shall be cut back to a short continuous face, or a series of stepped faces, to provide satisfactory abutment contact slopes for the embankments. Such rock faces shall, in general, be cut back to slopes of 0.75 horizontal to 1 vertical or flatter. Where it is not possible or desirable to meet these requirements, the foundations shall be treated in accordance with the Engineer's instructions.

3.4.5.4 Measurement and Payment

a. Measurement, for payment, shall be in accordance with Sub-Clause 3.4.1.11.

b. Payment for surface excavation for dam embankment will be made at the rate per cubic metre tendered therefor in the Bill of Quantities (Item C.3.2) in accordance with Sub-Clause 3.4.1.12.

3.4.6 Surface Excavation for Gallery

3.4.6.1 General

Excavation for the gallery shall be to the lines and levels as shown on the Drawings or as determined by the Engineer. The alignment of the gallery will remain fixed as shown on the Drawings and any additional excavation directed by the Engineer will be backfilled in as directed by the Engineer.

3.4.6.2 Measurement and Payment

a. Measurement, for payment, shall be in accordance with Sub-Clause 3.4.1.11.

b. Payment for surface excavation for gallery will be made at the rate per cubic metre tendered therefor in the Bill of Quantities (Item C.3.3) in accordance with Sub-Clause 3.4.1.12.

Backfilling of additional excavation directed by the Engineer will be paid for separately.

3.4.7 Surface Excavation for Spillway

3.4.7.1 General

Excavation for the spillway shall be to the lines and levels as shown on the Drawings or as determined by the Engineer.

3.4.7.2 Measurement and Payment

a. Measurement, for payment, shall be in accordance with Sub-Clause 3.4.1.11.

b. Payment for surface excavation for spillway will be made at the rate per cubic metre tendered therefor in the Bill of Quantities (Item C.3.4) in accordance with Sub-Clause 3.4.1.12.

3.4.8 Surface Excavation for Inclined Intake Structure

3.4.8.1 General

Excavation for the inclined intake structure shall be to the lines and levels as shown on the Drawings or as determined by the Engineer.

3.4.8.2 Measurement and Payment

a. Measurement, for payment, shall be in accordance with Sub-Clause 3.4.1.11.

b. Payment for surface excavation for inclined intake structure will be made at the rate per cubic metre tendered therefor in the Bill of Quantities (Item C.3.5) in accordance with Sub-Clause 3.4.1.12.

3.4.9 Surface Excavation for Hydro-Power Station

3.4.9.1 General

Excavation for the hydro-power station shall be to the lines and levels as shown on the Drawings or as determined by the Engineer.

3.4.9.2 Measurement and Payment

a. Measurement, for payment, shall be in accordance with Sub-Clause 3.4.1.11.

b. Payment for surface excavation for Hydro-Power Station will be made at the rate per cubic metre tendered therefor in the Bill of Quantities (Item C.3.6) in accordance with Sub-Clause 3.4.1.12.

3.4.10 Surface Excavation for Dam Management Complex

3.4.10.1 General

Excavation for the dam management complex shall be to the lines and levels as shown on the Drawings or as determined by the Engineer. Excavation shall be completed within the time for completion of this section of the works as stated in the Conditions of Contract, Appendix to Bid.

3.4.10.2 Measurement and Payment

a. Measurement, for payment, shall be in accordance with Sub-Clause 3.4.1.11.

b. Payment for surface excavation for dam management complex will be made at the rate per cubic metre tendered therefor in the Bill of Quantities (Item C.3.7) in accordance with Sub-Clause 3.4.1.12.

3.4.11 Excavation for Road Construction

3.4.11.1 General

Excavation for roadworks shall be to the lines and levels as shown on the Drawings or as determined by the Engineer.

3.4.11.2 Measurement and Payment

a. Measurement, for payment, shall be in accordance with Sub-Clause 3.4.1.11.

b. Payment for surface excavation for roadworks will be made at the rate per cubic metre tendered therefor in the Bill of Quantities (Item J.1) in accordance with Sub-Clause 3.4.1.12. In addition, the rate shall include the cost of subgrade preparation and testing of subgrade in cut in accordance with Sub-Clause 10.7.1.

3.4.12 Excavation for Trenches, Pits and Footings

3.4.12.1 Definition of Item

Excavation for Trenches, Pits and Footings includes all required excavation and support for:

a. lined surface drains

b. catch basin

c. trenches for drains pipes

d. trenches for drains under spillway

e. elsewhere as directed.

3.4.12.2 Method of Excavation

Trenches, pits and footings shall be excavated using hand tools and approved mechanical equipment, in such a manner as to prevent shattering of the sides and bottom of the excavation. At the option of the Contractor, and with the approval of the Engineer, lined drilled holes and light blasting holes may be employed in locations approved by the Engineer.

3.4.12.3 Support Excavation

All planking, strutting and supports necessary to retain the sides of the excavation shall be provided, erected and maintained in a safe condition by the Contractor.

