



Republic of the Philippines
National Irrigation Administration
Central Office

SUPPLEMENTAL BID BULLETIN NO. 6

to the

BID DOCUMENTS

for the

**Construction of Bayabas Rockfill Dam and its Appurtenant Structures
in Region 3 under Small Reservoir Irrigation Project**

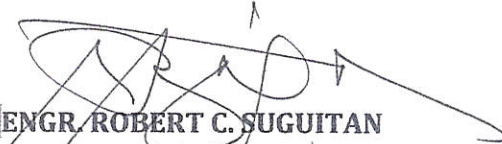
ITB No. R3-BSRIPD-C-37

- A. Please be advised of the following revisions in the Bidding Documents for the above-captioned project:
1. Delete all pages under Section III. Bid Data Sheet of the Bidding Documents, and substitute the herein Attachment Sheet Nos. "1" to "4";
 2. Delete page LC-1 of Section V-A. Local Conditions of the Bidding Documents, and substitute the herein Attachment Sheet No. "5";
 3. Delete all pages under Section V-B. Supplemental Information of the Bidding Documents, and substitute the herein Attachment Sheet Nos. "6" to "8";
 4. Delete Section XIV. Tunneling and Underground Works of the Technical Specifications, and substitute the herein Attachment Sheet Nos. "9" to "31";
 5. Delete Sheet No. 195 to 215 of Section VII. Drawings of the Bidding Documents;
 6. Delete all pages under Section VIII. Bill of Quantities of the Bidding Documents, and substitute the herein Attachment Sheet Nos. "32" to "42"; and
 7. Delete pages 59, 64, and 65 under Section IX-A. Bidding Forms of the Bidding Documents, and substitute the herein Attachment Sheet Nos. "43" to "45".
- B. In response to the questions raised during the pre-bidding conference, and other additional inquiries, please be informed of the following:
1. The BAC-A, upon recommendation of the TWG, has resolved to remove the Tunnel Boring Machine from the minimum equipment requirement (ITB No. 10.5). However, the Contractor may opt to use or utilize a TBM, at his own discretion, during construction activities, subject to the approval of NIA;



Republic of the Philippines
National Irrigation Administration
Central Office

2. For Joint Venture, the Special PCAB License issued to the Joint Venture should comply with the license and registration particulars required under ITB Clause No. 5.2 of the Bidding Documents;
 3. The bidders may use Purchase Agreement as its proof of ownership during the bidding for the pledged brand-new service vehicle. However, the service vehicle subject of Purchase Agreement, must be readily available once the NTP was issued;
 4. Clearing and Grubbing for the access road is a different item of work from Clearing and Grubbing for the dam area; and
 5. A joint survey will be conducted between NIA representative/s and the Contractor's representative/s prior to the start of construction activities. During the conduct of the joint survey, both parties will be able to determine and finalize the volume/quantity of excavated materials and materials for disposal.
- C. Receipt of this Notice must be acknowledged by the Bidders at the Office of the BAC-A Secretariat, 6th Floor, NIA Building "A", EDSA, Diliman, Quezon City.
- D. This Notice shall form part of the Bidding Documents.


ENGR. ROBERT C. SUGUITAN
(BAC-A Chairperson)

Bid Data Sheet

ITB Clause													
5.2	<p>For this purpose, contracts similar to the Project refer to contracts which have the same major categories of work, which shall be:</p> <p>Construction of Dam (for agricultural and/or hydropower projects) and/or Flood Control Projects (Protection Dikes and/or Sabo Dam and/or Floodway) and/or Irrigation Canal/Canal Structures, and/or other Major Hydraulic Structures and/or Drainage Canals/Structures for Irrigation with a value of at least fifty percent (50%) of ABC. All prospective bidders should possess a valid PCAB license with a Principal Classification and Category in General Engineering as “AAA” and Registration Particulars with respective size range of “Large B” in Dam, Reservoir or Tunneling, and/or Irrigation or Flood Control.</p>												
7.1	<p>Subcontracting is allowed, subject to evaluation and approval of the sub-contracting agreement in accordance with NIA MC No. 37, s.2014. The sub-contractor shall undertake not more than 50% of the contract works.</p> <p><i>NOTE: The contractor shall undertake not less than 50% of the contracted works with its own resources.</i></p>												
10.1	<p>The prospective bidders shall submit <u>Certificate of Site Inspection</u> duly signed by the authorized NIA employee/official.</p>												
10.3	<p>No further instructions.</p>												
10.4	<p>The key personnel must meet the required minimum years of experience set below:</p> <table><tr><th>Key Personnel</th><th></th><th>Relevant Experience</th></tr><tr><td>1 – Project Manager</td><td>–</td><td>A licensed Civil Engineer (PRC License) with at least five (5) years experience as Project Manager;</td></tr><tr><td>1 – Project Engineer</td><td>–</td><td>A licensed Civil Engineer (PRC License) with at least three (3) years experience as Project Engineer in similar works (refer to SLCC);</td></tr><tr><td>2 – Office Engineer</td><td>–</td><td>A Licensed Civil Engineer (PRC License) with at least one (1) year experience in engineering works with AUTOCAD training certificate;</td></tr></table>	Key Personnel		Relevant Experience	1 – Project Manager	–	A licensed Civil Engineer (PRC License) with at least five (5) years experience as Project Manager;	1 – Project Engineer	–	A licensed Civil Engineer (PRC License) with at least three (3) years experience as Project Engineer in similar works (refer to SLCC);	2 – Office Engineer	–	A Licensed Civil Engineer (PRC License) with at least one (1) year experience in engineering works with AUTOCAD training certificate;
Key Personnel		Relevant Experience											
1 – Project Manager	–	A licensed Civil Engineer (PRC License) with at least five (5) years experience as Project Manager;											
1 – Project Engineer	–	A licensed Civil Engineer (PRC License) with at least three (3) years experience as Project Engineer in similar works (refer to SLCC);											
2 – Office Engineer	–	A Licensed Civil Engineer (PRC License) with at least one (1) year experience in engineering works with AUTOCAD training certificate;											

	1 – Material Engineer II	–	With at least two (2) years’ experience as Materials Engineer II duly accredited by the DPWH;
	1 – Mechanical Engineer	-	A Licensed Mechanical Engineer (PRC License) with at least three (3) years experience in Mechanical Works;
	1 – Electrical Engineer	-	A Licensed Electrical Engineer (PRC License) with at least three (3) years experience in Electrical Works;
	1 – Civil Engineer	–	A Licensed Civil Engineer (PRC License) with at least 3 years of experience in Geotechnical works;
	1 – Geologist	–	A Licensed Geologist (PRC License) with at least three (3) years experience in Dam Embankment foundation treatment;
	1 – Safety/Health Officer	–	With Training Certificate duly accredited by DOLE and with at least two (2) years experience as Safety Officer;
	1 – Geodetic Engineer	–	with at least two (2) years experience as Geodetic Engineer (PRC License);
	3 – Foreman:		
	2 – for Earthworks	–	with at least three (3) years experience as Foreman for Earthworks;
	1 – for Concreting	–	with at least three (3) years experience as Foreman for concreting and/or other related works.
<u>No replacement of personnel shall be allowed by NIA until after fifty percent (50%) of the project has been completed, except for justifiable reason to be approved by NIA Regional Office 3.</u>			

10.5	Minimum major equipment requirements with at least 30% (23 out of 76 units) of which must be owned by the bidder are the following:		
	Equipment	Capacity	Number of Units
1.	Dozer with Ripper	180 HP	4 units
2.	Loader	2.0 cu.m. capacity	10 units
3.	Dump Truck	8 cu.m. loading capacity	8 units
4.	Dump Truck	12 cu.m. loading capacity	12 units
5.	Dump Truck	20 cu.m. loading capacity	4 units
6.	Crane	30 tons	1 unit
7.	Backhoe with Breaker	162 HP, 1.0 cu.m. bucket cap.	12 units
8.	Batching Plant	10.0 cu.m./hr	1 unit
9.	Concrete Vibrator	5.0 HP	1 unit
10.	Crawler Drill	215 HP	6 units
11.	Grout Pump	3 cu.m./hr	3 units
12.	Grout Mixer		3 units
13.	Self-Propelled Tandem Smooth Drum, Vibratory	12 tons	3 units
14.	Rotary Core Drilling Machine for grout hole	75.7 mm. diameter core bit, 20 HP min.	4 units
15.	Grader	145 HP	2 units
16.	Vibratory Roller	10 tons static weight	2 units
	Total No. of Units		76 units
	Other minimum major equipment requirements are the following:		
	Equipment	Capacity	Number of Units
17.	Transit Mixer	8.0 cu.m. capacity	2 units
18.	Water Pump	75 mm diameter	6 units
19.	Air Compressor	251-315 cfm	6 units
20.	Air Compressor	500 cfm	3 units
21.	Agitator		3 units
22.	Pump (for Pressure Testing)	10.8 cu.m./hr	3 units
23.	Water Truck	360 HP; 16,000 L	2 units
24.	Generator	50 Kva	1 unit
25.	Pumpcrete	35 cu. m/hr	1 unit
26.	Welding Machine	400 Amp	3 units
27.	Tamping rammer	4 strokes	2 units
28.	Service Vehicle (exclusive for NIA Resident Engineer Use)	Brand-new 4x4 Pick-up, latest model (2023 and up)	1 unit
	Total No. of Units		33 units

	<p>In reference to NIA Memorandum Circular No. 56, s. 2007, A1 condition is defined as a condition wherein the equipment is in good operating condition and within its economic life. It can be relied upon to operate efficiently and effectively up to the duration of the assigned activity or series of activities.</p> <p><u>For Brand-new Service Vehicle:</u></p> <p>The Contractor must provide within twenty (20) calendar days upon receipt of notice to proceed, a brand-new one (1) unit 4x4 Pick-up Type Service Vehicle exclusive for NIA Resident Engineer use, must have comprehensive insurance, and must provide preventive maintenance for the entire project duration.</p> <p>NIA shall provide a driver and shall supply appropriate fuel which is sufficient for daily operation during project implementation.</p> <p><u>No replacement of equipment shall be allowed by NIA until after fifty percent (50%) of the project has been completed, except for justifiable reason to be approved by NIA Regional Office 3.</u></p>
12	No further instructions.
15.1	<p>The bid security shall be in the form of a Bid Securing Declaration or any of the following forms and amounts:</p> <p>a. The amount of not less than PhP 38,989,996.18 <i>[two percent (2%) of ABC=PhP1,949,499,808.86]</i>, if bid security is in cash, cashier's/manager's check, bank draft/guarantee or irrevocable letter of credit; or</p> <p>b. The amount of not less than PhP 97,474,990.44 <i>[five percent (5%) of ABC=PhP1,949,499,808.86]</i> if bid security is in Surety Bond.</p>
16	Each Bidder shall submit one (1) original and two (2) copies of the first and second component of the bid.
20	No further instructions
21	Additional contract documents relevant to the Project that may be required by existing laws and/or the Procuring Entity, such as construction schedule and S-curve, manpower schedule, construction methods, equipment utilization schedule, construction safety and health program approved by the DOLE, Materials Quality Control Program and other acceptable tools of project scheduling.

LC-01 LOCATION

The main dam and reservoir area of the project is located in the municipality of Doña Remedios Trinidad in the province of Bulacan at geographic coordinates of 14° 57' 0.184" North latitude and 121° 30.147" East longitude. Doña Remedios Trinidad is located in the north easternmost part of Bulacan Province in Central Luzon Region or Region III. It is one of the 24 cities and municipalities comprising the province. Doña Remedios Trinidad is approximately 73 km northeast of Manila, which is the nation's capital, and 43 km away from the City of Malolos, which is the provincial capital.

