		Quantity	Unit
(3)	Others		
3.1.	For Air Chamber Control Panel		
	a. Signal lamp bulb	200	%
	b. Signal lamp globe	30	%
	c. Complete signal lamp	10	%
	d. Magnetic contactor	1	No.
	e. Thermal relay	1	No.
	f. Fuse element	100	%
	g. Aux. relay	10	%
3.2.	For 630 KW Motor		
	a. Bearing	6	set

2506. MEASUREMENT AND PAYMENT

(1) Measurement for payment for supply of electric equipment in the substation, which consists of 22 KV receiving cubicle, 22 KV incoming circuit breaker cubicle, 22 KV circuit breaker cubicle, main transformer, transformer secondary cubicle, bus connecting cubicle, feeder cubicle A and B, shall be the number of each packaged unit for respective equipment supplied. Necessary instruments, accessories, wiring and cabling in the respective packaged unit for the above mentioned equipment shall be included into the respective items of the equipment.

(2) Payment for supply of the electric equipments in the Substation mentioned in above sub-clause (1) will be made under the Pay Items 2501 to 2503 and 2505 to 2508 of the Bill of Quantities, and shall cover the supply of packaged unit of the equipment with shop test expenses, shop paint and necessary accessories specified in Clause 2503 of the Particular Specifications, and any other works related.

(3) Measurement for payment for supply of 22 KV bus duct materials, which are specified in (4) of Clause 2503 of the Particular Specifications, shall be on a lump-sum basis.

(4) Payment for supply of the 22 KV bus duct materials will be made under Pay Item 2504 of the Bill of Quantities.

(5) Measurement for payment for supply of cables and wires for substation shall be on a lump-sum basis, and shall cover all necessary materials of connecting wires and cables from the supply point of public power supply line to the equipment installed in the substation building and between main transformer and equipment installed except delivery cable line to the Control House.

(6) Payment for supply of the cables and wires for substation will be made under Pay Item 2509 of the Bill of Quantities.

(7) Measurement for payment for supply of spare parts and tools for substation which are specified in (1) of Clause 2505 of the Particular Specifications shall be on a lump-sum basis.

(8) Payment for supply of spare parts and tools for the substation will be made under Pay Item 2510 of the Bill of Quantities, and shall cover the supply of tools and the spare parts with shop painting and shop test charges, and any other works related.

(9) Measurement for payment for transportation of all electric plants and equipment, wires, cables and necessary materials for substation shall be on a lump-sum basis.

(10) Payment for transportation of all electric plants and equipment, wires, cables and necessary materials for substation will be made under Pay Item 2511 of the Bill of Quantities, and shall cover all costs, charges and expenses associated with the transportation of all electric plants, equipment and materials from the shop to the Site including the ocean-freight charge, insurances, port charges, customs, taxes, demurrage, inland transportation and packing charges.

(11) Measurement for payment of installation works of all electric plants and equipment and appurtenances which are covered in Clause 2503 "Equipment of Substation" of the Particular Specifications shall be on a lump-sum basis.

(12) Payment for installation of the electric plants and facilities and appurtenances of the substation will be made under Pay Item 2512 of the Bill of Quantities, and shall cover all kinds of necessary works to complete the installation of the electric plants and facilities and appurtenances and conducting the site tests.

Payment will be made when the relevant test results of all the electric facilities and equipment have shown complete compliance with the requirements of the Specifications.

(13) Measurement for payment for supply of electric facilities in and around Intake Facilities, which consist of 3.3 KV receiving cubicle, 3.3 KV bus connecting cubicle, feeder cubicle for pumping station supply transformer, main motor starter, station service transformer cubicle, motor control center and sequence relay cubicle, DC/AC uninterruptable power source cubicle, central supervising and control panel, and local control panel of drainage pump, shall be the number of package units for respective equipment supplied. Necessary instruments, accessories, wiring and cabling in the respective packaged unit for the above mentioned equipment shall be included into the respective items of the equipment.

(14) Payment for supply of the electric facilities in the Control House mentioned in above sub-clause (1) will be made under Pay Items 2513 to 2521 of the Bill of Quantities, and shall cover the supply of the packaged units of the equipment, shop test charges, shop painting and necessary accesories specified in Clause 2504 of the Particular Specifications, and any other works related.

(15) Measurement for payment for supply of diesel engine generator unit for station power supply at the Control House, which is specified in Item (11) of clause 2504 of the Particular Specifications, shall be on a lump-sum basis.

(16) Payment for supply of the diesel engine generator unit for station power supply at the Control House will be made under Pay Item 2522 of the Bill of Quantities.

(17) Measurement for payment for supply of the cables and wires for Control House shall be on a lump-sum basis, and shall cover all necessary materials of the connecting wires and cables from the Substation to the Control House, between Air Chamber and Control House, inside of the Control House except the building supply around Intake Facilities' compound and lighting in the Control House.

(18) Payment for supply of the cables and wires for Control House will be made under Pay Item 2523 of the Bill of Quantities.

(19) Measurement for payment for supply of spare parts and tools for Control House which are specified in Item (2) of Clause 2505 of the Particular Specifications shall be on a lump-sum basis.

(20) Payment for supply of spare parts and tools for Control House will be made under Pay Item 2524 of the Bill of Quantities, and shall cover the supply of tools and the spare parts with shop painting and shop test charges, and any other works related.

(21) Measurement for payment for transportation of all electric plants and equipment, wires, cables, and necessary materials for Control House shall be on a lump-sum basis.

(22) Payment for transportation of all electric plants and equipment, wires, cables, and necessary materials for Control House will be made under Pay Item 2525 of the Bill of Quantities, and shall cover all costs, charges and expenses associated with the transportation of all electric plants, equipments and materials from the shop to the Site including the ocean-freight charge, insurances, port charges, customs, taxes, demurrage, inland transportation and packing charges.

(23) Measurement for payment for installation works of all electric facilities and appurtenances at Control House which are covered in Cluase 2504 "Equipment of Control House in the Intake Tower" of the Particular Specifications, shall be on a lump-sum basis.

(24) Payment for installation of the electric facilities and appurtenances of Control House will be made under Pay Item 2526 of the Bill of Quantities, and shall cover all kinds of necessary works to complete the installation of the electric facilities and appurtenances and conducting the site tests.

Payment will be made when the relevant test results of all the electric plants and equipment have shown complete compliance with the requirements of the Specifications.

(25) The down payment of the supply items including Pay Items 2501 to 2510 inclusive and Pay Items 2513 to 2524 inclusive of the Bill of Quantities will be made as follows:

Fifty (50%) percent of the amount of the supply item will be payable at the time of delivery of the supply materials to the Site.

The remaining fifty (50%) percent of the payment will be made at the time of completion of installation works and the relevant site tests have shown complete compliance with the requirements of the Specifications.

DIVISION 3. PIPELINE

SECTION 3000. GENERAL

3001. SCOPE OF WORKS

The scope of Works of the Pipeline consists of:

a. Supply of Pipes and Valves
b. Installation of Pipes and Valves
c. Civil works for Pipeline and Appurtenances

3002. SUBMITTALS

(1) The shop(s) and/or manufacturer(s) for producing the pipes, valves and couplings shall be nominated by the Contractor at the time of the Contract. The Contractor shall not be allowed to change the shop(s) and/or manufacturer(s) without written approval of the Engineer.

(2) The Contractor shall submit the following to the Engineer for approval, prior to commencement of the Works:

a. Drawings of plan and profile which show original ground surface on the alignment of the pipeline, in accordance with the result of detailed topographic survey executed by the Contractor.

b. Shop Drawings for plan and profile of the pipeline, which shall be prepared in accordance with the approved survey drawings for plan and profile as well as the indications of the Contract Drawings and the Specifications, and which shall show locations and elevations of the pipes, valves, couplings, branches and appurtenant facilities, and also show the locations of standard pipes, bend pipes and other kinds of non-standard pipes including tee pipes, flanged pipes and jacking pipes.

c. List of quantities and Shop Drawings for manufacturing of standard pipes, bend pipes, non-standard pipes, valves, couplings, flexible joints, flanges, etc.

d. Shop Drawings with detailed measurements for the valve chambers, valve boxes, blow-off pits, river crossings and any other facilities.

e. Detailed work schedule for supply and manufacturing of pipes, valves and couplings as well as detailed schedule for machinery and labour supply by critical path method.

3003. TEMPORARY WORKS

(1) The Contractor shall submit to the Engineer for approval full details of the Contractor's temporary works relating to pipeline works including the arrangement of temporary access road, borrow area of sand-bed, proposed area of spoiling, method of drainage, and any other temporary works related.

(2) The Contractor shall pay special attention to protection of the existing gas pipeline of PTT along Route 3191. The Contractor shall mark out, using stakes painted yellow, the exact alignment of PTT Gas Pipeline which shall be detected by magnetic sensor or other way by the Contractor, before commencement of excavation works. The intervals between yellow stakes shall be approx. 20 meters. No construction machinery or other heavy equipment shall cross over the alignment of existing gas pipeline.

Any kind of compensational works for the damages caused by the Contractor's activities, if any, shall be the liability of the Contractor.

(3) The Contractor shall not use and/or occupy, without obtaining approval from the Department of Highways of Thai Government, the land inside the right-of-way but outside the limitation of the Site. When and in case the Contractor intends to use the land inside the right-of-way and/or part of road surface of Route 3191 and Route 3, the Contractor shall submit his proposal to the Department of Highways for approval through the Engineer, at least six (6) weeks before the commencement of related works.

(4) Clearing works shall be performed where necessary along the pipeline as the Contractor's temporary works. Trees cut by clearing works shall be the property of the Employer. The Contractor shall store these trees in the designated place, if and when the Employer so orders.

3004. COMPENSATIONS

(1) The Contractor shall submit to the Engineer for approval following details of the Contractor's temporary arrangements prior to commencement of the Works:

a. Way and method for delivery or compensation of water to the people at downstream of rivers and streams which will be crossed by the pipeline and be cut during the installation works.

b. Way and method for preparation of temporary accesses for the people where the existing roads and accesses will be crossed by the pipeline and be cut during the installation works.

c. Way and method for repair of asphalt pavement to the satisfaction of the Department of Highways or other authorities where existing highways and asphalt paved roads will be crossed by the pipeline and be damaged.

d. Way and method of removal, replacement, rearrangement and/or reinstatement of such public articles as electric poles, telephone lines, sign-boards, land marks, etc.

3005. REPLACEMENT OF EXISTING WATER PIPE

(1) There exist two concrete-made pipelines of 150 mm in diameter nearby the alignment of the Project pipeline in parallel with Highway Route 3.

The Contractor shall execute the replacement works of the said water pipelines as the nominated temporary works. The Contractor shall propose for the Engineer's approval the way and method of replacement of the water pipes, which shall meet the satisfaction of the owners of the water pipelines, in connection with the Contractor's planning for excavation, installation and backfill works of the main pipeline.

(2) In case the Contractor intends to execute the works of main pipeline without replacing one or two of pipelines, the Contractor may so propose to the Engineer for approval.

3006. EXPLORATION PIT

(1) The Contractor shall execute, prior to the excavation works, the exploratory pits along the alignment of the pipeline in accordance with the instruction of the Engineer.

(2) Size of the pit shall be approximately 1.5 m x 1.5 m and depth of the pit shall be about 4 meters. The pit shall be excavated by manpower.

(3) The Contractor shall make provisions around the pits to prevent people and animals from falling into the pits.

3007. MEASUREMENT AND PAYMENT

(1) All kinds of temporary works necessary for construction of the Pipeline including preparation, construction, maintenance, removal, compensation of land and crops, other compensations specified in Clause 3004 of the Particular Specifications, exploration pits specified in Clause 3006 of the Particular Specifications, etc. will be paid in lump sum under Pay Item 3001 of the Bill of Quantities.

Thirty (30%) percent of the lump-sum under Pay Item 3001 will be payable when the Engineer deems the temporary works necessary for commencement of construction of the Pipeline are substantially completed. Ten (10%) percent of the lump sum will be payable when the removal works are substantially completed. And the remaining sixty (60%) percent of the lump sum will be paid in equal monthly payments such that the total sum shall be fully disbursed upon the Stage Two Provisional Take-over of the Works.

