ROYAL GOVERNMENT OF LAOS

THA NGON AGRICULTURAL DEVELOPMENT PROJECT

CONTRACT

FOR

MECHANICAL AND ELECTRICAL INSTALLATION

[illegible]

1971 - 1972

[illegible]

[illegible]

Prepared by

Overseas Technical Cooperation Agency

Tokyo, March 1969

THA NGON AGRICULTURAL DEVELOPMENT PROJECT

INDEX

Page

SECTION 1 INSTRUCTIONS TO TENDERERS

Page

SECTION 2 GENERAL CONDITIONS

Page

SUBSECTION 6G DISTRIBUTION LINE

SECTION 1

INSTRUCTIONS TO TENDERERS

1.1 GENERAL

This tender is called for the design, manufacture, supplying, testing, painting, export packing, insuring, shipping, delivery to the site, erecting and site testing of the following equipment for the Tha Ngon Agricultural Development Project (hereinafter designed as "Tha Ngon Project") of the Royal Government of Laos:-

(a) Two sets of pumping equipment consisted of water pump-motors, outlet valves, check valves and their control system.

(b) One lot of discharge pipe.

(c) Two sets of trash racks.

(d) One set of roller gate.

(e) Many sets of slide gates.

(f) One lot of electrical equipment.

(g) One lot of distribution line.

1.2 SUBMISSION OF TENDER

Sealed Tenders clearly marked as follows shall be submitted to the following address:

"Tender for Equipment,

Tha Ngon Project"

---

and delivered there before _____ on _____ 19____ at the latest.

Bids received after this time shall be returned unopened.

1.3 COMPLETENESS OF TENDER

The Tender must be prepared according to the Forms annexed to the

specification with all blanks therein and in all schedules duly filled up and signed.

Any tender which is incomplete or does not include the whole of the works covered by the specification will not be considered.

1.4 PRICE

Prices quoted for each item in the Form of Tender shall be reasonable for each item, in the judgement of the Government. Prices shall be in United States dollars.

1.5 BID BOND

The Tender shall be accompanied by a bid bond or certified cheque for an amount not less than 5 per cent of the tender price to guarantee the fulfilment of the terms of the tender. The bid bond or certified cheque of the Tenderer will be returned when the contract is signed, and the Performance Bond referred to in Clause 2.11 of the General Conditions is received by the Government. If the Tenderer to whom the contract is presented for signature refuses or neglects to sign, or fails to furnish the required Performance Bond, his bid bond or certified cheque shall be forfeited.

The bid bonds or certified cheques of the unsuccessful tenderers will be returned after the signing of the contract.

1.6 VALIDITY OF TENDER

The tender is to be held open for acceptance or rejection for a period of six months from the date of delivery of tenders.

1.7 ACCEPTANCE AND REJECTION OF TENDERS

The Government does not bind himself to accept the lowest or any tender, nor to assign any reason for the rejection of any tender.

1.8 CORRESPONDENCE

All correspondence in connection with the tender and contract

and all matters accompanying the tender which are relevant to its examination are to be in the English language and expressed in units of the metric system.

1.9 EXPENSES IN PREPARATION OF TENDER

The Government will neither be responsible for, nor pay for or any expenses or loss which may be incurred by any Tenderer in the preparation of his tender.

1.10 DOCUMENTS TO BE SUBMITTED BY TENDERERS

Tenderers shall submit four copies of under-mentioned drawings and other documents in tender to the Government.

(a) Drawings describing the layout, structure and dimension of the equipment.

(b) Calculating sheets for the structure.

(c) Weight lists of the equipment.

(d) List of materials to be used for the equipment.

(e) Work schedule.

(f) Explanatory statement for the work of each item of the equipment.

1.11 STANDARDS

If the Tenderer offers material or equipment which conform to standards other than those stipulated in the specification, full detail including copies in English language of such standards shall be submitted with the tender. If approved, the alternative standards shall be incorporated in the contract, otherwise the specified standards shall apply.

1.12 DEPARTURE FROM THE SPECIFICATIONS

The Tenderer shall submit with his tender, in order of the relevant clauses, a statement of any proposed departures from the specifications. Notwithstanding any description, drawings or literature which

may be submitted, all details other than those in such statement of departures shall be deemed to be in accordance with the specifications. Such departures shall not be binding on the Government unless incorporated in the contract and prices bid in the tender shall not take into account any such proposed departures. The Tenderer shall, however, indicate in the statement of departures, the amount of increase or decrease in the tender prices for each proposed departure if such departure is incorporated in the contract.

1.13 ALTERATIONS IN TENDER

No alteration is to be made in the Form of Tender or the Schedules thereto except in filling up the blanks as directed. If any such alterations are made or if these instructions are not fully complied with, the tender may be rejected.

1.14 ADDITIONS IN TENDER

The Tenderer, however, is at liberty to add further details that he may desire and in the event of his so doing, shall print or type such details and annex the said details to his tender. Such additional details shall not be binding on the Government if they conflict in any way with requirement of the contract documents unless they are subsequently incorporated in the contract.

1.15 SITE CONDITIONS

The Tenderer shall have personal knowledge of the location of the proposed work and access thereto and shall acquaint himself with the actual conditions and requirements thereof, including labour conditions and labour rates and shall not claim at any time after the submission of the tender or the subsequent execution of a contract that there was any misunderstanding with regard to the conditions imposed by the contract or prevailing at the site or in the countries of Laos.

1.16 TRANSPORTATION

The Tenderer's attention is directed to Clause 5.5 of the General

Specifications which state the arrangement for transportation of the equipment and roads to site.

1.17 CONTRACTOR'S STAFF ACCOMMODATION

The Tenderer's attention is directed to Clause 5.7 of the General Specifications which state camp accommodation for the Contractor's staff. The cost of this expense will be taken into account in the comparison of the tenders.

SECTION 2

GENERAL CONDITIONS

2.1 MEANING OF TERMS

The following words wheresoever used in the contract shall have the meanings herein assigned to them.

"Government" shall mean the Government, the Government staffs of the Royal Government of Laos or persons duly assigned by the Government.

"Tenderer" shall mean any party or parties tendering on the work covered by these contract documents.

"Contractor" shall mean the party or parties to whom shall have been let a contract for the work to be done under these contract documents, and the legally appointed representatives, successors and assigns of said party or parties.

"Subcontractor" shall mean any party or parties having a direct contract with the Contractor for the performance of any part or parts of the work to be performed under the contract.

"Other contractor" shall mean any party or parties having a direct contract with the Government for work outside the scope of this contract and shall include any subcontractor of this other contractor.

"Contract" shall mean the agreement between the Government and the Contractor and all appendixes and schedules thereto, including without limitation the Instructions to Tenderers, the Tender, the General Conditions, the Specifications and Schedules thereto annexed, the Drawings annexed hereto or to be provided or approved by the Government and any samples and patterns to be provided under the provisions of the Contract.

"Equipment" shall mean and include machinery, apparatus, materials, articles and things of all kinds, to be provided under the Contract, other than the Contractor's equipment.

"Work" shall mean and include all equipment to be provided and work to be done by the Contractor under the Contract.

"Site" shall mean the place or places where the various field construction of work is to be carried out for the Government, or the immediate vicinity of such place or places.

"Approved" or "approval" shall mean approved or approval in writing by the Government.

2.2 INTENT

The intent and spirit of the contract is to provide for the work herein specified to be fully completed within the contract time, in every detail for the purpose designed and it is hereby understood that the Contractor, in accepting the contract, agrees to furnish any and everything necessary for such purpose notwithstanding any omission in the drawings or specifications. All matters omitted from the Contract Documents which may reasonably be inferred to be obviously necessary for the efficiency, stability and completion of the work shall be deemed to be included in the Contract Price. The Contractor shall apply to the Government for any explanation which he may require with reference to the meaning and intent of any part of the contract and shall be held responsible for any errors or losses he may make in consequence of failure to obtain such explanation.

2.3 LETTER OF INTENT

Following the opening and assessment of the tenders, the Government will issue by registered post or by otherwise depositing at the registered office of the Successful Tenderer a letter of intent to enter into a contract with the Successful Tender for the execution of the work in accordance with the Contract Documents and such exceptions to the said documents which are acceptable to the Government. Upon issue of such letter of intent by the Government, the contract shall be deemed to have been fully and sufficiently made and the Government and the successful Tenderer shall become bound by all the terms and conditions of the contract until the signing of the Agreement in accordance with Clause 2.4 herein.

2.4 AGREEMENT

As soon as possible after the date of issue of the letter of intent as provided for in Clause 2.3 herein, the Successful Tenderer shall enter into a contract with the Government for the execution of the work in the form of Agreement attached herein.

2.5 ALTERATIONS, ADDITIONS, DEDUCTIONS AND EXTRA WORK

The Government shall have the right to make alterations, deductions and additions to the work or any part thereof, either before or after its commencement.

The Contractor, if instructed in writing by the Government, shall perform extra work and furnish extra materials which are not included in the contract, but which nevertheless forms an inseparable part of the work.

All extra and additional work shall be performed strictly in accordance with the terms of the contract insofar as they are applicable thereto. The class of employee used on extra work shall be the same as that used or employed on work of similar character done in the performance of other portions of the contract.

The Government may grant the Contractor such extensions of time as seem reasonable and proper to the Government for the completion of work which the Government considers extra and addition to the original contract.

In any case in which the Contractor has received a written order from the Government which will involve an increase or decrease in the Contract Price, the amount of such increase or decrease shall be agreed between the Government and the Contractor and included in the order. Whenever in the opinion of the Government it is impracticable because of the nature of the work or for any other reason to agree on the value of altered or extra work or any part thereof before such work is carried out, then the value of such work or part shall be taken as the actual necessary cost thereof as determined by the Government, plus 10 per

cent of such actual necessary cost to cover the Contractor's superintendence overhead and profit.

If a deduction from the work is approved by the Government, the Contractor shall grant the Government a credit for each such deduction, the amount of such credit being either a lump sum, or based on a unit price which shall be agreed upon by the Contractor and the Government,

2.6 PAYMENTS

(a) The Government will pay to the Contractor 90 per cent of the F.O.B. price of the shipped equipment within 30 days after shipping of the equipment.

(b) The Government will pay to the Contractor 90 per cent of the transport and erection charge of the equipment progressively for the erected equipment within 30 days after receipt of the corresponding bill for payment.

(c) The Government will pay to the Contractor all remaining portion of the contract price within 30 days of issue of an completion certificate after finishing of the performance tests for the equipment at the site.

Payment to the Contractor will be made by the Government in United States dollars at a bank designated by the Contractor.

(d) Damages for Delay in Completion

Time shall be of the essence of this contract. If the Contractor fails to complete the entire work, or any part thereof for which a completion date is specified, within the time fixed by the contract, or any extension of that time granted pursuant to the contract, and such delay is not attributable to the Government, there shall be deducted from the Contract Price as liquidated damages 0.1 per cent of the Contract Price for each week of delay in completion of the Works but the amount so deducted shall not in any case exceed 10 per cent of the said Contract Price.

2.7 EQUIPMENT, MATERIALS AND LABOUR

The Contractor shall furnish all equipment, materials and Contractor's equipment, labour and all other items that may be necessary for full completion of the work, and the testing of the same, unless otherwise provided wholly or in part by the Government, under the terms of the contract.

All materials and equipment supplied under the contract shall be free of liens.

All equipment and materials supplied under the contract shall be new, unless otherwise specified and of the best and most suitable quality.

The Contractor's equipment may, subject to the approval of the Government, be either new or fully reconditioned.

If any equipment or materials brought into the site by the Contractor is unsuitable or inefficient, the same shall be immediately removed from the site by the Contractor upon the Government's written instruction, and if not promptly so removed the Government may cause the same to be removed at the Contractor's risk and expense.

All equipment, materials, Contractor's equipment and tools brought onto the site or for which the Contractor has received any payment shall, from the time of their being so brought, or from the time of such payment vest in, be the property of the Government, but shall remain at the risk of the Contractor except as provided in Clause 2.28 "Liability for Special Risks" until the final and formally acknowledged completion and acceptance of the contract. Equipment, materials and Contractor's equipment and tools shall not be removed from the site except with the written permission of the Government.

The equipment, Contractor's equipment, tools and materials purchased by the Contractor inside Laos or imported into Laos for which duty and tax concessions were obtained under this contract shall be subject to the full amount of such duty and tax if offered for sale

to parties within Laos other than the Government of Laos, within a period of 12 months following the date of importation into Laos or purchase within Laos.

Should the Government be of the opinion and so state in writting to the Contractor that the force of men, or the quantity of Contractor's equipment or tools supplied for the performance of the work is insufficient, or that the character of the said equipment or tools is unsuitable, or that the maintenance of the Contractor's equipment or tools is inadequate, or that the methods employed are not such as to assure that the work will be completed within the time specified in the contract, the Contractor shall forthwith increase the number of men employed upon the work, make the required additions and improvements to his Contractor's equipment and tools, and conform to the methods of procedure, maintenance and use of such Contractor's equipment and tools as are directed by the Government.

Should the Government be of the opinion and so state in writing to the Contractor that materials proposed for the permanent work are not arriving at such a rate or within the time specified in the contract, the Contractor shall forthwith proceed to obtain such materials at the rate or within the time directed by the Government.

2.8 MANNER OF EXECUTION

The work shall be manufactured and executed in the manner set out in the specifications, or where not so set out, to the statisfaction of the Government, and all the work on site shall be carried out in accordance with such direction as the Government may give.

2.9 TARIFFS, DUTIES, TAXES

(a) Export Tariffs

All tariffs, duties, and other taxes or charges levied by the country of origin or country of purchase of the goods, on equipment or materials called for by this contract, shall be paid by the Contractor, and the Contractor shall not receive

any additional reimbursement from the Government in respect of any such tariffs, duties and other taxes or charges, paid by him for services, equipment or materials.

(b) Laotian Custom Duties, Sales and Excise Taxes

The equipment, Contractor's equipment, tools, goods and other property or services necessary or desirable for the purpose of carrying out the Project shall be exempt to the Contractor from Laotian custom duties and excise taxes, and all other taxes levied by the Government. No reimbursement shall be due to the Contractor in respect of any payment once made by him for Laotian customs, duties, sales and excise taxes.

2.10 INSURANCE

(a) Unless the Government shall have approved in writing other arrangements, the Contractor shall in the joint names of the Contractor and the Government insure the Equipment and keep each part thereof insured for its full value against loss, damage, or destruction by fire, lightning, earthquake, theft and perils of the sea from the date of shipment or the date on which it becomes the property of the Government whichever is the earlier, until it is taken over by the Government, and shall from time to time, when so required by the Government, produce the policy and receipts for the premiums. All moneys received under any such policy shall be applied in or towards the replacement and repair of the Equipment lost, damaged or destroyed but this provision shall not affect the Contractor's liabilities under the Contract. Any moneys payable in respect of any claim under the insurance policy or policies entered into in accordance with the provisions of this clause shall either be in the same currency as the original payment for the Equipment thereof or in United States dollars.

(b) The term "insured for its full value" shall be deemed to mean insurance cover to the aggregate value of the replacement cost of the Equipment as at the date of shipment or on the date at

which it becomes the property of the Government as the case may be, and, the cost of the freight together with a further amount of not less than 10 per cent of the aggregate of such costs.

(c) Before commencing the execution of the Works the Contractor shall insure against any damage, loss or injury which may occur to any property (including that of the Government) or to any person (including any employee of the Government) by or arising out of the execution of the Works or in the carrying out of the Contract. Such insurance shall be effected with an insurer and in terms approved by the Government for at least the Contract Price for any single incident, there being no limit to the number of incidents so covered, and the Contractor shall, whenever required, produce to the Government the policy or policies of insurance and the receipts for the payment of the current premiums any of which may be retained by the Government. The policy or policies of insurance shall be endorsed indemnifying the Government in the event of any claim being made upon the Government as a principal and arising out of the performance by the Contractor to the Contract. The policy of insurance shall be in the joint names of the Government and the Contractor.

(d) The Government shall not be liable for or in respect of any damages or compensation payable at law in respect or in consequence of any accident or injury to any workmen or other person in the employment of the Contractor and the Contractor shall indemnify and keep indemnified the Government against all such damages and compensation and against all claims, demands, proceedings, costs, charges and expenses whatsoever in respect thereof or in relation thereto. The Contractor shall insure against such liability with an insurer approved by the Government and shall continue such insurance during the whole of the time that any persons are employed by them on the Works and shall when required produce to the Government such policy of insurance and the receipt for payment of the current premium.

(e) If the Contractor shall fail to effect and keep in force the insurances referred to in this clause or any other insurance which he may be required to effect under the terms of the Contract then and in any case the Government may without prejudice to any other rights for remedies he may have effect and keep in force any such insurance and pay such premiums as may be necessary for that purpose and from time to time deduct the amount so paid from any moneys due or which may become due to the Contractor or recover the same as a debt due from the Contractor.

2.11 PERFORMANCE BOND

Within fifteen (15) days after the receipt of notification of acceptance of his tender, the successful Tenderer undertakes to enter into a bond for the due and proper performance of the Contract and observance of all provisions, covenants, conditions and stipulations therein contained with good and sufficient sureties for an amount equal to ( ) per cent of the total tender sum until twelve (12) months after the date of the Completion Certificated from the date of sigining of the Contract,

The bond shall be prepared in the form attached hereto and the terms of the bond shall be such as shall be approved by the Governmment and such that the bond will be enforceable in Laos. The sureties shall be subject to the approval of the Government (which approval shall not unreasonably be with held).

If the successful Tenderer offers as surety a Bank or Insurance Company so approved by the Government, the Government will accept such bank or insurance company.

2.12 ROYALTIES AND PATENTS

The Contractor shall pay all royalties and license fees for the use of any patented item, whether an invention, method, arrangement, article, process or appliance used in connection with the performance of this contract. The Contractor shall indemnify and save harmless

the Government from and against any and all costs, damages, and expenses of any nature or kind whatsoever which may arise out of or result from a claim by any person, firm or corporation that the manufacture, purchase, use or sale of any of the inventions, methods, arrangements, articles, processes or appliances used in connection with the performance of this contract.

2.13 CORRESPONDENCE

Unless otherwise required under the terms of the contract, all correspondence on matters arising out of the contract shall be addressed by the Contractor to the Government.

2.14 SITE REPRESENTATIVES

There shall be continuously on duty at the site during working hours, a duly appointed representative of the Contractor who shall be acceptable to the Government and in whom shall be vested the necessary authority to supervise the proper execution of the work under the contract. The Contractor's representative shall be affirmed by the Government prior to his being appointed. Once the Contractor's representative has been appointed, he shall not be removed from the project without the written consent of the Government.

At least one of the Contractor's senior competent representatives on the site shall be capable of speaking, reading, writing and understanding English.

2.15 METHODS OF PROCEDURE

As far as is consistent with the interest of the work and the results to be attained, the order and methods or prosecuting the said work will be left to the discretion of the Contractor, with whom ordinarily the responsibility of such order and methods shall rest; provided, however, that the Government shall at any time have the right to prescribe and control such order and methods with a view to the safety, rapidity and economy of construction of said work, and to

ensure harmony and cooperation with other contractors.

If required by the Government, before commencing the work or any portion thereof the Contractor shall furnish the Government with full information as to his plans and methods for carrying out the work or any portion of the work.

2.16 CO-OPERATION

During the progress of the work covered by the contract, it will be necessary for other contractors or persons to perform work on or about the site. The Contractor shall co-operate with and allow such other contractors or persons the use of such facilities as required and as the Government may specify. Any differences or conflicts which may arise between the Contractor and others in regard to their respective work will be arbitrated by the Government, whose decision will be final and binding on all parties concerned.

2.17 LANGUAGE

Tender schedules, specifications, notices, site instructions, correspondence, operating and maintenance instructions, drawings or any other writing must be written in the English Language. Operating and maintenance instructions shall also be prepared in the French language.

2.18 UNITS OF MEASUREMENT

The metric system of measurement shall be used exclusively on this contract.

2.19 INSPECTION OF SITE

The Contractor shall be deemed to have relied upon his own examination of the site and access thereto and to have informed himself fully and at his own expense as to all data, matters and things, local or otherwise, requisite to the fulfillment of the contract. Failure to acquaint himself fully with all available information concerning

conditions affecting the work will not relieve the Contractor of the responsibility for estimating the difficulties and costs of satisfactorily performing the work.

2.20 ASSIGNMENT

The contract or any part thereof shall not be assigned without the written consent of the Government, nor shall the Contractor assign any monies due or to become due to him thereunder, without the previous written consent of the Government.

2.21 CONTRACTOR'S LIABILITY

The Contractor shall be responsible for observance of all laws by his employees, as they may affect operations under the contract. The Contractor shall give all notices and comply with all applicable laws, ordinances, rules and regulations under which he is operating and bearing on the conduct of the work.

The Contractor shall conform with all applicable safety and sanitary laws, regulations and ordinances and with the regulations of all governmental bodies having jurisdiction over the work and the manner in which it is performed. The Contractor shall assume all responsibility for the work and take all reasonable precautions to prevent injuries to persons and property on or adjacent to the site of the work.

The Contractor shall be solely responsible for the safety of the work and of all equipment and materials to be used in connection therewith until final completion and acceptance thereof and shall promptly repair any damage thereto, however caused except as provided for under Clause 2.28 Liability for Special Risks.

2.22 DRAWINGS AND SPECIFICATIONS

The Contractor shall at all times keep a copy of the drawings and specifications of his work on the site. Such drawings and specifications must be the latest revised issue received and must bear the Government's stamp of approval.

In addition to the drawings and specifications attached hereto, the Government will during the progress of the work, furnish additional drawings, specifications, and instructions as may be necessary for the purpose of the proper and adequate execution and maintenance of the work, and the Contractor shall make his work conform to all such drawings, specifications, and instructions. Such drawings, specifications and instructions shall be deemed to be part of the contract documents.

2.23 DRAWINGS TO BE FURNISHED BY THE CONTRACTOR

When requested to do so by the Government, or stated in the contract documents, the Contractor shall submit drawings of temporary and permanent works to be constructed by or supplied and installed by the Contractor or his subcontractors.

The drawings shall be on uniform size as far as applicable, except for brochures and typical drawings which may be allowed.

The Contractor shall be expected to check thoroughly all shop drawings provided by his subcontractors including measurements, size of members, materials, and details to satisfy himself that they conform to the intent of the Government's specifications and drawings. Drawings found to be inaccurate or otherwise in error are to be returned to the subcontractors for correction before submitting them to the Government.

All drawings submitted to the Government for approval shall bear the Contractor's stamp and date of submission. The Government's approval of drawings, schedules and calculations submitted by the Contractor shall not relieve the Contractor from the responsibility for errors or omissions they may contain. The Contractor shall verify all dimensions at the site prior to commencing the work. Where errors or omissions are discovered later, they shall be made good the Contractor at his expense.

On completion of the work, the Contractor shall furnish the Government with drawings of the work as completed in sufficient detail to

enable the Government to maintain, dismantle, re-assemble and adjust all parts of the work.

2.24 TERMINATION OF CONTRACT BY GOVERNMENT

The Government shall have the right at his sole discretion to terminate the contract at any time prior to the completion of the work.

Upon receipt of written notice of the Government's intent to terminate the contract, the Contractor shall forwith cease all operations, other than those which are necessary to secure the safety of and to protect partially completed work, The Contractor shall, at the same time, take all reasonable stops to cancel commitments for the equipment and others. The Contractor shall undertake such work as the Government shall direct to protect and secure work already completed and underway, and shall protect, transport, store or dispose of materials provided and ordered and shall remove the Contractor's equipment and tools temporary buildings and other supplies and clean up the site to the satisfaction of the Government.

Upon completion of all operations, the Government will prepare a final progress estimate which will form the basis for payment for the work performed.

2.25 VESTING CONTRACT IN RECEIVER

If Contractor shall compound with his creditors, or shall become bankrupt or insolvent or carry on business under a receiver, or become incapable from any cause whatsoever of carrying out the work, any such receiver or any person in whom by law the contract shall become vested, shall forthwith give notice to the Government of the fact that the contract has become vested in it and shall take all reasonable steps to carry on the work at a rate fulfilling contract requirements. Thereupon, if the Government so desires, such receiver or other such person as aforesaid shall have the option during the period of one month from the date when the contract becomes so vested in it, of carrying out the contract. In the event of the work being stopped, this option

shall be open only for a period of 14 days from the stoppage date. In the event of the receiver, or such other person, not electing to carryout the contract, the Government shall be entitled to apply such monies as may be due to the Contractor at the time of his bankruptcy,, insolvency, or inability, or as may become due to him at any time thereafter, to the completion of the work.

Completion of the work may be performed by the Government himself or by any Contractor that may be selected by the Government for that purpose. Such application of monies due to the Contractor to the completion of the work including therein all additional costs incurred as a result of the failure of the Contractor to complete the contract, shall be without prejudice to any claim for damage the Government may have against the Contractor for the latter's failure to complete the contract.

2.26 FORFEITURE OF CONTRACT

If the work, or any part of it, be not completed at the expiry of the respective periods specified in the contract, or if the Contractor assigns or sublets his contract, or any part of it, without the written consent of the Government, or if he commits any act of insolvency whatsoever, or if he permits any execution to be levied on his property, or any portion of the work covered by the contract, then the Government may forthwith declare the contract forfeit. In which case, the Government shall enter into possession of all the equipment and materials pertaining to the contract and may complete the contract in the Contractor's place and stead.

The Contractor shall be liable for all loss or damage which the Government may suffer on account of the noncompletion of the work by the Contractor, and he shall have no claim for payment in respect of work thereafter performed. Any monies due or becoming due to the Contractor up to the date of forfeiture of the contract, shall be retained by the Government until the completion of the work and may be applied by the Government to satisfy the whole or any part of loss

or damage, suffered in completing the contract. In default of other satisfaction for loss or damage, the Contractor's equipment and materials remaining may be disposed of in any manner as may be most advantageous for the purpose of reimbursing the Government.