The dam site can be reached via four entry points, namely: Angat, Akle (San Ildefonso), Sibul (San Miguel) and Matictic (Norzagaray) Bulacan. However, the most convenient way going to the town center is through the Angat-DRT Road and the Akle (San Ildefonso) Road.

The shortest access to the dam site would entail a 3.60 kilometer eastward direction travel across the Bayabas River then negotiating the existing logging road. The river crossing is proposed as bridge site in this study. The road would then be connected with 548-meter road leading to the main dam and its appurtenant structures. The 4.158-kilometer road and the bridge are included as part of the project cost estimates.

LC-02 PROJECT LOCATION AND ACCESS TO THE SITE

The access road going to Project site shall be provided by NIA.

In the event the Contractor considers additional access routes, the Contractor shall secure right-of-way and access routes at his own expense and all such costs shall be considered included in the bid prices for the various items of work in the Bill of Quantities.

The Contractor shall abide by all limitations, laws and regulations relating to the use of public transportation routes and shall be responsible for all damages caused by misuse of same. The Contractor shall improve and/or widen to his satisfaction the existing roads, canals, strengthen and reinforce bridges therein to meet his haulage requirements, to the extent he deems desirable or necessary for his work. All works that the Contractor proposes to do in connection with roads and bridges shall be scheduled and conducted as to offer the least disturbance to traffic and will be subject to approval by the NIA which will make such arrangement as maybe necessary with other Government Agencies and private parties.

The Contractor shall make any necessary repairs or replacements, as the case maybe, to any structure which is damaged by him as the result of his own negligence. Such repairs or replacements shall be made to the satisfaction of the NIA or the appropriate governmental authorities.

Existing barangay roads and provincial roads within the project area can be utilized by the Contractor for his construction operation provided that these facilities being utilized shall be maintained satisfactorily by the Contractor to avoid damages. Otherwise, the Contractor shall at his own expense make any and all necessary repairs and/or replacement to any road/structure which is damaged as a result of his construction operation. Cost of access road maintenance and repair of road/structures to be utilized shall be included by the Contractor in the contract unit price of the relevant item of work in the Bill of Quantities.

PROJECT : Construction of Bayabas Rockfill Dam and its Appurtenant Structures in
Region 3 under Small Reservoir Irrigation Project
LOCATION : Doña Remedios Trinidad, Bulacan, Region 3

1. Site Visit and Inspection, register at NIA Regional Office III, located in Tambubong, San Rafael, Bulacan.
2. List of Officers/Offices to be furnished correspondence from the Contractor.
- a) The Deputy Administrator
for Engineering & Operations
3rd Floor, IEC Building
NIA Complex EDSA,
Diliman, Quezon City
 - b) The Regional Irrigation Manager
Regional Office 3
National Irrigation Administration
Tambubong, San Rafael, Bulacan
 - c) The Division Manager
BANE Irrigation Management Office
National Irrigation Administration
Tambubong, San Rafael, Bulacan

3. List of Initial Major Equipment required to be mobilized within twenty (20) calendar days after receipt of Notice to Proceed, Page TS-I-2, paragraph 101 (b) Section I.

Equipment		Capacity	Number of Units
1.	Dozer with Ripper	180 HP	2 units
2.	Loader	2.0 cu.m. capacity	2 unit
3	Dump Truck	12 cu.m. loading capacity	6 units
4	Backhoe with breaker	162 HP, 1.0 cu.m. bucket capacity	2 units
5.	Transit Mixer	8.0 cu.m. capacity	2 units
6.	Batching Plant	10.0 cu.m./hr	1 unit
7.	Crane	30 Tons	1 unit
8.	Concrete Vibrator	5.5 HP	1 unit
9.	Crawler Drill	215 HP	3 units
10	Water Pump	75 mm diameter	3 units
11.	Compressor	251-315 cfm	3 units

Equipment		Capacity	Number of Units
12.	Service Vehicle (exclusive for NIA Resident Engineer Use)	Brand-new Pick-up 4x4, latest model (2023 and up)	1 unit

4. Minimum Major Equipment Requirements for the Contract.

Equipment		Capacity	Number of Units
1.	* Dozer with Ripper	180 HP	4 units
2.	* Loader	2.0 cu.m. capacity	10 units
3.	*Dump Truck	8 cu.m. loading capacity	8 units
4.	*Dump Truck	12 cu.m. loading capacity	12 units
5.	*Dump Truck	20 cu.m. loading capacity	4 units
6.	*Crane	30 tons	1 unit
7.	*Backhoe with Breaker	162 HP, 1.0 cu.m. bucket cap.	12 units
8.	*Batching Plant	10.0 cu.m/hr	1 unit
9.	*Concrete Vibrator	5.5 HP	1 unit
10.	*Crawler Drill	215 HP	6 units
11.	*Grout Pump	3 cu.m./hr	3 units
12.	*Grout Mixer		3 units
13.	*Self-Propelled Tandem Smooth Drum, Vibratory	12 tons	3 units
14.	*Rotary Core Drilling Machine for grout hole	75.7 mm. diameter core bit, 20 HP min.	4 units
15.	*Grader	145 HP	2 units
16.	*Vibratory Roller	10 tons static weight	2 units
17.	Transit Mixer	8.0 cu.m. capacity	2 units
18.	Water Pump	75 mm diameter	6 units
19.	Air Compressor	251-315 cfm	6 units
20.	Air Compressor	500 cfm	3 units
21.	Agitator		3 units
22.	Pump (for Pressure Testing)	10.8 cu.m./hr	3 units
23.	Water Truck	360 HP; 16,000 L	2 units
24.	Generator	50 Kva	1 unit
25.	Pumpcrete	35 cu. m/hr	1 unit

Equipment		Capacity	Number of Units
26.	Welding Machine	400 Amp	3 units
27.	Tamping rammer	4 strokes	2 units
28.	Service Vehicle (exclusive for NIA Resident Engineer Use)	Brand-new 4x4 Pick-up, latest model (2023 and up)	1 unit

SECTION XIV

TUNNELING AND UNDERGROUND WORKS

1401 SCOPE

This section covers above ground and underground excavation works, installation of applicable and prescribed tunnel supports, contact and consolidation grouting, shotcreting, rock bolt, and installation of drain pipes and pressure release pipes, and other subsidiary works. This also includes common and rock excavation above ground in the tunnel portals and hauling of excavated material from portals and underground works to the disposal area, in accordance with the applicable provisions of Section IV – Excavation and Foundation Preparation and this Technical Specification.

The tunnel cross sections shall have dimensions as specified in the Drawings. The tunnel shall be concrete lined having compressive strength as shown on the drawings. The different tunnel supports are shown in the approved Plans.

Tunneling and underground works are done by drilling and blasting, including installation of adequate lighting and air ventilation system and equipment, and duct tubing to keep the tunnel in environmentally comfortable working condition. Electrical work and dewatering are also part of the scope of this work.

In addition to the drilling and blasting method, the Contractor may choose to adopt an alternative tunneling method, including the use of a Tunnel Boring Machine (TBM). If the Contractor chooses to work with a TBM or any other tunneling method, Contractor is required to submit, upon the receipt of Notice to Proceed (NTP), a comprehensive request and justifications, along with all necessary documentation and requirements to NIA for thorough review and approval. This submittal shall include the details about the intended TBM machine type, alternative design layout, including specification and schematic drawings, operational plan, construction method, safety protocols, environmental compliance, and other relevant information/documents. The Contractor shall also be responsible for acquiring all necessary permits and clearances required for the operation of the Contractor's alternative tunneling method at no additional cost to NIA. The use of an alternative tunneling method shall be at the Contractor's discretion and will not result in additional payment beyond the bid price for the tunnel construction.

1402 EARTHWORKS

a) **Clearing and Disposal**

The Contractor shall clear all trees, bushes, and vegetation from the areas to be excavated in the tunnel portal or in the disposal areas in accordance with Section II – Clearing and Grubbing. Topsoil may be required to be stockpiled for reuse. Unless otherwise stated elsewhere, other cleared materials shall be disposed of by the Contractor in accordance with the applicable provisions of Section IV – Excavation and Foundation Preparation of this specification. All materials from the clearing, if considered unsuitable, shall be disposed of separately from the suitable disposal area.

b) Open Cut Excavation and Underground Excavation

This section covers the general excavation in the open for tunnel portals and in spoils/disposal areas.

The Contractor shall submit to the Engineer full details concerning the methods and equipment proposed for each section or type of open cut excavation, including drilling and blasting patterns where appropriate. These details shall be submitted upon receipt of NTP before the programmed commencement of work in the area concerned and shall be approved by the Engineer.

Except as otherwise specified, the Contractor shall provide, maintain and operate temporary drainage and/or pumping facilities, etc. which may be required to dispose of surface and groundwater in order to keep the excavations stable and as dry as practicable.

The Contractor shall be responsible for the stability of all permanent and temporary slopes and shall support, protect and make safe surfaces exposed by the excavations. Such support and protection shall include the provision and removal of all temporary supports including sheeting and bracing where necessary, the diversion of surface water and the provision and maintenance of such drainage facilities as are necessary to stabilize the slopes and prevent excessive water from entering the excavations.

Where appropriate, excavations shall be supported with temporary shoring and bracing so that the surrounding ground and structure will be secured against all risks of subsidence and injury.

Rock bolts and shotcrete for the support of excavated rock slopes shall be as specified elsewhere herein.

Any damage resulting from the Contractor's operations during excavation, including damage to foundation and excavated surfaces shall be repaired at the expense of the Contractor.

Excavation from portal inlet and outlet shall be measured and paid per cu.m. in accordance to Section IV of this Technical Specification, including shoring and disposal.

Underground excavation provisions shall be in accordance with Paragraph 1403 of this section.

c) Disposal Fills

Excavated tunnel spoil and material from open cut excavations and underground shall be placed in areas designated for this purpose. These areas shall first be cleared and stripped in accordance with paragraph "Clearing and Disposal" of Section 1402(a).

The disposal fills shall be placed and spread in layers not exceeding 0.6m in thickness and compacted by the passage of construction equipment.

Finished fill shall not be more than 8m above original ground level and shall be graded for drainage and to blend with original ground contours.

Cut and fill batters in soil shall be topsoiled and grassed and adequate drainage works constructed to deal with rainfall rates of up to 100 mm per hour. Completed spoil disposal fills shall be left in the conditions such that it is acceptable and will not cause damage to the nearby environment.

1403 UNDERGROUND EXCAVATIONS

a) Approval Methods

Before such section of underground excavation commenced, the Contractor shall provide the Engineer with detailed proposals for carrying out the work, including a program of operations, equipment to be used, drilling method and pattern, charging and firing sequence. Details shall include drilling and blasting, mucking, transporting, and hoisting equipment; tunnel air ventilation, lighting and drainage systems; tunnel support systems; and the progress schedule with due allowance for geological conditions likely to be encountered.

These details shall be submitted upon receipt of NTP and shall be approved by NIA before the program commencement of the work. The Contractor shall not vary from the approved procedure or details without the prior approval of the Engineer.

Support of rock surfaces shall be as proposed by the Contractor and approved by NIA. The Contractor shall employ competent Licensed Engineering Geologist to determine the earth and rock in the tunnel to supervise the underground operation. The engineering geologist shall undertake mapping, evaluate the type of foundation and determine the tunnel Rock Mass Rating (RMR) classification and the rock tunneling quality Index. Based on the types of classifications tunnel rock could be classified as very good, good, fair, poor/heavy and very poor/very heavy. Also, the type of support (permanent and temporary) and thickness of concrete lining in accordance to the Drawings should be identified.