(2) The Works for replacement of existing water pipes along the Highway Route-3 specified in Clause 3005 of the Particular Specifications will be paid in lump sum under Pay Item 3002 of the Bill of Quantities. Appropriate percent of the lump sum under Pay Item 3002 will be paid in accordance with the Engineer's estimation of progress of the Works.

(3) No separate payment will be made for compliance with the provisions stated in Clause 3002 of the Particular Specifications, and all costs for the submittals and field survey works related shall be deemed to be included in the rates for various items of the Bill of Quantities.

SECTION 3100. SUPPLY OF PIPES AND VALVES

3101. SUPPLY OF STEEL PIPE ϕ1,350 mm

(1) Manufacturing and supply of the steel pipe shall be performed in accordance with indications of the Drawings and Section 5300 of the General Specifications, except otherwise specified hereunder.

The manner and method of manufacturing, coating, testing, transportation, etc. shall be subject to approval by the Engineer.

(2) Standard straight pipe of the main pipeline to be supplied shall be as follows:

Diameter	:	1,350 mm
Wall thickness	:	11.9 mm
Standard length of unit pipe	:	9.0 m or approved length
Material of steel	:	SS-41
Manufacturing	:	in accordance with JIS G 3443 both bending roll and spiral methods will be acceptable.
Internal coating	:	350 μm of Tar Epoxy in accordance with JWWA K 115
External coating	:	one coat of Coal Tar Enamel with one layer of glass cloth in accordance with JIS G 3492
Shape of pipe ends	:	inside beveled end in accordance with JIS G 3443.

(3) Bend pipe of the main pipeline to be supplied shall be as follows:

Diameter	:	1,350 mm
Wall thickness	:	11.9 mm
Material of steel	:	SS-41
Manufacturing	:	in accordance with JIS G 3451
Internal coating	:	350 μm of Tar Epoxy in accordance with JWWA K 115
External coating	:	two coats of Coal Tar Enamel with one layer of glass cloth in accordance with JIS G 3492
Shape of pipe ends	:	same as straight pipe.

The Contractor shall propose to the Engineer for his approval the bend pipe of less than 5-5/8° of angle by the Shop Drawings.

(4) The specifications for tee pipe of the main pipeline to be supplied shall be the same as those of bend pipe, and the Contractor shall manufacture tee pipes in accordance with indications of the Drawings and the Specifications.

(5) Jacking pipe shall be manufactured in accordance with the indications of WSP 017-78 (Type II) and the Shop Drawings. Internal coating shall be the same as the coating of standard pipe. The Shop Drawings showing manufacturing details shall be submitted to the Engineer for his approval.

(6) Following shop coatings shall be made on steel pipe at the internal and external surfaces of 300 mm for pipe ends. 200 μm of Tar Epoxy coating shall be made on the internal surface of between 100 mm and 300 mm from pipe ends, and only Tar Epoxy Primer shall be only coated on the internal surface between the pipe ends and 100 mm from pipe ends.

Coal Tar Enamel coating with glass cloth shall be made at the external surface up to 150 mm from both ends of each pipe unit, and only Coal Tar Primer shall be coated at the external surface between the pipe ends and 150 mm from pipe ends.

(7) The flange of 1,350 mm diameter to be supplied shall be Class I flange in accordance with JIS B 2212, and shall ensure the working pressure of 15 kg/cm^2.

3102. SHOP TEST AND INSPECTION OF STEEL PIPE

(1) The Contractor shall nominate a qualified chief inspector of shop tests of the steel pipe who has the responsibility to execute and inspect the shop tests of the pipes.

(2) The Contractor shall submit to the Engineer five (5) copies of the inspection report which shall contain the results of inspections and tests executed at shop and signed by the chief inspector of shop tests of the Contractor. The Inspection Report shall be prepared and submitted for every 1,000 tons of steel pipe produced.

(3) The Contractor shall accept and facilitate at any time Engineers' inspection of the shop during the manufacturing of the steel pipes, and the Contractor shall perform tests, at his own cost, which may be ordered by the Engineer during his shop inspection.

(4) The following tests and inspections shall be at least required at shop:

a. Material tests in accordance with JIS G 3457 and JIS Z 2241.

b. Hydrostatic pressure test in accordance with JIS G 3457. The hydrostatic pressure shall be 25 kg/cm^2.

c. Inspection of weld seam on under-cut, overlap, etc. as well as X-ray test. All T-cross welds and not less than 6% on spiral weld shall be tested by X-ray film in accordance with JIS Z 3104.

d. Circumferential and dimensional inspections.

Outside circumference measured at distance of 100 mm from both ends shall have tolerance $\pm$ 4 mm. Inside diameter measured at distance of 100 mm from both ends shall have tolerance $\pm$ 3 mm.

e. Inspection for Coal Tar Enamel coating in accordance with JIS G 3492. Inspection for Tar Epoxy coating in accordance with JWWA K 115.

3103. SUPPLY OF STEEL PIPE LESS THAN 800 mm IN DIAMETER

(1) Wall thickness of the pipe used in this Section shall be as follows:

Diameter	Wall Thickness
500 mm	6.0 mm
400 mm	6.0 mm
250 mm	6.6 mm
150 mm	5.0 mm

(2) Material of steel, internal and external coating of this pipe shall be the same as those of main steel pipe of 1,350 mm.

3104. SUPPLY OF FLEXIBLE COUPLING

(1) Dresser type couplings to be supplied for the Pipeline shall be in accordance with JIS G 3451. All kinds of Dresser type coupling shall ensure the working pressure of 15 kg/cm^2.

(2) Flexible and expansive coupling to be supplied for the Pipeline shall be the Victaulic closer type coupling or approved equal.

All kinds of Victaulic closer type coupling to be supplied for the Pipeline shall ensure the working pressure of 15 kg/cm^2.

(3) Other details shall be in accordance with Section 5300 of the General Specifications.

3105. SUPPLY OF VALVES

(1) Butterfly valves to be supplied for the Pipeline shall be manufactured in accordance with JWWA B 114.

The Contractor shall propose to the Engineer for his approval the manufacturer who will supply the butterfly valves.

(2) Sluice valves to be supplied for the Pipeline shall be manufactured in accordance with JWWA B 115.

The Contractor shall propose to the Engineer for his approval the manufacturer who will supply the sluice valves.

(3) High speed air valve to be supplied for the Pipeline shall be manufactured in accordance with JWWA B 118. The manufacturer of the air valve shall be subject to Engineer's approval.

(4) All kinds of valves to be supplied for the Pipeline shall be Class I and ensure the working pressure of 15 kg/cm^2.

(5) Other details shall be in accordance with Section 5300 of the General Specifications.

3106. MEASUREMENT AND PAYMENT

(1) Measurement for payment for supply of steel pipe, except for supply of steel jacking pipe, tee pipe, flanged pipe, shall be the length in meter of steel pipe manufactured and supplied, and shall include the provisions of steel pipe, internal and external coatings and measures of pipe manufacturing, blasting, coating, shop testing, transportation to Site and any other works related.

No separate or additional measurement for payment shall be made for supply of any kind of bend pipes.

(2) Payment for supply of steel pipe will be made under Pay Items 3101, 3110 and 3114 of the Bill of Quantities.

(3) Measurement for payment for supply of steel jacking pipe shall be the length, measured in meters, of jacking pipe supplied, and shall include the provisions of steel pipe, steel segment, mortar, internal and external coatings, and measures of pipe and segment manufacturing, blasting, coating, shop testing, mortar grouting, transportation to Site and any other works related.

(4) Payment for supply of steel jacking pipe 1,350 mm in diameter will be made under Pay Item 3102 of the Bill of Quantities.

(5) Measurement for payment for supply of steel tee pipe shall be the number of each kind of tee pipe supplied, and shall include the provisions of steel tee pipe, internal and external coatings, and any other works related.

(6) Payment for supply of steel tee pipe will be made under Pay Items 3103 to 3108 inclusive of the Bill of Quantities.

(7) Measurement for payment for supply of steel pipe with flange(s) shall be the number of each kind of flanged pipes supplied, and shall include the provisions of steel pipe, flange, bolts and nuts of flange, packing materials, internal and external coatings, and measures of pipe and flange manufacturing, blasting, coating, shop testing, transportation to Site and any other works related.

(8) Payment for supply of steel pipe with flange(s) will be made under Pay Items 3109, 3111, 3112, 3115, 3116, 3117, 3119 and 3120.

(9) Measurement for payment for supply of blind flange shall be the number of each kind of blind flanges supplied, and shall include the provisions of flange, bolts and nuts, packing material, coatings, and measures of flanged manufacturing, coating, transportation to Site and any other works related.

(10) Payment for supply of blind flange will be made under Pay Items 3113, 3118, 3121 and 3122 of the Bill of Quantities.

(11) Measurement for payment for supply of Victaulic closer type coupling for steel pipe shall be the number of Victaulic closer type couplings supplied and shall include the provisions of coupling and all kinds of accessories and measures of manufacturing, testing, transportation to Site and any other works related.

(12) Payment for supply of Victaulic closer type coupling for steel pipe will be made under Pay Item 3123 of the Bill of Quantities.

(13) Payment for supply of Dresser type coupling for steel pipe will be made under Pay Items 3124, 3125 and 3126 of the Bill of Quantities.

(14) Measurement for payment for supply of valves shall be the number of each kind of valves supplied, and shall include the provisions of valves, operating nut, bolts and nuts, packing and any other accessories, and measures of manufacturing, testing, transportation to Site and any other works related.

(15) Payment for supply of butterfly valve will be made under Pay Items 3127 and 3128 of the Bill of Quantities.

(16) Payment for supply of sluice valve will be made under Pay Items 3129, 3130 and 3131 of the Bill of Quantities.

(17) Payment for supply of high speed air valve will be made under Pay Item 3132 of the Bill of Quantities.

(18) The down payment of the supply items including Pay Items 3101 to 3132 inclusive of the Bill of Quantities will be made as follows:

Fifty (50%) percent of the amount of the supply items will become payable at the time of delivery of the supply materials to the Site.

The remaining fifty (50%) percent of the payment will be made at the time of completion of installation works and the relevant site tests have shown complete compliance with the requirements of the Specifications.

SECTION 3200. INSTALLATION OF PIPES AND VALVES

3201. INSTALLATION OF STEEL PIPE

(1) Installation of the steel pipe shall be performed in accordance with indications of the Drawings and Section 5300 of the General Specifications.

(2) When and in case the Contractor intends to occupy the area of road surface and/or inside the right-of-way of the Highway Route 3191 and Route 3 for unloading, handling and storing of pipe, the Contractor shall prepare and submit to the Department of Highways through the Engineer, Contractor's proposal containing the way and method of unloading, handling and storing of pipe, traffic safety and protection of pipe against road traffic as well as against third parties, and shall get the permission of the Department, through the Engineer, prior to the commencement of Works.

(3) Before starting the welding of pipe joints on site, the Contractor shall submit for Engineer's approval details of the plant, methods and materials which he proposes to use, including make and size of electrodes, number of runs, current strength, and arrangements for X-ray testing and coloring testing of individual joint.

(4) The welding works shall be performed in accordance with JIS G 3443. The welders in charge shall have the qualification prescribed in JIS Z 3801 or approved equal.

Pipes manufactured with longitudinal or spiral welds shall be lined up before jointing so that these welds are at least 15 degrees apart at around the joint circumference.

(5) After completion of welding at each joint, magnetic crack detection tests shall be carried out on all fillet welds made, and all T-cross weld and not less than 6 percent on butt welds made shall be tested by X-ray film in accordance with JIS Z 3104. The coloring test shall be also performed on 100 percent of butt welds, and examination on defects or incompletion shall be executed in accordance with JIS Z 2343. All such tests shall be carried out by the Contractor in the presence of the Engineer. Where necessary, welds shall be repaired in accordance with instruction of the Engineer, at the Contractor's own expense.

The Contractor shall nominate a qualified chief supervisor for field tests of the steel pipe who has the responsibility to perform and to supervise the field tests of steel pipe.

The Contractor shall prepare the field test report which shall contain the results of tests, films, photographic records, analysis, etc., and be signed by said chief supervisor, and submit to the Engineer's supervisor for his approval and his signature. Five (5) sets of the field test report shall be submitted to the Engineer at end of each month.

All expenses for said testings including expenses for equipment, tools, materials, labours, reportings, and any other works related shall be deemed to be included in the rates of Pay Items for installation of steel pipes.