2.27 SUSPENSION AND EXPENSION OF TIME

If, by reason of any of the following:

(a) - negligence or default on the part of the Government or his agents,

(b) - failure on the part of other contractors,

(c) - extra work,

(d) - deviation from the specifications or suspension of the work at the written direction of the Government for reasons beyond the control of the Contractor,

(e) - any unpreventable accident,

(f) - war or delay caused by war,

(g) - riot or civil commotion,

(h) - lawful orders of civil or military authorities,

the Contractor claims that he has been unduly delayed in the progress of the work, he shall make written request to the Government for an extension of time for completion of the work or any portion of it. Should the Government consider such claims to be valid, he will grant such extension of time as may seem to him to be reasonable, without thereby prejudicing or in any manner affecting the validity of the contract. No extension of time will be granted unless the Contractor makes the written request within 14 calendar days of the happening of the event which it is claimed resulted in the delay.

Other than claiming an extension of time for completion of the work, the Contractor shall not have any further recourse or claim against the Government, nor shall be have any right of action against the Government for loss or damage suffered by reason of such delay,

except as provided for in Clause "Liability for Special Risks" or elsewhere in the contract.

2.28 LIABILITY FOR SPECIAL RISKS

The Government shall hold the Contractor harmless from all liability for damages or destruction of the work or property in Laos whether owned by the Government or third parties and for injury or loss of life, caused directly or indirectly by act of God, declared or undeclared war, invasion, insurrection, usurped power or riot, commotion or disorder in Laos, hereinafter referred to as special risks. The Government shall further compensate the Contractor for all reasonable claims in respect of costs and expenses and loss or damage to property of the Contractor at the work site and in transit in Laos, occasioned directly or indirectly by the said special risks.

2.29 LABOUR DISPUTES

The Contractor shall bear the risk and responsibility of any loss, damage or expense to the work or to himself of any nature and kind whatever arising from strikes or labour disputes.

2.30 GOVERNMENT'S RIGHT TO DO WORK

In the event of the Contractor failing to meet the requirement of the Government in the matter of labour, Contractor's equipment and materials, the Government is hereby empowered to employ such additional labour, obtain such materials and additional facilities as may be necessary for the successful prosecution of the work and the cost of so doing shall be paid to the Government by the Contractor or shall be deducted from payments due to the Contractor. In such cases, the Government shall pay wages or prices as he may think proper. In the execution of the work under this clause until its completion, the Government may use all the Contractor's equipment and materials provided by or on behalf of the Contractor. The Government shall not be liable to the Contractor for wear or tear thereto, nor for the loss, damage or destruction thereof, other than as may be provided for the contract.

2.31 GOVERNMENT'S RIGHT OF USE

Until all defective or faulty work has been made good or altered as provided elsewhere the Government shall have the right to use any such faulty or defective work at the Contractor's sole risk, and without thereby in any way affecting the Government rights requiring correction of faulty work by the Contractor unless the Contractor shall have notified the Government in writing that, in the opinion of the Contractor, the faulty or defective work cannot be so used without undue risk to the work or to persons in the vicinity of the work.

2.32 NOTICES

Notices to the Government shall be served in writing upon the Government or his authorized representative at the site. Notices to the Contractor shall be served in writing upon the Contractor or his authorized representative at the site. Any notice or other communication required under the terms of the contract shall be deemed to be well and sufficiently given on the part of the Government, if the same be left at the Contractor's site office, or is mailed in any post office or otherwise sent to the address given in his tender for the work.

2.33 CLAIMS

The Contractor shall give notice to the Government, in a form prescribed by the Government, of any claim to be made under the terms of the contract, within seven (7) days of the commencement of that specific portion of the work from which the claim arises and he shall submit his claim not later than thirty (30) days after the date of completion of the said portion of work. Where such notice of claim is not given or the claim is not submitted within the periods prescribed in this clause, the Government may disallow the claim.

The Government shall, within ninety (90) calendar days after the claim has been submitted in complete and detail form, render a decision on each claim made by the Contractor. The Government's decision shall be final subject only to the terms of clause 2.34 Settlement of Disputes.

2.34 SETTLEMENT OF DISPUTES

If, in the opinion of the Contractor, any decision of the Government pursuant to Clause 2.33 is improper or unreasonable or if any dispute or difference shall arise between the Government and the Contractor concerning the interpretation or application of the Contract, the matter shall be referred to arbitration upon written notice of either party and shall be settled in accordance with the Rules of Conciliation and Arbitration of the International Chamber of Commerce - 38 Cours Albert 1 er, Paris III, France - by three arbitrators appointed in accordance with such Rules.

The arbitrators shall decide ex aequo et bono in accordance with the provisions of the Contract and their award shall be final and binding on the parties.

Arbitration proceedings shall take place in Laos, unless the Court of Arbitration of the International Chamber of Commerce or the arbitrators decide otherwise.

Pending the final award of the arbitrators, the Contractor shall comply with the decision of the Government.

2.35 CONSTRUCTION PROGRAM

Within one month of the award of the contract, the Contractor shall submit to the Government a construction program in chart form or otherwise, as may be required by the Government, showing in detail his proposed program or operations and providing for the orderly completion of the work by the date specified in the contract. This detailed construction program shall contain similar items to those in the basic construction schedule prepared by the Government, included in the contract documents, shall show the anticipated starting and completion dates for each item and shall be in such form as to allow the progress of each item to be shown and shall be acceptable to the Government in every way.

Upon acceptance by the Government of the Contractor's construction program, it shall be referred to as the Approved Construction Program and shall become a part of the contract.

The work and each portion of the work shall be performed in accordance with the Approved Construction Program.

The Government shall have the right to review with the Contractor during the progress of the work, the manner in which the several parts of the work shall be performed and to require the Contractor to adopt such methods and time limits for the performance of the various parts of the work as in the opinion of the Government are necessary to ensure the safety, accuracy and satisfactory rate of progress of the work.

2.36 LINES AND LEVELS

The Contractor shall do all setting out of the work from bench marks and points of reference provided by the Government.

The Contractor shall be responsible for the true and proper setting out of the work and for the correctness of the position, dimensions and alignment of all parts of the work and for the provision of all necessary instruments and labour in connection therewith and for the preservation of his own setting out work as well as the bench marks and points of reference provided by the Government. If at any time during the progress of the work any error shall appear or arise in the position, dimensions or alignment of any part of the work, the Contractor shall rectify such error to the satisfaction of the Government.

The Government may, at any time, check the lines and levels set by the Contractor. The checking by the Government of any lines or levels shall not in any way relieve the Contractor of his responsibility for the correctness thereof.

2.37 INSPECTION AND TESTING

The Government shall at all reasonable times be permitted entry

and free access to all parts of Contractor's factory of elsewhere where any work is being done for the purpose of inspection and testing that may be required.

All equipment to be provided and work to be performed under the contract shall at all times be subject to inspection and testing by the Government who shall be allowed every facility for inspecting and testing same. On beginning or resuming operations, the Contractor shall notify the Government so as to enable him to arrange for proper inspection. Whether inspection and tests take place on the site, at the Contractor's factory or at the factory of a subcontractor, the Contractor shall supply all necessary labour, material, equipment, apparatus, instruments and competent test personnel who shall be able to take complete charge of the inspection and tests and shall be authorized to represent and make decisions for the Contractor for the proper carrying out of the inspection and test to the entire satisfaction of the Government.

When tests are made at the site, the Government will permit the Contractor to use such instruments and apparatus supplied under the contract free of charge, but the use of such instruments and apparatus by the Contractor shall be at Contractor's risk and the contractor shall be liable for any loss, injury or damage thereto, and to any person, and to property by whomsoever owned, caused by or resulting from such use.

Four copies of all test certificates, performance curves and data sheets shall be supplied by the Contractor to the Government. Sufficient information is to be given on all test certificates, performance curves and data sheets to enable the material or equipment to which the certificates refer to be identified.

All work condemned by the Government shall be removed and rebuilt or replaced in accordance with the contract at the Contractor's expense and in a manner satisfactory to the Government. All work or other property of the Government which is disturbed, injured, damaged or destroyed in the course of removal of the condemned work shall be

promptly repaired and made good at Contractor's own proper cost and expense.

If the Government shall waive the right of inspecting or testing as herein provided, it shall in no way relieve Contractor of full liability for the quality, proper operation and performance of the complete work, and every part of it, nor shall it prejudice or affect the rights of the Government set forth in the contract documents.

(a) Inspection and Tests at Factory

All work shall be subject to inspection and testing at the Contractor's factory and shall conform to the requirements of the contract.

Unless otherwise agreed, all equipment shall be given the usual factory commercial test.

At least 14 days' notice of the data, time and place of all tests shall be given to the Government so that arrangements can be made to have the tests witnessed.

(b) Inspection and Tests at Site

All work shall be subject to inspection and testing on the site and shall conform to the requirements of the contract.

After installation or erection of the work on the site, the Contractor shall carry out such designated tests as are required by the Government to prove compliance with the contract, notwithstanding any tests which may have been carried out earlier at the Contractor's factory.

The Contractor shall give the Government every facility in witnessing all tests of equipment at the site, but this testing will not relieve the Contractor from liability for defects.

2.38 FAULTY OR DEFECTIVE WORK

If, in the opinion of the Government, the work or any portion thereof, fails to comply with the requirements of the contract, or if the final tests prove or indicate the existance of any fault or defect in the work, or any part thereof, the Government shall give the Contractor notice herein provided, together with particulars of failure, fault,or defect and the Contractor shall, at Contractor's expense, forthwith re-execute or make good the defective or faulty work or alter the same to make it comply with the requirements of the contract. Thereafter, completely new tests shall, if required by the Government or requested by the Contractor, be carried out in the manner provided by Clause "2.37 Inspection and Testing hereof". If, after such notification, the Contractor shall make default or delay in diligently commencing, continuing and completing the making good of the defective or faulty work so as to make it comply with the requirements of the contract, then the Government may do so or cause the same to be done by any person, firm or corporation in any manner and by any means which the Government considers expedient or advisable. The Contractor shall be liable for all costs, charges and expenses incurred by the Government in connection therewith, and shall forthwith pay to the Government an amount equal to such costs, charges and expenses upon receipt of invoice therefor certified correct by the Government. The Government may, at the Government's option, apply any monies due or to become due from the Government to the Contractor in or towards payment of such costs, charges and expenses, in which event Contractor shall remain liable for any deficiency.

2.39 MAINTENANCE GUARANTEE

If, within twelve months from the date of the Government's Completion Certificate, any part of the work becomes broken or defective or fails due to faulty or improper design, material, workmanship, manufacture, fabrication, shipment, delivery, erection or installation, or fails to meet the requirements of the contract, then the Contractor, upon notification in writing from the Government shall, as soon as possible thereafter, make good every such breakage, defect or failure without cost.

If the Contractor, after such notification, shall make default or delay in diligently commencing, continuing and completing the making good of such breakage, defect or failure in a manner satisfactory to the Government, then the Government may cause the work to be placed in good operating condition in accordance with the contract, and Contractor shall be liable for all costs, charges and expense incurred by the Government in connection therewith and shall forthwith pay to the Government an amount equal to such costs, charges and expenses, upon receipt of invoices therefor certified correct by the Government.

Provided the Contractor is not otherwise in default under the terms of the contract and subject to all other provisions of the contract, the Contractor's liability in respect of the work, whether in contract, tort or otherwise, shall cease upon the fulfilment by the Contractor of the Contractor's obligations under the clause, provided further that any part of the work made good under this clause shall be subject to all the provisions of this clause for a further period of twelve months from the date when the same has been made good as aforesaid, and provided further that the Contractor shall have obtained a Completion Certificate in accordance with Clause 2.40.

2.40 COMPLETION CERTIFICATE

As soon as the performance tests required under the terms of the contract have been satisfactorily completed, the Government shall issue a certificate (herein called a "Completion Certificate") in which he shall certify the date on which the said performance tests have been completed, and the Maintenance Guarantee referred to in Clause 2.39 shall commence from the date thereof.

2.41 CLEANING UP

The Contractor shall at all times during the execution of the work, keep the site clean and free from all hazards, accumulations of waste material and rubbish and debris caused by his employees or the work. If the Contractor fails to maintain or leave the site in

a clean and tidy condition within a reasonable time after receiving written notice from the Government, the Government may remedy this default, or cause the same to be remedied, at the Contractor's expense. Before the completed work will be accepted and taken over by the Government and the Completion Certificate issued the Contractor shall remove from the site and dispose of all temporary buildings, surplus materials, Contractor's equipment, rubbish and debris in, upon and about the site and shall leave the site and the works clean, to the satisfaction of the Government.

2.42 SUBCONTRACTS

The Contractor shall not sublet any part of the work except with the prior written approval of the Government. The Contractor shall state, in writing to the Government, the name of the subcontractor to whom he proposes to sublet a portion of the work and shall give full details of the nature and extent of such work. Any and all subcontractors will be regarded as employees of the Contractor and shall be subject to all the applicable terms and conditions of this contract.

Nothing contained in this contract shall constitute any contractual relations or commitments between any subcontractor and the Government.

Should any subcontractor fail to carry out any portion of the work in a manner satisfactory to the Government such subcontract shall be cancelled by the Contractor upon written notice from the Government and the Contractor or another approved subcontractor shall proceed with and complete the work forthwith.

2.43 RIGHT OF WAY TO AND POSSESSION OF THE SITE

Right of way to and possession of the site shall be afforded to the Contractor by the Government subject to the provision that such Right of way and possession shall not be exclusive to the Contractor but only such as shall enable him to execute the work. The Contractor

shall afford to the Government and to other contractors whose names shall have been previously communicated in writing to the Contractor by the Government every reasonable facility for the execution of their work concurrently with his own.

In the execution of the work, no persons other than the Contractor, subcontractors and his and their employees shall be allowed on the site, except by the written permission of the Government but facilities to inspect the work at all times shall be afforded to the Government and his representatives and other authorized officials or representatives of the Government.

2.44 SAFETY

The Contractor shall take all necessary precautions against risks of loss of life or of injury to any person employed on the work to the satisfaction or the Government. The Contractor shall furthermore take all necessary precautions against damage to the property of the Government or of others located at or adjacent to the site.

The Contractor shall at all times comply with any accident prevention regulations and any safety regulations peculiar to the various trades employed on the work and any safety regulations published by the Government.

The Contractor shall report promptly to the Government all accidents involving the death of or serious injury to any person, on the site or resulting from the Contractor's operations.

2.45 FIRE

The Contractor shall take every precaution to prevent fire occurring on or about the site. He shall comply with the laws and regulations respecting fires and with the instructions of the Government with respect to the prevention of fires. No fire may be lit in the dry season without permission in writing obtained through the Government.

The Contractor shall fight diligently any fire which occurs on the site, however and whenever the fire may originate. He will employ all requisite equipment and manpower up to the limit of his equipment and manpower employed at the site, including the equipment and manpower of his subcontractors.

SECTION 3

FORM OF AGREEMENT

THIS AGREEMENT made this _____day of_____19

BETWEEN

THE ROYAL GOVERNMENT OF LAOS

(hereinafter referred to as the "Government")

OF THE FIRST PART

and

_____

a _____ with head office in the

_____of_____in_____

(hereinafter referred to as the "Contractor")

OF THE SECOND PART

WITNESSETH that the parties covenant, promise, and agree each with the other as follows:

(1) - The Contractor Agrees:

(a) - To do all the work and furnish all the labour, materials, tools, equipment and Contractor's equipment, appliances, and transportation and erection necessary or proper for performing and completing the work in accordance with the terms, conditions, and requirements of the documents and papers set forth below, which are included in, attached to, and form part of this Agreement, and which have been signed in duplicate for identification by both parties.

(i) - Contract Documents prepared by _____
entitled _____
dated _____19 _____which Documents shall be deemed to include:

Instructions to Tenderers

General Conditions

Form of Agreement

Form of Performance Bond

General Specifications

Detailed Specifications

Form of Tender

All drawings and documents referred to in the Specifications

All additional drawings, agreements, detail specifications and written instructions when issued or approved in writing by the Government, and which alter, modify, detail or explain the work.

(ii)- Tender of the Contractor dated _____19

(iii)- The letter of intent dated _____19__ from the Government.

It being agreed that the terms, conditions and requirements of the Contract Documents shall prevail except to the extent that they are expressly modified or altered by this Agreement.

The said Contract Documents are intended to cover and provide for first class completed work in all respects; and everything necessary to carry out this intent which may be reasonably implied from the Contract Documents shall be done by the Contractor, even if not particularly referred to in the Contract Documents.

(b) - To complete the work set forth, on the dates indicated in the Contract Documents.

(c) - That the Contractor has examined the site of the works and access thereto and has satisfied himself as to the working conditions, the nature and kind of work to be done, the special risks associated therewith, and to any and all matters which may be necessary in order to form a proper conception of the conditions under which the work will be performed.

(2) - The Government Agrees:

(a) - To provide the Contractor with access to, and use of, its lands and promises to whatever extent may be necessary for the continuous and unrestricted prosecution of the Contractor's operation.

(b) - To make to the Contractor, the payments as set forth in Clause 2.6 "Payments", of Section 2 "General Conditions", of the Contract Documents.

(3) - It is Mutually Agreed:

(a) - (Herein insert particulars of any modifications or alterations of the Contract Documents contained in the tender of otherwise).

(b) - (Herein insert any other matter of mutual agreement).

(c) - That the work as hereinbefore set forth shall be performed and completed to the approval of the Government.

(d) - That the date from which this Contract is to be in force is the _____ day of _____ 19__.

(e) - That this Agreement shall extend to, be binding upon, and insure to the benefits of the successors and assigns of the parties hereto.

IN WITNESS WHEREOF the Contractor and the Government have respectively affixed their seals and the hands of their proper offices on the day and year first above written.

SIGNED SEALED AND DELIVERED

THE LOYAL GOVERNMENT OF LAOS

BY _____

in the presence of _____

THE CONTRACTOR

BY _____

in the presence of _____

SECTION 4

FORM OF PERFORMANCE BOND

KNOW ALL MEN BY THESE PRESENTS, that we, _____

_____

(Name of Contractor)

(hereinafter called "Principal"), as Principal, and the _____

_____

(Name of Surety, Bank or Insurance Company)

(hereinafter called "Surety"), are jointly and severally held and firmly bound unto the Royal Government of Laos its successors and assigns, (hereinafter called the "Government") in the penal sum of $_____of lawful money of the United States of America for the payment whereof we the Principal and the Surety bind ourselves and our successors and assigns and each of us jointly and severally, firmly, by these presents.

SEALED with our seals and dated this _____day of_____ 19__.

WHEREAS the Principal has, by means of a written Agreement dated the _____ day of _____19___, entered into a Contract with the Government for the provision of equipment for the Tha Ngon Agricultural Development Project, including the maintenance thereof for a period of _____months after the issue of a Completion Certificate for the work shown and described in the said Contract, which Agreement is by reference made a part hereof and a copy is attached hereto.

AND WHEREAS, the Surety has agreed to execute these presents to secure the due performance on the part of the said Principal of the said Contract as in the said Agreement set forth or as the same may be changed, altered or varied as hereinafter provided.

NOW the condition of this bond is such that if the Principal, its successors or assign shall henceforth and at all times faithfully perform and observe the said Contract as in the said Agreement set forth or as the same be changed, altered or varied as hereinafter provided and shall fully indemnify and save harmless, the Government from all loss, damage and cost which they may suffer by reason of or incidental to the failure so to do and shall fully reimburse and repay Government for all outlay and expense which they may incur in making good any such default, then this obligation shall be null and void, otherwise it shall remain in full force and effect.

Provided further and it is hereby agreed and declared that the Principal and Surety, their successors and assigns, or any of them, shall not be discharged or released from any liability hereunder or such liability be in any way affected by any such changes, alternations, or variations, taking or receiving of security, or extension of time as aforesaid, or by any dealing or transaction or forbearance which may take place between the Principal and Government, and the Government shall not be required to give the Surety notice of any such or of any default of the Principal such notice being hereby waived but upon request from the Surety, the Government shall furnish any information which it may have at the time of such request.

SIGNED, SEALED AND DELIVERED
in the presence of:

(
(
(_____
((Principal)
(
(_____
(Surety)

SECTION 5

GENERAL SPECIFICATIONS

5.1 EXTENT OF CONTRACT

The contract shall include the design, manufacture, supply, testing painting, export packing, insurance, shipping, delivery to the site, erection and testing on site of the following:

(a) Two sets of pumping equipment consisting of water pump-motors, outlet valves, check valves and their accessories.

(b) One lot of discharge pipe.

(c) Two sets of trash racks.

(d) One set of roller gate.

(e) Many sets of slide gates.

(f) One lot of electrical equipment.

(g) One lot of distribution line.

5.2 GENERAL DESCRIPTION OF THE PROJECT

The purpose of the Tha Ngon agricultural development project is to develop 800 hectares of cultivable area to be reclaimed by supplying irrigation water, draining excess water and preventing inflow from the Nam Ngum into the project area, to make feasible two crop production a year.

The project area is located approximately 25 kilometers due north of Vientiane, Laos, near B. Tha Ngon, and some 530 kilometers northeast of Bangkok, Thailand which is the nearest available sea port. The location is shown on the drawing.

5.3 WORKS BY OTHER CONTRACTORS

The Government will make arrangements for the works necessary for the completion of the project other than that covered by this contract,

to be executed by other contractors. The Contractor shall cooperate with such other contractors to ensure the satisfactory completion of the project as a whole.

The following works connected with this Contract will be carried out by other contractor in this Project.

(i) Construction of pumping station building and foundation.
(ii) Construction of discharge pipe line foundation.
(iii) Construction of inlet canal and suction pit.

5.4 CLIMATE

The normal climatic cycle is composed of a dry season from November to April, the remaining months being the wet season. Air temperature in the open air will normally vary between 10 degrees C and 40 degrees C. The relative humidity is recorded as high as 80 to 100 per cent.

5.5 ACCESS AND TRANSPORTATION

5.5.1 Access

The contractor shall make all arrangements and pay all the necessary costs, duties and taxes required in respect of the transportation of the materials, equipment, contractor's equipment and personnel to the site.

Access from Bangkok to Vientiane is available by:-

a) air from Bangkok to Vientiane

b) combined route of railway and public road to Nongkhai, by Mekong ferry from Nongkai to Tha Deua or Tha Naleng, and by road from Tha Deua or Tha Naleng to Vientiane.

Loading clearance of the railway is shown on the attached drawing No.10004.

Access from Vientiane to the site is available over the Route National No.13 from Vientiane to B. Don Noun at a distance of 15

kilometers and then over a branch public road at a distance of 10 kilometers to the site. More detailed information on the access road from Vientiane to the site is given later in this Clause.

Transit goods through Thailand to Laos are required to be transported by road or railway from Bangkok to Nongkhai, then ferried to the Laotian Customs Station at Tha Naleng, all under the control of the Express Transportation Organization (ETO); an organization authorized by the Thai Government.

5.5.2 Mekong ferry

A ferry service is maintained throughout the year across the Mekong river between Nongkhai (Thai side) and Tha Naleng (Laos side).

The river at the ferry site is about 700 meter wide; the one-way trip by ferry boat takes 20 minutes. At present two ferry boats each having a capacity of 90 tons are operated during working hours 8:30 - 12:00 and 13:00 - 16:00.

The Laotian Government has agreed to the free use of the Mekong Ferry and to the unrestricted entry of Thai Vehicles into Laos for the purpose of this Contract.

5.5.3 Tha Naleng - Vientiane - Tha Ngon

The road from Tha Naleng to Vientiane and the Route National No.13 from Vientiane to B. Dong Noun at a distance of 15 kilometers, total distance of about 34 kilometers has an effective width of 8.0 meters or more and is asphalt paved. The public road to Tha Ngon branched off from the Route National No.13 at B. Don Noun, a distance of about 10 kilometers, is paved with laterite and has an effective width of 6.0 meters to 8.0 meters.

The existing bridges and culverts in these route have enough capacity to pass the heavy loads anticipated for this project.

5.5.4 Tha Ngon to and in the site

The section of access from Tha Ngon to the site, a distance of 2.0 kilometers, has an effective width of 2.0 meters to 5.0 meters, and is not paved. This road shall be enlarged and paved with laterite as a main farm road by other contractor of this Project.

In the Project Area, full or part of main and secondary farm roads to be constructed by other contractor of this Project will be useful for access and transportation to the site.

These roads including bridges and culverts shall be maintained by the Contractor at his own responsibility and expense.

Necessary access roads and culverts in addition to the above shall be constructed and maintained by the Contractor at his own expense. The Contractor shall submit the drawing of his proposed road plan for the approval of the Government before his execution.

The Contractor shall satisfy himself as to further detailed information on access to the site.

5.6 POWER SUPPLY DURING CONSTRUCTION PERIOD

A construction power supply will be provided by the Government. The electric power supply will be available at 380/220-volt, 3-phase, 4-wire, 50 HZ system, free of charge at low tension side terminal of step - down transformers or diesel engine generator. The approximate available load capacities are 100 kw - 150 kw.

The Contractor shall be fully responsible for all connections and wiring installation from the step - down transformers or diesel engine generator provided by the Government.

5.7 CONTRACTOR'S STAFF ACCOMMODATION

(a) General

The Contractor shall provide, maintain and operate under a competent manager, such camps and facilities convenient to the work

as are necessary for housing, feeding and accommodating his employees during site installation work at his expense. The location, construction and maintenance of the such camps and facilities shall be subject to the approval of the Government.

The Contractor will be permitted to use, for construction camp purpose, the land available in the vicinity of the work. Within 3 months of the award of the contract, the Contractor shall submit for the approval of the Government, drawings and specifications in sufficient details to permit determination of the suitability of the construction and its compliancy with the specifications; and no camp of any kind other than that of the most temporary nature shall be constructed until such drawings and specifications have been approved by the Government.