3.4.12.4 Measurement and Payment

a. Measurement, for payment, shall be in accordance with Sub-Clause 3.4.1.11.

b. Payment for excavation for trenches, pits and footings along permanent access roads and in designated spoil areas will be made at the rate per cubic metre tendered therefor in the Bill of Quantities (Item J.1) in accordance with Sub-Clause 3.4.1.12.

c. Payment for excavation for trenches, pits and footings for at the toe of the cut near the spillway will be included for payment in item C.4.4.

3.5 EXPLORATORY TRENCH EXCAVATION

3.5.1 General

A fault which exists in the reservoir area is required that exploratory trenches be excavated in common material in order to expose the surface of the fault.

Foundation conditions beneath the gallery may need to be investigated by the Engineer. Excavation is expected to be in rock as defined in Sub-Clause 3.5.2.

3.5.2 Classification of Material

For the purposes of payment under this clause only, all excavated materials from exploratory trench exploration will be classified by the Engineer as follows:

a. Common

Exploratory excavation in common shall include excavation of all common soil materials including river bed material, sand, gravel, boulders or detached pieces of solid rock less than one cubic meter in volume which can be removed without ripping by a Komatsu D85a bulldozer 228 rated H.P. or equivalent.

b. Rock

Exploratory trench excavation in rock shall consist of excavation of rock which can be removed by ripping with a Komatsu D85a bulldozer 228 rated H.P. or equivalent or by pneumatic jack hammers.

3.5.3 Exploratory Trenches in the Reservoir Area

The Contractor shall excavate exploratory trenches as directed by the Engineer.

After completion all trenches shall be backfilled to the satisfaction of the Engineer using dozers or similar equipment. Further compaction will not be required.

3.5.4 Exploratory Trenches in Gallery Foundation

The Contractor shall excavate exploratory trenches as directed by the Engineer.

The exposed surfaces shall be to the same quality as described in Sub-Clause 3.5.2.

3.5.5 Measurement

a. Measurement, for payment for the different classes of exploratory trench excavation shall be made of the volume of material excavated to the lines, grades directed by the Engineer and shall be taken only in the

presence of the Engineer. The Engineer shall be notified at least 24 hours before taking such measurements.

b. Before commencing and immediately after completion of exploratory trench excavation the Contractor shall take survey measurements sufficient to define the dimensions and elevations of the original and final surfaces.

3.5.6 Payment

3.5.6.1 Exploratory Trench Excavation in Common

Payment for the exploratory trench excavation in common will be made at the applicable rate per cubic meter tendered therefor in the Bill of Quantities (Item C.4) The rate shall include the cost of all labour, materials, temporary works, pumping, bailing, draining and all other work necessary to maintain the exploratory trench excavations in good order during the period of inspection directed by the Engineer, and of removing such temporary works on completion. The rate shall also include the entire cost of excavating, temporarily stockpiling the material and backfilling the excavation all as described in the Specification.

3.5.6.2 Exploratory Trench Excavation in Rock

Payment for the exploratory trench excavation in rock will be made at the applicable rate per cubic meter tendered therefor in the Bill of Quantities (Item C.5) The rate shall include the cost of all labour, materials, temporary works, pumping, bailing, draining and all other work necessary to maintain the exploratory trench excavations in good order during the period of inspection directed by the Engineer, and of removing such temporary works on completion. The rate shall also include the removing all excavated material in accordance with that specified for surface excavation and for preparing the exposed surfaces of the excavation in accordance with the specification.

3.6 COMMON FILL OR BACKFILL

3.6.1 General

The Contractor shall furnish, place and compact common fill or backfill to the lines, grades and dimensions and in the locations shown on the Drawings which shall include the following areas:

- adjacent to the spillway
- adjacent to the inclined intake structure
- adjacent to the powerhouse
- foundations for transmission lines
- foundations for main transformer yard
- other areas as directed

Common fill or backfill shall be obtained from required excavation and other approved sources and shall be subject to approval. Common fill or backfill shall be free from stumps, roots, rubbish, topsoil and other objectionable matter. Common fill or backfill placed within 1.0 m of structures shall be selected material containing rocks not larger than 75 mm in maximum dimension and shall be placed carefully so as not to damage the structure. The maximum size of any rock placed in the common backfill shall be 150 mm.

3.6.2 Placement

a. Common fill or backfill shall be placed in approximately horizontal layers not more than 300 mm thick before compaction and shall be compacted to not less than 90 percent of the maximum dry density at optimum moisture content. The Contractor shall carry out tests on the compacted material when directed by the Engineer.

b. Prior to the commencement of placing backfill materials adjacent to structures, the concrete shall be approved and the areas to be backfilled shall be cleared of all concrete forms and other temporary works, or as directed by the Engineer. Backfill materials shall be placed in such a manner as will ensure satisfactory compaction without damage to the structures compacting adjacent to all structures shall be carried out by approved hand operated power tampers. Vibrating rollers, with the exception of small hand-held equipment, shall not be permitted within 0.5 m of concrete walls or within 0.5 m vertically of the surface of the concrete, except with the prior approval of the Engineer.

c. The surface of filled or backfilled materials shall be compacted so as to give a slightly cambered surface to facilitate drainage. At all times, the fill or backfill materials shall be moistened or allowed to dry, if necessary, to maintain or achieve the required moisture content for compaction as determined by the Engineer. The cost of such moistening or drying out shall be covered by the unit rate for common fill or backfill in the Bill of Quantities.

d. Unless otherwise specified by the Engineer backfill materials shall not be placed and compacted within 14 days after the placing of concrete for the structure against which backfill is to be placed.