The RMR is published by Bieniawski which shows the detail of rock mass classification which also called Geomechanics classification. The parameters in classifying a rock mass using RMR system are the following:

- i. Uniaxial compressive strength of rock material
- ii. Rock quality Designation (RQD)
- iii. Spacing of discontinuities
- iv. Condition of discontinuities
- v. Ground water conditions
- vi. Orientation of discontinuities

The RMR or rock mass rating is shown on the following table ;

Rock Mass Classification		RMR Rating
I	Very Good Rock	81-100
II	Good Rock	61 - 80

Tunneling and Underground Works

III	Fair Rock	41 - 60
IV	Poor Rock/heavy	21 - 40
V	Very Poor Rock/very heavy	Less than 20

The Contractor shall determine and provide to the Engineer the stand-up time of the earth or rock based on the given RMR Rating above for the purpose of proper installation of the supports.

Underground excavation, Barton et al (1974) of the Norwegian Geotechnical Institute proposed a tunneling Quality Index (Q) for the determination of rock mass characteristics and tunnel support requirements.

$$Q = RQD/J_n \times J_r/J_a \times J_w/SRF$$

Where: Q = Rock Quality Index

- RQD = Rock Quality Designation
- J_n = is the Joint set number
- J_r = is the Joint roughness number
- J_a = is the Joint alteration number
- J_w = is the Joint reduction number
- SRF = is the Stress Reduction Factor

In using the above RMR system and Rock Quality Index methods of classification, it is assumed that the License Geologist/Geotechnical Engineer and Mining Engineer are aware of Table 4: rock Mass Rating System (After Wieniawski 1989), Table 5: Guideline for excavation and support of 10 m. rock tunnels in accordance with the RMR System (After Bieniawski 1989) and Table 6: Classification of Individual Parameters used in the Tunneling Quality Index (Q) (After Barton et al 1974) shall be used as a guide in the design of support.

b) Safety Precautions

General Requirements

Attention is drawn to the requirements for provision of rescue teams for underground works. Prior to commencement of any underground works, the Contractor shall undertake the organization, equipping and training of the rescue teams. These teams shall be trained in underground rescue work and general first aid work. They shall be kept to full strength and in an efficient state of training for the full duration of the underground works.

No workmen shall be employed on underground works until they have shown themselves conversant with all basic safety precautions and methods of working to be adopted. All safety regulations shall be strictly enforced and the Contractor shall provide adequate personal protective equipment /clothing.

The Contractor shall be entirely responsible for safety matters and shall observe all precautions to avoid accidents or injury to Works or workmen and to minimize the extent and severity of any accident or injury which may occur. Such precautions

have due regard to the skill and training of the labour force employed on tunneling work and to the best modern tunneling practices and shall comply with the local mining and other applicable regulations.

The Contractor shall take due consideration of all relevant provisions of relevant Philippine regulations and shall assume that representatives of the competent statutory authorities will visit the site and enforce applicable regulations.

The Contractor shall submit a detailed mine rescue and safety plan to the Engineer for approval in writing prior to commencing any work on site. Log book of person going inside and outside shall be updated daily.

Telephone Communications

Telephone communications shall be provided by the Contractor between the working faces, portals, and to the working areas inside the tunnel. Underground telephone locations shall be prominently identified. The portal telephones shall be manned at all times when work is in progress underground. The system shall be made available for use by the Engineer, or the Contractors' Supervisors/Management.

Electric Cables

All lighting and power cables installed in the underground works shall be adequately insulated and mounted, with joints made in an approved manner. All installation and maintenance work shall be done by qualified workmen to a high standard. Cables shall be securely fixed above floor level.

Separate circuits shall be provided for power and lighting supplies and they shall be kept well separated from signaling and telephone cables. Circuits used for firing explosives shall be kept separate from all other circuits by fastening to the opposite wall.

All electrical installations shall be adequately earthed in accordance with local requirements and shall be protected by each leakage trip circuit breakers, all in accordance with modern practice and safety standards.

Ventilation and Dust Prevention

The entire ventilation system shall be designed by the Contractor to meet the requirements of his program of excavation and the nature of the Works.

All parts of the underground excavations shall be maintained in a healthy state for working, and sufficiently clear for surveying operations, by the circulation of an adequate amount of fresh air for each person present in the area, excluding air supplied for any drills or other plant. The ventilation system shall be arranged so that air may be force-supplied to the face or exhausted from it, with a rapid changeover being possible between the two methods. Care shall be taken to avoid unventilated pockets.

Should any diesel engines be used in the underground works, additional air shall be supplied at a rate of at least 5.5 m³ per minute per kW of power output of the engines. Engines will be fitted with contained air scrubbers and catalytic converters for preventing the emission of excessive amounts of hot exhaust gases, toxic gases, sparks of fumes including maintaining engines in good operating condition. No internal combustion engines other than diesel shall be permitted underground.

The Contractor shall provide the necessary equipment and monitor the quality of air systematically. Should the proportion of noxious gases at any time be in excess of that considered acceptable by the National Safety Standards as determined by the Engineer, the Contractor shall improve ventilation arrangements to the extent deemed necessary.

Ventilation shall be maintained in all headings until completion of the underground works.

After blasting, all personnel shall be kept away from the area until all toxic and obnoxious fumes and gases have been removed. Portable Equipment for measuring toxic level, dust oxygen level shall be provided by the Contractor. The contractor shall make all means to remove the objectionable gasses as soon as possible, within 2 hours after blasting, so that hauling/mucking of excavated materials could start the soonest.

c) Lighting

All underground excavations shall be illuminated during working hours with caged electric lights and adequate size and number to allow work, inspection and surveying to be carried- out in a proper and safe manner.

The general level of illumination through tunnels shall be equivalent to that provided by 150 watt lamps at 10m intervals and additional illumination shall be provided to the extent deemed necessary at all other places where work other than material haulage is in progress.

The lighting system in underground excavations shall not be higher than 240 volts.

All power and lighting wires shall be adequately insulated, securely installed and regularly checked for any damage by blasting and other operations.

Power and lighting wires shall be installed on one side of the tunnel and the firing cable shall be installed on the opposite side and sufficiently distant from any telephone or communication system wires.

All personnel shall be provided with protective helmets incorporating cap lamps, rubber boots. Additional hand inspection lamps and electric battery torches shall be available at all working areas at all times.

d) Excavation Procedures

General

The contractor shall allow the Engineer access at any time, given reasonable notice, to enable the Engineer to carry out survey checks or other necessary inspection work.

The contractor shall ensure at all times that all of his excavation methods and equipment to be used comply with the regulations of the relevant authorities of the Republic of the Philippines.

For each advance in the tunnel, the contractor shall survey the actual excavated profile after scaling to ensure that the profile conforms with the minimum excavation requirements and to determine the extent of over break and any rock that is susceptible to cave-in. Proper identification and marking of the excessively cave-in rock.

The contractor shall use drilling and blasting techniques which will produce a smooth final profile, a minimum of overbreak, and a minimum of stressing or fracturing of the rock beyond the design section.

The contractor shall retain an engineer experienced in controlled blasting techniques on Site for the duration of the underground excavation to provide expert construction advice on smooth blasting and rock reinforcement support methods required by the Specifications.

Before drilling and subsequent tunnel, the drilling pattern shall be painted on the face indicating the holes to be drilled, and the relationship of the blast pattern to the minimum excavation line.

Immediately after each blast, the crown and walls of the excavation shall be tested by experienced scalers whose duty is to dislodge loose or shattered rock which is liable to fall. Previously excavated and supported portions shall be inspected periodically for loose rock and signs of instability.

Precautions Concerning Explosives

The Contractor's drilling pattern and blasting sequence and the amounts of powder charges shall, at all times, follow the special procedure included in the Contractor's Quality Plan, if any, as approved by the Engineer.

The Contractor shall provide suitable magazines at approved locations for the storage of all explosives. Storage transportation, handling, charging, etc. shall be performed by experienced personnel using approved equipment in accordance with the relevant local statutory regulations. The cost of all handling, storage and other charges connecting with conforming to any regulations shall be deemed to be included in the Contracts Unit Price of the tunnel per cubic meter.

The Contractor shall use explosives for blasting in connection with the work and shall be solely responsible for injury, loss, inconvenience to persons, damage to the Works or to adjoining structures, roads, places and things by the use of explosives. The Contractor's blasting foreman shall have suitable experience and be licensed by the Philippine Government in the type of work required. The Contractor shall be entirely liable for any accident which might occur and shall meet any necessary compensation for injury or damage caused to persons and property.

Explosives shall be used in quantities and with strength to comply with the following requirements.

- Fracturing and loosening of the excavation surface shall be minimized;
- The least possible vibration shall be imparted to all tunnel supports, concrete linings and structures, formwork, neighboring tunnels, surrounding masses, and existing buildings;
- The least possible amount of overbreak shall occur; and
- No avoidable rock falls shall remain in fault zones.

The contractor shall establish by field trials his blasting techniques to produce a minimum of overbreak and fracturing of the rock outside the prescribed lines of the areas to be excavated. These trials shall be performed by varying the drill size and hole pattern, hole depth, explosive type and quantity. The blasting pattern and powder load shall vary depends on the quality of the rock, changes has to be reported to the Engineer for approval.

Damage or alterations at any of the work areas caused by wrong blasting or due to any incorrect operation by the contractor shall be repaired at his expense.

Loading operations shall be carried out always and only by specialized personnel under the personal supervision of a competent, trained and licensed blaster, and the presence of non-authorized personnel shall not be allowed for such operations.

The excavations close to structures or to installation, or where expressly requested for safety reasons, shall be carried out without using explosives.

No blasting will be permitted in any case within a distance less than 25 m from such pertinent areas as concrete or pressure grouting are already completed.

If firing is done electrically, all precautions shall be taken to prevent premature explosions. During thunderstorms or other electrical disturbances, no connections for electrical firing will be permitted. After blasting, no person shall approach the area until it has been examined by the foreman or other responsible individual and declared safe. In the case of misfires, the proper precautions shall be taken.

Revision of Blasting Procedures

If at any time the Contractor proposes to alter his methods of excavation, he shall revise the procedure and submit it to the Engineer giving full details of the revised drilling, charging, and blasting patterns he proposes to use in such an area. The Contractor shall not change his methods of excavation until his revised procedure

for drilling and blasting patterns and methods of excavation have been approved by the Engineer.

If, in the opinion of the Engineer, the methods of excavation being used by the Contractor are unsatisfactory in that they result in excessive overbreak or liable to cause damage to any nearby structures, excavations or rock, the contractor shall adopt such revised methods, techniques and procedures as are acceptable to the Engineer to achieve the desired results notwithstanding the Engineer prior approval of the original methods. Except as may otherwise be specified, all costs incurred by the Contractor in adopting such other methods, techniques and procedures shall be at the expense of the Contractor.

Blasting Near Other Works

Blasting charges near existing structures or adjoining excavations or future excavation shall be kept to a minimum and wherever there is a danger of causing damage to nearby structures or installations by flying materials, the charges shall be suitably blanketed. The Contractor will not normally be permitted to blast in open excavations within 15m of any fill, concrete, or shotcrete previously placed any permanent structure or any previously grouted rock. Where blasting is required within this 15m limit, the weight of explosive detonated by each delay shall be restricted and the Contractor shall, at his own expense, provide suitable instruments to monitor the shock waves reaching the structure to the satisfaction of the Engineer. Purely as an indication, the order of the restriction is likely to be that peak particle velocities be limited to about 50 mm/s and accelerations to 1.5 g, but no guarantee can be given that these particular values will be applied in practice.

Pre-Shearing

Pre-shearing will comprise drilling a line of holes of not less than 50 mm diameter in the plane of the required rock excavation surface and charging the holes with the minimum amount of explosive which will shear the rock in a plane along the line of drill holes. The charging rate for these holes shall not exceed the equivalent of 350 grams of 75 percent gelignite per square meter of pre-sheared area, or as otherwise indicated as a result of blasting tests. The distance between drill holes of pre-shearing shall not exceed 0.6 m and such holes shall be drilled at closer spacings if required to prevent damage to the surface produced by the pre-shearing. Holes for pre-shearing shall not exceed 6 m in length.