Regardless of the approval of the Government, the Contractor shall comply with all laws and regulations of Laos which are applicable to the building, maintenance, or operation of such camps, and shall be responsible for any and all damages or claims resulting from inadequate or improper camp facilities.

Upon completion of the work, all items of the contractor's camp and services shall be removed from the site and the site shall be left in a clean state.

(b) Water Supply System

Water supply system for every day living of the Contractor's employees as well as for kitchen, bathroom and others shall be provided by the Contractor. The Contractor shall be responsible for extending the system to his camp facilities and hygienic administration of the system.

(c) Sewerage and waste water systems

The Contractor shall provide sewerage and waste water systems for his own camp areas, offices and his work areas. The Contractor's sewerage and waste water systems, the design of which

shall be subject to the approval of the Government, shall include septic tanks of adequate design and soak areas to absorb effluent from the septic tanks. The sewerage and waste water systems including the tanks shall be hygienically administered to avoid the outbreak of epidemics,

(d) Electric power and lighting

The Government will provide electric power for camp purposes as specified in Clause 5.6. The Contractor shall provide and be responsible for all connectings and electrical wiring to his electrical equipment in the camp. The Contractor shall submit in advance the detailed lists specifying electrical capacity and quantity of each electrical equipment to be used in his camping area for the approval of the Government. All electrical installations shall be subject to the prior approval of the Government for the purpose of the control of electric power supply.

5.8 CONSTRUCTION EQUIPMENT AND TOOLS

The Government will prepare all power-operated lifting and handling equipment (including one set of movable type crane, hoisting capacity of 16 tons in maximum, when 3 m working radius) with an operator and with all necessary fuel and oils, and will also arrange for all necessary maintenance and repairs. Slings, chains, packing and the like required for use with lifting and handling equipment shall be supplied by the Contractor. The Contractor may use the above equipment for his site erection work at free of charge with operator.

Tenderers shall submit the detailed lists of the equipment to use for erection work when tendering.

The Contractor shall prepare all equipment, tools and expendable materials for the site erection at his exponse.

The Contractor shall supplied the tools for the equipment provided by him at his expense. The tools supplied shall be used for adjusting, assembling and dismantling of the equipment in case of maintenance and repairing, and selected and recommended by the Contractor.

The Contractor shall be responsible for the operation of the erection equipment provided by him and shall from time to time check the equipment to avoid accidents which may occur as the result of any damage or breakdown.

5.9 INSTRUCTION OF LOCAL STAFF

From the date of commencement of erection work until the date one month after the date of issue of the Completion Certificate, the Contractor shall give instructions to those employees designated by the Government who will subsequently assume responsibility for the operation and maintenance of the equipment. Instruction shall be given to the satisfaction of the Government. The cost of such instructions shall be deemed to be included in the contract price.

5.10 UNITS OF MEASUREMENT

In all correspondence, all technical schedules and or all drawings, metric units of measurement shall be employed. On drawings or printed pamphlets where other units have been used, the equivalent metric measurement shall be marked in addition.

5.11 WORKING STRESS AND DESIGN

The design, dimensions and materials of all parts shall be such that they will not be damaged under the most adverse conditions nor be affected by deflections and vibrations which might exercise adverse affects over the operation of the equipment. Mechanisms shall be such as will avoid sticking due to rust or corrosion.

The design shall be such that the installation, replacement and general maintenance may be undertaken with the minimum of the fee and

expense. The tolerance used for dimensions and finishes shall be selected with due consideration of the particular properties and the function of the parts and the corresponding accuracy required to obtain proper operation.

Wherever possible, all similar parts, including spare parts, shall be made to gauge and interchangeable. Such parts shall be of the same materials and workmanship and shall be constructed to such tolerance as to enable substitution or replacement of spare parts to be made easily and quickly. The equipment shall be designed to minimize the risk of consequential damage, to prevent ingress of dust and dirt, and accidental contact with electrically energized or moving parts. The equipment shall be capable of continuous operation with minimum attention and maintenance in the exceptionally severe conditions likely to occur in a tropical country. The Contractor shall be deemed to have examined the specifications and drawings herewith and unless stated specifically, to the contrary in the schedule of departure from the specification to have concurred with the design and layout of the works as being sufficient to ensure reliability and safety in operation, freedom from undue stresses and other essential for a satisfactory working equipment.

5.12 TROPICALIZATION

As regards the choice of the material and the design of the equipment and the accessaries supplied by the Contractor under this contract, special consideration shall be given to the fact that the equipment will be used under high temperatures and humidity.

5.13 DOCUMENTS TO BE SUBMITTED BY CONTRACTOR

The Contractor shall submit to the Government five copies of the following drawings and documents for approval within two months from the date of verification of the contract.

(a) Detailed drawings of the equipment
(b) Calculating sheets for design of the equipment

(c) Detailed lists of weight of the equipment

(d) Layout and connection diagram of the pumping station and distribution transformer circuit.

(e) Profile drawings, route of line and type of supports to be used.

(f) Foundation of the equipment.

(g) Work Schedule

(h) Specifications of the work by the Contractor

Operating and maintenance instructions shall be submitted to the Government, as early as possible, before dispatch of the equipment.

The Contractor shall submit to the Government revised documents within one month after receiving the Government's instructions requiring the revision of the above drawings and documents.

The Contractor shall not commence the manufacturing of the equipment before the approval has been obtained for the above drawings and documents. Operating and maintenance manuals shall describe and illustrate in detail the operating method and the system of the equipment, the use of all erection equipment and measuring devices, procedure for assembling, adjusting, operating and dismantling of each component, the maintenance of each component including the recommended frequency of inspection and lubrication.

It is to be understood, however, that approval of the drawings and calculating sheets will not exonerate the Contractor from any responsibility in connection with the work. Claims or extensions of time will not be permitted on account of delayed submission of the drawings and other documents to the Government.

5.14 STANDARDS

Latest American standards as issued by the United States of America standards Institute have been used throughout these specifications. Other national or international standards equivalent to the U.S. Standards may be accepted provided the requirements

therein are approved by the Government.

5.15 WORKMANSHIP

(a) General

All materials shall be new, the best of their respective kinds and of such as are usual and suitable for work of like character.

All workmanship shall be of the highest class throughout to ensure smooth operation under all possible operating conditions.

All parts shall conform to the dimensions shown on and shall be manufactured in accordance with the approved drawings.

(b) Shop Assembly

All items of the equipment shall be assembled in the shop prior to shipment and tests shall be performed by the Contractor as may be required to demonstrate to the satisfaction of the Government the adequacy of the equipment and its component parts. All tests should simulate normal operating conditions as closely as possible. All dismantled parts shall be properly matchmarked to ensure correct assembly in the field.

(c) Casting

All castings shall be dense, sound and true to pattern, of workmanlike finish and of uniform quality and conditions, free from blowholes, porosity, hard spots, shrinkage defects, cracks or other injurious defects, and shall be satisfactorily cleaned for their intended purposes.

All castings shall be checked for defects before final machining. Castings shall not be plugged or welded to repair the cracks, blowholes and other defects yielded on the castings. Excessive segregation of impurities or alloys at critical points of a casting will become the cause of its rejections.

Surfaces which do not undergo machining and are exposed in the

final installation shall be dressed to provide a satisfactory appearance so that they will not require surface smoothing at site prior to painting.

(d) Forgings

The ingots from which the forgings are made shall be cast in metal molds, the workmanship shall be first-class in every respect and the forgings shall be free from all defects affecting their strength and durability, including flaws, cracks, scales, porosity, hard spots, segregations and others defects. All finished surfaces of forgings shall be smooth and free from tool marks.

(e) Machine Work

(i) General

All tolerances for machined parts shall be within the tolerances stated in relative provision of the U.S.A. standards or other standards approved. Bearing surfaces shall be true and exact to secure full contact. Journal and sliding surfaces shall be polished and all surfaces shall be finished with sufficient smoothness and accuracy to ensure proper operation when assembled. Parts entering any machine shall be carefully and accurately machines. All drilled holes for bolts shall be accurately located.

(ii) Finished Surfaces

Surface finish shall be indicated on the Contractor's drawings submitted. Compliancy with specified surface will be determined by sense or feel and by visual inspection of the work compared to standard roughness specimens.

(iii) Unfinished Surfaces

So far as in practicable, all work shall be arranged to obtain proper matching of adjoining unfinished surfaces. When there is a large discrepancy between adjoining un-

finished surfaces, they shall be chipped and ground smooth, or machined, to secure proper alignment. Unfinished surfaces shall be true to the lines and dimensions shown on the drawings and shall be chipped or ground free of all projections and rough spots. Depressions or holes not affecting the strength or usefulness of the parts may be filled in an approved manner.

(iv) Keys and Keyways

Keyways shall be machined to minimize the affection on the strength of the parts. Keys applied shall be matched to the keyways accurately and shall not slip out of the position.

(v) Pins and Pinholes

Pinholes shall be bored to gauge, smooth and straight, and at right angle to the axis of the member. The boring shall be done after the member is securely fastened to its position. Pins shall be of hardened and ground steel and positively held in position.

(vi) Lubircant

Before assembly, all bearing surfaces, journals, and grease and oil grooves shall be carefully cleaned and lubricated with suitable oil or grease. After assembly, each lubricating system shall be filled with the lubricant.

(vii) Balancing

All revolving parts shall be truly balanced both statically and dynamically so that when running at normal speeds and at any load up to the maximum, there shall be no vibration due to lack of such balance and the equipment shall operate with the least possible amount of noise.

(f) All welding shall be done either manually by the shielded metallic

arc process or automatically by the submerged arc method. After welding, excessive projections in welds shall be chipped by grinding or other method not affecting the strength of welds, if needed.

All welds shall be made continuous and water tight. The surfaces of the parts or plates to be welded shall be cleaned of all rust, scale and other materials for a width of 30 m/m along the welding line. The dimensions and shape of the edges to be jointed shall be such as to allow through fusion and complete penetration and the edges of plates shall be properly formed to accommodate the various welding conditions.

The technique of welding employed, the appearance and quality of the welds made and methods used in correcting defective work, shall conform to the American welding standards or other approved equivalent standards.

All welding operators assigned to the work shall have passed a qualification test. The Contractor shall submit the operators' list which gives the name, year of birth, kind of qualification test and class, year in which operators passed the test, and other necessary information on the operators for the approval of the Government. The Government reserves the right to conduct necessary tests on the operators mentioned in the list submitted by the Contractor at the Contractor at the Contractor's expense, if needed.

The welding electrodes used shall conform to the American Standards or other approved standards.

5.16 PROTECTION, CLEANING AND PAINTING

(a) General

Before painting, the surface of all parts shall be descaled and cleaned of all rust and adherent matter. Such cleaning shall not detrimentally affect the strength of final operation and function of the equipment.

All machined parts or bearing surfaces shall be cleaned and protected from corrosion, before leaving the manufacturer's shop, by the application of rust preventive lacquer or peelable plastic film. After erection such parts shall be cleaned with solvent and lapped or polished bright. All parts which will be exposed after erection shall be thoroughly cleaned and given one coat of best quality approved primer at manufacturer's shop, and after erection at the site the parts shall be given two coats of best quality paints.

All parts which will be ultimately buried in concrete shall be cleaned and protected, before leaving the manufacturer's shop, by effective method.

Primer and finish coats of paints shall be applied to surfaces prepared in accordance with the paint manufacturer's instructions. The paint and colour samples for all equipment shall be submitted by the Contractor for the approval of the Government and paints shall be the products of reputable manufacturers.

Commercial equipment shall be painted in accordance with the manufacturer's standard practice.

(b) Surface preparation

All oil, grease and dirt shall be removed from the surfaces to be painted, using solvents. Following solvent cleaning, all weld spatters, slug, loose rust and mill scale and other foreign substances shall be removed to satisfactory condition. The interior surface of the discharge pipe shall be mechanically cleaned or sandblasted to the commercial standards. Special attention shall be given to cleaning of corner and converging angles.

If rust forms or the surfaces become contaminated in the interval between cleaning and painting, recleaning to the same degree shall be required.

Surfaces not to be painted shall be protected by appropriate and adequate masking during cleaning and painting.

(c) Application procedure

All paints when applied, shall provide a satisfactory film and a smooth, even surface. Paints shall be thoroughly stirred, strained and kept at the uniform consistency during application. Paint shall not be applied when the temperature of the metal or of the surrounding air is below 10 degrees C. Surfaces shall be free from moisture at the time of painting. Painting shall be performed by brushing. The first coat shall be applied immediately after surface preparation. Each coat shall be allowed to drug or harden thoroughly before the succeeding coat is applied.

(d) Surface not to be painted

Bronze, brass, surface of gear teeth, surfaces in rolling or sliding contact after field assembly shall not be painted. All corrosion resisting steel surfaces for bearings and machinery parts, except the sealing and roller pass surface or guide frames, shall not be painted.

On completion of cleaning, the surfaces shall be coated with an adhesive plastic film to protect during shipment and storage at the site. The film shall be stripped off immediately prior to field erection of the equipment.

5.17 PACKING

Each item shall be packed properly or protected for shipment from the place of manufacture to the site. Each crate or package shall contain a packing list in a waterproof envelope and copies in triplicate shall be forwarded to the Government prior to dispatch.

All cases, package etc., shall be clearly marked on the outside to indicate the total weight, to show where the weight is bearing and the correct position of the slings and shall bear identification marks

relating them to the appropriate shipping documents.

The Government shall reserve the right to inspect and approve the equipment and the packing before the items are dispatched. The Contractor shall be entirely responsible for ensuring that the packing is suitable for transit and such inspection will not relieve the Contractor from responsibility for any loss or damage due to faulty packing. All packing materials shall remain the property of the Contractor and shall be removed from the site at the earliest opportunity and disposed of to the satisfaction of the Government.

5.18 DELIVERY

No part of the work or Contractor's equipment shall be delivered to the site until approval in writing has been obtained from the Government for such delivery. Each application shall include a complete shipping list of the contents of each package to be delivered and shall indicate the anticipated date of delivery and the serial number for each component to be used for indentification and evidence of the insurance cost arranged for it.

Upon shipment of each package or item, a copy of the shipping list shall be attached to the Bill of Lading and an additional copy shall be attached to the package or item shipped. The Contractor shall be responsible for the reception at site of all deliveries made for the purpose of the contract.

5.19 EMBEDDED METAL WORK AND BLOCKOUT

The Contractor shall supply all anchor metals, pipings and other necessary materials required for the equipment being provided and for the installation work, to be installed in primary concrete, and installation of these embedded metal work will be performed by other contractor during foundation and primary concreting.

The embedded metal work to be supplied by the Contractor shall be as follows:

(i) Drain pipe of discharge pipe.

(ii) Anchor bolts buried in primary concrete of discharge pipe line.

(iii) Anchor metals in blockouts for embedded members of fixed trash racks.

(iv) Anchor metals of the main pumps.

(v) Anchor metals in blockouts for guide frames of the slide gates and rollergate.

(vi) Temporary anchorages to be buried in primary concrete required for installation work by the Contractor.

Above pipes to be buried in foundation concrete shall be covered with temporary covers on both sides to prevent the entering of concrete or cement milk into the pipe placed during the concreting. The Contractor shall show the location full details of all embedded components and blockouts on his drawings and shall be responsible for the completeness and accuracy of his drawings and the information supplied to others.

All components to be embedded in primary concrete and foundation will be installed in accordance with the Contractor's drawings.

The Contractor shall be responsible for the adequacy and accuracy of location of embedded components supplied by him, whether installed by himself or by others. The Contractor shall clearly indicate on his construction schedule when embedded components are to be installed, and identify and indicate the date of delivery of all embedded components to be installed in primary concrete.

5.20 TEST PROCEDURE INSTRUCTIONS

The Contractor shall submit to the Government for approval, during or immediately following the submission of drawings, an instruction procedure describing each test to be performed for commission and performance testing.

The procedure shall define the sequence of the tests, the equipment preparation and operation procedures to be followed and the detailed procedure for conducting the tests.

5.21 PHOTOGRAPH

The Government will keep photographic records of the progress of the work. The Contractor shall cooperate with the Government and provide such assistance, access to the work and temporary facilities as the Government may require to enable him to photograph any part of the work at any stage of construction or manufacture.

5.22 SPARE PARTS

The Contractor shall furnish the spare parts as listed in the tender.

Any spare parts supplied shall be packed or treated in such a manner as to be suitably stored in the climate at the site for a period of not less than two years, and each part shall be clearly marked with its description and purpose on the outside of the packing.

Spare parts so provided must be delivered into such stores as may be nominated by the Government and delivery will not be deemed to be complete until the packages have been opened by the Contractor, their contents checked by a representative of the Government and the articles reprotected and repacked by the Contractor to the satisfaction of the Government.

The spare parts to be supplied in this contract shall be listed up for one year normal operation of all equipment supplied by the Contractor and shall be recommended by the Contractor.

SECTION 6

DETAILED SPECIFICATIONS

SUBSECTION 6A PUMPING EQUIPMENT

A.1. DESCRIPTION

Two sets of pumping equipment shall be designed, supplied and installed in the pumping station by the Contractor.

These pumping equipment shall be used for supply of irrigation water. The pumps shall be operated in single or in parallel according to the necessary quantity of water for irrigation.

The pumping equipment shall consist of water pumps, driving motors, outlet valves, check valves, discharge pipe to outlet valve, control system and their accessories, and shall be manually controlled from the pump-motor cubicle specified in Clause F.2.3.

A.2. DESIGN CONDITIONS

A.2.1. WATER PUMPS

Water pump shall be designed in accordance with the following specifications:-

(a)	Displacement	28.5 m^3/min.
(b)	Type of pump	Submerged tubular, vertical type
(c)	Total head	21 m.
(d)	Driven method	Directly coupled with electric motor
(e)	Low water level in suction pondage	EL. 152.000 m
(f)	Speed	Recommended by the Tenderer
(g)	Water level in delivery pondage	EL. 168.300 m
(h)	Flood water level in inlet channel	EL. 166.500 m

A.2.2. OUTLET VALVES

Outlet valve shall be designed in accordance with the following items:-

(a)	Type of valve	Sluice valve
(b)	Interior diameter	450 mm
(c)	Maximum internal water pressure	1.0 kg/cm^2
(d)	Operation	Manual operation

A.2.3. CHECK VALVES

Check valve shall be designed in accordance with the following items:-

(a)	Interior diameter	450 mm
(b)	Closing time	5 seconds
(c)	Maximum internal water pressure	1.0 kg/cm^2

A.2.4. ELECTRIC MOTORS

Electric motor shall be designed in accordance with the following items:-

(a)	Type	Three-phase, vertical shaft, totally enclosed, oil-filled, submersible type, special squirrel cage induction motor.
(b)	Rating and voltage	
	Output	Continuous output of the motor shall be ample to drive a corresponding pump at $\pm$10% of the rated voltage.
	Torque	Starting torque of the motor with starting reactor shall be sufficient to drive the pump under the conditions that the outlet valve is fully closed and the casing is fully filled with water.

	Frequency	50 Hz
	Speed	Speed shall be recommended by the Tenderer.
	Voltage	Rated voltage shall be 380 V.
(c)	Direction of rotation	The direction of motor rotation shall be anti-clockwise viewed from the pump side.
(d)	Maximum allowable temperature	Maximum water temperature around the pump-motor may be assumed 30°C. Under this condition, the maximum allowable temperature of stator winding and insulating oil in the motor shall be as follows:-
		Stator winding measured by resistance method: 100°C
		Insulating oil measured by thermometer: 90°C
(e)	Insulation of winding	The stator winding shall be insulated with class E materials.

A.2.5. DISCHARGE PIPE TO OUTLET VALVE

Steel discharge pipe shall extend from water pumps installed in the suction pit to outlet valve. The discharge pipe shall be designed in accordance with the following items:-

(a)	Kind of pipe	Welded steel pipes
(b)	Steel material to be used	Mild steel
(c)	Interior diameter of pipe	450 mm.
(d)	Maximum discharge	28.5 m^3/sec.
(e)	Maximum design head	19.410 m
(f)	Minimum thickness of steel plate to be used for pipe shell	4 mm.

(g) Corrosion allowance — 2 mm.

(h) Factor of safety against buckling — Factor of safety against buckling due to external pressure by earth fill shall be more than 2.

A.2.6. CONTROL SYSTEM

The schematic connection diagram of the pumping station is shown on the attached drawing No.10001.

All control, indication and protective circuits shall be operated by A.C. 110 V source from 380/110 V control source transformer specified in Clause F.2.3.

Starting and normal stopping of the motor shall be made by control handle on the pump-motor cubicle. Requirements for the motor starting are as follows:

(a) Outlet valve (sluice valve) in fully close.

(b) All protective relays in reset.

(c) Magnetic contactor (MC-2) in open.

By turning the control handle to "START" side with the conditions stated above, the motor shall be supplied power through starting reactor specified in Clause F.2.3 and shall start under reduced - voltage condition.

At a present time after motor start, the reactor shall be short-circuited by magnetic contractor (MC-2) automatically and the motor shall become in running condition.

When outlet pressure reaches predetermined value, the outlet valve shall be opened by manual operation.

At normal stopping, the control handle shall be turned by manual operation to "STOP" side.

In case of the following conditions, the magnetic contactor (MC-1) shall be opened automatically. The conditions shall be indicated on the group fault annunciator, giving sound of the bell alarm.

(a) Operation of under voltage relay for 380-220 V bus

(b) Operation of open phase relay for motor

(c) Operation of over load relay for motor

(d) Operation of over current ground relay for motor

(e) No-fuse breaker trip of motor circuit

(f) Additional conditions recommended by the tenderer

When the following conditions occurred, buzzer alarm and fault indication shall be made on the cubicle.

(a) Insulating oil level down in the oil tank

(b) Other alarms deemed necessary by the tenderer

A.3. DETAILED REQUIREMENTS

A.3.1. WATER PUMPS

(a) Water pumps shall be so designed and manufactured that the pump is rigidly fixed by bolting pump body under the delivery pipe which shall be hung from the ground line.

(b) Pumps shall operate without undue vibration under any water level stipulated in Clause A.2.1.

(c) Characteristics of pumps such as pressure-displacement and efficiency curves shall be stated and guaranteed in the tender.

(d) Pump casing shall be made of anticorrosion materials by casting. Pump Casing shall be of removable structure with bolt fitting and contact surface of each part shall be accurately machine-finished for smooth erection.

(e) Impeller shall be so designed and manufactured that pumping efficiency be maximum under the full load. The impeller shall be made of cast steel.

(f) The drive shafts for impeller shall be made of forged steel or equivalent material to have sufficient strength and shall be of removable structure by cotter pin or other approved means. The shafts shall be attached with protection covers to protect them from water flow in casings.

(g) Water pressure gauge in meter scale shall be provided for each pumps and mounted on the station service cubicles stated in Clause F.2.3.

A.3.2. OUTLET VALVES

(a) The outlet valves shall be installed at the delivery side of the check valve to stop water during repair, maintenance and inspection of the water pump and check valve.

(b) The valves shall be designed and manufactured to have sufficient strength against internal water pressure including pressure rise by water hammer which may be caused by closing of check valves and other forces encounted under operation of the pumps.

(c) Valve casings and valve leaves shall be made of cast iron by casting or steel plate by building up.

The valve casings shall be of removable structure with bolt fitting for the convenient positioning of the valve leaves and the easy repairing of the seal part.

Contact surfaces of the valve casing blocks and seal parts between the casing and leaves shall be accurately machine-finished so as to ensure sufficient water tightness when the valve closed.

(d) The valve shall be operated by man power and equipped with position indicator of the valve leaf to avoid over-opening or over-closing. The man power required for operation shall be less than 10 kilograms.

Spindle shaft for valve leaf movement and other mechanical part shall be so machine-finished that operation of the valve be smooth.

A.3.3. CHECK VALVES

Check valves shall be installed between the water pumps and outlet valves to stop the adverse stream of water from the delivery side when the water pump stops suddenly.

The valves shall be designed and manufactured to have sufficient strength against internal water pressure. The valve body shall be made of cast iron.

The check valves shall be equipped with the adjustable mechanism of closing time of the valve.

The check valves shall be equipped with a time adjustable valve on the by-pass to minimize the pressure rise which may be caused by closing of the check valves.

The closing time of the by-pass valve shall be adjustable upto 5 seconds after the flap leaf has been completely closed.

A.3.4. LOOSE TYPE CONNECTING JOINT

Coupling of the outlet valves and the discharge pipes shall be made by loose type connection for easy removing of the pumping set in case of repairing and for avoiding the over stress to the set due to dimensional change of the discharge pipe by the thermal effect. The joint shall be provided with seal rubber or other approved means. Sealing surface of the joint, which are contact with seal rubber, shall be formed by fine machine-cutting.

A.3.5. ELECTRIC MOTORS FOR WATER PUMPS

Coupling of the motor and pump casing shall be made by bolt fitting.

The inside of the motor shall always be filled with insulating oil kept a certain pressure to prevent water permeation from the outside. The insulating oil shall be circulated by small oil pump mounted on the motor shaft or by oil pump installed in the control house between the motor and oil tank with oil filter, which shall be supplied and installed in the control house. Pipe for insulating oil and power cable to the motor shall be protected by means of suitable manner to avoid damage.

Thrust bearing shall be of oil-lubricated ball-and-roller type to be bearable water thrust, weight of impeller and rotor. The insulating oil shall also be available for bearing lubrication.

Anti-corrosive and/or oil-proof materials shall be used for motor parts exposed in the water and oil.

The efficiency shall be stated and guaranteed in the tender at 40%, 60%, 80% and 100% of the rated output.

The Contractor shall supply the following accessories and materials:-

(a) Submersible type terminal box with interior cabling to the stator winding terminals.

The box shall be of convenient construction for cable connection.