3.6.3 Measurement and Payment

a. Measurement, for payment, of furnishing, placing and compacting common fill or backfill shall be made of the material in place to the lines, grades and dimensions shown on the Drawings or directed.

b. Payment for furnishing, placing and compacting common fill or backfill, will be made at the rate per cubic meter tendered therefor in the Bill of Quantities (Item C.6) which shall include the cost of all labour, materials, equipment, testing as directed by the Engineer and all other costs to complete the work in accordance with the specification.

   Material from required excavation used for common fill or backfill will be paid for as surface excavation when removed from required excavation and as common fill or backfill when placed. Payment will not be made for excavating materials from stockpiles or sources other than required excavation.

3.7 GRAVEL BACKFILL AND BEDDING

3.7.1 General

a. The Contractor shall furnish and place gravel backfill or gravel bedding to the lines, grades and dimensions and in the locations shown on the Drawings or directed by the Engineer.

b. Except as otherwise specified, gravel for gravel backfill or gravel bedding shall be a free draining mixture of crushed rock. The gravel fill or backfill shall be clean, free from clay or other deleterious materials, graded as follow:

Sieve Designation (mm)	50	40	20	10	5
Percentage Passing by Weight	100	90-100	35-70	10-30	0-5

c. The gravel fill or backfill shall be tamped with approved hand operated power tampers to the dimensions as shown on the Drawings or directed by the Engineer. Vibrating rollers, with the exception of small hand-held equipment, shall not be permitted within 0.5 m of concrete walls, except with the prior approval of the Engineer.

d. Gravel fill or backfill shall be deposited in horizontal layers not more than 300 mm thick after being compacted and shall be thoroughly wetted for the purpose of compaction, as determined by the Engineer.

e. Where concrete is to be placed or gravel fill or backfill, the gravel shall be covered with either building paper, polyethylene sheet, or a thin concrete screed. Where other types of fill are to be placed on the gravel fill, the gravel fill shall be covered with either galvanised iron or polyethylene sheets.

3.7.2 Measurement and Payment

a. Measurement, for payment, of furnishing and placing gravel fill or backfill will be made of the volume of the gravel in place to the lines, grades and dimensions shown on the Drawings or directed by the Engineer.

b. Payment for furnishing, placing and compacting gravel fill or backfill will be made at the rate per cubic meter tendered therefor in the Bill of Quantities (Item C.7) which rate shall include all costs for excavating, processing, transporting, placing and compacting gravel fill or backfill to the lines and grades shown on the Drawings or directed and covering the top surface as specified.

c. Separate payment will not be made for gravel fill or backfill placed for drains through shotcrete and all costs shall be included in the applicable rates for the respective items of shotcrete work.

d. Separate payment will not be made for gravel fill placed around wall drains (weep holes) and all costs shall be included in the applicable items which incorporate such gravel fill.

3.8 RANDOM FILL

a. The Contractor shall furnish, place and compact random fill for construction of the temporary main cofferdam embankment upstream of the diversion tunnel to the lines, grades, dimensions and elevations shown on the Drawings or directed.

b. Random fill shall be obtained from required excavation or other approved sources and shall be subject to approval. Rock fragments or lumps of clay having maximum dimensions of 400 mm or more shall be removed or broken down at the site of excavation.

3.8.1 Placement

a. Random fill material shall be placed in horizontal layers not more than 500 mm thick before compaction.

b. Successive loads of material shall be dumped so as to achieve the best practicable distribution of material as determined by the Engineer.

c. The Contractor shall compact the fill by uniformly distributing the routing of his hauling, spreading and placing equipment over each layer of fill material as placed to cover the entire width of the fill so as to obtain the maximum compaction practicable.

d. The Contractor shall ensure material has sufficient moisture for maximum compaction practicable without rutting the surface. Material so dry as to be dusty shall not be accepted.

e. The Contractor shall ensure the outer slopes of the random fill are compacted and conform to the lines and grades shown on the Drawings or directed.

f. The Contractor shall repair and maintain the temporary main cofferdam until the structure is no longer required as part of the diversion work. The repair and maintenance shall include, but not be limited to, rectification of damage caused to the cofferdam by the Contractor's operations, natural causes, including flood flows in the Kreo River, or any other cause.

3.8.2 Measurement and Payment

a. Measurement, for payment, of furnishing, placing and compacting random fill shall be made of the volume of material in place to the lines, grades and dimensions shown on the Drawings or directed.

b. Payment for furnishing, placing and compacting Random fill will be made at the rate per cubic metre tendered therefor in the Bill of Quantities (Item C.9) which rate shall include all costs for excavating, processing, transporting, placing and compacting Random fill to the lines and grades shown on the Drawings or directed and shall include the cost of repair and maintenance of the cofferdam as specified in Sub-Clause 3.8.1 paragraph f.