(6) After pipe joints have been made, the external and internal coatings equivalent to the factory-applied coating shall be applied across the joints. These field coatings shall extend (i.e. overlap) 20 mm over the shop coatings.

(7) The cover depth of earth for the pipe shall be, as a general rule, between 1.5 m minimum to 3.0 m maximum from the ground surface to the top of pipe, except at the river and highway crossings. At the river crossing point, pipe shall be encased in reinforced concrete and have a minimum cover depth of one (1) meter between river bed and pipe top. Requirements at highway crossings are described in Clause 3202.

3202. JACKING WORKS

(1) Pipe driving (Jacking) method shall be applied to the pipeline works at the crossings of Highway Route 3 and Route 36.

(2) Cover depth of the jacking pipe shall be 3.5 m minimum from the surface of highways. The length of jacking pipe at Highway Route-36 crossing will be 28 m and that at Highway Route-3 crossing will be 20 m. The length of jacking shall be subject to change in accordance with the instruction of the Engineer.

(3) The Contractor shall submit to the Engineer for his approval proposal containing manner and method of jacking including details of equipment, jacking head, counter wall for jacking, manner of excavation and dewatering, etc. The Contractor shall also submit to the Department of Highways, through the Engineer, detail schedule of jacking works at least six (6) weeks prior to the commencement.

3203. INSTALLATION OF VALVES AND COUPLINGS

(1) The Contractor shall submit to the Engineer for approval the standard manual of installation of valves and couplings, and shall perform the installation works in accordance with the approved manual in addition to indication of the General Specifications.

3204. FIELD WATER PRESSURE TEST

(1) The Contractor shall perform the field water pressure test for the whole alignment of pipeline when installation works of pipes and valves are substantially completed. The field water pressure test shall be executed section by section of the pipeline divided by stop valves under full water pressure. The test is performed by filling water in the pipeline and observing the lowering rate of water level of Head Tank during the duration of 12 hours.

(2) The Contractor shall continue the test for more than 12 hours if ordered by the Engineer.

(3) The Contractor shall perform all kinds of repairing works at his own expense, in accordance with instruction of the Engineer, when any kind of defects or incompletion are found by the testings.

(4) All expenses required for the field water pressure test shall be deemed to be included in the rates of Pay Items for installation of steel pipes.

3205. MEASUREMENT AND PAYMENT

(1) Measurement for payment for installation of steel pipe shall be the length in meters of steel pipes installed, as computed on centerline of the alignment of pipeline including the lengths for straight pipes, bend pipes, tee pipes, joints, and valves, etc., but excluding the lengths for jacking pipes.

(2) Payment for installation of steel pipe will be made under Pay Items 3201, 3203, and 3204 of the Bill of Quantities, and shall cover the storage, handling, installation, field welding and coatings, all kinds of field testings including X-ray test, coloring test and field water pressure test, and any other works related.

(3) Measurement for payment for jacking of pipe shall be the length in meters of jacking pipe installed by pipe driving method.

(4) Payment for jacking of pipe 1,350 mm in diameter will be made under Pay Item 3202 of the Bill of Quantities. Payment shall cover jacking works, excavation and disposal of excavated material, dewatering, excavation pit at each end of jacking pipe for pipe driving, supply of jacking head, field welding and coatings, and any other works and materials related.

(5) Measurement for payment for installation of butterfly valves, sluice valves and air valves shall be the number of valves installed.

(6) Payment for installation of butterfly valve will be made under Pay Items 3205 and 3206 of the Bill of Quantities.

(7) Payment for installation of sluice valve will be made under Pay Items 3207, 3208 and 3209 of the Bill of Quantities.

(8) Payment for high speed air valve will be made under Pay Item 3210 of the Bill of Quantities.

(9) Measurement for payment for installation of flexible couplings shall be the number of flexible couplings installed, and shall cover storage, handling, installation, coating if any, field tests and any other works related.

(10) Payment for installation of Victaulic closer type coupling will be made under Pay Item 3211 of the Bill of Quantities.

(11) Payment for installation of Dresser type coupling will be made under Pay Item 3212 and 3213 of the Bill of Quantities.

SECTION 3300. CIVIL WORKS FOR PIPELINE

3301. EARTHWORK FOR PIPELINE

(1) Earthwork including excavation, disposal, fill and backfill and backfill of selected material shall be performed in accordance with Division 2 of the General Specifications and the Drawings.

(2) Excavation shall be performed in accordance with the standard cross sections of the pipeline, and dimensions relating to the excavation works shown in the Contract Drawing are the minimum requirements. The Contractor may excavate deeper and/or larger than the standard cross-section shown in the Contract Drawing, and such expenses for over excavation shall be borne by the Contractor.

(3) When and in case the Engineer orders to excavate the trench cross sections other than the standard cross sections dependent upon the site conditions and from the viewpoint of safety, the Contractor shall obey the order of the Engineer and the expenses required for these works shall be deemed included in the unit rate in the Bill of Quantities.

(4) Excavated trench shall be kept free from the water. The Contractor shall prepare adequate facilities and equipment for drainage and drain the water at all times.

(5) Material to be backfilled under the pipeline shall be the approved selected material not containing silt or clay above 20% and solid matter larger than 10 mm in diameter and to be placed in layer not exceeding 10 cm in thickness and to be compacted by approved hand tamping, as shown in the Drawings.

(6) Material to be backfilled beside and up to 30 cm above the pipeline shall be the approved selected material not containing silt or clay above 30% and solid matter larger than 10 mm in diameter and to be placed in layers, each not exceeding 20 cm in thickness and to be compacted by approved hand tamping, as shown in the Drawings.

(7) Backfill above 30 cm above the pipeline shall be placed in layers, each not exceeding 30 cm in thickness and compacted by approved methods.

(8) No backfill works shall be executed without approval of the Engineer. Backfill under the pipeline shall be performed after obtaining the approval for trench excavation. Backfill beside the pipeline shall be performed after obtaining the approval for installation works of pipeline.

(9) Special attention shall be paid to the earthwork when working beside and crossing existing PTT gas pipeline. The Contractor shall submit to the Engineer for approval the proposal containing manner and method of excavation of trench along and crossing the gas pipeline.

Stakes indicating the excavation line in accordance with the setting out shall particularly be required for excavation works along the gas pipeline prior to commencement of the excavation works.

(10) Hydraulic compaction or other approved method of compaction shall be applied for the backfill at crossing of the gas pipeline.

(11) Borrow area and material for the selected material of backfill shall be subject to Engineer's approval. All the expenses for compensation and development of such borrow area shall be borne by the Contractor.

(12) Way and method of spoil banking shall be subject to Engineer's approval.

3302. VALVE CHAMBER

(1) The Contractor shall construct the valve chambers at the place where the stop valve shall be installed, in accordance with the Drawings.

(2) The exact location and elevation of the valve chamber shall be proposed for Engineer's approval by the Contractor's Shop Drawings, which shall be prepared in accordance with result of topographic survey as well as the requirement indicated on the Contract Drawings.

(3) Concrete for the valve chamber shall be D-concrete. All the works for concrete, formworks, reinforcing bars, etc. shall be executed in accordance with the General Specifications.

(4) Cast iron cover and steel plate cover for manhole and handhole, chain and rungs shall be supplied and installed under the conditions stipulated in the General Specifications. The steel plate cover and chain shall be galvanized and the rung shall be painted.

3303. AIR VALVE BOX

(1) The Contractor shall construct the air valve boxes, at the place where the air valves are installed, in accordance with the Drawings.

(2) The exact location and elevation of the boxes to be constructed shall be proposed on the Contractor's Shop Drawings, for the Engineer's approval, which shall be prepared in accordance with the result of topographic survey as well as the requirements indicated on the Contract Drawings.

(3) Concrete for the box shall be D-concrete, and all the works for concrete, formworks, reinforcing bars, cast iron cover, rung, etc. shall be executed in accordance with the General Specifications.

3304. SURFACE VALVE BOX

(1) Surface valve boxes shall be constructed at the place where sluice valves are installed, in accordance with the Drawings.

(2) Concrete for the surface valve box shall be H-concrete and reinforced concrete pipe shall be pre-cast in accordance with the diameter of steel pipe and result of topographic survey.

Round bar connected to anchor concrete shall be painted.

3305. BLOW-OFF

(1) Blow-off facilities shall be constructed where indicated in the Drawings.

(2) Concrete for blow-off pit shall be D-concrete and all concrete works including formworks and reinforcing bar works shall be executed in accordance with the General Specifications.

(3) Drainage ditch to existing river or stream shall be excavated and/or filled and be lined by placed rip-rap. The Contractor shall execute the works of placed rip-rap for the river protection where the Engineer may instruct.

(4) Slide gate to be installed at open mouth of the blow-off pit shall be galvanized steel plate, 1,050 mm by 1,050 mm and 3 mm in thickness, with handle.

The slide gate and embedded steel shall be considered as miscellaneous metal.

3306. RIVER CROSSING

(1) All the pipeline crossing under existing water or stream shall be encased in concrete as shown in the Drawings.

(2) Length of concrete encasement will be instructed after profile survey of alignment is approved.

(3) Concrete encasement shall be of D-concrete.

(4) Where and in case instructed by the Engineer, the Contractor shall execute mortared rip-rap for river-bed protection in accordance with the instruction of the Engineer.

(5) River protection works including river training works as well as river-bed and slope protection works shall be executed at River Crossing R-19, as shown in the Drawings.

The Contractor shall perform topographic survey around and prepare detailed Shop Drawings of river protection works in accordance with the instruction of the Engineer.

Thickness of mortared rip-rap shall be 30 cm and 5 cm thickness of gravel shall be placed under the mortared rip-rap.

A weep-hole of P.V.C pipe, 2 inches in diameter, shall be provided in each 4 square meters.

3307. MARKING POST

(1) Marking posts shall be constructed on the ground over the alignment of pipeline installed and backfilled. The marking posts shall be installed, as soon as backfilling is completed, at every 300 meters distance of the alignment, every bending point and any other points instructed by the Engineer.

(2) Marking post shall be the precast concrete made as shown in the Drawings, and the concrete shall be Class-D.

3308. MEASUREMENT AND PAYMENT

(1) Measurement for payment for earthwork of pipeline shall be the length of pipeline alignment excavated as computed by the length of alignment of center line of pipes including the length of straight pipes, bend pipes, valves, joints but excluding the length of jacking pipe installed, measured in meters. No separate measurement for payment shall be made for the earthwork including excavation, fill and backfill for the pipeline of non-standard sections such as bend pipes, tee pipes, flanged pipes, inclined pipes, pipes with couplings and pipes covered by concrete at river crossings, etc., and for the structures on the alignment of pipeline such as valve chambers, air valve boxes, blow-off pits, surface valve boxes, and any other structures.

No separate measurement for payment shall be made for excavation of pipe driving portion under the highways for which payment shall be included in the rate of Pipe Jacking.

No separate measurement for payment shall be made for excavation of swampy and/or rock materials, if any, which is to be regarded as part of the earthworks for the pipeline.

(2) Payment for earthwork for pipeline shall cover excavation, dewatering, borrow area development, transportation of material, backfill of selected material, fill and backfill, compaction, spoiling of excavated material, and any other works related.

(3) Payment for earthwork for pipeline 1,350 mm in diameter will be made under Pay Item 3301 of the Bill of Quantities.

(4) Payment for earthwork for pipeline 500 mm and 400 mm in diameters will be made under Pay Item 3302 of the Bill of Quantities.

(5) Payment for earthworks for pipeline 250 mm and 150 mm in diameters will be made under Pay Item 3303 of the Bill of Quantities.

(6) Measurement for payment for common excavation shall be the volume of earth material excavated as computed in place from the original ground surface to the required line, measured in cubic meters.

Volume of voids formed shall be computed by the average-end-area method with cross sections taken every 5 meters or at such intervals as directed by the Engineer.

(7) Payment for common excavation will be made under Pay Item 3304 of the Bill of Quantities, and shall cover excavationa, disposal of excavated material, preparation of foundation and other requirements stated in the Specifications and the Drawings.

(8) Measurement for payment for fill and backfill shall be the volume of compacted fill and backfill placed and measured in cubic meters. Measurement shall be made between the original ground surface as determined by surveys in the field or in case of backfill in excavation the foundation lines upon completion of excavation and the lines upon completion of fill and backfill. Allowance for the volume arising from the stripping works shall not be considered nor included in the calculation of fill and backfill measurement. Volumes shall be computed by the average-end-area method with cross sections taken every 5 meters or at such intervals as directed by the Engineer.