(b) Power cable between pump-motor cubicle specified in Clause F.2.3. and the motor terminal box. The power cable shall be of 600 V, three core, submersible type and shall have a sufficient sectional area to supply power to the motor.

(c) Sufficient insulating oil for initial filling and oil of 200 liter for spare with sealed non-returnable drums.

(d) Other necessary accessories recommended by the tenderer.

A.3.6. DISCHARGE PIPE TO OUTLET VALVE

Steel discharge pipe lines to the outlet valve shall be designed in accordance with Subsection 6B where applicable and manufactured, supplied and installed by the Contractor.

Air pipe shall be mounted on each discharge pipe as shown on the attached drawing No. 9004. The air pipe shall have an ample interior diameter to avoid excessive negative pressure in the discharge pipe at the time of motor stop and to exhaust the air in the pipe at motor start.

A.4. SHOP ASSEMBLY AND TESTS

The pumping equipment shall be completely assembled in the shop and tested to prove the proper function in the presence of inspector.

The test for the pump shall be as follows and shall be carried out in combination with the motor specified in Clause A.3.5.

(a) General inspection and measurement of important dimension.

(b) Measurement of displacement, total head and motor input power.

(c) Calculation of efficiency and shaft power.

The test for electric motor shall be as follows:

(a) General inspection and measurement of important dimension.

(b) Measurement of resistance of stator winding.

(c) No-load test.

(d) Locked-rotor test (including low frequency locked-rotor test).

(e) Temperature rise test.

(f) High voltage test (stator winding only).

(g) Calculation of efficiency and characteristics.

The shop assembly inspection and test shall be subjected to the Government's approval.

The following tests at site shall be carried out by the Contractor before commissioning. The Contractor shall prepare necessary testing apparatus and materials.

(a) Measurement of insulation resistance including power cable to the motor.

(b) Running test.

(c) Power failure test.

A.5. PAINTING

Painting for the pumping equipment shall be performed in accordance with the followings:-

Kind of paints:

Interior surfaces	Three coats of red lead oil paint
Outside surfaces	
Primer coat	Red lead oil paint
Middle coat	Red lead oil paint
Finishing coat	Oil paint

A.6. INSTALLATION

The pumping equipment completed with all accessories shall be assembled and installed in accordance with the approved drawings.

SUBSECTION 6B DISCHARGE PIPE

B.1. DESCRIPTION

Steel discharge pipe line shall be designed manufactured, supplied and installed by the Contractor. The discharge pipe line shall extend from delivery side of the outlet valves installed in the valve house to the delivery pondage, and shall consist of branch pipes connecting the outlet valves and confluent pipe, embedded pipe in concrete or earth, exposed pipe in the valve house, bend pipes and their accessories.

The layout and arrangement of the pipe line shall be referred to the attached drawing.

B.2. DESIGN CONDITION AND DESIGN STRESS

B.2.1. DESIGN CONDITION

The discharge pipe line shall be designed in accordance with the following specifications:-

(a)	Kind of pipe	Welded steel pipe
(b)	Steel material to be used	Mild steel
(c)	Interior diameter of pipe	
	Main pipe	700 mm
	Branch pipes	450 mm
(d)	Maximum discharge	57 m^3/min. for main pipe
(e)	Support of embedded pipe by earth	120^o concrete saddle
(f)	Water level in delivery Pondage	EL. 168.300 m
(g)	Center level of outlet valves	EL. 166.500 m
(h)	Maximum static water head	1.800 m
(i)	Maximum pressure rise by water hammer	3.160 m (at center of check valves)

(j) Maximum design water head 4.960 m

(k) Minimum thickness of steel plate to be used for pipe shell 6 mm

(l) Corrosion allowance 2 mm

B.2.2. DESIGN STRESS

The discharge pipe shall be designed based on the following.

(a) Tensile Stress and Compressive Stress

The following safety factors shall be applied to the yield strength of the materials used.

Material	Factor of safety based on the yield strength
Rolled steel	2
Rolled or forged steel bolt	4

(b) Shear Stress

The allowable shear stress shall be three - fourths (3/4) times of the allowable tensile stress of the material used.

(c) Combined Stress

Combined stress in pipe shell shall be computed from the following formula:

$$\sigma g = \sqrt{\sigma_1^2 + \sigma_2^2 - \sigma_1 \sigma_2 + 3\tau^2}$$

where σg : Combined stress
$\sigma 1$: Circumferencial tensile stress
$\sigma 2$: Longitudinal stress
τ : Shearing stress

The value of combined stress shall not exceed 1.5 times of ordinary allowable stress.

(d) Factor of Safety against Buckling

Factor of safety against buckling due to external pressure by earth fill shall be more than 2.

B.2.3. WELDING EFFICIENCY

The strength of welds on the discharge pipe shall be rated at 95 per cent for automatic welding and 90 per cent for manual welding of the plate strength.

B.2.4. DETAILED REQUIREMENT FOR DESIGN

(a) Stress Analysis

Stress analysis of the discharge pipe in design shall be done on longitudinal stress consisting of bending stress and axial stress, circumferential stress due to internal water pressure and circumferential bending stress occurred in the shell plate of the pipe at the supported points on the concrete saddles.

(b) Bending Pipes

Bending pipes shall be designed and manufactured to have exact bending angle and the maximum deflection angle between segments of a bend in bending pipe shall not exceed 7 degrees.

(c) Confluent Pipe

Confluent pipe, which is positioned at the intersection point of the branch pipes and the main pipe, shall be designed to have sufficient strength against maximum internal water pressure to which it is subjected. Suitable tapered pipes shall be used as joint pipes to reduce the confluent loss in the confluent pipe.

(d) Drain Pipe and Valve

One set of drain pipe with stop valve, interior diameter 150 milimeters, shall be supplied and installed from the bottom of the confluent pipe to the suction pondage of the water pump to dewater the

discharge pipe line for its maintenance and repainting. Drain pipe and valve shall be designed, manufactured and installed in accordance with the attached drawing No. 9004.

(e) Thrust Collars

Thrust collar made of steel plate shall be provided on pipe buried in concrete to anchor the pipe line against thrust of pipe line.

(f) Anchor Bands and Bolts

Anchor bands made of steel plate and bolts made of round bar shall be attached to the pipe buried in concrete against uplift yielded when concreting. The bands and bolts shall not be welded on the pipe shell.

B.3. FABRICATION

B.3.1. STEEL MATERIAL

The Contractor shall submit three copies of mill sheets of steel material used issued by the iron & steel works for the approval of the Government before fabrication. Submission of mill sheets may substitute the material tests.

B.3.2. CUTTING AND BENDING

All steel plates shall be cut accurately true to the dimensions shown on the Contractor's approved drawing, with allowance for possible shrinkage during welding. All edges shall be accurately cut and inspected to be free from surface cracks and other injurious defects. Cylindrical shells shall be rolled to true curved sections after the edges have been pressed. Correction of curvature by hammering shall not be permitted.

B.3.3. WELDING

All welding of the discharge pipe shall be performed in accordance with the welding specified in the General Specifications.

B.3.4. TOLERANCES

The completed unit pipe shall conform to the dimensions shown on the approved drawings and to the tolerances specified hereunder.

(a) Cylindrical sections shall be sufficiently round so that the difference between maximum and minimum diameters measured at any cross section shall not exceed 1 per cent of design diameter for those sections.

(b) Outside circumferencial lengths of both ends and center of unit pipe shall be within a tolerance of plus or minus 0.2 per cent of the design lengths.

(c) Longitudinal lengths of 4 directions of up, bottom, right and left in unit pipe shall be within a tolerance of plus or minus 5 millimeters.

(d) Bending angle of the bend pipes shall be within a tolerance of plus or minus 10 minutes of the design angle.

B.4. TESTS AND INSPECTION

B.4.1. MILL TESTS

The steel plates for the discharge pipe shall pass the following mill tests.

(a) Tensile test.

(b) Bend test.

The results of mill tests shall be specified in the mill sheets mentioned under B.3.2.

B.4.2. RADIOGRAPHIC EXAMINATION

All T-joints of weld, which are formed inevitably by joining of longitudinal and girth weld, shall be radiographed by the Contractor in accordance with the requirements of boilder and pressure

vessel code. If objectionable defects should be discovered in the T-joints, welding line of 500 millimeter lengths from the defective parts to each direction of welding lines shall be chipped or arc-gauged and rewelded. The repaired welds shall be radiographed again. The Contractor shall furnish all equipment, films and other necessary aparatus for radiographic examination.

The negatives of the radiographs stored in good condition shall be submitted to the Government by the Contractor. Radiographic inspection shall be conducted in accordance with the standards required for boilder and pressure vessel.

B.4.3. INSPECTION

The discharge pipe shall be inspected in the field, on welding and surface imperfections such as undercut weld, clamp marks, surface pitting in the plate and other similar surface irregularities. If improper welds or surfaces discovered, the Contractor shall repair them under the instructions from the Government.

B.5. PAINTING

The discharge pipe shall be coated in accordance with the following specifications.

Interior surface	Three coat of coal-tar epoxy
Outside surface of the exposed pipe	
Primer coat	Red lead oil paint
Middle coat	Red lead oil paint
Outside surface of the embedded pipe by earth	Coal-tar paint or asphalt

Total thickness of the coats with coal-tar epoxy shall be more than 0.45 - 0.60 millimeters.

Total thickness of painted coats with coal tar paint or asphalt shall be more than 2.0 millimeters.

B.6. INSTALLATION

B.6.1. GENERAL

The Contractor shall carefully proceed with the installation in accordance with the schedule and under the instructions from the Government with due consideration to the progress of related works.

B.6.2. FIELD WELDING

Welding at the installation site shall be performed manually and applied to girth welding for the connection of the unit pipes, all other welding shall be done at the shop.

SUBSECTION 6C FIXED TRASH RACKS

C.1. DESCRIPTION

Two sets of fixed trash rack shall be designed, manufactured, supplied and installed by the Contractor in the intake of the water pumps for its dust-proof operation.

The trash racks shall adequately withstand the impact force and static loads, which may rise during inflow through trash racks. The trash racks shall consist of panels and embedded members.

C.2. DESIGN CONDITION AND STRESS

C.2.1. DESIGN CONDITION

The track racks shall be designed in accordance with the following specifications:-

Design load	1 ton/m^2
Clear height	1,700 mm
Clear span	1,250 mm
Steel bar element pitch	60 mm
Steel element bar	9 mm x 75 mm
Inclined angle of element bar	75^o

C.2.2. DESIGN STRESS

Fixed trash racks subjected to the design load specified in said design conditions, shall have the following factors of safety.

(a) Structural Steel Members and Element bars

Material	Factor of safety based on yield strength
Rolled steel	2

(b) Concrete bearing stress

Allowable concrete bearing stress for design shall be taken less than 50 kg/cm^2.

C.3. DETAILED REQUIREMENTS

(a) Panels

The panels shall be designed and manufactured with flat and round bars, and are fixed onto supporting members anchored in the base concrete by bolt fitting.

The bar element pitches of the panels shall be properly maintained at an enough pitch.

(b) Supporting Members

The supporting members shall be of the structure sufficient to convey the static load and impact force loaded on the panels to the concrete base, especially the horizontal interval beam shall be of the structure having sufficient strength against bending due to the load to which the panels are subjected.

The supporting members shall be anchored to the concrete base rigidly.

C.4. PAINTS

The trash racks shall be coated with following paints.

Three coats of coal-tar epoxy.

Total thickness of the coats shall be more than 0.45 - 0.60 millimeters.

C.5. SHOP ASSEMBLY INSPECTION

Trash racks shall be assembled at the shop in correct with the structure and dimensions as given in the approved drawings.

C.6. INSTALLATION

(a) Supporting Members

The supporting members shall be correctly positioned in the

blockouts on concrete base and fixed rigidly to the anchor metals which are previously set in the blockouts by other contractor to prevent moving during mortar filling.

(b) Panels

The panels shall be rigidly fitted to the supporting member by bolting after the installation of the supporting members and the mortar filled has hardened.

SUBSECTION 6D ROLLER GATE AND HOIST

D.1. DESCRIPTION

One set of roller gate with a guide frame and electric hoist shall be designed, manufactured, supplied and installed by the Contractor at the main canal near Lat Khouei. The roller gate shall be used to close for the back-flowing.

D.2. DESIGN CONDITIONS AND DESIGN STRESSES

D.2.1. DESIGN CONDITIONS

(a) Gate

The gates shall withstand the following loads.

(i) The water load developed by:
Head water at elevation 166.50 meters, no water behind the gate.

(ii) The load caused by raising or lowering of the gate, including maximum starting friction of the seal and of the rollers of the gate.

(iii) Self-weight.

(b) Guide Frame

The guide frame shall withstand the impact loading due to the rollers of the gate at rated speed. The guide frame shall be capable of transferring the gate load to the primary concrete.

(c) Electric Hoist

The electric hoist shall be capable to raise or lower the dead weight plus all friction loads of the gate. The rated speed shall be of 0.3 meters per minute, plus or minus 10 percent.

D.2.2. DESIGN STRESSES

The gate and its accessories shall be designed based on the following factors of safety.

(a) Structural Steel Member

Materials	Factor of safety based on the yield strength
Rolled steel	2
Rolled or forged steel bolts	4

(b) Concrete Bearing Stress

Allowable concrete bearing stress for design shall be less than 35 kg/cm^2.

D.2.3. DEFLECTION

Maximum deflection of the gate subjected to the maximum load shall be less than 1/1,000 of clear span of the gate.

D.3. DETAILED REQUIREMENTS

(a) Gate

The gate shall be of roller type and be of welded steel construction, and shall be equipped with rubber seal, rollers and other necessary components. The rollers shall be equipped with bronze bush.

(b) Guide Frame

The guide frame shall consist of roller paths, sealing frames, lintel beam, sill beam and other necessary components.

When the guide frame have been assembled, the sealing surfaces shall be true and flat within a tolerance of plus or minus 1 millimeter.

The sill beam shall be straight and true for a close fit with the bottom seal of the gate.

(c) Electric Hoist

The electric hoist shall be of spindle-screw type and be operated by a electric motor. Hoisting capacity of the hoist shall be at least 20 percent ample for the lifting load of the gate, the friction force.

The hoist shall be operated by means of the push bottom switches on the control cabinet. The hoist shall be automatically stopped at fully opened and closed position by using the limit switches. Electric source for the hoist shall be A.C. 3-phase, 3 wire, 380 volts and 50 cycles.

D.4. PAINTS

The gate and its accessories shall be coated as follows:-

Three coats of coal-tar epoxy.

Total thickness of the coats shall be more than 0.45 - 0.60 millimeters.

D.5. SHOP ASSEMBLY INSPECTION

The gate and its accessories shall be assembled to prove the structure is proper and shall be tested at the shop by the Government.

D.6. INSTALLATION

(a) Guide Frame

The guide frame shall be erected in the blockouts in accordance with the approved drawings, brought to line and graded within the erection tolerance.

The guide frame shall be anchored to anchor metals placed in base concrete firmly and secured in position while concrete is being placed in the blockouts.

(b) Gate

After completion of the erection, the gate shall be carefully inspected to ensure the water-tightness of the seal rubber, contact surfaces between the gate and guide frame in placed condition.

(c) Hoist

After completion of the erection, the hoist shall be actually load tested to check the hoisting.

SUBSECTION 6E SLIDE GATE AND HOIST

E.1. DESCRIPTION

Many sets of slide gates with a guide frame and hand-operated hoist shall be designed, manufactured, supplied and installed by the Contractor at the intake of the pumping station, and in the canal. The slide gates shall be used to adjust the water-supply. List of the gates is shown in Clause E.7.

E.2. DESIGN CONDITIONS AND DESIGN STRESSES

E.2.1. DESIGN CONDITIONS

(a) Gate for the Intake of Pumping Station

The gate shall withstand the following loads.

(i) The water load developed by:
Head water at elevation 155.0 meters, no water behind the gate.

(ii) The load caused by raising or lowering of the gate, including maximum starting friction of the seal and of the bearing surface of the gate.

(iii) Self-weight.

(b) Gates except item (1)

The gates shall withstand the following loads.

(i) The water load of gates is shown in Clause E.7.

(ii) The load caused by raising or lowering of the gate, including maximum starting friction of the seal and of the bearing surface of the gates.

(iii) Self-weight.

(c) Guide Frames

The guide frames shall withstand the impact loading

due to the seating of the gate at rated speed. The guide frame shall be capable of transferring the gate load to the primary concrete.

(d) Hoists

The hand-operated hoists shall be capable to raise or lower the dead weight plus all friction loads of the gates.

E.2.2. DESIGN STRESSES

The gates and their accessories shall be designed based on the following factors of safety.

(a) Structural Steel Member

Materials	Factor of safety based on the yield strength	Factor of safety based on the tensile strength
Rolled steel	2	
Cast iron		5
Rolled or forged steel bolts	4	

(b) Concrete Bearing Stress

Allowable concrete bearing stress for design shall be less than 35 kg/cm^2.

E.2.3. DEFLECTION

Maximums deflection of the gate subjected to the maximum load shall be less than 1/800 of clear span of the gates.

E.3. DETAILED REQUIREMENTS

(a) Gates

Each gate shall be of slide type and be of welded steel or cast iron construction, and shall be equipped with rubber seal and other necessary components.

(b) Guide Frames

Each guide frame shall consist of sealing frames, bearing plates, sill beam and/or lintel beam and other necessary components. When the guide frames have been assembled, the sealing surfaces shall be true and flat within a tolerance of plus or minus 1 millimeter. The sill beam shall be straight and true for a close fit with the bottom seal of the gate.

Each guide frame except the intake gate for the pumping station shall place the hoist at the top as shown on Drawings Nos.1012, 2025, 2026 and 2027.

(c) Hoists

Each hoist shall be of spindle-screw type and be operated by a manpower. The manpower required for the operation of hoist shall be less than 10 kilograms. A hoist for the intake gate of pumping station shall be submerged in flood season.

E.4. PAINTS

The gates and their accessories shall be coated as follows:-

Primer coat	Red lead oil paint
Middle coat	Red lead oil paint
Finishing coat	Oil paint

E.5. SHOP ASSEMBLY INSPECTION

The gates and their accessories shall be assembled to proved the structure is proper and shall be tested at the shop by the Government.

E.6. INSTALLATION

The installation shall be conform to the requirements of Paragraph D.6. The gates and their accessories shall be installed in accordance with the attached drawing No.9005 and Clause E.7.

E.7. LIST OF SLIDE GATES

Place of foundation and gate number	Span x Height or Diameter	Water head (M)	Seal	Height from handle center to bottom seal
Intake of Pumping Station	1,500 x 1,500	3.00	four edges	5,400
Regulators				
North	800 x 800	2.40	four edges	3,400
South	400 x 400	"	"	"
Check Structures				
N, No. 1 CS	1,200 x 1,200	1.00	three edges	3,000
N, No. 2 "	" "	0.90	"	"
N, No. 3 "	1,100 x 1,100	0.89	"	"
N, No. 4 "	800 x 800	0.60	"	2,000
N, No. 5 "	700 x 700	0.42	"	"
S, No. 1 "	" "	0.50	"	"
Turnout				
N, No. 1	200 Dia.	0.80		1,600
N, No. 2	"	0.79		"
N, No. 3	"	0.80		1,500
N, No. 4	"	0.78		"
N, No. 5	"	0.77		"
N, No. 6	"	0.74		"
N, No. 7	"	0.72		"
N, No. 8	"	0.69		"
N, No. 9	"	0.66		"
N, No. 10	700 x 700	0.57	three edges	2,150
N, No. 11	300 Dia.	0.60		1,350
N, No. 12	200 Dia.	0.49		1,300
Lateral No. 1	"	0.45		"
" No. 2	300 Dia.	0.43		1,350
" No. 3	200 Dia.	0.43		1,300
S, No. 1	"	0.55		"
S, No. 2	"	0.54		"
S, No. 3	"	0.52		"
S, No. 4	"	0.51		"
S, No. 5	"	0.59		"

SUBSECTION 6F ELECTRICAL EQUIPMENTS

F.1. DESCRIPTION

F.1.1. TRANSFORMER

Transformer shall be of outdoor type, three phase, 21KV/380-220V, 500KVA.

F.1.2. SWITCHGEARS

22KV switchgears shall be installed outdoor and 380-220V low tension switchgears shall be indoor cubicle type. The colour of porcelain shall be brown.

The schematic connection diagram and arrangement of equipment at the pumping station are shown on the attached drawing Nos. 10001 and 10002.

General requirements are as follows:-

Rated frequency:	50 Hz.
Control source:	50 Hz, A.C., 110V control source from the transformer as shown in the schematic connection diagram.
Insulation level:	Basic insulation level of 22KV switchgears shall be of 150KV.

F.1.3. MISCELLANEOUS MATERIALS

Electrical conductors and fittings, earthing materials and other necessary materials shall be supplied.

F.2. DESIGN CONDITIONS

F.2.1. 500KVA TRANSFORMER

The transformer shall be designed with the following specifications:-

(a) Type and Ratio:

The transformer shall be of three phase, self-cooled, oil-immersed, outdoor type with radiators and shall be provided with such measures as required to isolate the oil from the atmospheric air. In the case of nitrogen gas isolating type, 50% extra of nitrogen gas shall be supplied in bombs. The no-load ratio of delta-star connection shall be 23F-22F-21R-20F KV to 380R-220V of three-phase four-wire system. The connection shall be arranged in accordance with vector symbol Dy 11 of JEC-168 (1966) or B.S.171: 1959.

(b) Insulation

All windings shall have full insulation.
The basic insulation level of primary winding (22KV side) shall be of 150KV.

(c) Temperature Rise

The maximum temperature rise shall not exceed the followings:-

Oil (by thermometer)	50°C
Winding (by resistance)	50°C

(d) Frequency

The transformer shall be designed for a frequency of 50 Hz.

(e) Tap Changer

A convenient externally operated tap changer, operable under no-voltage, shall be provided on the 22KV side.

(f) Bushing

The bushings may be of oil-immersed type for 22KV side and solid type for low tension side. The colour of bushing shall be brown.

(g) Insulating oil

Insulating oil shall be of non-sludging and of medium viscosity, characteristics of which shall be stated in the tender. Sufficient oil for the first filling up plus 10% extra shall be supplied in sealed non-returnable drums.

F.2.2. 22KV SWITCHGEARS

(a) Power Fuses

Three power fuses shall be of outdoor, single pole, 24KV, 30A and 250MVA r.m.s. symmetrical rupturing capacity, downward and oblique position.

(b) Disconnecting Switch

One disconnecting switch shall be of outdoor, three pole, single throw, remote hand operated with pad lock and earthing blade and rating shall be 24KV, 400A.

Disconnecting switch shall be able to interrupt the magnetizing current of 500KVA transformer.

(c) Lightning Arresters

Three lightning arresters shall be of outdoor, 28KV, 10KA discharge current rating with fitting.

(d) Metering Outfit

One three phase metering outfit shall be supplied for measuring electric energy for power trading. The metering outfit shall be of oil-immersed, outdoor type and the rating shall be as follows:-

Rated voltage	22KV
Voltage ratio	22KV/110V
Current ratio	20/5A
Rated burden	PT 2 x 15VA
	CT 2 x 15VA
Accuracy class	0.5% class

Outdoor meter box furnished with watthour meter (1.0% class) for power trading shall be mounted on the tank of the metering outfit.

F.2.3. LOW TENSION SWITCHGEAR

The circuits shall be as follows:-

(a) One main and station service circuit.

(b) Two motor circuits.

Cubicles for low tension circuits shall be of enclosed, dead front, indoor and sheet steel type. Low tension switchgears including bus conductor and current transformers shall have an electrical and mechanical strength to endure 10,000 amps. overcurrent under the condition of short circuit accident.

(a) Main and station service cubicle

The cubicle shall be equipped with the following apparatus:-

(i) One - Air circuit breaker of three pole, 600V, 1,200A 40KA r.m.s. symmetrical rupturing current capacity, hand operated, condenser trip type with signal lamps and auxiliary switches.

(ii) One - Transformer of ample capacity for control source of the pumping station of single phase, indoor, dry type, 380V to 110V.

(iii) Three - Potential transformers of single phase, indoor dry type, $380V/\sqrt{3}$ to $110V/\sqrt{3}$.

(iv) Three - Current transformers of indoor, dry type and current ratio of 1,200/5A.

(v) Three - Current transformers of indoor, dry type and current ratio of 50/5A.

(vi) One - A.C. 600V, 3P, 50AF, 50 AT no-fuse breaker.

(vii) Two - A.C. 600V, 3P, 50AF, 30 AT no-fuse breakers.

(viii) Two - A.C. 600V, 3P, 50AF, 15 AT no-fuse breakers.

(ix) Two - A.C. 600V, 2P, 50AF, 20 AT no-fuse breakers.

(x) Four- A.C. 600V, 2P, 50AF, 15 AT no-fuse breakers.

(xi) One - Voltmeter with selector switch
Two - Ammeters with selector switch
One - Wattmeter (used for three phase, four wire circuit)
Two - Watthour meters (used for three phase, four wire circuit)
One - Power factor meter
Three - Over current relays. (ACB trip and bell alarm)
One - Under voltage relay (three phase)(MC-1 trip and bell alarm)

(xii) One - Bell for trip alarm

(xiii) One - Buzzer for alarm

(xiv) One - Set of cable ends

(b) Pump motor cubicles

Each cubicle shall be equipped with the following apparatus:-

(i) One - A.C. 600V, 3P, 400AF, 400 AT, no-fuse breaker.

(ii) Two - Magnetic contactors of 600V, 3P, 400A.

(iii) Three - Current transformers of indoor, dry type and ratio of 500/5A.

(iv) One - Set of starting reactor with 80-65-50% voltage taps. The reactor shall have a suitable rating to start the motor specified in Clauses A.2.4 and A.3.5.

(v) One - Set of static condenser of oil filled type, three phase, 50 Hz, 380V, 50KVA capacity.

The maximum temperature rise of the condenser shall not exceed 25°C.