All holes in a pre-sheared plane shall be drilled, charged and detonated simultaneously prior to drilling the production holes for the bulk excavation adjacent to the pre-shear plane. It is to be expected that the first row of production holes adjacent to the pre-sheared face will need to be lightly charged to ensure that no damage occurs to the pre-sheared face when the main charge is detonated.

The Contractor may submit alternative methods to obtain the degree of smoothness to the funnel finish. Only methods approved by the Engineer in writing will be accepted.

Line Drilling

Line drilling will comprise forming excavated rock faces by drilling a single line of closely spaced holes not less than 50 mm in diameter in the plane of the required rock surface to provide a plane of weakness along which the rock will break. The distance between the centres of holes for line drilling shall not be greater than 0.3 m and such holes shall be drilled at closed spacing if required by the Engineer. Holes for line drilling shall not exceed 6 m in length.

Blasting will normally be permitted in line drilled holes and only light charges for blasting will be permitted in the first row of production holes adjacent to the line drilled holes.

Peripheral Blasting Techniques for Underground Works

In order to obtain a smooth excavated surface, the Contractor will be expected to make appropriate use of pre-shearing techniques or alternative methods may be adopted subject to the approval of the Engineer.

Pilot Drives

When excavation is initiated by pilot drives, a minimum amount of 600 mm shall be left between the periphery of the pilot excavation and the final excavation line.

Procedure for Portals

Excavation of tunnel portals in open cut shall proceed carefully in stages in order to minimize disturbance of rock. As far as necessary, the side slopes shall be shaped to take account of any joints and fractures in the rock. Approved smooth blasting or pre-shearing techniques shall be employed.

When any stages of the excavation of the portal face or open cut reaches its final profile, it shall be supported by rock bolts and/or mesh and shotcrete in accordance with pertaining provisions before excavation of the adjacent rock proceeds. The perimeter of portal excavation in open cut shall be protected by a trench of bank to prevent the entry of water or any rock or other material displaced on the hillside above.

Before underground excavation proceeds in full tunnel diameter, the portal should have been fully supported with the final portal support, even if the Drawings does not specify. Controlled blasting is required for the first 50m of tunnel excavation from the portal. It is the contractor's obligation to provide ample support from the portal to the tunnel, prior to full scale drilling and blasting.

Procedure Adjacent to Other Excavations

Special attention will be required to the spacing, charging, and firing of holes when blasting rock in places where adjacent openings are either existing or scheduled for excavation.

Tunneling and Underground Works

The Contractor shall not break through from any tunnel to the surface or into the side of the previously excavated tunnels or cavities. At all such intersections the Contractor shall leave at least 10 m of undisturbed rock and shall first excavate tunnel portals as specified from the surface or previous excavation prior to blasting the remaining rock in the tunnel behind the portal.

Investigation Ahead of Excavated Face

The Contractor shall make observations during the drilling of each round to gain information as to the soundness of the rock about to be excavated, including the presence of any soft, decomposed, or water-bearing areas.

If the presence of poor or water-bearing ground is suspected, it may be necessary for the Contractor to carry out forward probing by drilling cored holes for inspection. The proving shall be proposed to the Engineer for approval.

Scaling

Unstable or loose material appearing after blasting or during excavation operations, which may be dangerous for the personnel or for the work shall be immediately removed by picking, barring, wedging, and air water jets.

Overbreak

In entire lengths of the diversion tunnel, isolated rock points not exceeding 0.02 m² in area and spaced at a minimum clear distance of 500 mm will be allowed to project not more than 35 mm inside the payment line of the tunnel.

In other underground excavations where concrete is to be cast or shotcrete to be sprayed against the rock, isolated points not exceeding 0.02 m² in area and spaced at a minimum clear distance of 500 mm will be allowed to project not more than 30 mm inside the payment line.

All excavation outside the minimum excavation line will be classed as overbreak. Overbreak up to 150 mm beyond the payment line will normally be left as excavated. Where overbreak occurs more than 150 mm beyond the minimum excavation line of unlined excavated surfaces, the Engineer will inspect the area and instruct whether shotcrete, cast in-situ concrete or other filling will be required in order to maintain the hydraulic roughness used in design, or for any other reason.

In areas where there is to be a concrete lining or other adjacent concrete construction, the overbreak filling shall be of the same quality concrete as that required for the adjacent work.

The Contractor shall check the excavated profile after each round as detailed as possible and properly recorded and reported. Overbreak shall be properly identified so that a pipe for backfilling and contact grouting will be installed.

Whether there is an overbreak or none, contact grouting shall be made between the concrete lining and the rock excavation or shotcrete lining in the crown. The

contractor shall submit to the Engineer the design and method of contact grouting, for approval.

Dewatering

The Contractor shall maintain the Works free from water to the extent necessary for the work to be undertaken, irrespective of its source. The Contractor shall take all necessary precautions at points of discharge of water to avoid flooding of other works and public facilities, contractor's sites and buildings, erosion and sloping ground or polluting of watercourses.

Placing of concrete in underground excavations shall not commence until standby pumps sufficient to keep the area to be concreted adequately dry are at hand.

Water Jetting

Surfaces of underground excavations shall be washed down on completion of operations by directing a jet of water at the rock surface from a distance of about 1 m through a 20 mm diameter nozzle at pressures between 1 to 3 bar, or such other effective method that removes all rock loosened during the process of excavation.

All resulting debris and loose rock fragments shall be collected from the tunnel invert and removed, except in any area of the nominally unlined section of the tunnel which is to have a concrete invert lining.

Any damage or falling rock during the water jetting shall be the contractor's responsibility.

Instrumentation

The Contractor if so required, shall prepare to drill holes in the underground excavation for the purpose of in-situ tests or installation of instrumentation that may be necessary to monitor the performance of underground excavations. Instrumentation will be the expenses of the contractor. Instrumentation shall be installed to determine the rock engineering properties, such as internal friction angle, cohesion and rock movement, and tunnel surface deformation.

Support Rock Surfaces

The Contractor shall assume full and sole responsibility for the safety of all excavated rock faced formed during the construction of the works and for the prevention of injury to personnel, regardless of any approval of the method of rock reinforcement and support which may be approved by the Engineer.

The following clauses describe the supply, testing, installation and maintenance of rock reinforcement and the support to be installed by the Contractor in areas of potentially unstable rock in fulfillment of the above obligation and wherever shown on the Drawings or required pursuant to this Technical Specification.

The contractor shall not proceed with surface excavation more than 3 m below a point until the required support has been installed. In underground excavation, support shall not lag behind the working face more than 10 m in the tunnels.

Types of Support

The intention is that rock bolts will be used for underground rock support wherever possible. However, this does not exclude the possibility that other methods may be required. Thus, the support work shall be provided by, but not limited to, tensioned rock bolts or grouted dowel bars, steel fibre reinforced shotcrete (fibercrete) or mesh reinforced shotcrete, concreting, or steel arch ribs of approved design. The Contractor must be prepared to install any of these support systems or a combination thereof at any time.

The contractor shall conduct pullout test to the rock bolts installed in every type of rock encountered, prior to the full installation. The supply of equipment, and cost in the pullout test shall be shouldered by the contractor. The method of pullout test shall be approved by the Engineer.

Agreement on Procedures

As soon as practicable after the commencement of the contract, within 2 months thereof, the Contractor shall submit to the Engineer drawings showing typical details of his proposed rock reinforcement and support methods.

Where the conditions encountered are considered by the Engineer to require the installation of support works, the Contractor shall install the support with the minimum possible delay. Where the conditions encountered are considered by the Contractor to require the installation of support works, he shall immediately inform the Engineer, and the Engineer shall give his decision on the requirement with due urgency.

The Contractor may install support works for his own purposes where they are not otherwise required and if it is necessary to increase any cross-section to allow for the use of his own support works the Contractor shall undertake such work subject to the approval of the Engineer.

Temporary Protections and Supports

According to the difficulties encountered during the excavation works, the contractor may select the temporary protections and supports he deems most convenient and suitable to bear and stabilize the unstable material and to facilitate the installation of permanent protections and supports.

Temporary protections and supports shall be removed by the contractor shortly prior to placing the concrete or when the work is completed, and it shall be the contractor's responsibility during excavation to conduct his operations so that no temporary protections and support are installed which cannot be removed when considered by the contractor.

Permanent Protections and Supports (For open and underground excavation)

Only the following materials will be considered permanent protections and supports:

- i. Steel rib supports with side & top laggings, pillow block, spacers, tie rods and spiles;
- ii. Rock bolts; (either using mechanical anchoring, fast-setting chemical anchoring or cement grout with non-shrink admixture);
- iii. Grouted anchor bars;
- iv. Steel Fiber Reinforced Shotcrete (SFRS);
- v. Concrete liner;
- vi. Welded steel wiremesh with concrete protection.

The permanent protections and supports shall be installed on the final line of excavation when:

- Instructed by the Engineer; and
- Proposed by the contractor without previous approval in case of clear signs of imminent loosening, cave-ins or slides.

Cleaning Inverts

Where any concrete lined invert is directed in the tunnel, debris on the inverts may be left under the invert slabs provided it has been adequately compacted by construction traffic. The tunnel spoil shall be finished to a uniform surface profile which shall be clean, compacted, and free from all material that is not suitable for placement of tunnel invert concrete. Elsewhere, the inverts in underground Works shall be cleaned to sound rock.

Structural Steel Ribs

Structural steel ribs, tie bars, etc. shall be cold bent and installed to the design shown on the Drawings. They shall be supplied unpainted and free from loose rust and other deleterious materials. Steel ribs shall be installed true to line and level and be subject to the clearances indicated on the Drawings. They shall be adequately braced and maintained in proper condition by the Contractor until such time as they are removed or incorporated in the permanent concrete or shotcrete lining. The steel ribs shall be approved by the Engineer prior to procurement and fabrication.

The Contractor shall provide and place such either top or side laggings and packing between the ribs and rock face as is necessary to stabilize the excavations. Lagging will normally be of steel and shall be of a section appropriate to the spacing of the steel ribs, to the load conditions, and to the nature of the packing material. Where concrete is used for packing, the lagging shall be continuous sheeting, e.g. corrugated sheet. Packing shall be of the same quality concrete as the subsequent tunnel lining unless otherwise approved by the Engineer. All timber used as support shall be removed before the permanent concrete or shotcrete lining is placed. Steel and concrete used as temporary support may be left in position.

Where any space between lagging and rock has been packed with approved rock, the filling shall be thoroughly hosed down with water immediately before the permanent concrete or shotcrete lining is placed in order to remove dirt and dust. After the lining has been placed 50 mm holes shall be drilled through the concrete into the rock filling and grout shall be injected into it. The grouting operation shall be controlled so that no air or water is trapped in the filling.

Where indicated on the Drawings, ribs shall be fully encased in mass concrete or shotcrete of at least the same quality as the subsequent tunnel lining.

Lattice Girders

Materials for lattice girders shall comply with grade 60 reinforcing steel bar. Fabrication of materials, the design shall be approved by the Engineer. Test certificates shall be obtained from the supplier/designer confirming compliance with the appropriate standards or anticipated load.

Lattice girders shall be fixed soleplates or support beams which shall be supported by steel shims and wedges. Timber footplates, blocks or wedges shall not be used to support lattice girders.

Lattice girders shall have three or four circumferential bars. When using lattice girders with three bars, two bars shall be positioned next to the excavated surface or initial shotcrete application unless shown otherwise on the Drawings.