No allowance shall be made in measurement for payment for fill and backfill for any settlement of the structure foundations, for internal settlement of the fill and backfill during the construction, or any fill and backfill which is eroded, removed or wasted during construction. All these losses shall be refilled at the Contractor's own expense and it shall not be measured for payment.

(9) Payment for fill and backfill will be made under Pay Item 3305 of the Bill of Quantities, and shall cover all kinds of necessary expenses for development of borrow area including the compensation for land and crops, excavation of borrow material, hauling, transportation, spreading, compaction, watering, obtaining and transporting test samples, and any other works related.

(10) Measurement for payment for mortared rip-rap shall be the volume of rip-rap placed, measured in cubic meters, and shall include the works of foundation gravel layer, weep hole and any other works related.

(11) Payment for mortared rip-rap will be made under Pay Item 3306 of the Bill of Quantities.

(12) Measurement for payment for placed rip-rap shall be the volume of rip-rap placed, measured in cubic meters.

(13) Payment for placed rip-rap will be made under Pay Item 3307 of the Bill of Quantities.

(14) Measurement for payment for aggregate foundation shall be the volume of aggregate foundation placed, measured in cubic meter.

(15) Payment for aggregate foundation will be made under Pay Item 3308 of the Bill of Quantities.

(16) Measurement for payment for concrete for the Pipeline including reinforced concrete of valve chambers, valve boxes, blow-off pits, and levelling concrete, shall be the volume in cubic meters of concrete placed, and shall include for the provision of all necessary materials including cement, aggregate and sand, and for all measures necessary for batching of materials, the mixing, transportation, preparation prior to placing, placing compaction, protecting, curing, temperature control, supply and transport of test cylinders and any other works related.

(17) Payment for levelling concrete will be made under Pay Item 3309 of the Bill of Quantities.

(18) Payment for reinforced concrete Class-D of valve chambers, valve boxes, and blow-off pits, will be made under Pay Item 3310 of the Bill of Quantities.

(19) Measurement for payment for formwork shall be the area, measured in square meter, of concrete surfaces formed, and shall include for the supply of all materials and for all measures necessary for preparation, transportation, placing, supporting scaffolding, removing and any other works related.

No measurement for payment shall be made for formworks to levelling concrete.

No separate measurement for payment shall be made for the formworks to concrete of encasement of pipe.

(20) Payment for formworks to concrete Pay Item 3310 will be made under Pay Item 3311 of the Bill of Quantities.

(21) Measurement for payment for reinforcing bars shall be the weight of reinforcing bars placed in the concrete in metric tons as computed from the approved detail bar bending schedule, using theoretical unit weights, and shall include supply and placing of reinforcing bars, tie wire, metal and concrete supports, spacers and other fixing devices, splice coupling or welding, and any other works related.

(22) Payment for reinforcing bars to concrete Pay Item 3310 will be made under Pay Item 3312 of the Bill of Quantities.

(23) Measurement for payment for concrete encasement of the pipe shall be the length of concrete encasement placed, measured in meters, as computed on the length of centerline of the alignment of encased pipeline, and shall cover concrete works, formworks, joint formworks, reinforcing bars, dowel bars at joint and any other works required.

(24) Payment for concrete encasement will be made under Pay Item 3313 of the Bill of Quantities.

(25) Measurement for payment for supply and installation of miscellaneous metal shall be the weight in kilograms of miscellaneous metal installed, and shall include the provision of anchor bolts, connectors and any other materials and measures necessary to complete the supply, erection, painting or galvanizing of the miscellaneous metal items. No measurement shall be made for any embedded metal which are required for installation of valves, gates, coverings, etc.

Cast iron manhole covers, galvanized steel plate covers, metal chains, slide gates of blow-off, ladders and rungs, etc., shall be deemed as miscellaneous metal.

(26) Payment for supply and installation of miscellaneous metal will be made under Pay Item 3314 of the Bill of Quantities.

(27) Measurement for payment for surface valve box shall be the number of box installed, and shall include the works of aggregate foundation, concrete, galvanized round bar for fixing of pipe, supply and installation of reinforced concrete pipe and cast iron hat and any other works related.

No different measurement for payment shall be made for surface valve boxes depending upon the different sizes and/or different heights of reinforced concrete pipes.

(28) Payment for surface valve box will be made under Pay Item 3315 of the Bill of Quantities.

(29) Measurement for payment for supply and installation of marking post shall be the number of marking posts installed, and shall include manufacturing, transportation, excavation, installation, backfill and any other works related.

(30) Payment for supply and installation of marking post will be made under Pay Item 3316 of the Bill of Quantities.

DIVISION 4. HEAD TANK

SECTION 4000. GENERAL

4001. SCOPE OF WORKS

The scope of works of the Head Tank consists of:

a. Head Tank
b. Spillway

4002. TEMPORARY WORKS

(1) The Contractor shall submit to the Engineer for approval full details of the Contractor's temporary arrangements for construction of the Head Tank including following details, prior to commencement of the Works.

a. Construction method of the Head Tank.
b. Shop Drawings for post-tensioning arrangements, reinforcing bar arrangements, formworks arrangements and supporting and scaffolding details, etc.

(2) Clearing works shall be performed where necessary at the yard of Head Tank and along the spillway pipeline as the Contractor's temporary works. Trees cut by clearing works shall be the property of the Employer. The Contractor shall store those trees in the designated place, when and in case the Employer so orders.

4003. EXPLORATORY DRILLINGS

(1) The Contractor shall execute prior to the excavation works an exploratory drillings at the foundation of the Head Tank, in accordance with the instructions of the Engineer.

(2) Exploratory drill holes shall be NX size with a 75 mm hole diameter and a minimum core diameter of 55 mm. Penetration tests shall be performed in every one meter of drill holes the Contractor shall take all care and precaution to maximize core recovery.

4004. MEASUREMENT AND PAYMENT

(1) All kinds of temporary works necessary for construction of Head Tank including preparation, construction, maintenance and removal works shall be paid by a lump sum under Pay Item 4001 of the Bill of Quantities.

Thirty (30%) percent of the lump sum under Item 4001 will be payable when the Engineer deems the temporary works necessary for construction of Head Tank are substantially completed. Twenty (20%) percent of the lump sum will be payable when the removal works are deemed to be substantially completed. The remaining fifty (50%) percent of the lump sum will be paid in equal monthly payments such that the total sum shall be fully disbursed upon the Stage Two Provisional Take-over of the Works.

(2) Measurement for payment for the exploratory drilling shall be the length, measured in meters, of drilled holes executed. Measurement shall include drillings, all testing required, sampling and reporting, etc. Payment for the exploratory drilling will be made under Pay Item 4002 of the Bill of Quantities.

SECTION 4100. HEAD TANK

4101. EARTHWORK

(1) Earthwork at Head Tank shall be performed in accordance with the Drawings and Division 2 of the General Specifications.

(2) Excavation works of foundation of Head Tank shall be executed carefully so as not to disturb the foundation soil of Head Tank.

When and in case over-excavation than the indicated excavation line is made, the Contractor shall backfill such over-excavation with concrete, at the Contractor's own expense, in accordance with the instruction of the Engineer.

(3) Excavation for the foundation of concrete at inlet and outlet pipes and pit as well as spillway pipe for Head Tank shall be the hand-excavation by man-power and shall be executed so that the surface treatment on the excavated face described next shall form line of outside face of concrete. Immediately after completion of excavation, surface of such excavated soil shall be covered by mortar or timber shutterings to be the formworks to concrete.

(4) No excavation work shall be commenced without obtaining the Engineer's approval on the whole construction method of Head Tank.

4102. CONCRETE WORKS

(1) Levelling concrete shall be H-concrete and reinforced concrete of base slab of Head Tank shall be C-concrete. Reinforced concrete of the Valve Box and the Level-meter Box shall be D-concrete.

(2) Upper structure of Head Tank shall be constructed by post-tensioning prestressed concrete method. This prestressed concrete of Head Tank shall be A-concrete but the concrete mix design shall be proposed by the Contractor for Engineer's approval.

(3) The waterstop shall be placed in every construction joints of concrete for the pit of outlet pipe. The waterstop shall be W-1015-P and/or R-1006 of Span Seal which are made of nonvulcanized butyl reclaimed rubber or approved equal. No construction joint shall be allowed on the base slab concrete of Head Tank.

4103. PRESTRESSED CONCRETE WORKS

(1) The Contractor shall submit to the Engineer for his approval, the Contractor's proposal containing the design report, report of detailed construction planning and schedule, Shop Drawings and technical specifications for prestressed concrete works of Head Tank, in accordance with the requirements stipulated in the Specifications, the Contract Drawings and the approved Contractor's proposals at the time of Tender.

(2) Design criteria of the prestressed concrete tank shall be as follows:

a. Inner Diameter of the Tank: 16 m
b. Top of the Tank: EL 105.4 m
c. Designed High Water Level: EL 103.4 m
d. Floor Base at Tank Foundation: EL 81.0 m - EL 80.9 m
e. Unit Weight of Materials:

Water:	1.00 t/m^3
Plain concrete:	2.30 t/m^3
Reinforced concrete:	2.50 t/m^3
Prestressed concrete:	2.50 t/m^3
Soil:	1.80 t/m^3
Steel:	7.85 t/m^3

f. Allowable Stress:
* Reinforcing bar
  - Deformed bar shall be used.
  - Allowable tensile stress..... 1,400 kg/cm^2
* Reinforced concrete
  - Strength of 28 days age fc' = 210 kg/cm^2
  - Allowable compressive stress: fc

Bending compressive stress	94.5 kg/cm^2
Axial compressive stress	52.2 kg/cm^2
Shear stress without diagonal reinforcement	6.3 kg/cm^2
Shear stress with diagonal reinforcement	25.2 kg/cm^2
Bond stress with deformed bar	8.4 kg/cm^2

g. Prestressed Concrete
* Allowable stress for concrete
  - Compressive stress after 28 days fc' =350 kg/cm^2
  - Modulus of elasticity E = 325,00 "
  - Allowable bending compressive stress

Temporary stress before loss by creep and shrinkage	f_{ct} = 170 "
Stress at design load after loss	f_{ca} = 135 "

- Allowable axial compression stress
  - Temporary stress before loss by creep and shrinkage, f_{ct} = 132.5 kg/cm^2
  - Stress at design load after loss, f_{ca} = 105 "
- Allowable bending tensile stress
  - Temporary stress before loss by creep and shrinkage, f_{tt} = 13.5 "
  - Stress at design load after loss, f_{ta} = 0 "
- Allowable axial tensile stress
  - Temporary stress before loss by creep and shrinkage, f_{tt} = 0 kg/cm^2
  - Stress at design load after loss, f_{ta} = 0 "

* Allowable stress for steel material

	Horizontal	Vertical
- Nominal cross-section area (cm^2)	3.129	8.042
- Ultimate tensile stress (kg/cm^2)	18,660	11,000
- Yield point (kg/cm^2)	16,140	9,500
- Temporary stress before loss by creep and shrinkage (kg/cm^2)	13,060	7,700
- Stress at design load after loss (kg/cm^2)	11,200	5,700

h. Seismic Coefficient
- * Horizontal, K_h = 0.05
- * Vertical, K_v = 0

i. External Force
- * Wind Velocity, V = 40 m/s
- * Wind Pressure, q = 100 kg/m^2

j. Spillway
- * Design flow rate, Q = 2.62 m^3/s
- * Stream for diversion
  - Around 460 m upstream of the proposed pipeline from the head tank
- * Coefficient of roughness
  - For steel pipe, n = 0.014
  - For RCP, n = 0.017

k. Study Cases

* Normal case
  - Load: Internal water pressure
    Outer earth pressure
* At time of wind blow
  - Load: Internal water pressure
    Outer earth pressure
    Wind load
* At time of earthquake
  - Load: Internal water pressure
    Outer earth pressure
    Horizontal load by earthquake

l. Extra Allowable Stress

* At time of wind blow: 25% of Normal case
* At time of earthquake: 50% of Normal case

(3) The waterproof membrane shall be coated on the wall of Head Tank. The material of the waterproof membrane shall be Vandex or approved equal.