(vi) Two - Over load relays. (or one relay with two over load elements)

(vii) One - Open phase relay.

(viii) One - Over current ground relay.

(ix) One - Control handle with signal lamps for the motor start and stop.

(x) Group fault annunciator for protective relays.

(xi) One - Set of cable ends.

(xii) Installation space for pressure gauge specified in Clause A.3.1.

F.2.4. MISCELLANEOUS MATERIALS

(a) Power cables

Power cables from 500KVA transformer to indoor cubicle shall be of crosslinked polyethylene insulated polyvinyl chloride sheathed type and of 600V, single core, 400 sq. mm.

The power cables shall be provided with suitable cable ends.

Power cables and fittings from pump-motor cubicle to submersible motor terminal box will be supplied under the preceding Clause A.3.5.

(b) Control cables and Insulated wires

Control cables shall be of jacket type, 600V, poly-vinyl chloride insulated, PVC sheathed, single or multi copper-cores, The sectional area shall not be less than 3.5 sq.mm.

For power circuits to be used for auxiliary equipment, 600V PVC insulated PVC sheathed power cable or 600V PVC insulated wire shall be used.

(c) Bare hard drawn copper conductors

Bare hard drawn copper stranded wire of 38 sq. mm shall be supplied for 22KV circuit.

(d) Bare annealed copper conductors

Bare annealed copper wire of 50 sq. mm and 14 sq. mm shall be supplied for earthing system.

(e) Galvanized steel wire

Galvanized steel wire of 7/2.0 mm (more than 90 kg/sq.mm in ultimate tensile strength) shall be used for overhead earth wire.

(f) Insulators

Each suspension or strain insulator string comprised 3 discs of 190 mm (7-$\frac{1}{2}$ inch) porcelain disc type with ball and socket shall be supplied.

If necessary, support insulators shall be supplied for supporting copper bars at secondary side of 500 KVA transformer.

The colour of insulators shall be brown.

(g) Earthing materials

The earthing materials shall consist of copper plates of 3mm x 1m x 1m, 25mm dia. copper earth rods with steel core, copper earth connectors for connecting with earthing conductors, and requisite quantity of bolts, nuts and other necessary items.

(h) Other materials

Steel tubular poles, clamps with fittings, terminals, conduit

pipes, angle steel, channel steel, steel plates, cable supporting brackets, cable supporting structures, supporting structure for disconnecting switch and metering outfit, and lightning arrester, bolts, nuts, and other items deemed necessary for erection and putting the plant supplied under this Contract into commission, shall be provided and shall comply with the highest grades specified in relevant standard. PG clamps for connection of 38 sq.mm copper to 55 sq.mm H.Al shall be provided and be free from electric corrosion.

(i) Installation

All electrical equipment shall be earthed directly by earthing conductor.

All earthing connections shall be made by bond or clamp, and no soldering shall be permitted.

F.3. ACCESSORIES AND SPARE PARTS

F.3.1. TRANSFORMER

(a) The following accessories shall be provided with the transformer:-

(i) One name plate showing maker's name, serial number, year of manufacture, type, capacity and other main characteristics.

(ii) One diagram plate.

(iii) Drain and inlet valves.

(iv) Line side clamps type terminals and earthing terminal.

(v) Explosion vent

(vi) Oil level gauge

(vii) Hand hole

(viii) Silicagel dehydrating breather (if necessary)

(ix) Dial type thermometer with alarm contact.

(x) Pressure gauge with alarm contact (if necessary)

(xi) Flat wheels.

(xii) Any additional accessories of the manufacturer's standard.

(b) The following spares shall be supplied:-

(i) One bushing for each type with conductor and terminal.

(ii) One set of gaskets.

(iii) One dial type thermometer.

(iv) Other necessary spare parts recommended by the Contractor.

F.3.2. SWITCHGEARS

(a) The Contractor shall provide name plate, line side clamp type terminals, earthing terminal, oil gauge and valves for metering outfit and other necessary accessories.

(b) Six fuse elements for the 22KV power fuse shall be provided as spare.

(c) Porcelain insulators (for one phase) of disconnecting switch shall be provided as spare.

(d) Necessary spare parts for other switchgears shall be recommended and supplied by the Contractor.

F.4. TEST

F.4.1. TRANSFORMERS

The following tests shall be carried out at the manufacturer's works:-

(a) Dimension check
(b) Ratio and polarity
(c) Characteristics
(d) Measurement of insulation resistance
(e) High voltage test
(f) Impulse voltage test
(g) Temperature rise test

F.4.2. SWITCHGEAR

The following tests shall be carried out before shipment:-

(a) For power fuses:

(i) Construction
(ii) Measurement of resistance
(iii) High voltage test
(iv) Impulse voltage test

(b) For disconnecting switch:

(i) High voltage test
(ii) Impulse voltage test
(iii) Operation test

(c) For lightning arresters:

(i) Measurement of insulation resistance
(ii) Power frequency breakdown voltage test
(iii) Impulse breakdown voltage test

(d) For metering outfit:

(i) Ratio and phase error test
(ii) High voltage test
(iii) Impulse voltage test

(e) For current transformers:

(i) Limits of ratio and phase error
(ii) High voltage test
(iii) Polarity test

(f) For potential transformers:

(i) Limits of ratio and phase error
(ii) High voltage test
(iii) Polarity test

(g) Static condensers:

(i) Capacitor test
(ii) Measurement of insulation resistance
(iii) High voltage test
(iv) Temperature rise test

(h) For cubicle:

(i) Inspection of construction
(ii) High voltage test
(iii) Measurement of insulation resistance
(iv) Calibration test for meters
(v) Characteristics test for relays
(vi) Checking of connection

The following test at site shall be carried out after completely assembled:-

(i) High voltage test in the lump with other circuit (as far as possible)
(ii) Operation test
(iii) Sequence test

F.4.3. MISCELLANEOUS MATERIALS

The tests stated in the applied standards recommended by the Contractor shall be carried out before shipment.

SUBSECTION 6G DISTRIBUTION LINE

G.1. CONDUCTORS AND EARTHWIRES

G.1.1. Power conductors and earthwires --- The power conductor shall be H.Al 55 sq.mm for the 22KV line including temporary 380V line (22KV design) to hoist for flood gate near Lat Khouei. Conductor and earthwire shall have the characteristics hereunder specified.

	Conductor	Earthwire
Size	H.Al	St.
	55 sq.mm	22 sq.mm
Stranding	Al 7/3.2 mm	St.7/2.0 mm
Ultimate strength not less than -	838 kg	1,780 kg

The aluminium shall be of the highest purity commercially obtainable which shall not be less than 99.5%. The steel wires shall be of galvanized high tension quality and the zinc coat shall be smooth, clean, of uniform thickness and free from defects. The minimum coating of zinc shall be more than 215g/m^2 for 2.0 mm wire.

G.1.2. Joints and repair sleeves --- Joints shall be of compression type for H.Al and earthwires and shall be free from slipping off, damage to or failure of the complete conductors, earthwires or any parts thereof at a load less than 95% of the ultimate breaking strength of the conductor or earthwire.

The electrical conductivity and current carrying capacity of joints for power conductor shall not be less than those of equivalent length of the conductor.

The cut ends of steel wires shall be protected from the weather in an effective and permanent manner.

Repair sleeves for H.Al conductors shall be of compression sleeve type and the conditions stated above for joints shall apply to repair sleeves where applicable.

The price for supply and erection of joints and repair sleeves is deemed to be included in the conductor or earthwire price.

G.1.3. Length of conductors and earthwires --- Conductors and earthwires shall be supplied on drum. The length on one drum shall be stated in the tender. The longer ones are preferable.

G.2. INSULATORS AND FITTINGS

G.2.1. Insulators

Insulators to be used for the lines shall be of porcelain pin type at a straight line and/or heavy angle supporting point up to 45 degrees and of porcelain multi- unit discs of the socket-cap, ball-pin type and pin type insulators where necessary at tension point, with all fittings complete. The colour of porcelain shell shall be brown.

The size of pin insulators shall be 229 mm (9 inch) in diameter and 165 mm (6-1/2 inch) in height. The pin hole shall have the porcelain thread suitable for a lead pin of 35 mm (1-3/8 inch) in diameter. The groove redius shall be suitable for clamping the conductor with performed grips.

The size of disc type insulator (suspension insulator) shall be 190 mm (7-1/2 inch) in diameter and 146 mm (5-3/4 inch) in spacing. The dimension of sockets and pins shall be in accordance with the American Standard, 16 mm pin and socket.

Electrical and mechanical characteristics of insulators shall be as undermentioned.

	Pin type	Suspension type
Flashover voltage:		
Power frequency, dry	110 KV (average)	60 KV (minimum)
" , wet	70 KV (")	30 KV (")
Impulse	175 KV (")	100 KV (")
Power frequency puncture voltage:	145 KV	110 KV
Mechanical strength:		
Cantilever strength	1,350 kg	
Minimum breaking strength		6,800 kg
Minimum impact strength		57 kg-cm

G.2.2. Suspension insulator sets

The sets shall consist of single or double string of 3 units with all fittings complete, including clamps. The sets of double string shall be used at the span crossing over main roads. Electrical and mechanical characteristics of insulator sets complete with all fittings shall be as specified hereunder.

Minimum flashover voltage:	
Power frequency, dry	170 KV
" , wet	85 KV
Impulse, positive	280 KV
Minimum mechanical strength:	1,500 kg

G.2.3. Insulator pins

Insulator pins shall be of tapered body type of 19 mm (3/4 inch) in diameter with lead heads of 35 mm (1-3/8 inch) in diameter and 50 mm (2 inch) in length. The pin shall be 280 mm (11 inch) in height and 420 mm (16-1/2 inch) in total length and shall be provided with a spring washer and a nut. The mechanical strength of the pin, defined as the load for 10 degrees deflection, shall be more than 900 kg.

G.2.4. Fittings

Each pin type insulator shall be provided with a performed grip of suitable design for wrapping use of the line conductor.

All fittings to make each insulator string set complete for beneficial use shall be supplied. Such bolts, nuts, washers, cotter pins, and retaining pins in sufficient quantities as may be necessary for the use of erection shall be deemed to be included in the appropriate items.

All ferrous fittings shall be made of drop forged steel or malleable iron and hot dip galvanized. Cotter pins shall be made of non-ferrous metal or stainless steel and designed as the self-locking type.

All bolts, nuts and cotters shall not be less than 15 mm or 5/8 inch in diameter.

G.2.5. Tension clamps for conductors

The tension clamp shall be of bolted type with aluminium liners and be free from slipping off, damage to or failure of the complete conductors at a load less than 95% of the ultimate breaking strength of the conductor.

G.2.6. Fittings for earthwire clamping

For earthwire clamping of type "A" and "B" supports, suspension clamp with fittings shall be supplied. U-clevis, eye-link and clevis-thimble with preformed dead-end grip sets shall be provided for earth-wire to be clamped to all supports except the type "A" and "B".

The grip strength shall not be less than the ultimate breaking strength of the earthwire used dead-end grip.

Earthwire shall be bonded to the cross-arms or steel member of supports by clamping with earthing clamps.

G.3. SUPPORTS

G.3.1. Types of supports --- All supports for 22KV line including temporary 380V line (22KV design) shall be of galvanized steel tubular poles or steel reinforced concrete poles or "Panzer Mast" type poles

with galvanized steel arms, stayed where necessary with galvanized steel wires. Wooden poles shall be rejected. Kinds of supports to be adopted by the Tenderer shall be advised in writing when tendering.

Power conductors shall be arranged in horizontal and earthwire shall be provided for the line.

The size and number of power conductors and earthwire shall be as follows.

Conductor : H.Al 55 sq.mm
single circuit, three phase, three wire system

Earthwire : Galvanized steel wire 7/2.0 mm 1 No.

The standard types of supports are as follows:-

(a) Type - A: Straight line and light angle support up to 5 degrees with pin insulators.

(b) Type - B: Heavy angle support in H shape up to 45 degrees with pin insulators.

(c) Type - C: Heavy angle support in triangle up to 90 degrees with suspension and pin insulators.

(d) Type - D: Terminal support in H shape with suspension insulators.

(e) Type - E: Support with disconnecting switch at beginning point of the line in this project.

(f) Type - E': Support at branching point.

(g) Type - F: Support with lightning arresters and fusible disconnecting switches at 50 KVA distribution transformer yard.

All supports of type A shall be provided without stay wires. Other types shall be reinforced with necessary stay wires.

At straight sections of lines, a type B support per about ten (10)

spans shall be used for reinforcement in longitudinal or transverse direction.

Standard span of 80 m shall be selected to the line.

The lowest conductor height from the ground level shall be as follows:

(a) Road crossing over : 6 m
(b) Railway crossing over : 5.5 m
(c) Others : 5 m

Typical design of supports are shown in the Drawing No.10003.

In principle, the supports of typical design shall be used for the line. When requirement to adopt other type supports or special foundation occurs unavoidably, the Contractor shall confer with the Government about application and unit price of the supports including foundation.

G.3.2. Working loading --- (a) The following loads shall be taken into consideration in the design of supports:-

(i) Vertical loadings --- The weight of the insulators and all other fittings, supports, power conductors and earthwire for 150% of the design span and effect of stay wires. In addition, the weight of a man being 100 kg is to be taken into account for design of arms.

(ii) Transverse loadings --- A wind pressure at right angles to the line on the whole projected area of the conductors and earthwire, poles, insulators and all other fittings, and the transverse horizontal component of maximum conductor and earthwire tensions.

(iii) Unbalanced longitudinal loading shall be as follows:
Support B : 60% of the maximum working tension of conductors and earthwire

Support C - F : 100% of the maximum working tension of conductors and earthwire

(b) Wind loads shall be as follows:

(i) On poles:

Circular section poles

... 43 kg/sq.m on projected area

Other poles

... 64 kg/sq.m on projected area

(ii) On beams, cross-arms and arm tie

Lattice structures

... 147 kg/sq.m on the exposed area of one face

Cross-arms and arm tie of single member

....86 kg/sq.m on projected area

(iii) On power conductors and earthwire

... 54 kg/sq.m on projected area

(iv) On insulators

... 75 kg/sq.m on projected area

(v) On stay wires

No wind load may be considered.

(c) Maximum working tensions of power conductors and earthwire shall be as follows:

(i)	Power conductor	H.Al 55 sq.mm	300 kg
(ii)	Earthwire	St. 22 sq.mm	290 kg

(d) No broken wire condition may be considered.

G.3.3. Design of supports

Each type of supports shall be designed so that no failure or permanent distortion shall occur when the load equivalent to twice the maximum simultaneous working loads are applied.

The design calculation and drawings of supports shall be submitted by the Contractor to the Government for approval.

G.3.4. Cross-arms --- All supports shall be provided with cross-arms or beam of appropriate dimension for power conductor and earthwire, and made of galvanized steel angles or channels or light gauge steel materials. Cross arms or beams shall be provided with necessary bolt holes for fixing insulators sets and earthwire clamps.

G.3.5. Fittings --- All supports shall be provided with such fittings in complete as a number plate, pole caps, fixing bolts or bands for cross-arm, arm tie, bolts or adjustable bands for arm tie and stay wire fixing use, and step bolts in 45 cm spacing starting from about 1.8 meter height above the ground. Fences for safety around 50KVA transformer and operating box of disconnecting switch shall be supplied as shown on the attached drawing No.10003.

Earthing materials for the line shall be supplied, if necessary.

The cost of these fittings shall be deemed to be included in the price of supports.

G.3.6. Stay wires --- Stay wires shall consist of a V-shape hanger with a thimble, steel stay wires with preformed grips or wire clips, a steel stay rod with a thimble. They shall be designed with a factor of safety of more than 2.5 against the expected load. All steel materials shall be galvanized.

If concrete poles are employed, a stay insulator shall be used for each stay.

The cost of stay wires including stay insulators if necessary shall be deemed to be included in the price of support.

G.3.7. Foundations

Poles are to be directly buried into ground. Footing depth of

poles shall be so designed that the overturning load may be supported with a factor of safety of more than 2.0. However, the minimum depth shall be 1.5 m.

The allowable bearing strength of soil is assumed to be 60 ton/sq.m. The weight of soil is assumed to be 1.6 ton/cu.m. and weight of concrete to be 2.3 ton/cu.m. The angle of repose may be reckened as 30 degree.

Where necessary, reinforced concrete logs shall be employed for increasing the stability of footing.

At the bottom of poles, there shall be laid concrete plate or anti-corrosive painted steel plate of suitable dimensions, or concrete shall be placed at site in similar dimension so as to give a sufficient bearing against the calculated vertical load.

Stay wires shall be anchored to concrete blocks or galvanized steel plate buried in suitable depth into ground. The factor of safety of stay wire foundation to uplift load shall not be less than 2.5.

G.4. TRANSFORMERS AND SWITCHGEARS

G.4.1. Transformers

Six distribution transformers of 50KVA capacity shall be provided for local power supply.

The transformer shall be of three-phase, 50 Hz, self-cooled, oil-immersed, outdoor type with a no-valtage tap changer. The no-load ratio of delta-star connection shall be 23F-22F-21R-20F KV to 380R-220V of three-phase four-wire system. The connection shall be arranged in accordance with vector symbol Dy 11 of JEC-168 (1966) or B.S. 171: 1959.

Insulation level, temperature rise, bushings and insulating oil for 500KVA transformer at the pumping station shall also be applied to these transformers.

G.4.2. Fusible disconnecting switches

Eighteen fusible disconnecting switches shall be of outdoor, single pole, hook operated type, 24KV, 5A and 250MVA r.m.s. symmetrical rupturing capacity, downward and oblique position. The switch shall be mounted on the poles of distribution transformer yard as shown on the attached drawing No. 10003.

G.4.3. Lightning arresters

Eighteen lightning arresters shall be of outdoor, 28KV, 5KA discharge current rating with fitting and mounted on the poles of the transformer yard.

G.4.4. Disconnecting switches

Two disconnecting switches shall be of outdoor, three pole, single throw, remote hand operated with pad lock and rating shall be 24KV, 400A. The disconnecting switch shall be installed on the beam of type-E support and be able to interrupt the charging current of the 22KV distribution line. Operating rods from operating box on the ground to the switch on the beam and suitable guides for the operating rods shall be supplied.

G.4.5. Power cable and earthing materials

Power cable from dead-end pole near the flood gate to control cabinet for the gate hoist shall be of 600V, rubber insulated chloroprene sheathed cable, three core, 8.0 sq.mm. Suitable cable ends for the above and cable supporting bands on the pole shall be supplied.

Bare annealed copper conductors and copper earth rods with steel core and clamp type terminal shall be provided for earthing of the above-mentioned equipment. The conductors and rods shall be subjected to the specification stated in clause F.2.4.

G.4.6. Accessories and spare parts

(a) For each transformer

(i) Name plate

(ii) Drain valve

(iii) 22KV side clamp type terminals (for H.Al 55 sq.mm) and earthing terminal

(iv) Oil level gauge

(v) Hand hole

(vi) Silicagel dehydrating breather

(vii) Thermometer

(viii) Any additional accessories of the manufacturer's standard

(b) As spares for all transformers

(i) Two bushings for each type with conductor and terminal

(ii) Two sets of gaskets

(iii) Other necessary spare parts recommended by the Contractor

(c) 22KV side clamp type terminals (for H.Al 55 sq.mm) and earthing terminal for fusible disconnecting switches, lightning arresters and disconnecting switches.

(d) One hook stick for fusible disconnecting switches

(e) Eighteen fuse elements for all fusible disconnecting switches as spare

(f) Porcelain insulators (for one phase) for two disconnecting switches as spare

(g) Other necessary accessories and spare parts shall be recommended and supplied by the Contractor

G.5. ERECTION

G.5.1. Access to site and compensation --- By the date of contracting the Government will obtain and compensate for the following facilities.

(a) Right of constructing the distribution line along the selected route.

(b) Right of using the land of reasonable width and space for access, transport of materials and equipments and erection.

(c) Removal of houses and other properties which are to be removed from the right of way for the operation of line.

(d) Compensation for clearing of trees, bamboos, palms, bushes and other vegetation to be cleared in accordance with the requirement of the Specification.

(e) Compensation for unavoidable damage to crops, valuable trees and other properties due to the Work.

The Contractor shall however be responsible for the followings:-

(f) Compensation or repairing expense for damage to public road, track, bridges and other properties for which the Contractor is responsible.

(g) Compensation for avoidable damage to crops, valuable trees and other properties.

It shall be understood that the Contractor shall be responsible and include in his Tender rates for, all costs in connection with the erection and removal of access to and along the route if necessary.

The Contractor shall also be responsible for giving occupiers of land advance notice of the commencement of work.

The Contractor shall take all precautions to avoid damage to land, property, roads, field drains, fences, gates, walls, trees, hedges, crops and the like and shall ensure that the work is adequately supervised so that damage is reduced to the minimum. Otherwise the Contractor shall be responsible for all damage.

Claims for unavoidable damage duly approved by the Government will be met by the Government, providing that notification in writing is to be submitted to the Government within fourteen days from date when the damage is caused. Otherwise, the Government may at his discretion refuse to consider any subsequent claims by the Contractor for compensation resulting therefrom.

G.5.2. Clearing --- Clearing of the right of way of all trees and tall scrub shall be carried out to a distance of 15 meters on either side of the line centreline. All trees and scrub within the right of way shall be cut off as close to the ground as practicable, and in no case shall they be cut off at a height of more than 0.3 meter above the ground, unless otherwise instructed by the Government.

The clearing shall include the cutting of tall trees outside the right of way if such trees could fall within 6 meters of the centre line of the route.

All cleared materials shall be burned, removed from the site, or otherwise disposed of as approved by the Government. Burning shall be done with utmost care so as to give the least fire risk and in accordance with local fire regulation.

The Schedule rate for clearing shall include all costs for the work specified in this Clause.

G.5.3. Surveys --- Line routes are as shown in the attached map and the location of terminal and angle positions will be indicated at site by the Government. The Contractor shall carry out the profile survey with the minimum delay.

Profile drawings shall be prepared by the Contractor at scales of 1/2000 in horizontal and 1/400 in vertical and proposed positions and types of supports shall be plotted thereon.

Profile drawings are to include the following features:-

Continuous longitudinal distance, angle deviation of the route, ground line salient level, ground line, line of lowest conductor at maximum sag, indication of side slope where necessary, buildings, streams and rivers, roads, power and communication lines crossed or to be crossed, sections unsuitable for support positions, kinds of land, and any other features affecting the line construction.

Crossing sketches for roads, power and communication lines are to be shown on the profiles or separate drawings.

Profile drawings shall be submitted to the Government for approval in section by section. The Contractor shall provide the Government with two complete sets of transparent sag templates before submission of the first profile for approval.

After approval, the Contractor shall peg out the locations of supports and survey the cross sections where necessary and conduct the subsoil test with a simple boring or penetrating tools for determing the type of foundation. The result of cross section survey and soil tests shall be submitted to the Government.

Schedules of supports and materials in approved forms shall be prepared and submitted to the Government by the Contractor.

The quantities entered in the Schedule of 22KV line are provisional only and shall be amended in accordance with the result of survey.

G.5.4. Foundations --- Concrete used for foundation and reinforcement logs is to consist of one part cement, three parts sand and six parts approved gravel or broken stone by volume.

All cement used is to be of Portland or other approved composition obtained from an approved manufacturer. Cement shall be adequately protected from moisture or contamination during transit and in storage at site. Any cement containing lumps or deleterious matter shall not be used.

The backfill of all types of foundations shall be thoroughly rammed.

G.5.5. Erection of supports --- Poles shall be erected vertically without giving excessive stress to pole itself or crossarms. Stay wires and anchor rods shall be arranged to make a straight line.

After erection all supports shall be cleaned of all foreign materials and dirt.

The parts buried in the ground of steel poles shall be painted with one coat of suitable anti-corrosive paint and two coats of finish paint in accordance with the Government's instruction.

G.5.6. Earthing

In case the concrete poles are employed, beams and/or cross-arms on each pole shall be connected to galvanized earth angle of 45 mm x 45 mm x 4 mm size and 1 m length with clamp type terminal. Earthing conductor size shall not be less than 2.6 mm diameter.

In case the conductor is mounted along the surface of concrete pole, 600V vinyl insulated wire shall be applied. The wire from 0.6 m depth under the ground to 2m height above the ground level shall be covered by conduit of insulating materials having durability to avoid the damage of the parts, and insulating compound shall be filled up in the conduit.

No earthing is necessary for directly buried steel pole lines.

Equipment at transformer yard, neutral point of the transformer and disconnecting switch shall be earthed by copper rod with steel core and copper earthing conductor.

G.5.7. Stringing --- Before stringing work, all poles as may be subject to excess loading during tensioning of wires shall be reinforced with backstays, and suitable scaffolding shall be provided for crossing main roads, power and telephone lines and others which the Government considers to be protected.

The Contractor shall be responsible for giving requisite notice to and obtaining the approval from the appropriate authorities of the date and time when be erect necessary scaffolding.

Utmost care shall be taken during paying out of aluminium conductors. In no case steel messenger wire shall pass aluminium alloy sheaves. Conductors and earthwire shall not be allowed to kink, birdcage or get damaged on account of rubbing on rocky or rough surface. Damaged conductors shall be replaced or repaired with repair sleeves. Repair sleeves shall be used with the permission of the Government.

The fullest possible use shall be made of maximum conductor lengths, in order to reduce the number of joints to the minimum. Midspan joints shall be not less than 5 meters from tension clamps and 2 meters from supporting points. There shall be not more than one such joint per conductor in any one span. No joint shall be used in spans crossing telecommunication lines, other power lines and highways.

Joints shall preferably be made after paying out of conductors or earthwire. Otherwise, joints shall be protected during paying out with approved protectors of suitable design.

Steel joints for earthwires shall be sufficiently painted after passing the last snatch-block.