Fully detailed fabrication drawings and specifications for all components of lattice girders shall be prepared by the Contractor and approved the Engineer before commencement of manufacture. Manufacture shall be in accordance with these drawings and specifications.

All connections shall be rigid unless shown otherwise on the Drawings.

Rigid connections shall be capable of resisting the full sectional bending moments, axial forces (tension and compression) and shear forces. These and other more complex connections shall be proved by testing to the approval of the Engineer.

Connections shall be designed to allow complete covering with shotcrete, so that no voided areas are created behind the connections. At the time when the lattice girders are encased in shotcrete, they shall be free from mud, oil paint, concrete retarders, loose rust, millscale, grease or any other substance which could adversely affect the steel or concrete chemically or reduce the bond.

Lattice girders shall not deviate from the required shape by more than 50 mm. The erected profile shall not intrude more than 100 mm inside the minimum excavation line.

Where indicated on the Drawings, lattice girders shall be fully encased in shotcrete of at least the same quality as the subsequent tunnel lining.

Pressure Relief

Pressure relief holes in tunnel linings shall be constructed at locations indicated on the Drawings or such other locations as identified by the Geologist as may be necessary.

Pressure relief holes, which are required where concrete is placed on cleaned rock, shall be drilled to a depth of 500 mm into rock. Where they are to be formed through inverts where the concrete is placed on compacted tunnel debris, the holes shall be drilled as formed through the concrete slab only. Each hole shall be partially filled with filter material and sealed by ramming a sheet of brass gauze firmly into each hole.

Pressure relief holes in primary shotcrete linings shall be 50 mm in diameter, drilled 500 mm into rock on a grid pattern of approximately 3000 x 3000 mm.

Drainage Holes

Drainage holes 50 mm in diameter shall be drilled or formed through concrete or shotcrete linings and drilled 500 mm into the rock at the centers and locations shown on the Drawings or to such other depth and in such other locations as may be necessary. The holes shall be drilled as close to normal to the rock face as is practicable.

- **Drains For Water-Bearing Fissures**

Drains for use along water bearing fissures shall consist of perforated hoses of approved type and size. They shall be covered by a layer of expanded polystyrene or other approved material to prevent ingress of grout during concreting or shotcreting. The hoses and polystyrene shall be securely fixed to the rock face.

- **Rock Bolts**

Rock bolts for temporary and permanent support of excavations in rock shall conform to the general requirements and or as directed by the Engineer. Details of rock bolts and dowels for temporary support shall be as proposed by the Contractor. Details of rock bolts for permanent support shall be shown on the Drawings. Rock bolts, shall be of grade 60 shall be adequate for the loading requirements specified or agreed or as otherwise shown on the Drawings.

When rock bolts are deemed necessary for the support of the excavation, they shall be installed as soon as is practicable and not later than 8 hours after excavation unless the need to install bolts or dowels becomes apparent at a later time. Rock bolts to be installed near the advance face, especially in the crown, shall use the fast-setting chemical anchoring or the mechanical anchoring.

Tunneling and Underground Works

Holes shall be drilled to depths and diameters suitable to accommodate the rock bolts, the proposed chemical and mechanical anchoring. If required the length of the drill hole shall allow 20 mm over drill beyond the length of the bolt or dowel and 6 mm minimum grout cover where applicable.

The method of installation of rock bolts shall be approved by the Engineer. It is applied as shown on the drawing but usually for the use of proprietary components which shall be followed wherever appropriate.

The rock bolts wide threads shall be protected against corrosion and shall be cleaned and corrosion inhibitor shall be applied immediately prior to installation. Those parts of the bolts or dowels due to be grouted in or surrounded with mortar shall be cleaned of grease, oil, loose rust or other matter that might impair the bond.

If a rock bolt is damaged by blasting operations or becomes ineffective due to any cause, it shall be repaired or additional bolts or dowels shall be installed.

The effectiveness of the installation procedure for rock bolts shall be determined by an initial series of pull-out tests and thereafter by in-situ testing to yield load at a minimum rate of one bolt or dowel in each 500 installed. Should the bolt or dowel assemblies fail at tensions less than the yield load, the Contractor shall investigate the cause and make such proposals for amendment of the installation procedure as may be necessary. Tests shall continue thereafter at a rate of one bolt or dowel in 50 until it is clear that the problem has been overcome. The Contractor shall also prove the competence of these bolts or dowels of which the failed assembly is a representative sample.

Rock bolts shall consist of a bar or bars with the appurtenant fittings such as an expansion shell unit or chemical cartridge, bearing plate, couplings, washer, and nut.

A reserve of all materials required for rock bolting shall be kept at Site stores, ready for use when required, and in an amount sufficient to avoid delays in the work progress.

The steel material of rock bolts shall be equivalent to grade 60. The bearing plate is ASTM A 263, nut is ASTM A 563 and washer ASTM A 220.

All rock bolts shall be provided with an anchorage at the end within the rock. The anchorage may be effected by means of an expanding shell or by grouting in an adequate length of the end of the bolt with cement or chemical grout using Cemextra or equivalent. All forms of bolt anchorage within the rock shall be capable of holding the bolt at a tension equal to the yield load of the bolt. The suitability of any form of anchorage shall be established by test when first placed in use under any given conditions and from time to time thereafter. In the case of grouted anchorages, an approved accelerator

Tunneling and Underground Works

shall be added to the grout or chemical formulation used to ensure that the bolt may be tensioned to the load specified in this Clause.

All such bolts shall be provided with suitable fixings at the end near the rock face by securing a washer plate having a minimum area of 200 square centimeters. Where this fixing is by threaded nut, the bolt shall be threaded for a minimum length of 150 mm. Washers and washer plates shall be of a pattern which permits close contact with the rock face at inclinations up to 30° from normal to the bolt. Plates shall be bedded on 3:1 proportion of sand/cement to mortar where directed. Details of the fixing at the rock face shall be such as to provide an anchoring load equal to the minimum yield load of the bolt.

Tensioning of rock bolts shall be carried out by means of a device imparting a direct pull to the bolt. The device shall be fitted with a gauge to indicate the tension in the bolt and shall be calibrated at regular intervals. Torque wrench tightening may be allowed provided the Contractor demonstrates by field tests conclusively that the required tension is achieved. Bolts shall be tensioned initially to between 60% and 80% of the minimum yield load. Thereafter, they shall be tested at intervals as necessary for safety and loosened bolts shall be re-tightened to the load required.

Grouted rock bolts shall be fitted with a device whereby grout may be injected after tensioning of the bolts to fill completely the intervening space between the bolt and rock, or cartridge systems may be used. Cement grout for rock bolts shall be as specified in the plan.

Rock bolts shall be provided with face plates as specified and as shown on the drawing except that mortar bedding shall not be required. Face plates shall be brought into intimate contact with the rock surface by hand tightening with an appropriate spanner or wrench.

For cement grouted rock bolt, a perforated steel tube filled with cement mortar shall be inserted to the full depth of the hole and the rock dowel device shall be inserted for the whole depth into the mortar filled tube.

Alternative methods for installing fully grouted rock bolt proposed by the Contractor will be subject to a satisfactory demonstration of the installation technique which shall not be changed.

The holes shall be filled with a sand-cement mortar mix as specified below by pumping using a tremie pipe or such other means that the hole is completely filled with mortar. The rock bolt shall then be inserted to its full length using vibration, if necessary.

Grout for cement grouted rock bolt shall be a mixture of cement, fine aggregate, water and aluminum powder admixture as a 'non-shrink' agent unless the use of proprietary product is accepted by the Engineer. The cement, fine aggregate and water shall be as specified elsewhere in the Specification. The aluminum powder admixture shall be commercial grade

extra fine aluminum powder. The fine aggregate/cement ratio of the mix shall be 3 by weight and the water cement ratio shall not exceed 0.6 by weight. The aluminum powder admixture dosage shall be 0.005% by weight of cement. The mortar ingredients shall be thoroughly mixed before placing.

Where pull-out tests are to be carried out on rock bolts, equipment, loading procedure/methodology shall be approved by the Engineer.

1404 CONSOLIDATION GROUTING

The contractor shall perform pressure grouting of rock surrounding the tunnel to consolidate the rock and to reduce permeability. The depth of holes in the tunnel will in general be 3 meters into rock unless ground conditions require otherwise.

Consolidation grout holes in the tunnels shall be drilled with rotary drills. The minimum diameter of each grout hole shall not be less than 38 mm. Only electric or air-driven equipment shall be used in the underground works.

The consolidation grouting shall not be commenced earlier than 15 days after backfill grouting is completed at the location.

Grouting, with water-cement grout, shall be performed in one stage unless it is deemed necessary. The grout line shall be connected to the hole by means of a packer installed within the concrete lining or to a nipple on a snub pipe, if previously embedded.

Grouting shall be commenced, after conducting a water pressure test, with grout at water: cement concentration of 4:1 by weight. In accordance with changes in injection volume and pressure, the grout mix shall be progressively thickened to 3:1, 2:1, 1:1, and 0.6:1 as instructed by the contractor's geologist. Grout shall mix with 2 kg. of silica fumes per bag of cement so that fine fissures shall be filled up with this cementitious material.

Grouting pressure will vary according to the geological condition, the thickness of overburden, ground water head, planned internal water pressure, and lining thickness, but will exceed 3.0 kg/cm². The grouting of any hole shall be continued 30 minutes after the hole takes out grout at a rate of less than 0.4 liters per minute per linear meter of the hole at the maximum pressure prescribed. As far as practicable the full grouting pressure shall be maintained constantly during the grout injection. After the grouting of the hole is completed, the pressure shall be maintained by means of stopcocks or other suitable valves.

If during the grouting of any hole, grout is found to flow from any part of the tunnel or surrounding rock, such flow or leaks shall be immediately plugged or caulked by the contractor.

After grouting, the consolidation hole shall be plugged with sand and cement mortar with a mixture of 1 cement to 2 part sand.

1405 CONTACT GROUTING

The Contractor shall perform contact grouting between the concrete plugs and the shotcrete lining or initial concrete lining or rock in the tunnel, and elsewhere as shown on the Approved Construction Drawings or as directed by the Engineer.

The grout mix shall be a water-cement grout within the range of 1:1 to 0.6:1 by weight. For big voids between the permanent lining and the rock or shotcrete, the grout mix shall be a mixture of water-cement and fine sand. The grout mix shall be provided with non-shrink chemicals to ensure positive contact. The contractor shall submit to the Engineer the proposed standpipe, longitudinal pipes, grout mix, and pressure for approval. The G.I. pipes shall be 50 mm dia. Schedule 40 consists of, standpipe and perforated longitudinal pipes.

1406 TUNNEL PLUGS

Diversion Tunnel shall be plugged from the inlet and in the inside as shown on the Drawings. The concrete and the method of plugging and contact grouting and schedule shall be submitted to the Engineer for approval. Placement of concrete for plugging may be made using pumpcrete equipment so it is expected that space in the crown will be developed.

The contractor shall apply contact grouting as mentioned above and as directed by the Engineer. The operations shall not commence until the concrete plugs have been cured and approved by the Engineer.

As directed by the Engineer, the grout pipe system for contact grouting of plug concrete shall consist of supply headers, return headers, vent return headers, 40 mm diameter steel for grout supply, return and vent, and 50 mm diameter grout riser pipes. Valves shall be attached at the end of all headers.

Before the pipes are embedded in concrete, they shall be cleaned inside and outside, and proven to be unobstructed, and any obstructed pipes shall be repaired or replaced by the contractor. The pipe shall be carefully laid and kept in position when concrete is being placed.

Grout outlets shall be provided in positions and in such manner as directed by the Engineer.

The maximum allowable grouting pressure shall be determined on Site by the Contractor's geologist and shall not exceed 5.0 kg/cm².