4104. SUPPLY OF STEEL PIPE

(1) The stipulations of Clauses 3101, 3102 and 3103 of the Particular Specifications shall be applied to the supply of steel pipe in this Section.

(2) Water stop ring and bell mouth pipe shall be welded to the steel pipe at the shop as shown in the Drawings and in accordance with JIS G 3443.

(3) Only the primer coating shall be made on external surface of the pipe to be covered by the concrete.

External and internal coatings of steel pipes to be placed in water shall be 350 um of Tar Epoxy in accordance with JWWA K 115.

(4) The drain pipe to be installed between the outlet pit and the energy dissipator-1 of spillway shall be the steel pipe 200 mm in diameter and 5.8 mm in thickness of wall. Specifications for material of steel, internal and external coatings of the pipe shall be the same as those of steel pipe 1,350 mm in diameter.

Water stop ring shall be also welded to the pipe.

(5) The galvanized steel pipe for level meter shall be 80 mm in diameter and 4.1 mm in thickness.

Water stop ring shall be also welded to the pipe.

(6) One sluice valve of 200 mm in diameter shall be supplied as the stop valve of drain pipe 200 mm in diameter. The sluice valve to be supplied shall be manufactured in accordance with JWWA B 115.

4105. SUPPLY OF FLEXIBLE COUPLING

(1) Dresser type couplings of ϕ200 mm to be supplied for drain pipe shall be manufactured in accordance with JIS G 3451.

4106. INSTALLATION OF STEEL PIPE, VALVE AND COUPLING

(1) The stipulations of Clause 3201 of the Particular Specifications shall be applied to the installation of steel pipe in this Section.

(2) The stipulation of Clause 3203 of the Particular Specifications shall be applied to the installation of valve and coupling in this Section.

4107. LIGHTNING ROD

(1) Three (3) sets of lightning rods shall be installed at the top of Head Tank. The lightning rods shall be galvanized steel or copperweld. The lightning conductor shall be 185 square millimeters stranded, bare, medium hard drawn copper, fastened to the rods.

(2) Earth rods shall be copperweld.

4108. METAL WORKS

(1) Ladders, handrail, platform, rung, supporting steel, and other miscellaneous metal works shall be executed in accordance with the Drawings and Division 6 of the General Specifications.

(2) All metals to be isntalled to Head Tank shall be galvanized.

(3) The Contractor shall propose for Engineer's approval the anchoring and fixing of those metal structures to the prestressed concrete of Head Tank.

4109. MEASUREMENT AND PAYMENT

(1) Measurement for payment for common excavation at Head Tank shall be the volume of material excavated as computed in place from the original ground surface to the required line and grades, measured in cubic meters.

(2) Payment for common excavation at Head Tank will be made under Pay Item 4101 of the Bill of Quantities, and shall cover excavation, hand excavation, disposal of excavated material, forming and preparation of foundation and other requirements stated in the Specifications and the Drawings.

(3) Measurement for payment for fill and backfill shall be the volume of compacted fill and backfill placed and measured in cubic meters. Measurement shall be made between the original ground surface as determined by surveys in the field or in case of backfill in excavation the foundation lines upon completion of excavation and the lines upon completion of the fill and backfill. Allowance for the volume arising from the stripping works shall not be considered nor included in the calculation of fill and backfill measurement. Volumes shall be computed by the average-end-area method with cross-sections taken every 5 meters or other method as directed by the Engineer.

No allowance shall be made in measurement for payment for fill and backfill for any settlement of the structure foundations, for internal settlement of the fill and backfill during the construction, or any fill and backfill which is eroded, removed or wasted during construction. All these losses shall be refilled at the Contractor's own expense and it shall not be measured for payment.

(4) Payment for fill and backfill at Head Tank will be made under Pay Item 4102 of the Bill of Quantities, and shall cover all kinds of necessary expenses for development of borrow area including the compensation for land and crops, excavation of borrow material, hauling, transportation, spreading, compaction, watering, obtaining and transporting test samples, and any other works related.

(5) Measurement for payment for concrete shall be the volume of concrete placed, measured in cubic meters, and shall include for the supply of all necessary materials, all measures necessary for the batching of materials, mixing, transporting, preparation prior to placing, placing, compacting, protection, curing, temperature control, supply and transport of test cylinders and finishing of this concrete.

(6) Payment for levelling concrete at Head Tank will be made under Pay Item 4103 of the Bill of Quantities.

(7) Payment for reinforced concrete of base slab of Head Tank will be made under Pay Item 4104 of the Bill of Quantities.

(8) Payment for reinforced concrete of level meter box and valve box will be made under Pay Item 4105 of the Bill of Quantities.

(9) Measurement for payment for formwork shall be the area, measured in square meters, of concrete surfaces formed, and shall include for the supply of all materials and for all measures necessary for preparation, transportation, placing, supporting

scaffolding, removing and any other works related.

No measurement for payment shall be made for formwork to levelling concrete.

Measurement for payment for formwork shall also be made on the area of concrete surface placed against timber shutterings or mortar covering to soil as described in Clause 4101 of the Particular Specifications.

(10) Payment for formwork to concrete Pay Items 4104 and 4105 of the Bill of Quantities will be made under Pay Item 4106 of the Bill of Quantities.

(11) Measurement for payment for reinforcing bars shall be the weight of reinforcing bars placed in the concrete, measured in metric tons, as computed from the approved detail bar bending schedule, using theoretical unit weights, and shall include supply and placing of reinforcing bars, tie wires, metals and concrete supports spacers and other fixing devices, splice coupling or welding, and other works related.

(12) Payment for reinforcing bars to concrete Pay Items 4104 and 4105 of the Bill of Quantities will be made under Pay Item 4107 of the Bill of Quantities.

(13) Measurement for payment for prestressed concrete works of super structure of Head Tank shall be the volume of capacity of tank, measured in empty-cubic meters.

The volume of capacity of tank means actual inner volume of tank measured as "inner area x inner height of the tank".

Measurement for payment shall not be changed depending upon the change of thickness of wall and/or reinforcing bar requirement and/or requirement of tensioning cables and steel and/or cement requirement of concrete and/or construction method, etc.

(14) Payment for prestressed concrete works of upper structure of Head Tank will be made under Item 4108 of the Bill of Quantities. Payment shall cover concrete works, formworks, reinforcing bars, supply and installation of post-tensioning cables and steels, anchoring, grouting, water stop if any, scaffolding and supporting, embedded metal and anchors, supply and transport of test cylinders and any other works related.

(15) Measurement for payment for supply of steel pipe 1,350 mm in diameter shall be the weight in kilograms of steel pipes manufactured and supplied, and shall include the provision of steel pipe, internal and external coatings and measures of pipe manufacturing, blasting, coating, shop testing, transportation to the Site and any other works related.

No separate measurement for payment shall be made for supply of any kind of bend pipes.

(16) Payment for supply of steel pipe 1,350 mm in diameter will be made under Pay Item 4109 of the Bill of Quantities.

(17) Measurement for payment for supply of bell mouth pipe 1,350 mm in diameter shall be the weight in kilograms of bell mouth manufactured and supplied.

(18) Payment for supply of bell mouth pipe 1,350 mm in diameter will be made under Pay Item 4110 of the Bill of Quantities.

(19) The down payment of the supply items including Pay Items 4109 and 4110 of the Bill of Quantities will be made as follows:

Fifty (50%) percent of the amount of the supply item will be payable at the time of delivery of the supply materials to the Site.

The remaining fifty (50%) percent of the payment will be made at the time of completion of installation works and the relevant site tests have shown complete compliance with the requirements of the Specifications.

(20) Measurement for payment for installation of steel pipe shall be the length in meters of steel pipeline installed, as computed on the length of centerline of the alignment of pipeline including the lengths for straight pipes, bend pipes, bell mouth pipes, joints, and valves, etc.

(21) Payment for installation of steel pipe including bell mouth pipe will be made under Pay Item 4111 of the Bill of Quantities, and shall cover the storage, handling, installation, field welding and coatings, all kinds of field testings including X-ray test and coloring test, and any other works related.

(22) Measurement for payment for supply and installation of steel pipe less than 600 mm in diameter shall be the weight, measured in kilograms, of steel pipes supplied and installed and shall include supply, transportation to Site, installation, tests of steel pipe, and all other earthworks related.

(23) Payment for supply and installation of steel pipe 200 mm in diameter will be made under Pay Item 4112 of the Bill of Quantities.

(24) Payment for supply and installation of steel pipe 80 mm in diameter will be made under Pay item 4113 of the Bill of Quantities.

(25) Measurement for payment for supply and installation of flexible coupling for steel pipe shall be the number of flexible couplings supplied and installed, and shall include the provisions of coupling and all kinds of accessories and measures of manufacturing, testings, transportation to Site, installation of flexible coupling, and any other works related.

(26) Payment for supply of Dresser type coupling for steel pipe 200 mm in diameter will be made under Pay Item 4114 of the Bill of Quantities.

(27) Measurement for payment for supply and installation of sluice valve shall be the number of valve supplied and installed.

(28) Payment for supply and installation of sluice valve 200 mm in diameter will be made under Pay Item 4115 of the Bill of Quantities.

(29) Payment for supply and installation of sluice valve 80 mm in diameter will be made under Pay Item 4116 of the Bill of Quantities.

(30) Measurement for payment for supply and installation of ladder and platform shall be the weight in kilograms of steel and metal of ladder and platform installed, and shall include the provision of anchor bolts and bars, connnectors and any other materials and measures necessary to complete ladder and platform.

(31) Payment for supply and installation of ladder and platform will be made under Pay Item 4117 of the Bill of Quantities.

(32) Measurement for payment for supply and installation of lightning rod shall be the number of the complete sets of lightning rods installed, and shall include the provisions of anchor bolts and bars, connectors, poles, strand cables, earth anchor and any other materials and measures necessary works to complete the installation of the lightning rod.

(33) Payment for supply and installlation of lightning rod will be made under Pay Item 4118 of the Bill of Quantities.

(34) Measurement for payment for supply and installation of miscellaneous metal shall be the weight in kilograms of miscellaneous metal installed, and shall include the provision of anchor bolts, connectors and any other materials and measures necessary to complete the supply, erection, painting or galvanizing of the miscellaneous metal items.

(35) Payment for miscellaneous metal will be made under Pay Item 4119 of the Bill of Quantities, and shall cover cast iron manhole cover, rung, and any othe miscellaneous metals.

SECTION 4200. SPILLWAY

4201. EARTHWORK FOR PIPELINE

(1) Earthwork including excavation, fill and backfill and backfill of selected material shall be performed in accordance with Division 2 of the General Specifications and the Drawings.

(2) Excavation shall be performed in accordance with cross-sections shown in Shop Drawings, and dimensions relating to the excavation works shown in the Contract Drawings are the minimum requirements. The Contractor may excavate deeper and/or larger than the standard cross-section shown in the Contract Drawing, and such expenses for over excavation shall be borne by the Contractor.

(3) When and in case the Engineer orders to excavate the trench cross sections other than the standard cross sections dependent upon the site conditions and from the viewpoint of safety, the Contractor shall comply with the order of the Engineer and the expenses required for these works shall be deemed included in the unit rate in the Bill of Quantities.

(4) Excavated trench shall be kept free from water. The Contractor shall prepare adequate facilities and equipment for drainage and drain the water at all times.

(5) Sand-bed to be backfilled under the pipeline shall be selected sandy material. Quality of sand-bed material is subject to Engineer's approval.

(6) Material to be filled or backfilled beside and up to 30 cm above the pipeline shall be approved selected material not containing silt or clay above 30% and solid matter larger than 10 cm in diameter and to be placed in layers, each not exceeding 20 cm in thickness and to be compacted by approved hand tamping, as shown in the Drawings.

(7) Fill or backfill above 30 cm above the pipeline shall be placed in layers, each not exceeding 30 mm in thickness and compacted by approved methods.

(8) Borrow area and material for the selected material of backfill shall be subject to Engineer's approval. All the expenses for compensation and development of such borrow area shall be borne by the Contractor.

(9) Way and method of spoil banking shall be subject to Engineer's approval.

4202. CONCRETE WORKS

(1) Concrete of each facility shall be the following classes:

Anchor block of pipe	:	D-concrete
Energy dissipator-1 at the yard of Head Tank	:	D-concrete
Energy dissipator-2 at outlet of Spillway	:	D-concrete
Levelling Concrete	:	H-concrete

4203. STEEL PIPE

(1) Manufacturing and supply of the steel pipe shall be performed, in accordance with indications of the Drawings and Section 5300 of the General Specifications.