Before stretching of the conductors, bamboo or other suitable materials shall be furnished on the beams or arms to protect the conductors from damage due to rubbing. A part of conductors to clamp with the tensioning device shall be protected by rubber or others.

Sag, tension and temperature charts shall be prepared and submitted to the Government for approval, in accordance with the detailed conditions detailed below:-

(a) Maximum wind pressure at 10°C.
(b) Maximum working tension to be as stated in Clauses 3.2.
(c) Maximum temperature of conductor to be 60°C for H.Al.

(d) Sag of earthwire to be 80% of that of conductor in still air at $0^{\circ}C$.

(e) Temperature range for sag calculation to be $10^{\circ}C$ to the maximum temperature of conductor.

Sag shall be measured in one span for the section of not more than 4 spans, two for 4 to 8 spans section and three for the section of more than 8 spans. In addition, one or more spans shall be observed if the Government considers necessary.

G.5.8. Erection of equipment --- Transformers and switchgears shall be installed in accordance with the Drawings No. 10003.

The Contractor shall keep the yard clean and on the completion of the Works all surplus materials, packing materials and other debris shall be disposed according to the Government's instruction.

G.5.9. Payment for erected work --- The method of payment is set out in the General Conditions of Contract.

Interim Certificates for Site Work of 22KV line shall be restricted in scope to the following items:-

(a) Profile survey

(b) Clearing of the right of way

(c) A complete support of poles with stay wires

(d) Line conductors and earthwire between straining points

All other items and extra work shall await payment due at erection until the issue of the Taking-over Certificate.

The measurement of length of clearing, conductors, and earthwire for the purpose of FOB, transportation and erection payment is to be made along the centre line of the distribution line without allowance for sag or scrap, and will be based on the horizontal distances involved.

The measurement shall be taken for each item with per cent progress.

It is noted that the Contract value for the 22KV lines shall be the pro rata base and adjusted in accordance with the quantities of works.

G.6. TESTS

G.6.1. General --- The Equipment will be inspected during manufacture and erection and tested by the Government.

Every facility shall be provided by the Contractor to enable the Government to carry out the necessary inspection of the Equipment and the costs of all tests during manufacture shall be borne by the Contractor.

The passing of such inspection or test will not, however, prejudice the right of the Government to reject the Equipment if it does not comply with the Specification when erected.

G.6.2. Tests at manufacturer's works

The Equipment shall be tested on the following items. In addition, the Government shall reserve the right to add any reasonable test, which shall be carried out by the Contractor without extra charge when so required.

(a) Transformers and switchgears

The tests shall be carried out in accordance with the items specified in clause F.4, where applicable. Test items for power fuses including operation test shall be applied to fusible disconnecting switches.

(b) Conductors and earthwires (sample test)

(i) Aluminium and steel wires

Outside view and diameter

Tensile strength and elongation

Conductivity for aluminium wire

Twisting and galvanizing (quantity, uniformity and wrapping) for steel wire

(ii) Stranded conductor and earthwire

Outside view

Construction and weight

Tensile strength

Resistance for conductor

(iii) Joints and repair sleeves

Outside view and dimension

Compression and conductivity

Tensile strength

(c) Insulators and fittings (sample test)

(i) Insulator units

Flashover voltage

Puncture voltage

Mechanical strength

Thermal tests

Withstand voltage test

Porosity test

Galvanizing

(ii) Insulator strings

Assembly

Withstand voltage

Flashover voltage

Mechanical strength

(iii) Clamps

Slipping load

Ultimate breaking strength

Galvanizing

Outside view and dimension

(iv) Fittings

Outside view and dimension

Load test

Galvanizing

(d) Supports

(i) Dimension check of assembled pole with fittings (one of each type supports)

(ii) Galvanizing

(iii) Load test

One of each type support shall be assembled at the manufacturer's works after galvanizing on a rigid foundation and shall be subject to loading test to prove compliance with the factor of safety stated in clause G.3.3. in an approved manner and maintained five minutes without showing signs of failure or permanent distortion.

Where the test is satisfactorily completed, the support shall be carefully inspected after dismantling to ensure that no parts has been damaged.

Where the test indicates weakness in design or manufacture, the Contractor shall carried out the modification at his own expense, and if required by the Government the test shall be repeated without any extra charge to the Government.

G.6.3. Packing --- The Government will inspect the packing of the Equipment from time to time before shipment, when necessary in the opinion of the Government.

G.6.4. Tests at sites --- The following tests shall be carried out at sites during and after erection:-

(a) Measurement of insulation resistance

(b) Operation of equipments

SECTION 7 FORM OF TENDER

SCHEDULE I TENDER PRICE

Item No.	Subsection	Particulars	Q'ty	Tender price			
				FOB Prices US$	Transportation US$	Erection US$	Total US$
1	6A	Water pumps with electric motors and accessories	2 sets				
2	"	Outlet valves	2 sets				
3	"	Check valves	2 sets				
4	6B	Discharge pipe	1 lot				
5	6C	Fixed trash racks	2 sets				
6	6D	Roller gate and hoist	1 set				
7	6E	Slide gates and hoists					
8	6F	Electrical equipment	1 lot				
Total							
9	6G	Distribution line	1 lot				
Grand total							

NOTE: The Contract value for the distribution line only shall be the pro rata base and adjusted in accordance with the quantities of works.

SCHEDULE II RATES AND PRICES FOR 22KV DISTRIBUTION LINE

The present quantities noted in the Schedule are provisional only. The final quantities for the various items will be established in accordance with the results of surveys, which are also included in this contract.

(US$)

Description	Q'ty	FOB price		Transportation		Erection		Total
		Rate	Total	Rate	Total	Rate	Total	
1. Conductor and earthwire								
1) Conductor HAl 55sq. mm	28.5 km							
2) Earthwire, steel 22sq.mm	9.5 "							
Total								
2. Insulators and fittings								
1) Pin type insulator	387 sets							
2) Strain insulator set	72 "							
3) Earthwire suspension set	108 "							
4) Earthwire strain set	24 "							
Total								
3. Supports								
1) Type A with fittings	99 sets							
2) " B "	9 "							
3) " C "	2 "							
4) " D "	2 "							
5) " E "	2 "							
6) " E' "	1 "							
7) " F "	6 "							
Total								

Description	Q'ty	FOB Price		Transportation		Erection		Total
		Rate	Total	Rate	Total	Rate	Total	
4. Spare materials								
1) Type A support with fittings	3 sets							
2) " B " "	1 "							
3) Conductor, H.Al 55 sq.mm	0.6 km							
4) Earthwire, steel 22 sq.mm	0.2 "							
5) Joint for H.Al 55 sq.mm	3 sets							
6) Repair sleeves for H.Al 55 sq.mm	6 "							
7) Pin type insulator set	20 "							
8) Strain insulator set	6 "							
9) Earthwire suspension set	8 "							
10) " strain set	2 "							
11) Suspension insulator unit	30 "							
Total								
5. Tools								
1) Portable hand-operated compressor with dies for H.Al 55 sq.mm and steel 22 sq.mm	1 set							
2) Tensioning device	8 sets							
Total								

Description	Q'ty	FOB Price		Transportation		Erection		Total
		Rate	Total	Rate	Total	Rate	Total	
6. Transformers and switchgears with accessories and spare parts								
1) 50 KVA transformers	6 sets							
2) Fusible disconnecting switches	18 Nos.							
3) Lightning arresters	18 "							
4) Disconnecting switches	2 sets							
5) Power cable and earthing materials	1 lot							
Total								
7. Concrete and materials								
1) Concrete for transformer foundation	11 m^3							
2) Concrete logs	132 Nos.							
3) Anchor block for stay wire	104 Nos.							
Total								
8. Profile survey	9.5 km							
9. Route clearing	7.5 km							
Grand total								

SCHEDULE III WEIGHT

Item No.	Subsection	Particulars	Quantity	Weight	
				Unit	Total
1	6A	Water pumps with electric motors and accessories	2 sets		
2	"	Outlet valves	2 sets		
3	"	Check valves	2 sets		
4	6B	Discharge pipe	1 lot		
5	6C	Fixed trash racks	2 sets		
6	6D	Roller gate and hoist	1 set		
7	6E	Slide gates and hoists			
8	6F	Electrical equipment	1 lot		
9	6G	Distribution line	1 lot		

SCHEDULE - IV

TECHNICAL PARTICULARS

The following particulars shall be filled in by the Tenderer for such article hereunder given. These particulars shall be binding to the Tenderer and shall not be departed from without written permission of the Government.

Especially the articles marked by (*) shall be guaranteed by the Tenderer and no alternation will be permissible.

Subsection 6A Pumping equipment

I. Water pumps

1.	Maker's name	
2.	Number	2
3.	Type	Submerged tubular vertical type
*4.	Normal displacement at 21 m total head	28.5 m^3/min.
5.	Normal speed	r.p.m.
*6.	Efficiency	
	(a) 120% displacement	%
	(b) 100% "	%
	(c) 80% "	%
	(d) 60% "	%
	(e) 40% "	%
*7.	Total head	
	(a) 120% displacement	m
	(b) 100% "	m
	(c) 80% "	m
	(d) 60% "	m
	(e) 40% "	m
	(f) 0% " (shut-off head)	m
8.	Cooling water or oil for bearings (if needed)	liter/min.

9.	Maximum temperature of main bearings	°C
10.	Volume of lubricating oil for bearing	liter
11.	Impeller - diameter	m
	- number of blades	
12.	Materials of impeller, casing and shaft	

II. Electric Motors

1.	Maner's name	
2.	Number	2
3.	Type	
*4.	Guaranteed rated output (shaft output)	KW
5.	Rated voltage	380V
6.	Rated frequency	50 Hz
7.	Rated full load current	A
8.	No load current	A
9.	Synchronous speed	r.p.m.
10.	Speed at rated output	r.p.m.
11.	Power factor at rated output	%
*12.	Starting torque	kg - m
13.	Breakdown torque	kg - m
*14.	Maximum starting current	A
*15.	Efficiency	
	(a) 100% load	%
	(b) 80% load	%
	(c) 60% load	%
	(d) 40% load	%
*16.	Maximum temperature	
	(a) Stator winding	°C
	(b) Insulating oil	°C
17.	Type of bearing	
18.	Quantity of insulating oil	
	(a) motor only	liter
	(b) motor with oil tank and oil pipe line	liter

19. Weights

(a)	Roter complete	kg
(b)	Total weight per unit	kg

Subsection 6B Discharge pipe

1. Maker's name
2. Used steel material and strength

Subsection 6C Fixed trash racks

1.	Maker's name	
2.	Number	2
*3.	Design load	ton/m^2
4.	Used steel material and strength	

Subsection 6D Roller gate and hoist

1.	Maker's name	
2.	Number	1
3.	Used steel material and strength	
4.	Hoisting capacity of electric hoist	
5.	Motor capacity of electric hoist	

Subsection 6E Slide gate and hoist (each gate if needed)

1. Maker's name
2. Number
3. Used steel material and strength
4. Hoisting capacity of hoist

Subsection 6F Electrical equipment

I. Transformer

1.	Maker's name		
2.	Number		1
*3.	Continuous rated output		500KVA
4.	Rated voltage (no-load)	1 ry	23F-22F-21R-20F KV
		2 ry	380R-220V

5.	Number of phase	three phase
6.	Rated frequency	50 Hz
*7.	No-load loss at normal voltage & frequency	W
*8.	Load loss at 75°C	W
*9.	Percent impedance voltage (75°C at normal ratio tap)	%
10.	No-load current at rated voltage	%
*11.	Maximum temperature rise	
	(a) of oil by thermometer	°C
	(b) of winding by resistance	°C
*12.	Efficiency (at 75°C, p.f. = 1.0)	
	100% load	%
	80% load	%
	60% load	%
	40% load	%
*13.	Inherent voltage regulation at rated output, 75°C and rated frequency	
	(a) p.f. 1.0	%
	(b) p.f. 0.85	%
14.	Volume of insulating oil	liter
15.	Weight	
	(a) Core and coils	ton
	(b) Tank and fittings	ton
	(c) Oil	ton
	(d) Total weight	ton

II. Power fuse

1.	Maker's name	
2.	Number	
3.	Type	
4.	Rated voltage	24 KV
5.	Rated current	A
*6.	Rupturing capacity	KVA
7.	Weight per phase	kg

III. Disconnecting switch

1.	Maker's name	
2.	Number	
3.	Type	
4.	Rated voltage	24 KV
5.	Rated current	A
*6.	Maximum withstand voltage	
	(a) dry	KV
	(b) wet	KV
*7.	Positive impulse withstand voltage (dry)	KV
8.	Exciting or charging current breaking capacity	A
9.	Total weight	kg

IV. Lightning arresters

1.	Maker's name	
2.	Number	
3.	Type	
4.	Rated voltage	KV
*5.	Power frequency break down voltage	KV
*6.	Impulse break down voltage	KV
*7.	Discharge current	A
8.	Weight per phase	kg

V. Metering outfit

1.	Maker's name	
2.	Number	
3.	Type	
4.	Rated voltage	
5.	Voltage ratio	
6.	Current ratio	
*7.	Accuracy class	
*8.	Rated volt-ampere	
	(a) Potential transformer	VA

	(b) Current transformer	VA
*9.	Over current strength for 1 second	times the rated lry current
*10.	Maximum withstand voltage (dry)	KV
*11.	Positive impulse withstand voltage (dry)	KV
12.	Volume of insulating oil	liter
13.	Total weight	kg

VI. Cubicle (each type)

1. Maker's name
2. Type and reference
3. Weight
4. Other information such as followings:-

   Instructions for control system.

   Instructions of static condenser, starting equipment including reactor.

   Instructions of circuit breakers, current transformers, potential transformers, instruments and relays of each type.

   List of instruments, relays etc., mounted on each cubicle respectively.

Subsection 6G Distribution line

Maker's name and technical particulars shall be stated here for major equipment and materials.

SCHEDULE - V

DEVIATIONS FROM SPECIFICATION

Page No.	Section & Clause	'Detail of Deviation	Reason for Deviation

SCHEDULE - VI

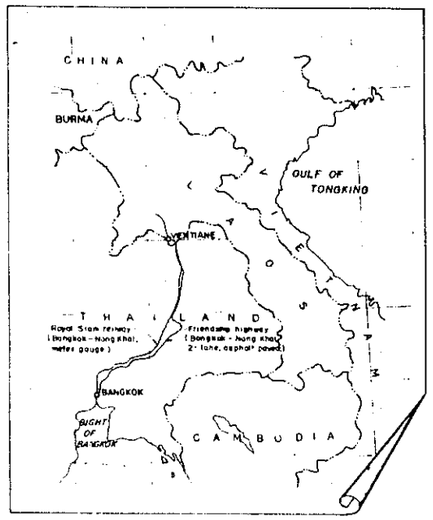
DRAWINGS TO BE SUBMITTED

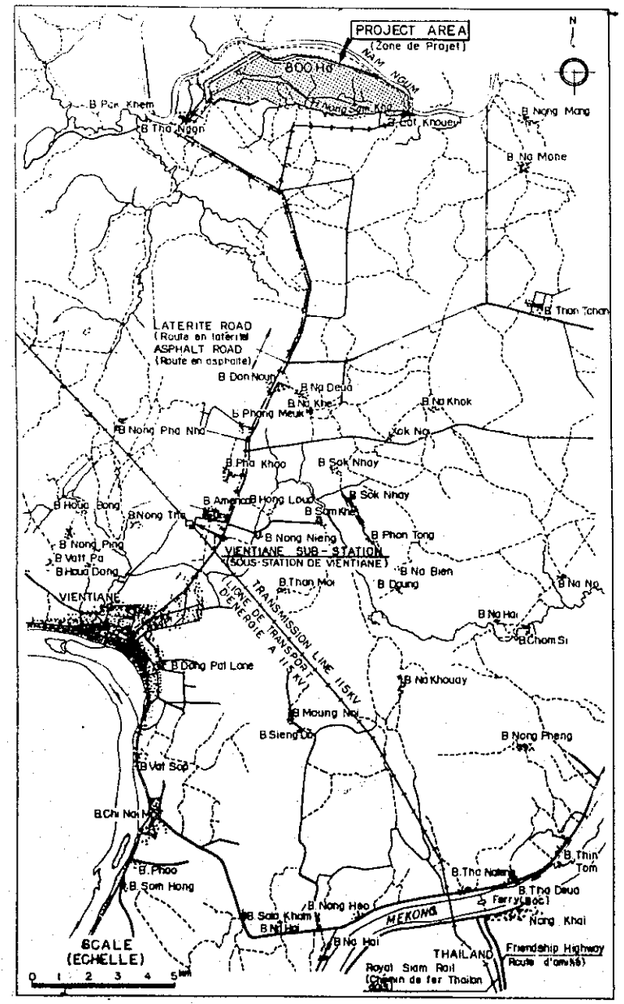
Section	Drawing No.	Description of Drawings	Remark

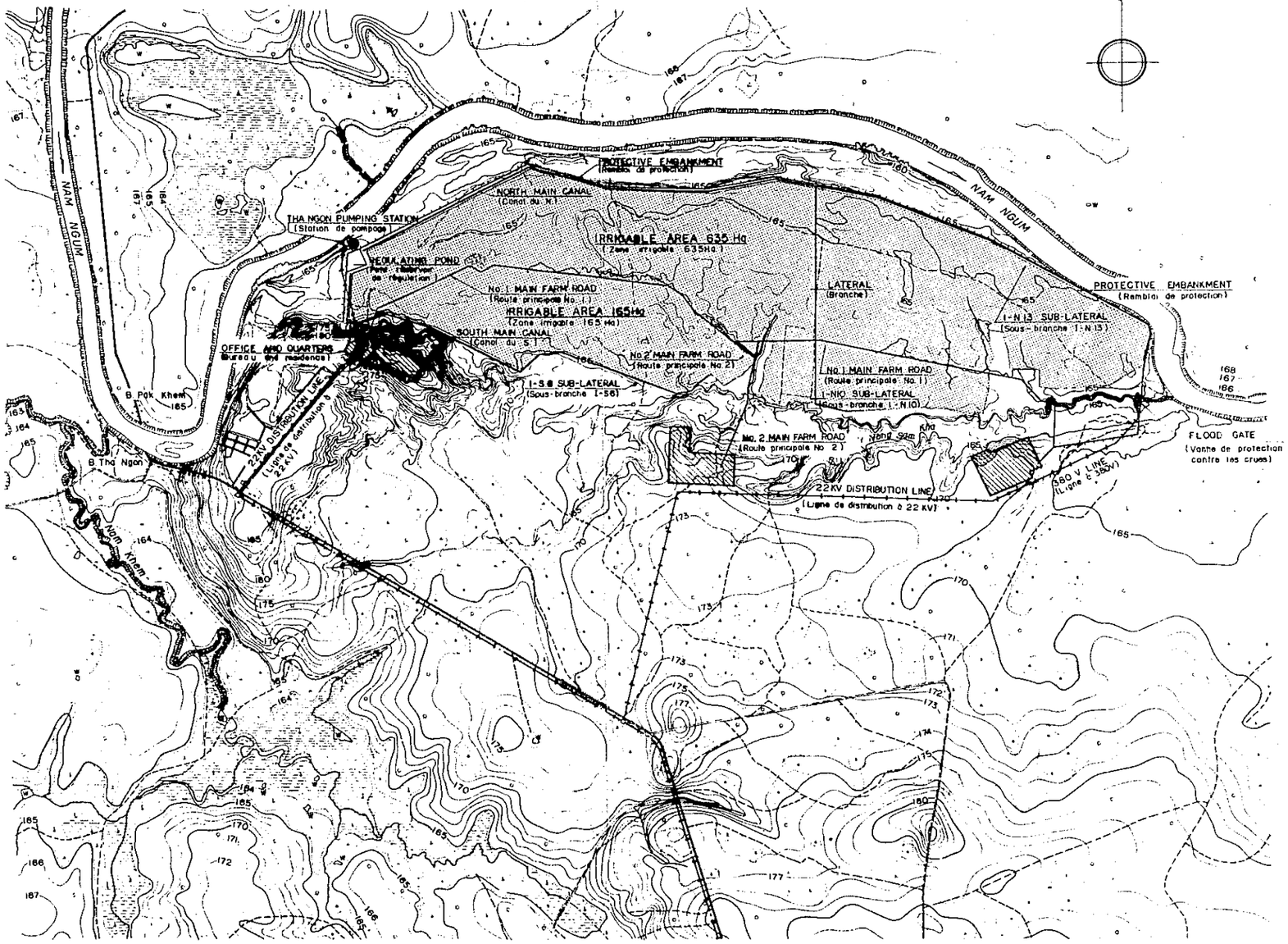
SECTION 8

DRAWINGS

	Drawing Number	Titel
1	0001	Location Map
2	1002	Tha Ngon Pumping Station, Plan and Profile
3	1005	- ditto - Intake and Sump (1)
4	1006	- ditto - Intake and Sump (2)
5	1012	- ditto - Regulator
6	2025	Main Canal and Lateral, Turnout
7	2026	Main Canal, No.10 Turnout
8	2027	- ditto - Check Structure
9	9001	Flood Gate, Roller Gate and Hoist
10	10001	Tha Ngon Pumping Station, Power Supply System and Schematic Condition Diagram
11	10002	- ditto - Arrangement of Equipment and Earthing System
12	10003	Distribution Line, Route Map and Typical Design of Supports
13	10004	Loading Clearance of Royal State Railway of Thailand







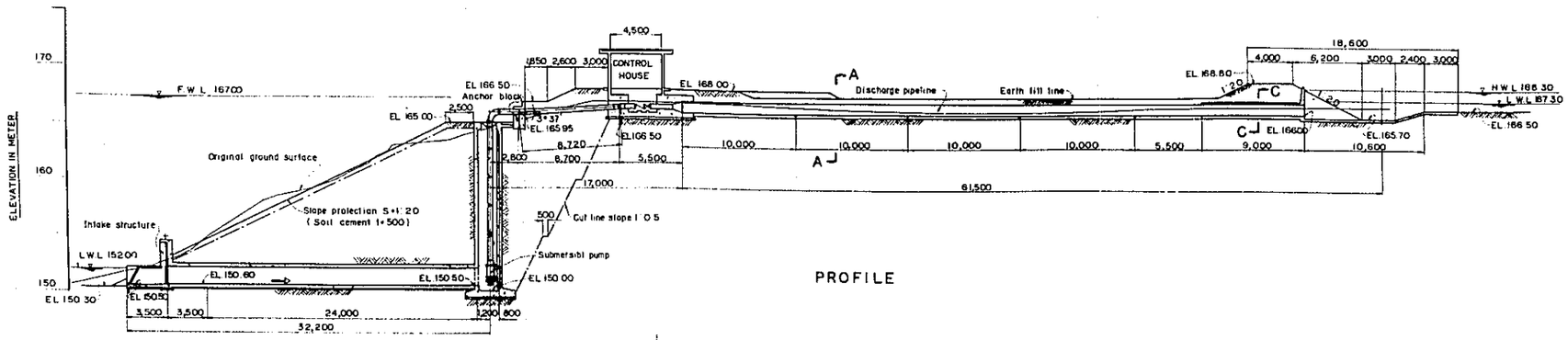
Main canal (Canaux principaux)
Lateral and sub-lateral (Branche et sous-branches)
Protective embankment (Remblai de protection)
Main farm road (Routes vicinales principales)
Power distribution line (Ligne de distribution électrique à 22 KV)
Power distribution line, not covered this project (Ligne de distribution électrique à 22 KV, non prévue dans ce projet)
Irrigable area (Zone irrigable)
Natural stream (Cours d'eau naturels)
Farmers residential area (Quartier résidentiel des fermiers)

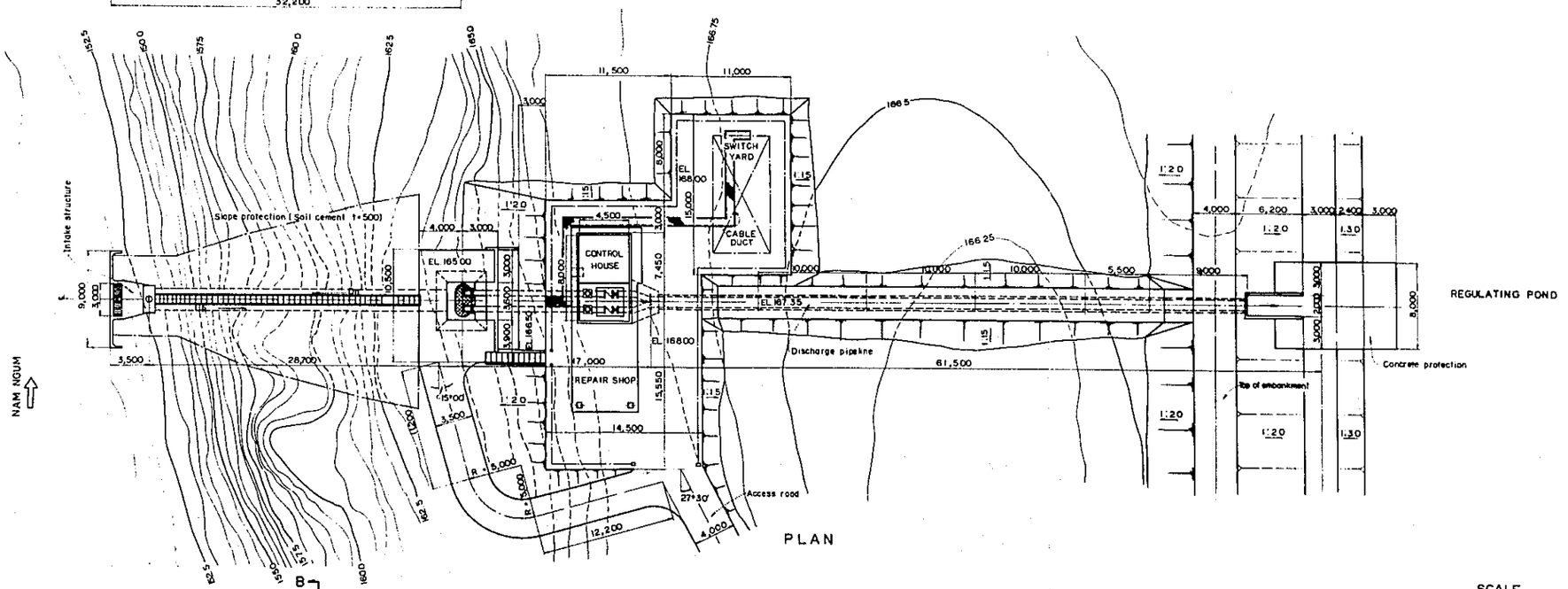
SCALE
0 1 2 km

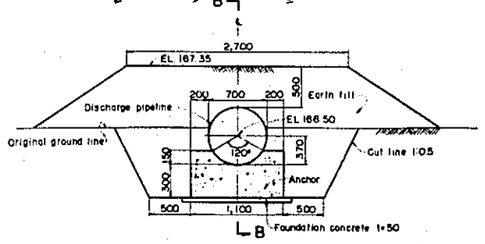
KINGDOM OF LAOS
THA NGON AGRICULTURAL DEVELOPMENT PROJECT

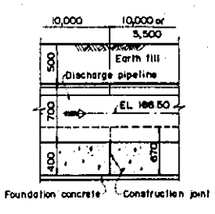
LOCATION MAP
(CARTE DE SITUATION)