Before grout is injected, all pipes and joints shall be thoroughly washed with clean water under a pressure of not more than the allowable maximum pressure. Immediately prior to grouting, the water shall be drained. All accessible leaks discovered at the washing or all leaks occurring during the grouting operation shall be caulked or stopped in a manner instructed by the Contractor's geologist.

Grout shall be injected through the supply headers. When the maximum allowable pressure has been attained and the grout take has decreased to zero, the valves at the supply headers shall be closed and then grout shall be injected through the vent headers under the allowable maximum pressure until the grout take becomes zero. The maximum allowable pressure shall be maintained at least 30 minutes after the grout take has become zero. The valves of headers shall not be opened until grout is set sufficiently to be retained in the pipes.

1407 MUCKING AND HAULING

After blasting and when objectionable gasses are removed through ventilation, mucking of the excavated materials shall immediately commence. Considering the diameter of the tunnel, the Contractor shall be responsible in planning of the appropriate equipment for mucking and hauling from the face to the portal and or to the disposal area. Mucking and hauling should be accomplished as soon as possible so that succeeding drilling could proceed.

1408 RECORDS

a) Geological

At intervals during the construction of the underground excavations, the NIA Engineer will carry out geological mapping of the excavated surfaces and the Contractor shall provide whatever assistance and incidental materials which may be required such as paint, ladders, and lighting.

b) Drilling and Supports

The Contractor shall keep a complete record of the underground excavations including size, length, and pattern of drilling, details of charging and firing and length of advance of each round. The records shall include the dimensions and positions of support including the exact dimensions and positions of sprayed concrete, steel arches, rock bolts, and any steel plates, channels, and concrete blocking used.

The records shall be maintained fully up-to-date and shall be made available immediately for the Engineer's use and inspection on request. The original copy of the record shall be kept at the Contractor's office and shall not at any time be taken underground.

The Contractor shall furnish the Engineer with a copy of the record each week covering the progress of the excavations for the previous week at each of the underground headings.

c) Excavated Tunnel Profile

The Contractor may expect, and shall allow for, the Engineer to make profile measurements at about 5 m centers over selected lengths of the tunnels.

d) Chainage Markers

Chainage markers will be required in the tunnel at intervals of 100m. It is expected that the markings will be painted on in white paint suitable for prolonged immersion. In lined areas a 500 x 500 x 10 mm, deep recess shall be formed in the lining.

In unlined areas, a 500 x 500 mm area slightly recessed below the surrounding rock surface shall be formed and a flat mortar surface added.

1409 SHOTCRETE

This section deals with the shotcrete to be used for temporary support inside the tunnel, permanent support in the portals. Shotcrete should be applied together with the steel wire mesh and rock bolts. The clauses in this section shall be read in conjunction with the materials and workmanship specification for shotcrete in Section XIII - Shotcrete of this Technical Specification.

1410 MEASUREMENT AND BASIS OF PAYMENT

The underground or tunnel works, have various complementary activities such as excavation by blasting, mucking or hauling, installation and grouting of rockbolt, shotcreting with wiremesh, installation of steel ribs support, concrete lining, contact grouting, consolidation grouting, installation of pressure release pipe, drain pipes and others.

Measurement for payment of the major item of works are as follows:

1) Under Ground Tunnel Excavation

The underground tunnel excavation as provided shall be measured for payment per cubic meter of completed and accepted tunnel from the inlet to outlet portal as per the Bill of Quantities. Included in the unit cost per cubic meter, are the drilling, blasting, provision of ventilation (equipment, ducting compressor, generator) and electric power and lighting, safety mucking, and other subsidiary items and incidentals to complete the work. In case the Contractor opt to use an alternative tunneling method, The measurement and payment for underground tunnel excavation shall remain

In case the Contractor used an alternative tunneling method, the measurement and payment for underground shall remain the same which is per cubic meter.

2) Disposal of Excavated Materials

Disposal of excavated materials from the tunnel to the area shall be measured and paid per cubic meter. Payment for overhaul for waste materials shall only be made after disposal of the materials in accordance with applicable provision of Section IV-A and duly certified by the engineer

3) Steel Rib Supports

The supports such as steel ribs support (SRS) is measured for payment per set of W 6x25, which includes the provision of stiffeners, base plate, bolts, installation of side and top leggings and spiles.

4) Shotcrete to stabilized tunnel portals

Shotcrete to stabilized tunnel portals shall be paid per square meter of 50 mm thick shotcrete including steel welded wiremesh and 16 mm x 3 m. rockbolt, testing as per Drawing and grouting.

5) Shotcrete inside the tunnel

Shotcrete inside the tunnel to provide support either temporary or permanent shall be paid per square meter of 100 mm thick applied and accepted, including admixtures, core sampling, wiremesh, rockbolt and testing.

6) Consolidation drilling

Consolidation drilling shall be measured per piece, as per BOQ. The consolidation hole shall be backfilled with sand cement whose cost is included in the consolidation drilling.

7) Consolidation grouting

Consolidation grout takes shall be measured for payment per bag of portland cement, as per BOQ. The unit cost per bag includes the mixture of 2 kg. of silica fumes per bag of cement.

8) Tunnel Plug

As indicated in the BOQ, contact grouting that will be conducted to fill up the space between the rock surface/shotcrete surface shall be measured as shown on the BOQ. The unit cost includes the admixtures and supply of materials and equipment. Grout shall have a compressive strength of 4,000 psi at 28 days, its consistency should be such that it is flowable inside the pipe and with nonshrink admixture.

Contact grouting requires conveyance pipes which is G.I. 50 mm dia. schedule 40 for the stand pipes/riser pipes and longitudinal perforated pipes. As indicated in the BOQ pipes for contact grouting shall be measured for payment per linear meter of properly installed stand pipe and perforated longitudinal pipes, including the supports.

9) Drain pipe

Drain pipe or pressure relief pipe shall be placed as directed by the Engineer. Pipe shall be not less than 37.5 mm dia., drilled to the rock, about 500 mm. It will be measured for payment per linear meter including drilling and supply and installation of pipe and cap, if necessary.

The price and payment of the above item of works shall constitute full compensation for furnishings all labor, respective equipment tools, materials, and all incidentals and subsidiary work necessary for the successful completion of the tunneling and underground works described under this Section.

BILL OF QUANTITIES AND BID PRICES
SMALL RESERVOIR IRRIGATION PROJECT
Construction of Bayabas Rockfill Dam and Its Appurtenant Structures in Region 3 under Small Reservoir Irrigation Project
Brgy. Bayabas, Doña Remedios Trinidad, Bulacan
Invitation to Bid No. R3-BSRIPD-C-37

NO.	SECTION	DESCRIPTION	QTY.	UNIT	UNIT BID PRICE IN WORDS & IN FIGURES	TOTAL
		I. GENERAL REQUIREMENTS				
1	I	A. Temporary Works, Construction Plant, Mobilization of Construction Equipment and Demobilization Works	1.00	Lump Sum	P_____	P_____
2	I-A	B. Construction Safety and Health Program	1.00	Lump Sum	P_____	P_____
		TOTAL (I)				
		II. CIVIL WORKS				
		A. Operation and Maintenance (Perimeter Fence)				
		A.1 Perimeter Fence				
3	II	A.1.1 Site Preparation				
		A.1.1.1 Clearing & Grubbing (Mechanized) including disposal (AHD = 1.5km)	90.00	sq.m.	P_____	P_____
4	IV	A.1.1.2 Excavation (Manual)	61.00	cu.m	P_____	P_____
5	V	A.1.1.3 Filling & Backfill	55.00	cu.m	P_____	P_____
6	VII	A.2. Concrete Works Concrete Structures (21 MPa), Class A	28.00	cu.m	P_____	P_____
7	XVIII	A.3. Cyclone Fence Supply, Delivery and Installation of Cyclone Fence	170.00	l.m.	P_____	P_____
8	XVIII	A.4. Metal Works Supply, Delivery and Installation of Structural Steel Main Gate	1.00	set	P_____	P_____
		SUB-TOTAL (A)				

The undersigned bidder hereby certifies that he has fully informed himself of all conditions, local and otherwise affecting the carrying out of the Contract Works and that his bid has been prepared in strict accordance with the terms and conditions of these Bid Documents.

Name of Firm: _____

Name in Print & Signature of Bidder _____

BILL OF QUANTITIES AND BID PRICES
SMALL RESERVOIR IRRIGATION PROJECT
Construction of Bayabas Rockfill Dam and Its Appurtenant Structures in Region 3 Under Small Reservoir Irrigation Project
Brgy. Bayabas, Doña Remedios Trinidad, Bulacan
Invitation to Bid No. R3-BSRIPD-C-37

NO.	SECTION	DESCRIPTION	QTY.	UNIT	UNIT BID PRICE IN WORDS & IN FIGURES	TOTAL
		B. DIVERSION TUNNEL				
9	III	B.1 Diversion and Care of Water with Dewatering during Diversion Tunnel Construction (Pre-Cofferdam)	1.00	Lump Sum	P	P
10	IV	B.2. Excavation and Foundation Preparation B.2.1 Common Excavation (Inlet and Outlet Area)	53,314.00	cu.m.	P	P
11	IV	B.2.2 Rock Excavation (Inlet and Outlet Area)	181,175.00	cu.m.	P	P
12	V	B.3 Filling and Backfilling	8,327.00	cu.m.	P	P
13	IV-A	B.4 Overhaul Waste Disposal (AHD = 1.5km)	42,905.25	cu.m.	P	P
14	XIII	B.5 Shotcrete 50mm thick @ Inlet and Outlet Tunnel including wiremesh with rockbolt	17,882.00	sq.m	P	P
		B.6 Tunnelling B.6.1 Underground excavation, all classes including disposals (includes muck bays, dewatering, blowers and all incidentals to complete the excavation)				
15	XIV	B.6.1.a Underground Excavation (Blasting)	13,552.00	cu.m.	P	P
16	XIV	B.6.1.b Disposal from Tunnel to Temporary Damping Site	16,500.00	cu.m.	P	P
17	XIII	B.6.2 Shotcrete 100mm thick @ Inside Tunnel including wiremesh with rockbolt	8,415.00	sq.m	P	P
18	XIV	B.6.3 Drain holes, 50 mm dia x 700/900 mm deep with pressure relief holes, supply and installation, provision of PVC perforated pipes and stand pipe	792.00	l.m.	P	P
19	XIV	B.6.4 Contact Grouting, perforated 50mm dia. G.I. pipes and riser pipes	792.00	l.m.	P	P

The undersigned bidder hereby certifies that he has fully informed himself of all conditions, local and otherwise affecting the carrying out of the Contract Works and that his bid has been prepared in strict accordance with the terms and conditions of these Bid Documents.