The manner and method of manufacturing, coating, testing, transportation, etc. shall be subject to approval by the Engineer.

(2) Steel pipe to be installed under ground shall be as follows:

Diameter	:	600 mm
Wall thickness	:	6.0 mm
Material of steel	:	SS-41
Manufacturing	:	In accordance with JIS G 3443 * Both bending roll and spiral methods will be acceptable.
Internal coating	:	350 μm of Tar Epoxy in accordance with JWWA K 115.
External coating	:	one coat of Coal Tar Enamel with one layer of glass cloth in accordance with JIS G 3492.
Shape of pipe ends	:	Inside beveled end in accordance with JIS G 3443.

(3) External and internal coatings of steel pipe to be installed inside of Head Tank shall be Tar Epoxy coating in accordance with JWWA K 115. All other specifications shall be the same as (2) above.

(4) Bend pipe shall be manufactured in the same manner as the main steel pipeline 1,350 mm in diameter.

(5) Water stop ring shall be welded to the steel pipe as shown in the Drawings.

(6) Only the primer coating shall be made on external surface of the pipe to be covered by concrete.

(7) Installation of the steel pipe shall be performed in accordance with the Drawings and Section 5300 of the General Specifications.

The welding works shall be performed in accordance with JIS G 3443. The welders in charge of field welding of the pipes shall have the qualification prescribed in JIS Z 3801 or approved equal.

After pipe joints have been made, the external and internal coatings equivalent to the factory-applied coating shall be applied across the joints. These field coatings shall extend (i.e. overlap) 20 mm over the shop coatings.

(8) Steel support of pipe for fixing to the wall of Head Tank shall be welded to the steel pipe and coated in the same manner as external coating for the pipe.

(9) Way and manner of fixing of steel support to the wall shall be subject to Engineer's approval.

4204. MORNING GLORY

(1) Morning glory shall be manufactured at the shop.

(2) The specifications for steel material, welding, etc. shall be the same as for steel pipe.

(3) External and internal coating of morning glory shall be 350 μm of Tar Epoxy in accordacne with JWWA K 115.

4205. REINFORCED CONCRETE PIPE

(1) Supply and installation works of reinforced concrete pipe shall be performed in accordance with Section 5400 of the General Specifications and the Drawings.

(2) The Contractor shall provide the sample pipe to the Engineer for approval.

4206. MEASUREMENT AND PAYMENT

(1) Measurement for payment for earthworks of pipeline shall be the length of pipeline alignment excavated and filled as computed by the length of alignment of center line of pipes including the length of straight pipes, bend pipes, valves, joints, measured in meters. No separate measurement for payment shall be made for excavation, fill and backfill for the pipeline of non-standard sections such as bend pipes, inclined pipes, pipes with couplings, etc., and for the structures at the alignment of pipeline such as anchor block, energy dissipators and any other structures.

(2) Payment for earthwork for pipeline shall cover excavation, dewatering, borrow area development, transportation of material, backfill of selected material, fill and backfill, compaction, spoiling of excavated material and other works related.

(3) Payment for earthwork for pipeline of spillway will be made under Pay Item 4201 of the Bill of Quantities.

(4) Measurement for payment for placed rip-rap shall be the volume of rip-rap placed, measured in cubic meters.

(5) Payment for placed rip-rap will be made under Item 4202 of the Bill of Quantities.

(6) (5) of Clause 4110 of the Particular Specifications shall be applied for the measurement for payment for concrete in this Section.

(7) Payment for levelling concrete will be made under Pay Item 4203 of the Bill of Quantities.

(8) Payment for reinforced concrete Class-D for anchor concrete and energy dissipators will be made under Pay Item 4204 of the Bill of Quantities.

(9) (9) of Clause 4110 of the Particular Specifications shall be applied for the measurement for payment for formworks in this Section.

(10) Payment for formworks to concrete Pay Item 4204 will be made under Pay Item 4205 of the Bill of Quantities.

(11) (11) of Clause 4110 of the Particular Specifications shall be applied for the measurement for payment for reinforcing bars in this Section.

(12) Payment for reinforcing bars to concrete Pay Item 4204 will be made under Pay Item 4206 of the Bill of Quantities.

(13) Measurement for payment for supply of steel pipe 600 mm in diameter shall be the length in meter of steel pipe manufactured and supplied, and shall include the provisions of steel pipe, internal and external coatings and measures of pipe manufacturing, blasting, coating, shop testing, transportation to Site and any other works related.

No separate measurement for payment shall be made for supply of any kind of bend pipes.

(14) Payment for supply of steel pipe 600 mm in diameter will be made under Pay Item 4207 of the Bill of Quantities, and shall cover the supply of steel support and fixing anchors.

(15) Measurement for payment for supply of morning glory steel pipe shall be the weight in kilograms of morning glory supplied, and shall include the provisions of morning glory steel pipe, internal and external coatings and measures of pipe manufacturing, blasting, coating, shop testing, transportation to Site and any other works related.

(16) Payment for supply of morning glory steel pipe will be made under Pay Item 4208 of the Bill of Quantities.

(17) The down payment of the supply items including Pay Items 4207 and 4208 of the Bill of Quantities will be made as follows:

Fifty (50%) percent of the amount of the supply item will be payable at the time of delivery of the supply materials to the Site.

The remaining fifty (50%) percent of the payment will be made at the time of completion of installation works and the relevant site tests have shown complete compliance with the requirements of the Specifications.

(18) (25) of Clause 4110 of the Particular Specifications shall be applied for the measurement for payment for supply and installation of Dresser type coupling.

(19) Payment for supply and installation of Dresser type couplings for steel pipe 600 mm in diameter will be made under Pay Item 4209 of the Bill of Quantities.

(20) Measurement for payment for installation of steel pipe and morning glory steel pipe shall be the length in meters of steel pipeline installed, as computed on the length of centerline of the alignment of pipeline including the lengths for straight pipes, bend pipes, joints, morning glory and valves, etc.

(21) Payment for installation of steel pipe including morning glory will be made under Pay Item 4210 of the Bill of Quantities, and shall cover the storage, handling, installation, field welding and coatings, supporting and fixing of pipe to the wall of Head Tank, and any other works related.

(22) Measurement for payment for supply and installation of reinforced concrete pipe shall be the length in meters of reinforced concrete pipe installed, as computed on the length of centerline of the alignment of pipeline including the length of pipe, joint, etc.

(23) Payment for supply and installation of reinforced concrete pipe will be made under Pay Item 4211 of the Bill of Quantities.

(24) (34) of Clause 4110 of the Particular Specifications shall be applied for the measurement for payment for supply and installation of miscellaneous metal.

(25) Payment for supply and installation of miscellaneous metal will be made under Pay Item 4212 of the Bill of Quantities.

DIVISION 5. RECEIVING FACILITIES

SECTION 5000. GENERAL

5001. SCOPE OF WORKS

The scope of Works of Receiving Facilities consists of:

a. Receiving Well
b. Receiving Reservoir
c. Piping Works
d. Receiving Yard
e. Electrical Facilities

5002. TEMPORARY WORKS

(1) The Contractor shall submit to the Engineer for approval full details of the Contractor's temporary works relating to Receiving Facilities including the arrangement of temporary access road, borrow area of embankment, proposed area of spoiling, method of drainage, and any other temporary works related.

(2) Clearing works shall be performed where necessary at the Receiving Yard as the Contractor's temporary works. Trees cut by clearing works shall be the property of the Employer. The Contractor shall store these trees in the designated place, when and in case the Employer so orders.

5003. EXPLORATORY DRILLING

(1) The Contractor shall execute, prior to the excavation works, the exploratory drilling at the foundation of the guyed-tripole tower in accordance with the instructions of the Engineer.

(2) Exploratory drill holes shall be NX size with a 75 mm hole diameter and a minimum core diameter of 55 mm. Penetration tests shall be performed in every one meter of drill holes and the Contractor shall take all care and precautions to maximize core recovery.

5004. MEASUREMENT AND PAYMENT

(1) All kinds of temporary works necessary for construction of the Receiving Facilities including preparation, construction, maintenance and removal works shall be paid in lump sum under Pay Item 5001 of the Bill of Quantities.

Thirty (30%) percent of the lump sum under Pay Item 5001 will become payable when the Engineer deems the temporary works necessary for construction of the Intake Facilities are substantially completed. Twenty (20%) percent of the lump sum will be payable when the removal works are deemed to be substantially completed. The remaining fifty (50%) percent of the lump sum will be paid in equal monthly payments such that the total sum shall be fully disbursed upon the Stage Two Provisional Take-over of the Works.

(2) Measurement for payment for the exploratory drilling shall be the length, measured in meters, of drilled holes executed. Measurement shall include drillings, all testing required, sampling and report, etc. Payment for the exploratory drilling will be made under Pay Item 5002 of the Bill of Quantities.

SECTION 5100. RECEIVING WELL

5101. EARTHWORK

(1) Earthwork of Receiving Well shall be performed in accordance with the Drawings and Division 2 of the General Specifications.

(2) All kinds of earthwork of Receiving Well shall be commenced after stripping works, which are specified in Clause 5401 of the Particular Specifications.

5102. CONCRETE WORKS

(1) Classes of concrete for structures of Receiving Facilities shall be as follows:

Levelling Concrete	:	H-concrete
Reinforced Concrete of the Receiving Well	:	C-concrete
Precast Concrete Cover	:	D-concrete
Stair Concrete	:	D-concrete
Cinder Concrete	:	G-concrete
Base Concrete	:	D-concrete

(2) When and in case the Contractor intends to make vertical contraction joints to concrete of Receiving Well, the proposal containing statical calculations and bar arrangement shall be submitted for the Engineer's approval. In such case, water-stops shall be installed at any of contraction joints at the Contractor's own expense.

(3) Method of fixing of P.V.C. pipe to formwork for the perforated wall of Receiving Well shall be proposed by the Contractor for the Engineer's approval.

5103. METAL WORKS

(1) Rung, grating metal cover of manhole and other miscellaneous metal works shall be executed in accordance with the Drawings and Division 6 of the General Specifications.

(2) All steel materials to be installed to Receiving Well shall be galvanized or painted.

5104. MEASUREMENT AND PAYMENT

(1) Measurement for payment for common excavation shall be the volume of material excavated as computed in place from the stripped ground surface to the required line, measured in cubic meters.

Volume of voids formed shall be computed by the average-end-area method with cross sections taken every 5 meters or at such intervals as directed by the Engineer.

(2) Payment for common excavation at Receiving Well will be made under Pay Item 5101 of the Bill of Quantities, and shall cover excavation, disposal of excavated material, preparation of foundation and other requirements stated in the Specifications and the Drawings.

(3) Measurement for payment for fill and backfill shall be the volume of compacted fill and backfill placed and measured in cubic meters. Measurement shall be made between the original ground surface as determined by surveys in the field or in case of backfill in excavation the foundation lines upon completion of excavation and the lines upon completion of fill and backfill. Allowance for the volume arising from the stripping works shall not be considered nor included in the calculation of fill and backfill measurement. Volumes shall be computed by the average-end-area method with cross sections taken every 5 meters or at such intervals as directed by the Engineer.

No allowance shall be made in measurement for payment for fill and backfill for any settlement of the structure foundations, for internal settlement of the structure during the construction, or any fill and backfill which is eroded, removed or wasted during construction. All these losses shall be refilled at the Contractor's own expense and it shall not be measured for payment.

(4) Payment for fill and backfill at Receiving Well will be made under Pay Item 5102 of the Bill of Quantities.

(5) Measurement for payment for concrete shall be the volume in cubic meters of concrete placed, and shall include for the supply of all necessary materials including cement, aggregate and sand, etc., and for all measures necessary for batching of materials, mixing, transporting, preparation prior to placing, compacting, protecting, curing, temperature control, supply and transport of test cylinders and any other works related.

(6) Payment for reinforced concrete Class-C of Receiving Well will be made under Pay Item 5103 of the Bill of Quantities, and shall cover the expenses for supply and installation of PVC pipes 100 mm in diameter at the perforated wall of Receiving Well.

(7) Payment for precast concrete cover, Class-D, of Receiving Well will be made under Pay Item 5104 of the Bill of Quantities, and shall cover all kinds of expenses for the works of concrete, formworks, reinforcing bars, and any other works to complete and place the precast concrete cover.