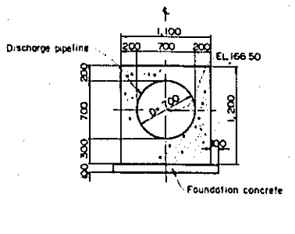
DRAWN SUBMITTED
CHECKED APPROVED
OVERSEAS TECHNICAL COOPERATION AGENCY
TOKYO MARCH 1969
0001







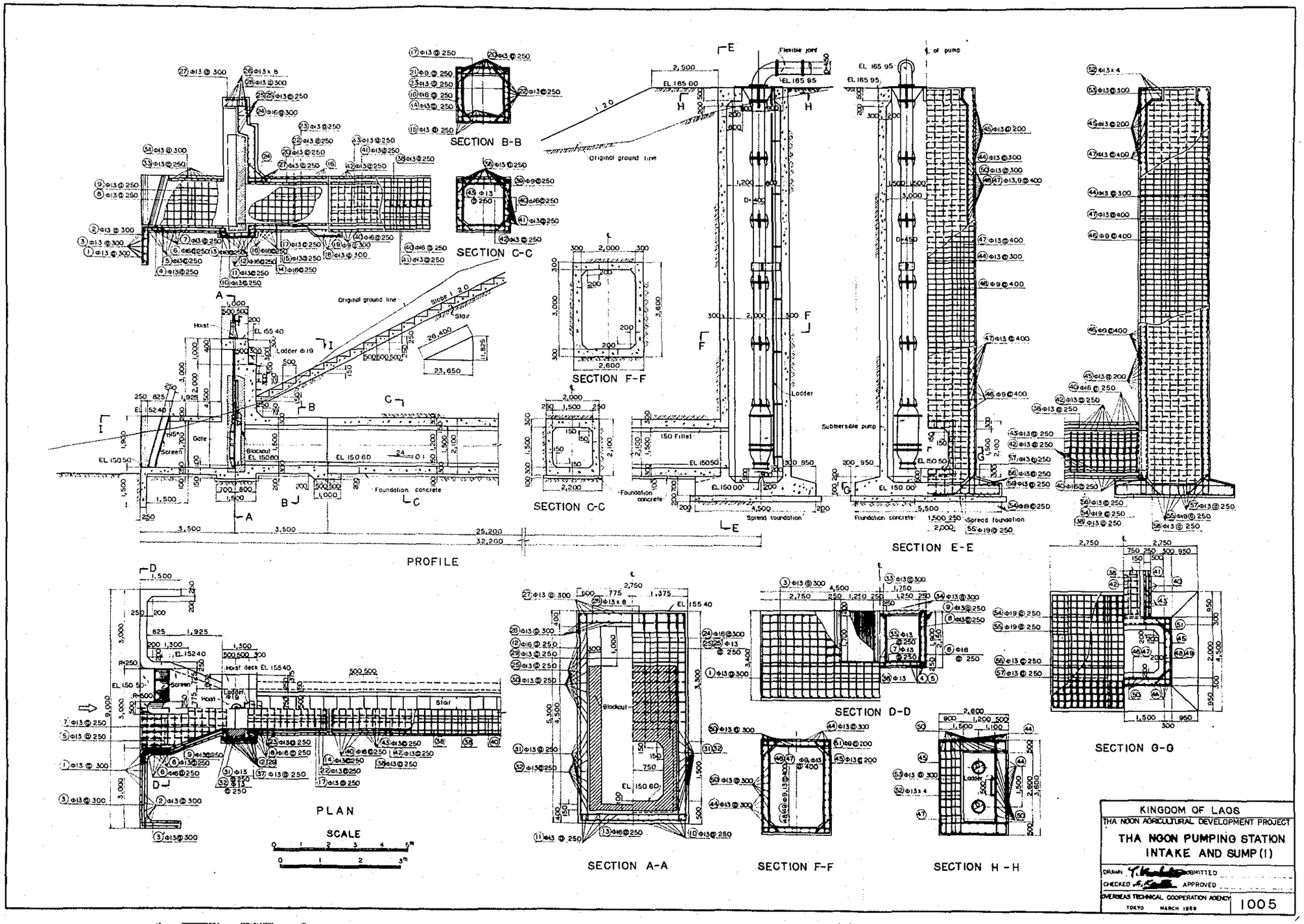


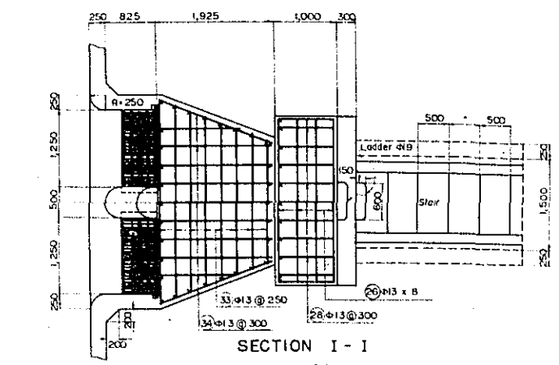


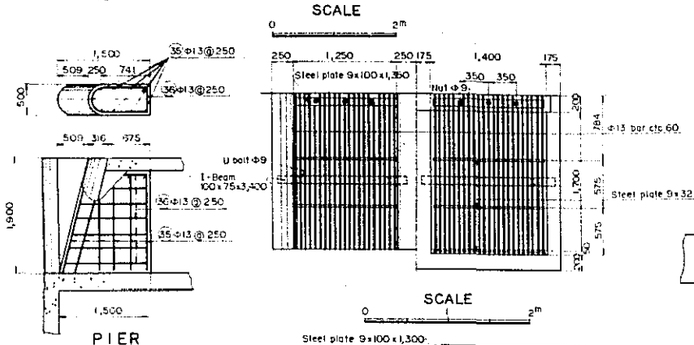
SCALE
0 1 2m

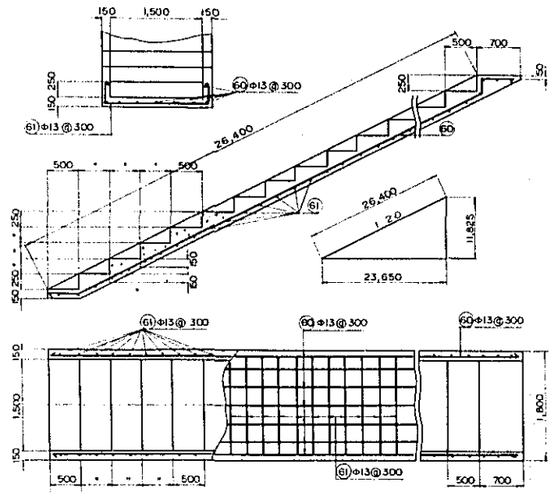
SCALE
0 5 10m

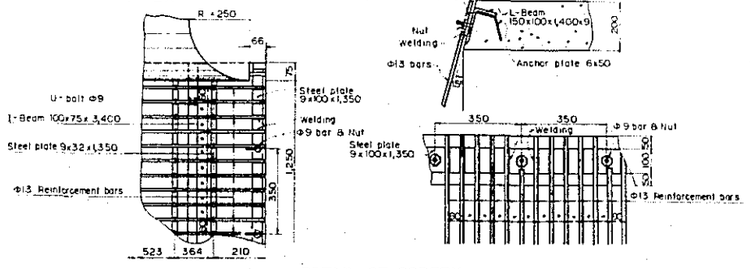
KINGDOM OF LAOS
THA NGON AGRICULTURAL DEVELOPMENT PROJECT
THA NGON PUMPING STATION
PLAN AND PROFILE
DRAWN
CHECKED
SUBMITTED
APPROVED
OVERSEAS TECHNICAL COOPERATION AGENCY
TOKYO MARCH 1988
1002

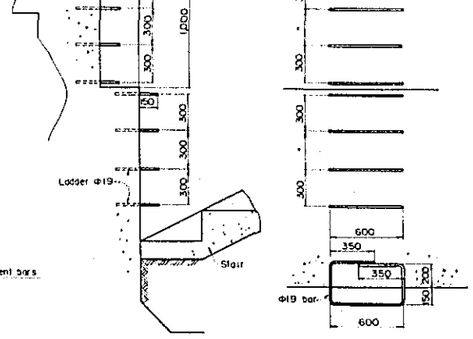

SECTION B-B
SECTION C-C
SECTION F-F
SECTION C-C
SECTION E-E
PROFILE
PLAN
SECTION D-D
SECTION G-G
SECTION A-A
SECTION F-F
SECTION H-H
Original ground line
Slope 1:2.0
Stair
Hoist
Ladder
Screen
Gate
Blockout
Foundation concrete
Spread foundation
Flexible joint
Submersible pump
Ladder
Stair
Hoist deck
KINGDOM OF LAOS
THA NGON AGRICULTURAL DEVELOPMENT PROJECT
THA NGON PUMPING STATION
INTAKE AND SUMP (1)
DRAWN
CHECKED
SUBMITTED
APPROVED
OVERSEAS TECHNICAL COOPERATION AGENCY
TOKYO MARCH 1989
1005











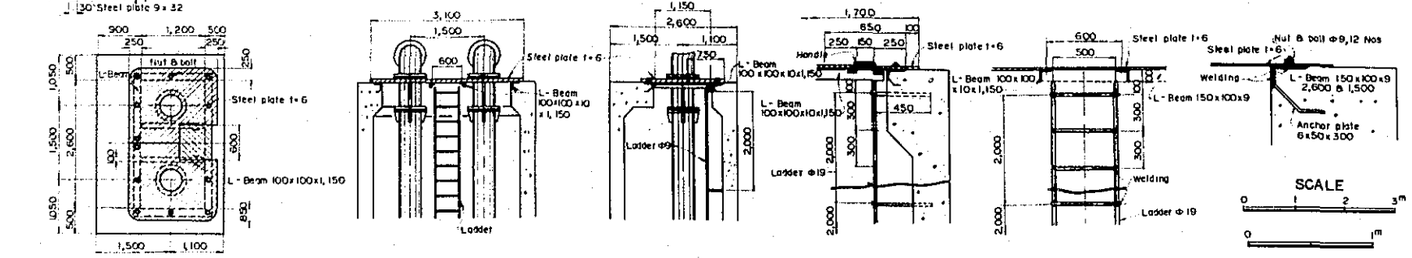


TABLE OF REINFORCEMENT BARS

MARK	Φ	LENGTH	NOS	T LENGTH	U WEIGHT	TOTAL WEIGHT	REMARKS
1	13	2.36	11	25.96	1.042	27.05	
"	"	3.26	30	97.80	"	101.91	
2	"	1.66	11	18.26	"	19.03	
"	"	3.26	28	91.28	"	95.12	
3	"	12.18	6	73.08	"	76.15	
"	"	5.56	12	66.72	"	69.53	
"	"	3.26	12	39.12	"	40.77	
3'	"	1.66	22	36.52	"	38.06	
4	"	3.36	8	26.88	"	28.01	
"	"	3.61	4	14.44	"	15.05	
"	"	2.41	4	9.64	"	10.05	
5	"	3.66	8	29.28	"	30.51	
"	"	3.61	4	14.44	"	15.05	
"	"	2.41	4	9.64	"	10.05	
6	16	8.74	4	34.96	1.578	55.17	
"	"	7.94	8	63.52	"	100.24	
7	13	3.66	4	14.64	1.042	15.26	
"	"	2.66	8	21.28	"	22.18	
8	"	2.26	24	54.24	"	56.52	
9	"	4.01	30	120.30	"	125.36	
10	"	2.31	12	27.72	"	28.89	
11	"	1.56	12	18.72	"	19.51	
12	16	14.28	12	170.62	1.578	269.56	
13	"	2.92	6	17.52	"	27.65	
14	13	3.66	9	32.94	1.042	34.33	
15	"	3.26	9	29.34	"	30.58	
16	16	9.64	13	125.32	1.578	197.76	
17	13	2.16	28	56.16	1.042	58.52	
18	"	2.21	14	30.94	"	32.24	
19	"	2.16	8	17.28	"	18.01	
20	"	3.26	18	58.68	"	61.14	
21	9	1.03	52	53.56	0.499	26.73	
22	13	3.26	24	78.24	1.042	81.53	
23	"	2.26	26	58.76	"	61.23	
24	16	3.62	7	25.34	1.578	39.99	
"	"	4.22	7	29.54	"	46.62	
24'	9	1.18	11	12.98	0.499	6.48	
25	13	4.46	2	8.92	1.042	9.30	
"	"	5.06	8	40.48	"	42.18	
25'	"	2.86	10	28.60	"	29.81	
26	"	3.86	4	15.44	"	16.09	
"	"	2.86	4	11.44	"	11.92	
27	"	1.56	11	17.16	"	17.88	
28	"	1.16	11	12.76	"	13.30	
29	"	2.51	12	30.12	"	31.39	
30	"	1.06	4	4.24	"	4.42	
"	"	1.36	16	21.76	"	22.68	
31	"	2.31	18	41.58	"	43.33	
32	"	1.51	18	27.18	"	28.33	
33	"	2.61	8	20.88	"	21.76	
34	"	2.06	5	10.30	"	10.74	
"	"	2.16	2	4.32	"	4.51	
"	"	1.41	4	5.64	"	5.88	
35	"	2.56	6	15.36	"	16.01	
"	"	2.36	1	2.36	"	2.46	
"	"	2.46	2	4.92	"	5.13	
"	"	2.86	2	5.72	"	5.96	
36	"	3.36	7	23.52	"	24.51	
37	"	0.66	32	21.12	"	22.00	
38	"	1.00	36	396.00	"	412.64	
"	"	15.56	36	560.16	"	279.88	
39	9	0.88	164	144.32	0.499	72.02	
"	"	0.88	220	193.60	"	96.61	
40	16	4.42	82	362.44	1.578	571.93	
"	"	4.42	110	486.20	"	767.23	
41	13	11.00	24	264.00	1.042	275.09	
"	"	15.58	24	372.92	"	388.59	
42	"	2.16	90	194.40	"	202.57	
"	"	2.16	110	237.60	"	247.56	
43	"	2.21	90	198.90	"	207.26	
"	"	2.21	110	243.10	"	253.31	
44	"	17.33	40	693.20	"	722.32	
45	"	14.88	75	1,116.00	"	1,162.68	
46	9	3.63	74	268.62	0.499	134.05	
47	13	3.71	76	281.96	1.042	293.81	
48	9	2.68	74	198.32	0.499	98.97	
49	13	2.76	76	209.76	1.042	218.57	
50	"	18.19	40	727.60	"	758.16	
51	9	0.98	300	294.00	0.499	146.71	
52	"	6.10	4	24.40	"	12.18	
53	"	3.06	12	36.72	"	18.33	
54	10	8.96	23	206.08	2.226	458.74	
55	"	10.01	18	180.18	"	401.08	
56	13	4.56	23	104.88	1.578	165.50	
57	"	6.52	18	117.36	"	185.20	
58	"	1.26	46	57.96	"	91.46	
59	"	2.91	36	104.76	"	165.32	
60	"	32.98	9	296.82	"	468.59	
61	"	2.58	87	222.72	"	351.46	
"	"	2.26	1	2.26	"	3.57	
"	"	1.96	3	5.88	"	9.28	
		TOTAL				12,022.12 kg + 12.03 ton	

KINGDOM OF LAOS

THA NGON AGRICULTURAL DEVELOPMENT PROJECT

THA NGON PUMPING STATION INTAKE AND SUMP (2)

DRAWN _____ SUBMITTED _____

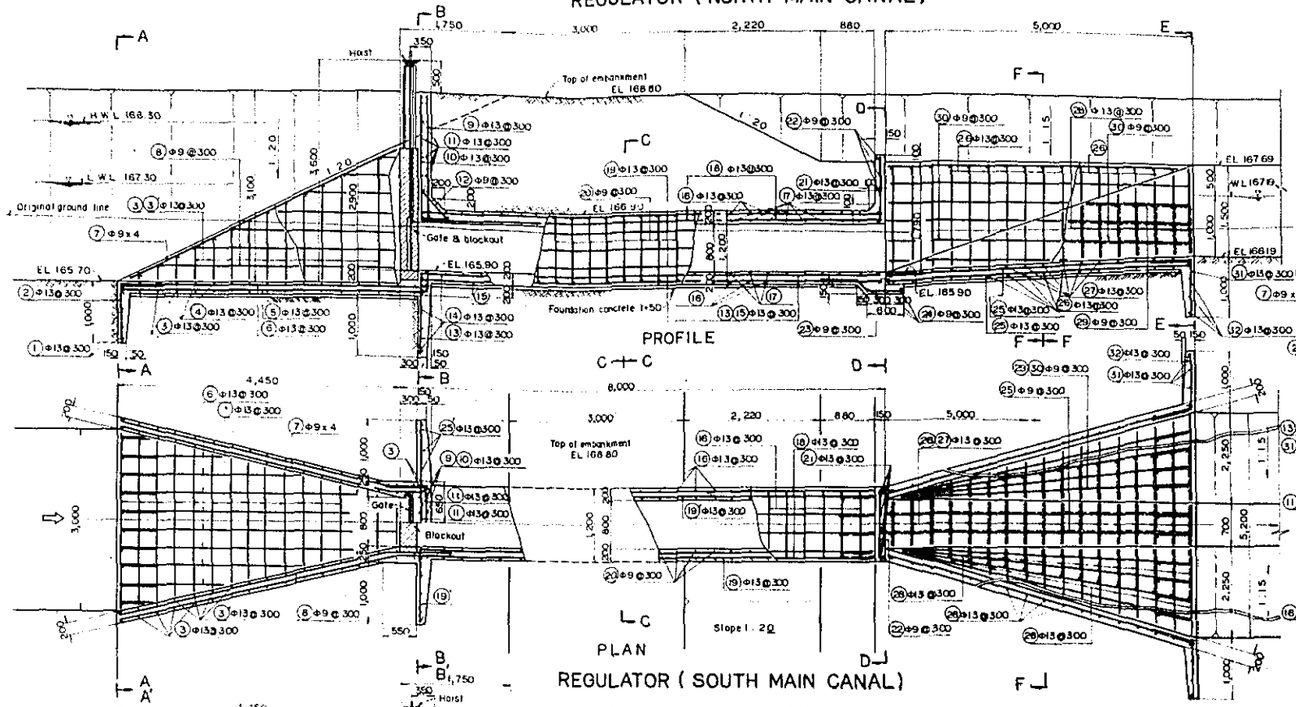
CHECKED _____ APPROVED _____

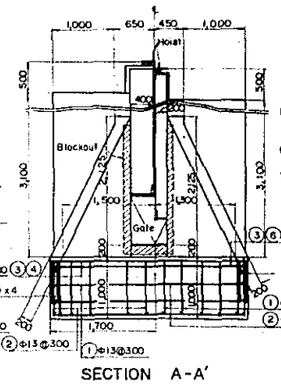
OVERSEAS TECHNICAL COOPERATION AGENCY

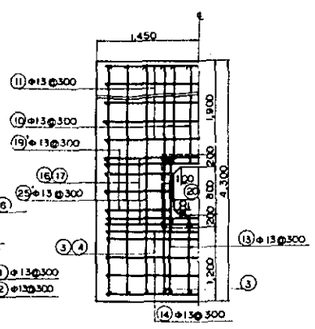
TOKYO MARCH 1968

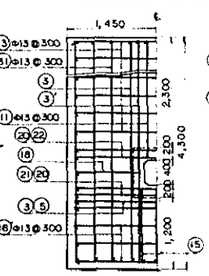
1006

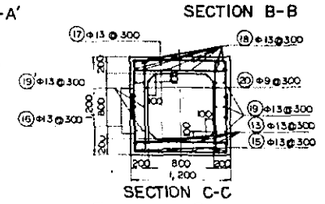
REGULATOR (NORTH MAIN CANAL)

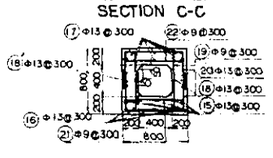




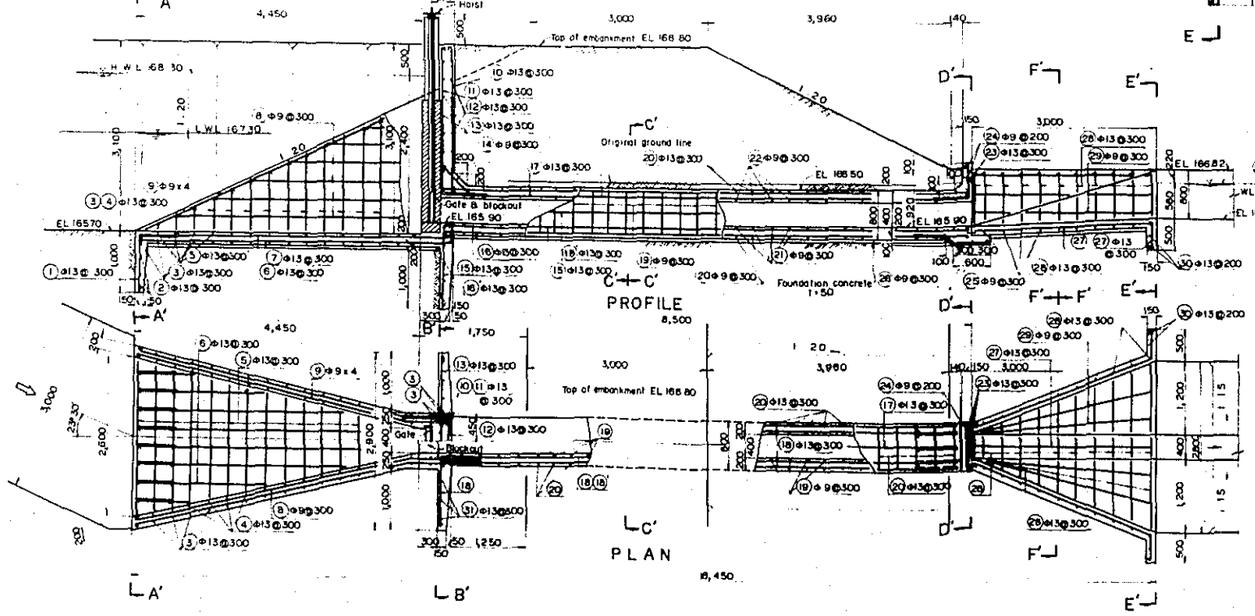


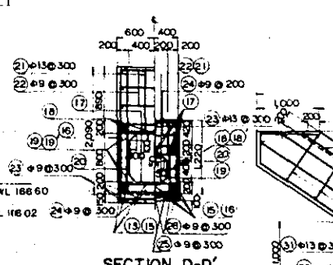


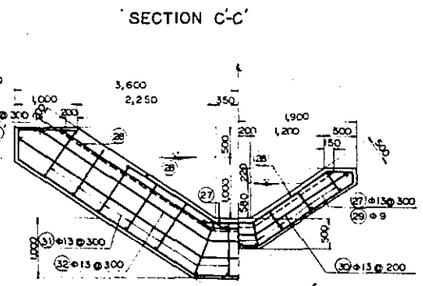


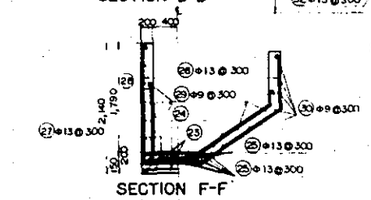


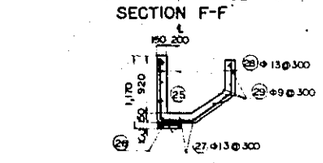
REGULATOR (SOUTH MAIN CANAL)