Name of Firm:

Name in Print & Signature of Bidder

BILL OF QUANTITIES AND BID PRICES
SMALL RESERVOIR IRRIGATION PROJECT
Construction of Bayabas Rockfill Dam and Its Appurtenant Structures in Region 3 Under Small Reservoir Irrigation Project
Brgy. Bayabas, Dofia Remedios Trinidad, Bulacan
Invitation to Bid No. R3-BSRIPD-C-37

NO.	SECTION	DESCRIPTION	QTY.	UNIT	UNIT BID PRICE IN WORDS & IN FIGURES	TOTAL
		B. DIVERSION TUNNEL				
20	XIV	B.6.5 Supply and Install W6 x 25 Steel Rib Support	313.00	set	P	P
21	XIV	B.6.6 Drilling and Grouting of M22 x 50mm long Bolt	2,512.00	pcs	P	P
22	VIII	B.6.7 Concrete for Floor slab, (35 Mpa), Class 2	992.00	cu.m.	P	P
23	VIII	B.6.8 Concrete Lining (35 MPa), Class 2	2,625.00	cu.m.	P	P
24	VIII	B.6.9 Concrete Lining (21 MPa), Class A	1,849.00	cu.m.	P	P
25	VIII	B.6.10 Concrete Plug (21 MPa), Class A	303.00	cu.m.	P	P
26	X	B.6.11 PVC water stop, 0.2 meter width, dumbbell type	1,274.00	l.m.	P	P
27	IX	B.6.12 Supply, Deliver, Furnish and Install of Reinforcing Steel Bars, Grade 60, various sizes	356,956.00	kgs	P	P
28	VIII	B.7 Intake Tower (Double Barrel RCBC and Tower) B.7.1 Concrete Structure, (35 Mpa), Class 2	1,622.00	cum.	P	P
29	VII	B.7.2 Concrete Plug, (21 Mpa), Class A	821.00	cum.	P	P
30	IX	B.7.3 Supply, Deliver, Furnish and Install of Reinforcing Steel Bars, Grade 60, various sizes	93,711.00	kgs	P	P
31	X	B.7.4 PVC Waterstop, 0.2 meter width, dumbbell type	299.00	l.m.	P	P
32	XXIII	B.7.5 Intake Trash racks complete w/accessories and embedded parts (2.3m W x 3.3m H)	6.00	set	P	P
33	XXVI	B.7.6 Intake Stoplog complete w/accessories and embedded parts (5.85m W x 6.0m H)	3.00	set	P	P

The undersigned bidder hereby certifies that he has fully informed himself of all conditions, local and otherwise affecting the carrying out of the Contract Works and that his bid has been prepared in strict accordance with the terms and conditions of these Bid Documents.

Name of Firm: _____

Name in Print & Signature of Bidder _____

BILL OF QUANTITIES AND BID PRICES
SMALL RESERVOIR IRRIGATION PROJECT
Construction of Bayabas Rockfill Dam and Its Appurtenant Structures in Region 3 Under Small Reservoir Irrigation Project
Brgy. Bayabas, Doña Remedios Trinidad, Bulacan
Invitation to Bid No. R3-BSRIDP-C-37

NO.	SECTION	DESCRIPTION	QTY.	UNIT	UNIT BID PRICE IN WORDS & IN FIGURES	TOTAL
		B. DIVERSION TUNNEL				
34	XXIV	B.8 Tunnel Pipeline (Penstock) B.8.1 Steel Pipes a. 2.00m Ø Pipe, 15mm thk	63.00	l.m.	P_____	P_____
35	XXIV	b. 2.50m Ø Pipe, 15mm thk	139.00	l.m.	P_____	P_____
36	XXIV	B.8.2 Fabrication and Installation of Hold down Strap	10.00	pcs	P_____	P_____
37	XXV	B.8.3 Supply, Delivery, Installation and Commissioning of Spherical Valve w/ Hydraulic Actuator 2.5mØ	2.00	set	P_____	P_____
38	XXV	B.8.4 Supply, Delivery and Installation and Commissioning of Fixed Cone Valve 2.00mm Ø, 2 assembly	2.00	set	P_____	P_____
39	XXV	B.8.5 Supply, Delivery, Installation and Commissioning of Spherical Valve w/ Hydraulic Actuator 2.0mØ	2.00	set	P_____	P_____
40	XXV	B.8.6 Steel Pipe Expansion Joint 2.0mØ. assembly	4.00	set	P_____	P_____
41	VIII	B.8.7 Structural Concrete for Thrust Block, (21 Mpa), Class A	390.00	cum.	P_____	P_____
42	VIII	B.8.8 Structural Concrete for Pipe Supports, (21 MPa), Class A	52.00	cu.m.	P_____	P_____
43	IX	B.8.9 Supply, Deliver, Furnish and Install of Reinforcing Steel Bars, (Thrust Block & Pipe support), Grade 60	14,699.00	kgs.	P_____	P_____
44	VIII	B.8.10 Lean Concrete (50mm thk for Thrust Block) (13.8 Mpa). Class B	8.00	cu.m.	P_____	P_____
45	XXX	B.9 Valve House and Valve Chamber B.9.1 Concrete Blocks, Walls and Partitions (150mm thk CHB Wall) with plaster both sides	326.00	sq.m	P_____	P_____
46	XXXI	B.9.2 GI Sheet Roofing	285.00	sq.m	P_____	P_____
47	XXXI	B.9.3 Pre-painted Rib Type Wall Cladding	216.00	sq.m	P_____	P_____

The undersigned bidder hereby certifies that he has fully informed himself of all conditions, local and otherwise affecting the carrying out of the Contract Works and that his bid has been prepared in strict accordance with the terms and conditions of these Bid Documents.

Name of Firm: _____
Name in Print & Signature of Bidder _____

BILL OF QUANTITIES AND BID PRICES
SMALL RESERVOIR IRRIGATION PROJECT
Construction of Bayabas Rockfill Dam and Its Appurtenant Structures in Region 3 Under Small Reservoir Irrigation Project
Brgy. Bayabas, Doña Remedios Trinidad, Bulacan
Invitation to Bid No. R3-BSRIDP-C-37

NO.	SECTION	DESCRIPTION	QTY.	UNIT	UNIT BID PRICE IN WORDS & IN FIGURES	TOTAL
		B. DIVERSION TUNNEL				
48	XXIX	B.9.4 Supply, Delivery, Assemble and Installation of Structural Steel for Trusses, ASTM A36, for Steel Column, Trusses, Purlins, base plates, bearing plates, stiffeners	25,257.00	kgs.	P	P
49	XXVII	B.9.5 Supply, Delivery, Installation & Commissioning of Overhead Travelling Crane (20 Tons Capacity), including Girder	1.00	lot	P	P
50	XVIII	B.9.6 Doors complete w/hardwares and accessories Double Panel Swing Steel (1.70m x 2.10m) 2 sets Motorized Roll up Door (5.0m x 4.9m) 1 set	1.00	lot	P	P
51	XVIII	B.9.7 Windows Sound Attenuated Louver Window (3.5m x 2.4m) 10 sets	1.00	lot	P	P
52	VIII	B.9.8 Structural Concrete, 24.5 Mpa, Class AA	647.00	cu.m	P	P
53	IX	B.9.9 Supply, Deliver, Furnish and Install of Reinforcing Steel Bars, Grade 60, various sizes	68,096.00	kgs.	P	P
54	XXVIII	B.9.10 Electrical Power and Lighting for Valve House	1.00	LS	P	P
55	XVIII	B.10. Handrail (G.I. Pipe 50mm Diameter)	72.00	l.m.	P	P
56	XVIII	B.11 Fabrication, Delivery and Installation of Steel Folding Gate (2sets)	2.00	lot	P	P
57	XXIX	B.12 Structural Steel for Catwalk	10,036.00	kgs.	P	P
58	II	B.13 Access Road to Valve House B.13.1 Clearing and Grubbing including disposal (AHD = 1.5km)	17,119.00	sq.m.	P	P
69	IV	B.13.2 Common Excavation	116,766.00	cu.m	P	P

The undersigned bidder hereby certifies that he has fully informed himself of all conditions, local and otherwise affecting the carrying out of the Contract Works and that his bid has been prepared in strict accordance with the terms and conditions of these Bid Documents.

Name of Firm: _____
Name in Print & Signature of Bidder _____

BILL OF QUANTITIES AND BID PRICES
SMALL RESERVOIR IRRIGATION PROJECT
Construction of Bayabas Rockfill Dam and Its Appurtenant Structures in Region 3 Under Small Reservoir Irrigation Project
Brgy. Bayabas, Doña Remedios Trinidad, Bulacan
Invitation to Bid No. R3-BSRIDP-C-37

NO.	SECTION	DESCRIPTION	QTY.	UNIT	UNIT BID PRICE IN WORDS & IN FIGURES	TOTAL
		B. DIVERSION TUNNEL				
60	IV	B.13.3 Overhaul Waste Disposal (AHD = 1.5km)	58,949.00	cu.m	P	P
61	XXI	B.13.4 Sub-base Preparation	2,803.00	cu.m.	P	P
62	XXI	B.13.5 Sub-base Gravel (150mm thk)	388.00	cu.m.	P	P
63	XXI	B.13.6 Base Course Gravel (150mm thk)	462.00	cu.m.	P	P
64	VIII	B.13.7 Line Ditch (21 MPa), Class A	258.00	cu.m	P	P
65	IX	B.13.8 Supply, Deliver, Furnish and Install of Reinforcing Steel Bars, for Line Ditch Grade 60, various sizes	11,551.00	kg	P	P
66	II	B.14 Irrigation Intake B.14.1 Clearing and Grubbing including disposal (AHD = 1.5km)	36.00	sq.m.	P	P
67	IV	B.14.2 Common Excavation	48.00	cu.m.	P	P
68	V	B.14.3 Filling & Backfilling	44.00	cu.m.	P	P
69	VIII	B.14.4 Concrete Structure (21 MPa), Class A	6.00	cu.m.	P	P
70	IX	B.14.5 Supply, Deliver, Furnish and Install of Reinforcing Steel Bars, Grade 60, various sizes	320.00	kgs.	P	P
71	XXII	B.14.6 Supply, Delivery and Installation of RCP with Collar	8.00	l.m.	P	P
72	XXVI	B.14.7 Supply, Delivery and Installation of Main Intake Slide Gate 0.80m x 0.80m x 6 mm thk	1.00	pc	P	P
		SUB-TOTAL (B)				

The undersigned bidder hereby certifies that he has fully informed himself of all conditions, local and otherwise affecting the carrying out of the Contract Works and that his bid has been prepared in strict accordance with the terms and conditions of these Bid Documents.

Name of Firm: _____
Name in Print & Signature of Bidder _____

NIA Bid Form

BILL OF QUANTITIES AND BID PRICES
SMALL RESERVOIR IRRIGATION PROJECT
Construction of Bayabas Rockfill Dam and Its Appurtenant Structures in Region 3 Under Small Reservoir Irrigation Project
Brgy. Bayabas, Doña Remedios Trinidad, Bulacan
Invitation to Bid No. R3-BSRIPD-C-37

NO.	SECTION	DESCRIPTION	QTY.	UNIT	UNIT BID PRICE IN WORDS & IN FIGURES	TOTAL
		C. DAM				
		C.1 Dam Foundation				
73	II	C.1.1 Clearing and Grubbing including disposal (AHD = 1.5km)	84,884.00	sq.m	P	P
74	IV	C.1.2 Excavation and Foundation Preparation				
		C.1.2.1 Common Excavation	338,052.00	cu.m	P	P
75	IV	C.1.2.2 Rock Excavation	37,561.00	cu.m	P	P
76	IV-A	C.1.2.3 Overhaul Waste Disposal (AHD = 1.5km)	16,619.50	cu.m	P	P
		C.1.3 Drilling and Curtain Grouting				
77	XV	C.1.3.1 Drilling and Grouting				
		a. Drilling of Holes for curtain grouting (primary, secondary tertiary and quaternary holes) and blanket grouting holes	9,152.00	l.m.	P	P
78	XV	b. Water pressure test prior to curtain grouting	2,080.00	l.m.	P	P
79	XV	c. Pressure Curtain grouting, assume 0.8 bag per meter with 2 kg./bag of cement	7,322.00	bag	P	P
80	XV	d. Set-ups (2 inches dia. G.I. Grout Pipe) and concrete pad	1,110.00	l.m.	P	P
81	VI	C.1.3.2 Slush grout including removal of unsuitable materials	6,527.00	sq.m	P	P
82	VIII	C.1.3.3 Dental Concrete Class C-1	60.00	cu.m	P	P
		SUB-TOTAL (C.1)				
		C.2 Dam Embankment				
83	III	C.2.1 Diversion and Care of River during Dam Construction	1.00	Lump Sum	P	P
84	VI	C.2.2 Impervious clay core, Selected common borrow	246,936.52	cu.m	P	P
85	VI	C.2.3 Test fill	1,500.00	cu.m	P	P

The undersigned bidder hereby certifies that he has fully informed himself of all conditions, local and otherwise affecting the carrying out of the Contract Works and that his bid has been prepared in strict accordance with the terms and conditions of these Bid Documents.