(8) Payment for cinder concrete Class G of Receiving Well will be made under Pay Item 5105 of the Bill of Quantities.

(9) Payment for levelling concrete Class H of Receiving Well will be made under Pay Item 5106 of the Bill of Quantities.

(10) Measurement for payment for formwork shall be the area, measured in square meters, of concrete surfaces formed and shall include for the supply of all materials and for all measures necessary for preparation, transportation, placing, supporting scaffolding, removing and any other works related.

No measurement for payment shall be made for formworks to levelling concrete.

No separate measurement for payment shall be made for the formworks to precast concrete of cover and concrete of stair.

(11) Payment for formworks to concrete Pay Item 5103 will be made under Pay Item 5107 of the Bill of Quantities.

(12) Measurement for payment for reinforcing bars shall be the weight of reinforced bars placed in the concrete in metric tons as computed from the approved detail bar bending schedule, using theoretical unit weights, and shall include supply and placing of reinforcing bars, tie wire, metal and concrete supports spacers and other fixing devices, splice coupling or welding, and other works related.

No separate measurement for payment shall be made for the reinforcing bars to precast concrete of cover and concrete of stair.

(13) Payment for reinforcing bars to concrete Pay Item 5103 will be made under Pay Item 5108 of the Bill of Quantities.

(14) Measurement for payment for supply and installation of miscellaneous metal shall be the weight in kilograms of miscellaneous metal installed, and shall include the provision of anchor bolts, connectors and any other materials and measures necessary to complete the supply, erection, painting or galvanizing of the miscellaneous metal items. No measurement shall be made for any embedded metal which are required for installation of valves, gates, coverings, etc.

(15) Payment for supply and installation of miscellaneous metal will be made under Pay Item 5109 of the Bill of Quantities, and shall cover expenses for supply and installation of cast iron manhole covers and accessories, supply and installation of rungs, grating metal, and supply and installation of any other miscellaneous metals.

(16) Measurement for payment for concrete stairs shall be the number of concrete stairs constructed, and shall include excavation and backfill for construction of stairs, preparation of foundation, concrete works, formworks, reinforcing bars and any other works related.

(17) Payment for concrete stairs at Receiving Well will be made under Pay Item 5110 of the Bill of Quantities.

SECTION 5200. RECEIVING RESERVOIR

5201. EARTHWORK

(1) Earthwork of Receiving Reservoir shall be performed in accordance with the Drawings and Division 2 of the General Specifications.

(2) Excavated materials shall not be used for borrow material for embankment of Receiving Reservoir.

The Contractor shall propose borrow area of impervious material for the embankment to the Engineer for his approval. The embankment shall be placed in layer not exceeding 10 cm in compacted thickness and compacted using roller more than 10 tons capacity.

The dry density of this homogenous embankment shall be at least 95 percent of the maximum dry density as per ASTM D698.

(3) Hand excavation by man-power shall be performed for the excavation works of spillway, after the embankment works of Receiving Reservoir are performed.

(4) Stripping works shall be executed for the whole area covered by the Receiving Reservoir works. All rubbish, vegetation together with its roots and the soil layer with organic matters shall be thoroughly removed. Spoil area shall be proposed by the Contractor for the Engineer's approval.

5202. SODDING

Bermuda grass or approved equal shall be used for sodding. Watering to grass during two months after sodding shall be the obligation of the Contractor.

5203. EPT RUBBER SHEET

(1) Inner surface of Receiving Reservoir shall be lined by the Ethylene Propylene Terpolymer rubber sheet (EPT sheet).

(2) Thickness of EPT sheet to be supplied shall be 1.5 mm, and physical properties of EPT sheet shall be as the following specifications:

Test Description	Test Method	Specifications
Tensile strength minimum kg/cm^2	ASTM D412	75
Modulus at 300 percent elongation, minimum kg/cm^2	ASTM D412	30
Ultimate elongation percent minimum	ASTM D412	450

Test Description	Test Method	Specifications
Tear resistance minimum kg/cm	ASTM D624	25
Heat aging - 7 days at 80°C	ASTM D573	
Tensile strength retained percent of original		80 - 150
Modulus at 300 percent elongation retained, percent of original		80 - 150
Elongation retained minimum percent of original		70
Ozone resistance	1000 ± 100 pphm at 40 ± 2°C Extension: 100% 168 hours	No cracks

(3) The ground surface to be lined should be raked, smoothed, and rolled. It should be free from all large, sharp rocks, gravel or other sharp objects. Any objects over 5 mm diameter should be removed. Also, the surface should be free from any vegetation and vegetation stubble, such as trees and plant roots that protrude.

(4) An air drain network shall be constructed at the bottom and the side slopes of the Receiving Reservoir prior to installation of EPT sheet to avoid accumulation of air beneath the EPT sheet. The drain shall consist of perforated PVC pipe 50 mm in diameter covered by gravel filter and surrounded by pervious non-woven fabrics. The Contractor shall submit a detail proposal for the Engineer's approval.

(5) Where spillways or other concrete come into contact with the EPT sheet, a concrete apron will be necessary to facilitate placement of the sheeting. The apron should extend at least 500 mm and should be flat. The area backfilled adjacent to the concrete apron must be sufficiently compacted to prevent any sinkage and consequent damage to the EPT sheet where the EPT sheet and the concrete apron meet.

(6) Room Temperature Vulcanization (RTV) jointing method shall be applied for jointing of sheets, and each joint shall be overlapped by at least 100 mm.

(7) The Contractor shall submit full details of materials to be supplied, method of installation and its technical specifications, work schedule and other applications to the Engineer for his approval prior to commencement of the Works.

5204. CONCRETE WORKS

(1) Concrete for shoulder anchoring of EPT sheet shown in the Contract Drawings is subject to change depending upon the kind of EPT sheet proposed by the Contractor.

The Contractor shall propose, by his Shop Drawings, shoulder anchoring including aprons to be provided at all concrete structures inside of the reservoir for jointing with EPT sheet.

(2) All kinds of concrete works at inside of reservoir shall be completed before installation works of EPT sheet are commenced.

5205. MEASUREMENT AND PAYMENT

(1) Measurement for payment for stripping shall be the area of material stripped, measured in square meters. The area stripped shall be calculated by the projection of the boundaries of the stripped surfaces onto the plane parallel to the average slope of these surfaces.

(2) Payment for stripping of Receiving Reservoir will be made under Pay Item 5201 of the Bill of Quantities.

(3) (1) of Clause 5104 of the Particular Specifications shall be applied for measurement for payment for common excavation in this Section.

(4) Payment for common excavation at Receiving Reservoir will be made under Pay Item 5202 of the Bill of Quantities, and shall cover common excavation for the reservoir foundation, hand excavation for the spillway, shoulder anchors, air drains, etc. Excavation for inlet pit, outlet pits, drain pit, and piping shall not be covered under this Pay Item.

(5) (3) of Clause 5104 of the Particular Specifications shall be applied for measurement for payment for fill and backfill in this Section.

(6) Payment for fill and backfill at Receiving Reservoir will be made under Pay Item 5203 of the Bill of Quantities, and shall cover fill and backfill works at the spillway, shoulder anchor concrete, etc. Fill and backfill for inlet pit, outlet pits, drain pit, and piping shall not be covered under this Pay Item.

(7) Measurement for payment for embankment shall be the volume of compacted embankment placed and measured in cubic meters. Measurement shall be made between the original ground surface as determined by surveys in the field or in case of embankment in excavation the foundation lines upon completion of excavation and the lines upon completion of the embankment. Volumes shall be computed by the average-end-area method with cross-sections taken at every 5 meters or at such intervals as directed by the Engineer.

No allowance shall be made on measurement for payment for embankment for any settlement of the structure foundations, for internal settlement of the embankment during the construction, or any embankment which is eroded, removed or wasted during construction. All these losses shall be refilled at the Contractor's own expense and it shall not be measured for payment.

(8) Payment for embankment of Receiving Reservoir will be made under Pay Item 5204 of the Bill of Quantities, and shall cover all kinds of necessary expenses for development of borrow area including the compensation for land and crops, excavation of borrow material, hauling, transportation, spreading, compaction, watering, obtaining and transporting test samples, and any other works related.

(9) Measurement for payment for sodding shall be the area, measured in square meters, of sodding placed.

(10) Payment for sodding at Receiving Reservoir will be made under Pay Item 5205 of the Bill of Quantities.

(11) Measurement for payment for supply of EPT rubber sheet shall be the area of bottom and slopes of reservoir to be lined by EPT rubber sheet, measured in square meters, and shall cover the supply of EPT sheet membrane, adhesive, lap seal, sealing tape, masking tape, seaming tape and any other materials related.

(12) Payment for supply of EPT rubber sheet at Receiving Reservoir will be made under Pay Item 5206 of the Bill of Quantities.

(13) Measurement for payment for installation of EPT rubber sheet shall be the area of bottom and slopes of reservoir lined by EPT rubber sheet, measured in square meters, and shall cover the supply and installation of air drain and air vent pipe, ground surface treatment, and storing and installation of EPT rubber sheet, jointing of EPT rubber sheet, jointing to concrete structures and any other works related.

(14) Payment for installation of EPT rubber sheet at Receiving Reservoir will be made under Pay Item 5207 of the Bill of Quantities.

(15) (5) of Clause 5104 of the Particular Specifications shall apply to measurement for payment for concrete in this Section.

(16) Payment for reinforced concrete for spillway will be made under Pay Item 5208 of the Bill of Quantities.

(17) Payment for shoulder anchor concrete for EPT sheet will be made under Pay Item 5209 of the Bill of Quantities.

(18) Payment for levelling concrete will be made under Pay Item 5210 of the Bill of Quantities.

(19) (10) of Clause 5104 of the Particular Specifications shall apply to measurement for payment for formworks to concrete in this Section.

(20) Payment for formworks to concrete Pay Items 5208 and 5209 will be made under Pay Item 5211 of the Bill of Quantities.

(21) (12) of Clause 5104 of the Particular Specifications shall be apply to measurement for payment for reinforcing bars in this Section.

(22) Payment for reinforcing bars to concrete Pay Item 5208 will be made under Pay Item 5212 of the Bill of Quantities.

(23) (16) of Clause 5104 of the Particular Specifications shall apply to measurement for payment for concrete stair in this Section.

(24) Payment for concrete stair will be made under Pay Item 5213 of the Bill of Quantities.

SECTION 5300. VALVE BOX, PIT AND PIPING WORKS

5301. SUPPLY OF STEEL PIPE

(1) Clauses 3101 and 3102 of the Particular Specifications shall be applied for supply, shop test and inspection works of steel pipe 1,350 mm in diameter of this Section.

(2) Wall thickness of the steel pipe used in this Section shall be as follows:

Diameter	Wall Thickness
1,350 mm	11.9 mm
1,200 "	11.1 "
900 "	7.9 "
700 "	6.0 "
400 "	6.0 "
300 "	6.9 "
200 "	5.8 "
150 "	5.0 "
80 "	4.2 "

(3) Material of steel and internal and external coatings of the pipes, listed in(2) hereinabove, less than 1,350 mm in diameter shall be the same as those of steel pipes of 1,350 mm.

(4) Flanged pipes, pipes with puddle flange, four cross pipes, Tee pipes, reducer and bend pipes shall be manufactured and supplied in accordance with the details of the Contract Drawings.

(5) Only the prime coating shall be made on external surface of the pipes to be covered by the concrete.

(6) Thickened spigot end shall be provided to the steel pipe where Victaulic type coupling shall be installed.

(7) All kinds of flanges to be supplied shall be Class II flange and shall ensure the working pressure of 7.5 kg/cm^2, in accordance with JIS B 2212.

5302. SUPPLY OF FLEXIBLE COUPLING

(1) JIS G 3451 shall be applied for Dresser type couplings to be supplied and installed. All kinds of Dresser type couplings to be supplied shall ensure the working pressure of 7.5 kg/cm^2

(2) W-type of Victaulic shoulder type coupling or approved equal shall be applied for Victaulic type couplings, to be supplied and installed.

All kinds of Victaulic shoulder type coupling shall ensure the working pressure of 7.5 kg/cm^2.

(3) Other specifications applied for the couplings shall be the same as Clause 3104 of the Particular Specifications.