SCALE

0 1 2 3m

0 1 2m

KINGDOM OF LAOS

THA NGON AGRICULTURAL DEVELOPMENT PROJECT

THA NGON PUMPING STATION

REGULATOR

DRAWN [redacted] SUBMITTED

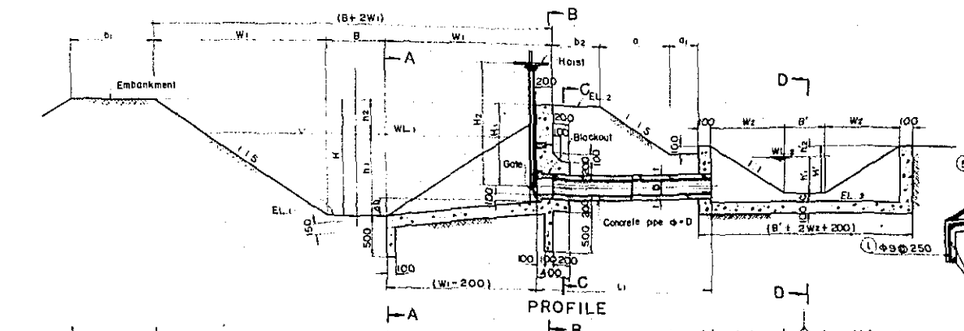
CHECKED [redacted] APPROVED

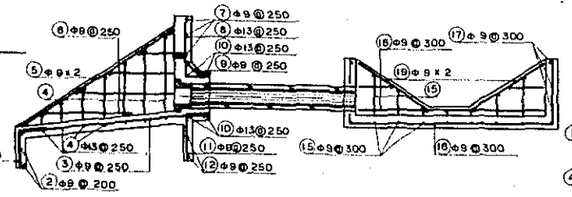
OVERSEAS TECHNICAL COOPERATION AGENCY

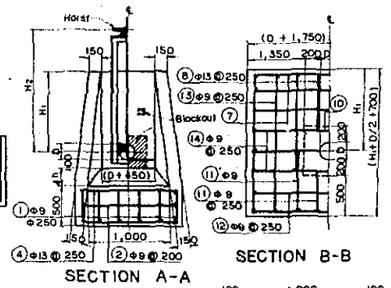
TOKYO MARCH 1989

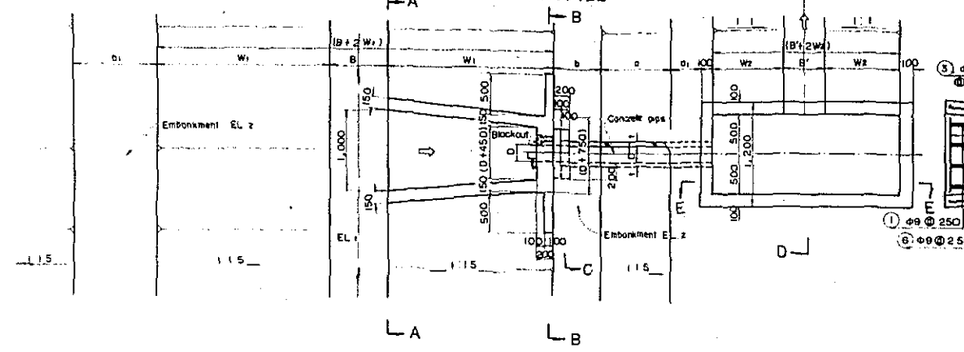
1012

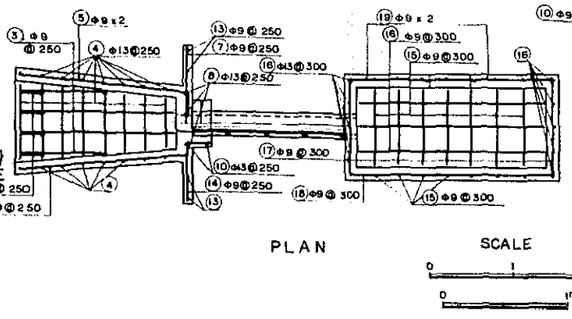
TURNOUT











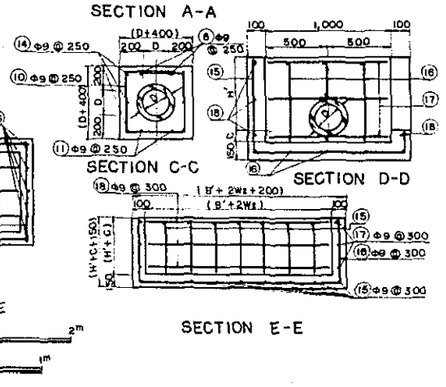


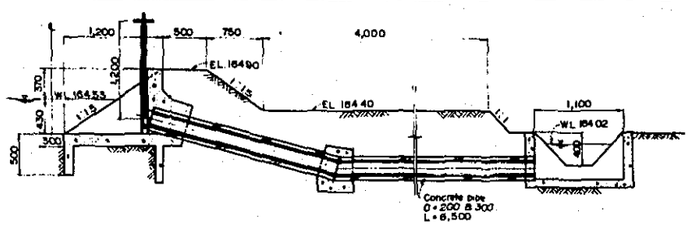
TABLE OF DIMENSION (MM)

	TO NO	STATION	B	W1	b1	b2	H	h1	h2	H1	H2	Δh	a	a1	D
NORTH MAIN CANAL	N-1	No 1+35.80	700	2,100	500	1,000	1,400	1,000	400	1,000	1,500	200	1,005	195	200
	2	No15+ 1.30	"	"	"	"	"	980	410	"	"	"	825	375	"
	3	No21+18.80	600	1,950	"	"	1,300	1,000	300	900	1,400	"	845	55	"
	4	No29+32.38	"	"	"	"	"	980	320	"	"	"	460	220	"
	5	No39+28.45	"	"	"	"	"	970	330	"	"	"	630	70	"
	6	No48+ 3.07	"	"	"	"	"	940	380	"	"	"	485	235	"
	7	No56+21.57	"	"	"	"	"	920	380	"	"	"	840	380	"
	8	No69+11.07	"	1,800	"	"	1,200	890	510	800	"	"	880	40	"
	9	No77+41.00	"	"	"	"	"	860	340	"	"	"	485	235	"
	11	No106+48.13	400	1,350	"	"	800	600	300	850	1,200	"	510	160	300
	12	No111+53.40	300	1,200	"	"	800	490	310	600	"	"	480	220	200
NORTH-L	L-1	No. 4+12.00	"	"	4,000	4,000	"	480	520	800	"	"	810	390	"
	2	No. 8+55.00	"	"	"	"	"	430	570	750	"	"	780	420	300
	3	No. 8+55.00	"	"	"	"	"	"	"	800	"	"	840	380	200
SOUTH MAIN CANAL	S-1	No 3+44.57	400	1,350	500	1,000	900	550	350	700	"	"	485	235	"
	2	No23+31.07	"	"	"	4,000	"	540	380	"	"	"	1,215	485	"
	3	No32+ 0.48	"	"	"	"	"	520	380	"	"	"	1,320	380	"
	A	No40+22.04	300	1,200	"	"	800	510	290	800	"	"	375	526	"
	5	No47+ 8.41	"	"	"	"	"	490	310	610	"	-10	405	295	"

	TO NO	l	B'	W2	h1	h'2	H'	C	WL1	WL2	EL.1	EL.2	EL.3	O.L	GATE
NORTH MAIN CANAL	N-1	50	300	400	220	180	400	470	167.15	166.80	166.15	167.55	166.11	166.21	C
	2	"	"	"	200	200	"	90	167.04	"	166.05	167.45	166.01	166.61	"
	3	"	"	"	"	"	"	160	166.93	166.70	165.95	167.23	165.92	166.42	"
	4	"	"	"	280	120	"	310	166.82	166.80	165.84	167.14	166.21	166.51	"
	5	"	"	"	200	200	"	250	166.66	166.80	165.72	167.02	166.06	166.15	"
	6	"	"	"	180	220	"	100	166.57	"	165.63	166.83	165.87	166.87	"
	7	"	"	"	220	180	"	750	166.46	166.20	165.54	166.84	165.23	166.33	"
	8	"	"	"	150	250	"	600	166.28	166.00	165.39	166.59	165.25	166.35	"
	9	"	"	"	200	200	"	600	166.17	166.10	165.31	166.51	165.30	166.40	"
	11	70	"	"	240	160	"	100	165.70	165.60	165.10	166.00	164.87	165.75	"
	12	50	"	"	"	"	"	100	165.47	165.40	164.98	165.78	164.65	165.59	"
NORTH-L	L-1		"	"	280	120	"	160	165.09	165.05	164.61	166.61	164.61	165.00	"
	2	70	"	"	230	170	"	150	164.93	164.02	163.81	164.81	163.81	164.00	"
	3	50	"	"	270	130	"	140	"	"	"	"	163.20	"	"
SOUTH MAIN CANAL	S-1	"	"	"	240	180	"	290	166.60	166.56	166.05	166.95	166.05	166.61	"
	2	"	"	"	220	180	"	100	166.19	165.65	165.65	166.55	165.53	166.38	"
	3	"	"	"	280	120	"	100	166.62	165.50	165.50	166.40	164.74	166.21	"
	4	"	"	"	220	180	"	250	165.87	165.83	165.38	166.18	165.38	166.51	"
	5	"	"	"	"	"	"	540	165.71	165.68	165.22	166.02	165.12	166.32	"

TABLE OF REINFORCEMENT BARS

			N-1 , N-2				N-3 , N-4 , N-5 , N-6 , N-7				N-8 , N-9				N-11,N-12 , N10-L-1,2,3 S-1, S-2, S-3, S-4, S-5				
MARK	Φ	U. WEIGHT	LENGTH	NOS	T. LENGTH	WEIGHT	LENGTH	NOS	T. LENGTH	WEIGHT	LENGTH	NOS	T. LENGTH	WEIGHT	LENGTH	NOS	T. LENGTH	WEIGHT	REMARKS
1	9	0.499	0.83	6	4.98	2.49	0.83	6	4.98	2.49	0.83	6	4.98	2.49	0.83	6	4.98	2.49	
2	"	"	1.35	2	2.70	1.35	1.35	2	2.70	1.35	1.35	2	2.70	1.35	1.35	2	2.70	1.35	
3	"	"	2.48	2	4.96	2.48	2.48	2	4.96	2.48	2.28	2	4.56	2.28	1.33	2	2.66	1.33	
"	"	"	2.63	2	5.26	2.63	2.58	2	4.36	2.18	2.38	2	4.76	2.38	1.18	2	2.36	1.18	
"	"	"	2.18	2	4.36	2.18	2.18	2	5.16	2.58	1.98	2	3.96	1.98	0.78	2	1.56	7.79	
4	13	1.042	2.41	8	19.28	20.09	2.31	8	16.48	19.28	2.28	7	15.52	16.49	1.63	4	6.52	6.80	
5	9	0.499	2.92	2	5.84	2.92	2.58	2	5.16	2.58	2.38	2	4.76	2.38	1.63	2	3.24	1.62	
6	"	"	1.08	8	8.64	4.32	1.08	8	8.64	4.32	1.10	6	6.60	3.30	1.03	4	4.12	2.06	
"	"	"	1.86	2	4.76	2.38	1.86	2	4.76	2.38	2.58	2	5.16	1.66	—	—	—	—	
7	"	"	2.03	3	6.09	3.04	2.03	3	6.09	3.04	2.03	2	4.06	2.03	2.03	2	4.06	2.03	
8	13	1.042	1.29	2	2.52	2.63	1.21	2	2.42	2.53	1.11	2	2.22	2.32	1.01	2	2.02	2.11	
"	"	"	3.46	2	8.92	7.21	3.46	2	8.92	7.21	3.36	2	6.72	7.01	2.76	1	2.76	2.86	
9	9	0.499	0.46	2	0.96	0.48	0.46	2	0.92	0.46	0.48	2	0.96	0.48	0.48	2	0.96	0.48	
10	"	"	3.36	1	3.36	1.69	3.36	1	3.36	1.69	3.36	1	3.36	1.68	3.36	1	3.30	1.69	
"	"	"	0.98	1	0.98	0.49	0.98	1	0.98	0.49	0.88	1	0.88	0.49	0.98	1	0.98	0.49	
11	"	"	0.93	2	1.86	0.93	0.93	2	1.86	0.93	0.93	2	1.86	0.93	0.93	2	1.86	0.93	
12	"	"	0.88	2	1.76	0.88	0.88	2	1.76	0.88	0.88	2	1.76	0.88	0.88	2	1.76	0.88	
"	"	"	1.98	2	3.96	1.98	1.98	2	3.96	1.98	1.88	2	3.76	1.88	1.98	2	3.96	3.90	
13	"	"	1.88	4	7.52	3.76	1.88	4	7.52	3.76	1.78	4	7.12	3.56	1.68	4	6.72	3.36	
14	"	"	0.83	6	5.58	2.79	0.83	6	5.58	2.79	0.83	6	5.58	2.79	0.83	6	5.58	2.79	
15	"	"	2.96	3	7.98	3.99	2.78	3	8.34	4.17	2.98	3	8.94	4.47	2.38	3	7.14	3.57	
16	"	"	2.83	5	14.14	7.06	3.03	5	15.15	7.56	3.23	5	16.15	8.07	2.63	5	13.15	6.57	
17	"	"	1.28	5	6.40	3.20	1.28	6	7.68	3.84	1.28	6	7.68	3.84	1.28	5	6.40	3.20	
18	"	"	1.18	3	3.54	1.77	1.18	4	4.72	2.36	1.18	4	4.72	2.36	1.18	2	2.36	1.18	
"	"	"	0.88	4	2.32	1.16	0.88	4	2.32	1.16	0.88	4	2.32	1.16	0.88	2	1.18	0.59	
19	"	"	1.18	2	2.32	1.16	1.38	2	2.76	1.38	1.48	2	2.96	1.48	1.18	2	2.36	1.18	
TOTAL			85.29 x 2 + 170.58 kg				TOTAL 85.90 x 5 = 429.50 kg				TOTAL 79.80 x 2 + 159.60 kg				TOTAL 62.53 x 10 = 625.3 kg				



PROFILE OF N-10-L No2,3 TURNOUT

KINGDOM OF LAOS

THA NOON AGRICULTURAL DEVELOPMENT PROJECT

MAIN CANAL
TURNOUT

DRAWN Y. Tanaka SUBMITTED

CHECKED [illegible] APPROVED

OVERSEAS TECHNICAL COOPERATION AGENCY
TOKYO MARCH 1968

2025

PROFILE

SECTION A-A

SECTION D-D

SECTION B-B

SECTION C-C

SECTION E-E

GENERAL PLAN

PLAN

PLAN OF DIVISION BOX

SECTION G-G

SECTION F-F

SECTION F'-F'

SECTION H-I

SECTION J-J

SECTION K-K

TABLE OF REINFORCEMENT BARS

MARK	⌀	LENGTH	NOS.	T LENGTH	U WEIGHT	WEIGHT	REMARKS
1	9	2.88	4	1.52	0.499	5.75	
"	"	2.38	2	4.76	"	2.38	
2	"	1.38	2	2.76	"	1.38	
3	13	1.91	2	3.82	1.042	3.98	
"	"	2.34	6	14.04	"	14.63	
4	9	2.68	2	5.36	0.499	2.68	
5	"	1.01	8	8.08	"	4.04	
6	13	1.56	6	9.36	1.042	9.76	
9	9	2.28	2	4.56	0.499	2.28	
10	13	1.75	10	17.50	1.042	18.24	
11	9	1.18	10	11.80	0.499	5.89	
12	"	1.28	10	12.80	"	6.39	
13	"	2.03	6	12.18	"	6.08	
14	"	1.18	10	11.80	"	5.89	
15	"	1.18	4	4.72	"	2.36	
15'	"	2.48	4	9.92	"	4.85	
16	"	1.78	4	7.12	"	3.56	
17	"	4.23	4	16.92	"	8.45	
"	"	1.33	2	2.66	"	1.33	
18	"	2.63	15	39.45	"	19.69	
"	"	0.83	18	14.94	"	7.46	
19	"	7.31	3	21.93	"	10.95	
"	"	9.31	2	18.62	"	9.30	
"	"	8.06	1	8.06	"	4.03	
20	"	4.78	2	9.56	"	4.77	
"	"	4.78	4	19.12	"	9.54	
"	"	2.73	2	5.46	"	2.73	
"	"	2.78	2	5.56	"	2.78	
21	"	1.98	6	11.88	"	5.93	
"	"	1.33	1	1.33	"	0.67	
22	"	2.45	3	7.35	"	3.67	
23	"	2.83	4	11.32	"	5.65	
"	"	1.13	1	1.13	"	0.57	
23	"	1.03	2	2.06	"	1.03	
24	"	2.83	2	5.66	"	2.83	
26	13	3.71	2	7.42	1.042	7.74	
"	"	4.56	2	9.12	"	9.51	
27	"	3.88	5	18.30	"	19.07	
28	9	3.68	5	18.40	0.499	9.19	
29	"	5.43	2	10.86	"	5.42	
30	"	0.83	10	8.30	"	4.15	
31	"	2.88	10	28.80	"	14.87	
"	"	1.08	2	2.16	"	1.08	
32	"	1.58	3	4.74	"	2.37	
"	"	0.73	2	1.46	"	0.73	
12	"	1.68	2	3.36	"	1.68	
TOTAL		27773 kg = 0.28 ton					

KINGDOM OF LAOS

THA NOON AGRICULTURAL DEVELOPMENT PROJECT

MAIN CANAL

NO. 10 TURNOUT

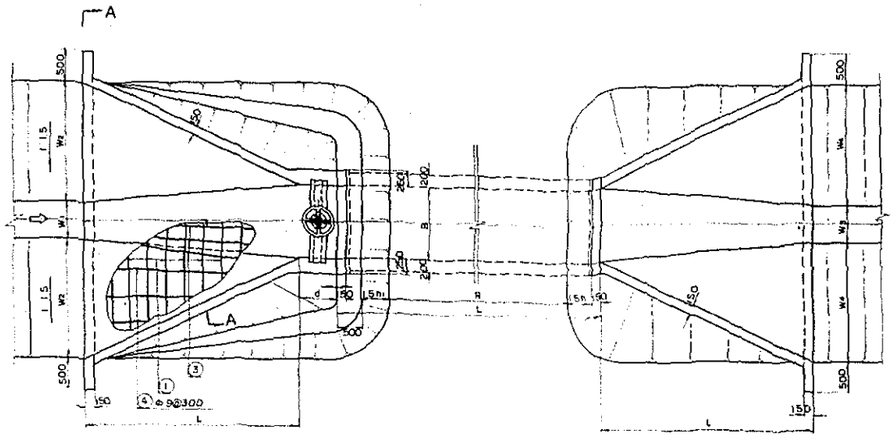
DRAWN Y. Tomiki SUBMITTED

CHECKED S. Kaneko APPROVED

OVERSEAS TECHNICAL COOPERATION AGENCY

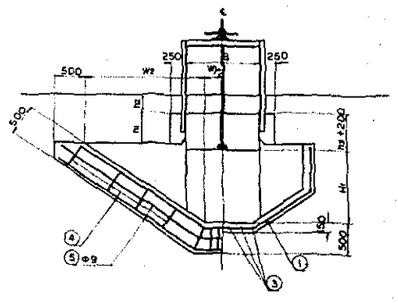
TOKYO MARCH 1969

2026

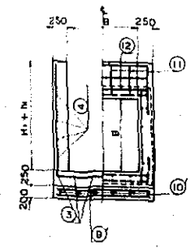


PLAN

PROFILE



SECTION A-A



SECTION B-B SECTION C-C

TABLE OF DIMENSION

	W1	H1	W2	L	d	B	h1	h2	h3	R	L	D	W3	H2	W4	EL 1 (m)	EL 2 (m)
N No 1CS	600	1,300	1,950	4,000	600	1,200	100	0	0	3,850	4,500	2,600	600	1,300	1,950	165.93	165.94
N No.2CS	600	1,300	1,950	3,500	600	1,200	100	0	0	6,350	7,000	2,600	600	1,300	1,950	165.83	165.64
N No 3CS	600	1,200	1,800	3,500	600	1,100	300	0	200	4,850	5,500	2,600	600	1,200	1,800	165.39	165.41
N No 4CS	800	1,200	1,800	2,500	500	600	0	200	200	4,250	5,500	2,000	400	900	1,350	165.23	165.45
N No 5CS	400	900	1,350	2,000	500	700	200	300	200	5,950	7,500	1,600	300	800	1,200	165.10	165.20
S No 1CS	400	900	1,350	2,000	500	700	0	0	0	700	1,000	1,600	400	800	1,200	165.50	165.52

TABLE OF REINFORCEMENT BAR

		N, No.1 CS			N, No 2 CS			N, No 3 CS			N, No.4 CS			N, No.5 CS			S, No.1 CS		
		INLET TRANSITION																	
NO.	Φ	LENGTH	NOS	WEIGHT	LENGTH	NOS	WEIGHT	LENGTH	NOS	WEIGHT	LENGTH	NOS	WEIGHT	LENGTH	NOS	WEIGHT	LENGTH	NOS	WEIGHT
1	13	5.10	14	74	5.10	12	64	4.78	11	55	4.52	9	42	3.53	8	29	3.53	8	29
2	13	4.76	2	10	4.76	2	10	4.76	3	15	4.16	2	9	3.86	2	8	3.46	2	7
3	9	5.06	6	15	4.56	6	13	4.56	6	13	3.43	5	8	2.96	4	6	2.96	4	6
4	9	5.20	8	20	4.70	8	18	4.70	8	18	3.58	8	14	3.08	6	9	3.08	6	9
5	9	6.45	2	6	6.45	2	6	6.10	2	6	6.10	2	6	4.81	2	5	4.81	2	5
SUB TOTAL				125			111			107			79			57			56
		BARREL																	
6	13	2.56	32	85	2.56	48	128	2.46	38	97	2.16	38	85	1.66	52	101	1.66	6	15
7	13	1.76	64	117	1.76	98	176	1.66	78	131	1.36	76	107	1.26	104	136	1.26	16	21
8	9	4.58	40	90	7.08	40	139	5.56	34	93	5.56	25	77	7.58	26	104	1.08	28	15
9	9	1.66	5	4	1.66	5	4	1.56	5	4	1.26	5	3	1.16	5	3	1.16	5	3
10	13	1.49	6	9	1.49	6	9	1.49	5	8	1.49	4	6	1.49	4	6	1.49	4	6
9'	8	1.88	5	4	1.88	5	4	1.58	5	4	1.28	5	3	1.18	5	3	1.18	5	3
10'	13	1.75	8	11	1.75	6	11	1.75	5	9	1.75	4	7	1.75	4	7	1.75	4	7
11	13	—	—	—	—	—	—	0.86	5	5	0.88	4	4	0.86	4	4	—	—	—
12	9	—	—	—	—	—	—	1.88	2	2	1.38	2	1	1.28	2	1	—	—	—
SUB TOTAL				320			471			353			293			365			70
		OUTLET TRANSITION																	
SUB TOTAL		TYPE C	118		TYPE D	98		TYPE M	96		TYPE K	53		TYPE J	44		TYPE N	46	
TOTAL (NO)				581			680			538			425			466			172

* See Drgw. No 2029, Culvert

KINGDOM OF LAOS

THA NGON AGRICULTURAL DEVELOPMENT PROJECT

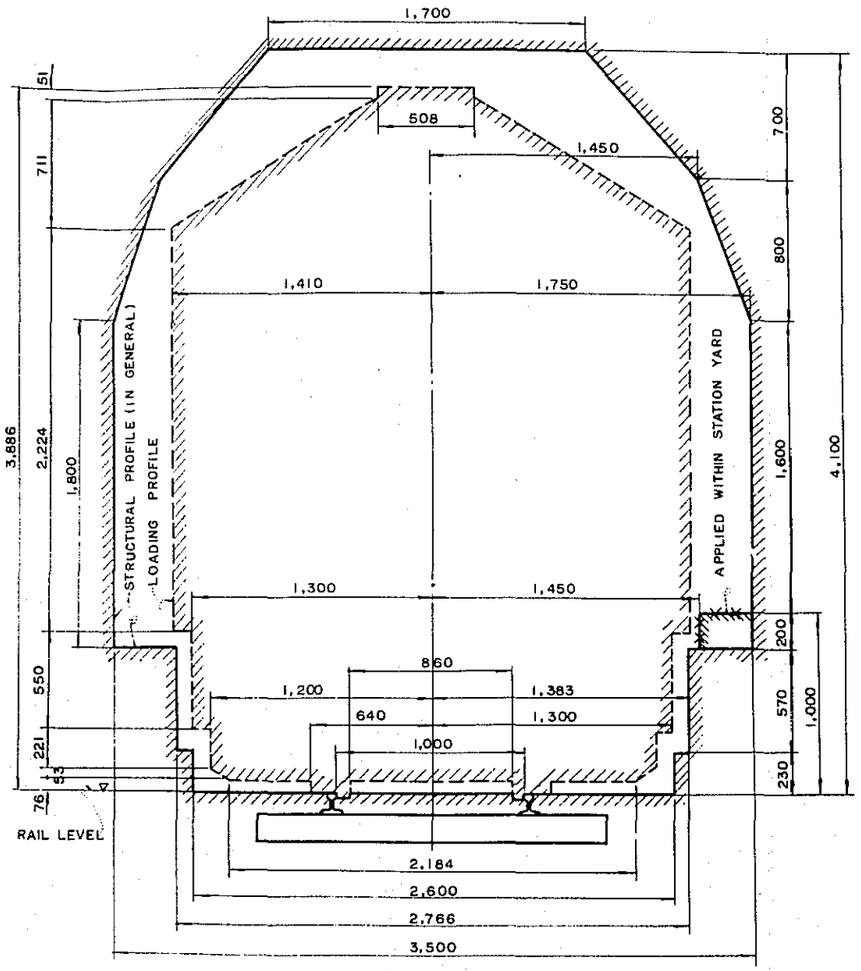
MAIN CANAL CHECK STRUCTURE (1)

DRAWN Y. Tanaka SUBMITTED .....

CHECKED K. Kawata APPROVED .....

OVERSEAS TECHNICAL COOPERATION AGENCY TOKYO MARCH 1969

2027



LOADING CLEARANCE OF ROYAL STATE RAILWAY OF THAILAND

KINGDOM OF LAOS
THA NGON AGRICULTURAL DEVELOPMENT PROJECT
LOADING CLEARANCE OF ROYAL STATE RAILWAY OF THAILAND
DRAWN SUBMITTED
CHECKED APPROVED
OVERSEAS TECHNICAL COOPRATION AGENCY TOKYO MARCH 1969
10004