Name of Firm:

Name in Print & Signature of Bidder

BILL OF QUANTITIES AND BID PRICES
SMALL RESERVOIR IRRIGATION PROJECT
Construction of Bayabas Rockfill Dam and Its Appurtenant Structures in Region 3 Under Small Reservoir Irrigation Project
Brgy. Bayabas, Doña Remedios Trinidad, Bulacan
Invitation to Bid No. R3-BSRIPD-C-37

NO.	SECTION	DESCRIPTION	QTY.	UNIT	UNIT BID PRICE IN WORDS & IN FIGURES	TOTAL
		C. DAM				
86	VI	C.2.4 Random fill, selected fill	257,146.00	cu.m	P	P
87	VI	C.2.5 Sand filter	107,445.23	cu.m.	P	P
88	VI	C.2.6 Gravel filter	66,304.77	cu.m.	P	P
89	VI	C.2.7 Rockfill (From Excavation)	849,351.00	cu.m.	P	P
90	VI	C.2.8 Transition Rockfill	310,692.00	cu.m.	P	P
91	VI	C.2.9 Impervious Zone	23,608.00	cu.m.	P	P
92	VIII	C.2.10 Concrete for side drainage and access foot path, (21 MPa) Class A	443.00	cu.m.	P	P
93	IX	C.2.11 Supply, Deliver, Furnish and Install of Reinforcing steel bars, Grade 40, various sizes	17,132.00	kg	P	P
94	XVIII	C.2.12 Access hand rail (G.I. Pipe schedule 40) 50mm dia.	487.00	l.m.	P	P
		SUB-TOTAL OF ITEM (C.2)				
95	XXI	C.3 Dam Crest C.3.1 Crest Sub-base Course [gravel]	275.00	cu.m.	P	P
96	XXI	C.3.2 Crest Surface Course [gravel]	77.00	cu.m.	P	P
97	XXI	C.3.3 Portland Cement Concrete Pavement, 150mm thk (28 MPa), Class AA	335.00	cu.m.	P	P
98	XVIII	C.3.4 Metal Guardrail (Flex Beam) including Concrete Post	688.00	l.m.	P	P
99	XVIII	C.3.5 Metal Guardrail (Flex Beam), End piece including Concrete Post, bolt, nut and washer	2.00	set	P	P

The undersigned bidder hereby certifies that he has fully informed himself of all conditions, local and otherwise affecting the carrying out of the Contract Works and that his bid has been prepared in strict accordance with the terms and conditions of these Bid Documents.

Name of Firm: _____
Name in Print & Signature of Bidder _____

BILL OF QUANTITIES AND BID PRICES
 SMALL RESERVOIR IRRIGATION PROJECT
 Construction of Bayabas Rockfill Dam and Its Appurtenant Structures in Region 3 Under Small Reservoir Irrigation Project
 Brgy. Bayabas, Doña Remedios Trinidad, Bulacan
 Invitation to Bid No. R3-BSRIPD-C-37

NO.	SECTION	DESCRIPTION	QTY.	UNIT	UNIT BID PRICE IN WORDS & IN FIGURES	TOTAL
		C. DAM				
100	XXVIII	C.3.6 Supply, Installation and Testing of Electrical Works (Perimeter Lighting including Lighting Control Panel distribution line, Hot dipped galvanized, pole, Lighting, grounding and cables with the dam crest and from dam crest to valve house	1.00	LS	P	P
		SUB-TOTAL OF ITEM (C.3)				
101	XVII	C.4) Supply, Installation and Testing of Dam and Spillway Instrumentation a. Bench Mark (2 unit) b. Surface Monuments (12 unit) c. Open type Piezometer (15 unit) d. Automatic Rainfall Gauge (1 unit) e. Seepage Monitoring Weir (2 unit) f. Reservoir Level Gauge (1 unit) g. Accelerometer (2 unit) h. Instrumentation Observation Station (1 unit)	1.00	LS	P	P
		SUB-TOTAL OF ITEM (C.4)				
		SUB-TOTAL (C)				
		D. SPILLWAY				
102	IV	D.1 Excavation and Foundation Preparation D.1.1 Common Excavation	454,466.00	cu.m.	P	P
103	IV	D.1.2 Rock Excavation	562,545.00	cu.m.	P	P
104	V	D.2 Filling & Backfilling	12,056.00	cu.m.	P	P
105	IV-A	D.3 Overhaul Waste Disposal (AHD = 1.5km)	439,396.00	cu.m.	P	P
106	VIII	D.4 Structural Concrete, (35 Mpa), Class 2	18,398.00	cu.m.	P	P

The undersigned bidder hereby certifies that he has fully informed himself of all conditions, local and otherwise affecting the carrying out of the Contract Works and that his bid has been prepared in strict accordance with the terms and conditions of these Bid Documents.

Name of Firm:

Name in Print & Signature of Bidder

NIA Bid Form

BILL OF QUANTITIES AND BID PRICES
SMALL RESERVOIR IRRIGATION PROJECT
Construction of Bayabas Rockfill Dam and Its Appurtenant Structures in Region 3 Under Small Reservoir Irrigation Project
Brgy. Bayabas, Doña Remedios Trinidad, Bulacan
Invitation to Bid No. R3-BSRIPD-C-37

NO.	SECTION	DESCRIPTION	QTY.	UNIT	UNIT BID PRICE IN WORDS & IN FIGURES	TOTAL
		D. SPILLWAY				
107	VIII	D.5 Structural Concrete, (28 MPa), Class AA	9,780.00	cu.m.	P	P
108	IX	D.6 Supply, Deliver, Furnish and Install of Reinforcing Steel Bar, Grade 60, various sizes	1,076,950.00	kgs.	P	P
109	X	D.7 PVC Water stop 0.2m width with center bulb and dumbbell type (10mm thk)	3,636.00	l.m.	P	P
110	X	D.8 Dowel Bars, 16mm dia. x 1.2 meter long, 0.6 meter wrapped with Denso tape	1,386.00	pc.	P	P
111	XVI	D.9 Supply and Installation of Anchor Bars, 25mmØ X 3.0m (for Rocks)	924.00	pc.	P	P
112	X	D.10 Supply and Installation of Bituminous Joint Filler	3,637.00	sq.m	P	P
113	XX	D.11 Supply and Installation of Geotextiles, unwoven filter	10,481.00	sq.m	P	P
114	XII	D.12 1/2" Gravel Filter Material	1,910.00	cu.m.	P	P
115	XVIII	D.13 250 mm. Ø HDPE / Concrete (Perforated) Pipe	2,669.00	lm	P	P
116	XVIII	D.14 Supply and Installation of PVC 50 mm dia., 3.4mm thick wall for weephole	710.00	lm	P	P
117	VIII	D.15 Spillway Bridge D.15.1 Structural Concrete (28 Mpa), Class AA	554.00	cu.m.	P	P
118	VIII	D.15.2 Structural Concrete (21 Mpa), Class A	124.00	cu.m.	P	P

The undersigned bidder hereby certifies that he has fully informed himself of all conditions, local and otherwise affecting the carrying out of the Contract Works and that his bid has been prepared in strict accordance with the terms and conditions of these Bid Documents.

Name of Firm: _____
Name in Print & Signature of Bidder _____

BILL OF QUANTITIES AND BID PRICES
SMALL RESERVOIR IRRIGATION PROJECT
Construction of Bayabas Rockfill Dam and Its Appurtenant Structures in Region 3 Under Small Reservoir Irrigation Project
Brgy. Bayabas, Dofia Remedios Trinidad, Bulacan
Invitation to Bid No. R3-BSRIPD-C-37

NO.	SECTION	DESCRIPTION	QTY.	UNIT	UNIT BID PRICE IN WORDS & IN FIGURES	TOTAL
		D. SPILLWAY				
119	IX	D.15.3 Supply, Deliver, Furnish and Install of Reinforcing Steel Bar a. Grade 60, various sizes	54,279.68	kgs	P	P
120	IX	b. Grade 40, various sizes	7,524.00	kgs	P	P
121	X	D.15.4 Preformed Expansion Joint Filler (12mm thk)	4.00	sq.m	P	P
122	X	D.15.5 Preformed Expansion Joint Filler (25mm thk)	10.00	sq.m	P	P
123	X	D.15.6 Joint Sealant	3.00	gal	P	P
124	XVIII	D.15.7 Elastomeric Bearing Pad (250X350X50mm)	24.00	set	P	P
125	X	D.15.8 Expansion Joint	62.00	l.m.	P	P
126	XVIII	D.15.9 Drain Pipe (12.5cm dia. Schedule 40, White PVC), 1900 mm long	12.00	pc	P	P
		SUB-TOTAL (D)				
		SUB-TOTAL (II)				
		(Total I + II) TOTAL AMOUNT OF BID In Words and Figures				

The undersigned bidder hereby certifies that he has fully informed himself of all conditions, local and otherwise affecting the carrying out of the Contract Works and that his bid has been prepared in strict accordance with the terms and conditions of these Bid Documents.

Name of Firm: _____
Name in Print & Signature of Bidder _____

National Irrigation Administration

Contract Number: _____

Name of Contract: _____

Qualification of Key Personnel Proposed to be Assigned to the Contract

Business Name : _____
Business Address : _____

	Project Manager	Project Engineer	Office Engineer	Office Engineer	Materials Engineer II	Mechanical Engineer	Electrical Engineer
1 Name							
2 Address							
3 Date of Birth							
4 Employed since							
5 No. of Years of Experience							
6 Previous Employment							
7 Education							
8 PRC License							

Minimum Requirements : Project Manager : Mechanical Engineer : Safety/Health Officer
: Project Engineer : Electrical Engineer : Geodetic Engineer
: Two (2) Office Engr. : Civil Engineer : Two (2) Foreman for Earthwork
: Materials Engineer II : Geologist : Foreman for Concreting

Note: a) Attach PRC License;
b) For Office Engineers, attach AUTOCAD Training Certificate;
c) For Materials Engr., attach Certificate of Accreditation as Materials Engr. duly accredited by the DPWH; and
d) For Safety/Health Officer, attach Training Certificate as Safety Officer duly accredited by DOLE.

Submitted by : _____
(Printed Name & Signature)
Designation : _____
Date : _____

National Irrigation Administration
Contract Number: _____
Name of Contract: _____

Qualification of Key Personnel Proposed to be assigned to the Contract

Business Name : _____
Business Address : _____

	Civil Engineer	Geologist	Safety/Health Officer	Geodetic Engineer	Foreman for Earthwork	Foreman for Earthwork	Foreman for Concreting
1 Name							
2 Address							
3 Date of Birth							
4 Employed since							
5 No. of Years of Experience							
6 Previous Employment							
7 Education							
8 PRC License							

Minimum Requirements : Project Manager : Mechanical Engr. : Safety/Health Officer
: Project Engineer : Electrical Engr. : Geodetic Engineer
: Two (2) Office Engr. : Civil Engineer : Two (2) Foreman for Earthwork
: Materials Engineer II : Geologist : Foreman for Concreting

Note:
a) Attach PRC License;
b) For Office Engineers, attach AUTOCAD Training Certificate;
c) For Materials Engr., attach Certificate of Accreditation as Materials Engr. duly accredited by the DPWH; and
d) For Safety/Health Officer, attach Training Certificate as Safety Officer duly accredited by DOLE.

Submitted by : _____
(Printed Name & Signature)
Designation : _____
Date : _____