5303. SUPPLY OF VALVE

(1) Specifications for supply of butterfly and sluice valves for Receiving Facilities shall be the same as Clause 3105 of the Particular Specifications, except otherwise specified hereunder.

(2) All kinds of butterfly and sluice valves shall ensure the working pressure of 7.5 kg/cm^2.

5304. WATER FLOW CONTROL VALVE

(1) The water flow control valve shall be installed on the main water pipeline at just upstream of Receiving Well at Receiving Facilities. The control valve shall have the function to control water flow rates depending upon the water demand at Receiving Facilities and water level at Head Tank without any harmful vibration and cavitation during operation of the valve.

(2) The valve shall also be equipped with electric motor operating system with necessary apparatus and self-removal system of the dust and grass root flowing into the valve chamber.

(3) The Contractor shall submit the Shop Drawing and design details of the valve for Engineer's apporval prior to commencement of manufacturing. Design conditions of the control valve shall be as follows:

- Internal diameter of the valve: 1,200 mm
- Unit: one (1)
- Flange: Type II in accordance with JIS G3451
- Maximum pressure at inflow side when valve closed: 4.5 kg per sq.cm
- Minimum pressure of outflow side when valve closed: 0.3 kg per sq.cm
- Discharge rating: 0 - 2.62 cu.m per sec.
- Allowable cavitation coefficient: 0.20

The opening of the valve shall be directly proportional, as much as possible, to the flow rates.

(4) The valve structures shall consist of motor driving devices, guide pipe, movable sleeve and fixed sleeve. Flow rate adjustment shall be made by the movable sleeve, in which tapered and round shape perforations shall be uniformly allocated for appropriate water passing. Valve connection to the main water pipeline shall be by flanged ends. The motion of movable sleeve shall be made through the driving shaft which will be constructed as double tube type, and the shaft shall have enough stroke within valve chamber.

(5) Materials to be used for main body shall conform to the following specifications:

Guide pipe:	SS41 and SUS 316L
Movable sleeve:	SUS 304
Fixed sleeve:	SUS 304
Driving shaft:	SUS 304

(6) The control valve shall be able to be operated both manually and electrically for complying with remote control.

(7) Electric motor driving system shall be equipped with the following switches and equipment and shall be covered with waterproof case:

a. Limit switch valve shall be operated at the time of full opening, or complete closing or during the operation of self-removal system.

b. Torque limit switch shall be put on when abnormal torques occurred on the limit switch.

c. Interlocking switch shall be put on at the time of changing the operation system to manual operation.

d. Speed reduction system.

e. Transmitter of gate opening rates.

(8) Coating of the valve shall be performed in accordance with JWWA K 115 "Tar Epoxy Resin Coating for Water Services". The coating of internal and external surface of the valve shall be made with two layers as primer coating with thickness of 0.20 mm and final coating with 0.15 mm.

(9) Prior to shipment the valve shall be tested at the manufacturer's plant to demonstrate complete compliance with the Specifications. Water pressure test shall be made at the maximum rate of 10 kg per sq. cm.

All tests shall be conducted or witnessed by and the test results certified by an internationally accepted testing

organization. The results so certified shall be submitted in triplicate to the Engineer for approval. No shipment shall be made until such approval has been approved.

(10) The water flow control valve shall be the multi-jet sleeve type CAVILESS VALVE of Maezawa Industry Ltd. or approved equal.

5305. INSTALLATION OF STEEL PIPE

(1) Clause 3201 of the Particular Specifications shall be applied for the installation of steel pipe in this Section, unless otherwise specified hereunder.

(2) Installation of pipes under Receiving Reservoir shall be completed before any kind of embankment works are commenced.

5306. INSTALLATION OF VALVES AND COUPLINGS

(1) Clause 3203 of the Particular Specifications shall be applied for installation of valves and couplings in this Section.

5307. REINFORCED CONCRETE PIPE

(1) Clause 4205 of the Particular Specifications shall be applied for supply and installation of reinforced concrete pipe in this Section.

5308. EARTHWORKS FOR PIPELINE

(1) Clause 3301 of the Particular Specifications shall be applied for the earthworks for steel pipe in this Section.

(2) Clause 4201 of the Particular Specifications shall be applied for the earthwork for reinforced concrete pipe in this Section.

5309. INLET AND OUTLET PIT

(1) The Contractor shall construct inlet pit and outlet pit in accordance with the Drawings and the General Specifications.

(2) Concrete for inlet and outlet pits shall be D-concrete. The concrete apron to be contacted with EPT rubber sheet shall be subject to change depending upon the Contractor's proposal of the sheet.

(3) Common excavation and fill and backfill in the General Specificaltons shall be applied for the earthworks of inlet and outlet pits.

5310. VALVE BOX & FLOW METER BOX

(1) The Contractor shall construct the valve boxes and the flow meter box at the place where the stop valve shall be installed, in accordance with the Drawings.

(2) Concrete for the valve boxes and the flow meter box shall be D-concrete. All the works for concrete, formworks, reinforcing bar, etc. shall be executed in accordance with the General Specifications.

(3) Cast iron cover and rungs shall be supplied and installed under the conditions stipulated in the General Specifications. The rung shall be painted.

(4) Base concrete shall be D-concrete.

5311. ENERGY DISSIPATOR & MANHOLE

(1) Concrete for energy dissipator and manhole shall be D-concrete. All the works for concrete, formworks, reinforcing bar, etc. shall be executed in accordance with the Drawings and the General Specifications.

5312. SURFACE VALVE BOX

(1) Clause 3304 of the Particular Specifications shall be applied for the works of surface valve box in this Section.

5313. MEASUREMENT AND PAYMENT

(1) Measurement for payment for supply of steel pipe including bend pipe, flanged pipe, pipe with puddle flange, four cross pipes, tee pipes, reducer, etc. shall be the length in meter of steel pipe manufactured and supplied, and shall include the provisions of steel pipe, internal and external coatings and measures of pipe manufacturing, blasting, coating, shop testing, transportation to Site and any other works related.

No separate or additional measurement for payment shall be made for supply of any kind of bend pipe, four cross pipe, flanged pipe, Tee pipe, reducer, etc.

(2) Payment for supply of steel pipe will be made under Pay Items 5301, 5302, 5303, and 5304 of the Bill of Quantities.

(3) Measurement for payment for supply of flexible couplings for steel pipe shall be the number of each kind of flexible couplings supplied, and shall include the provisions of coupling and all kinds of accessories and measures of manufacturing, testing, transportation to Site and any other works related.

(4) Payment for supply of Dresser type coupling for steel pipe will be made under Pay Items 5305, 5306, 5307, 5308, 5309, 5310 and 5311 of the Bill of Quantities.

(5) Payment for supply of Victaulic shoulder type coupling for steel pipe will be made under Pay Items 5312, 5313, 5314 and 5315 of the Bill of Quantities.

(6) Measurement for payment for supply of valves shall be the number of each kind of valves supplied, and shall include the provisions of valves, operating nuts, bolts, packings and any other accessories, and measures of manufacturing, testing, transportation to Site and any other works related.

(7) Payment for supply of control valve 1,200 mm in diameter will be made under Pay Item 5317 of the Bill of Quantities.

(8) Payment for supply of butterfly valve will be made under Pay Items 5316, 5318, 5319, and 5320 of the Bill of Quantities.

(9) Payment for supply of sluice valve will be made under Pay Items 5321, 5322 and 5323 of the Bill of Quantities.

(10) The down payment of the supply items including Pay Items 5301 to 5323 inclusive of the Bill of Quantities will be made as follows:

Fifty (50%) percent of the amount of the supply item will be payable at the time of delivery of the supply materials to the Site.

The remaining fifty (50%) percent of the payment will be made at the time of completion of installation works and the relevant site tests have shown complete compliance with the requirements of the Specifications.

(11) Measurement for payment for installation of steel pipe shall be the length in meters of steel pipeline installed, as computed on centerline of the alignment of pipeline including the lengths for straight pipes, bend pipes, Tee pipes, joints, etc., but excluding the lengths for valves.

(12) Payment for installation of steel pipe will be made under Pay Items 5324, 5325, 5326, and 5327 of the Bill of Quantities, and shall cover the storage, handling, installation, field welding and coatings, all kinds of field testings including X-ray test and coloring test, and any other works related.

(13) Measurement for payment for installation of flexible couplings shall be the number of flexible couplings installed, and shall cover storage, handling, installation, coating if any, field tests and any other works related.

(14) Payment for installation of Dresser type coupling will be made under Pay Items 5328, 5329 and 5330 of the Bill of Quantities.

(15) Payment for installation of Victaulic shoulder type coupling will be made under Pay Items 5331 and 5332 of the Bill of Quantities.

(16) Measurement for payment for installation of control valve, butterfly valves and sluice valves shall be the number of valves installed, and shall cover storage, handling, installation, coating if any, field tests and any other works related.

(17) Payment for installation of control valve and butterfly valves will be made under Pay Items 5333 and 5334 of the Bill of Quantities.

(18) Payment for installation of sluice valve will be made under Pay Item 5335 of the Bill of Quantities.

(19) Measurement for payment for earthwork of steel pipeline shall be the length of pipeline alignment excavated as computed by the length of alignment of center line of pipes installed including the length of straight pipes, bend pipes, valves, joints but excluding the length of pipe and valves inside of concrete structure, measured in meters. No separate or additional measurement for payment shall be made for excavation, fill and backfill for the pipeline of non-standard sections such as bend pipes, Tee pipes, flanged pipes, inclined pipes, and pipes with couplings.

Payment for earthwork for steel pipeline shall cover excavation, dewatering, borrow area development, transportation of material, backfill of selected material, fill and backfill, compaction, spoiling of excavated material and any other works related.

(20) Payment for earthwork for steel pipelines 1,350 mm and 1,200 mm in diameter will be made under Pay Item 5336 of the Bill of Quantities.

(21) Payment for earthwork for steel pipeline 900 mm and 700 mm in diameters will be made under Pay Item 5337 of the Bill of Quantities.

(22) Payment for earthworks for steel pipeline between 400 mm and 75 mm in diameter will be made under Pay Item 5338 of the Bill of Quantities.

(23) Measurement for payment for supply and installation of reinforced concrete pipe shall be the length in meters of reinforced concrete pipe installed, as computed on centerline of the alignment of pipeline including the length of pipe, joint, etc.

(24) Payment for supply and installation of reinforced concrete pipe will be made under Pay Items 5339 and 5340 of the Bill of Quantities.

(25) Measurement for payment for earthwork of reinforced concrete pipeline shall be the length of pipeline of alignment excavated and filled as computed by the length of alignment of center line of pipes including the lengths of straight pipes, bend pipes, joints, measured in meters. No separate measurement for payment shall be made for excavation, fill and backfill for the pipeline of non-standard sections such as bend pipes, inclined pipes, pipes with couplings, etc., and for the structures on the alignment of pipeline such as manhole, energy dissipators and any other structures.

(26) Payment for earthwork for reinforced concrete pipeline ϕ1,200 mm and ϕ1,000 mm in diameter will be made under pay Item 5341 of the Bill of Quantities.

Payment for earthwork for concrete pipeline shall cover excavation, dewatering, borrow area development, transportation of material, backfill of selected material, fill and backfill, sand-bed compaction, spoiling of excavated material and other works related.

(27) Measurement for payment for supply and installation of surface valve box shall be the number of boxes placed and installed, and shall include the works of filling cobble, concrete of Class-H, galvanized round bar for fixing of pipe, supply and installation of reinforced concrete pipe and cast iron hat and any other works related.

No different measurement for payment shall be made for surface valve boxes depending upon the different sizes and/or different heights of reinforced concrete pipes.

(28) Payment for surface valve box will be made under Pay Item 5342 of the Bill of Quantities.

(29) Measurement for payment for common excavation shall be the volume of earth material excavated as computed in place from the original ground surface to the required line, measured in cubic meters.

Volume of voids formed shall be computed by the average-end-area method with cross sections taken every 5 meters or at such intervals as directed by the Engineer.

Measurement for payment for common excavation shall cover the excavation works for inlet and outlet pits, valve boxes, water flow meter box and any other structures which are not covered by earthwork of pipelines.

(30) Payment for common excavation will be made under Pay Item 5343 of the Bill of Quantities, and shall cover excavation, disposal of excavated material, preparation of foundation and other requirements stated in the Specifications and the Drawings.

(31) Measurement for payment for fill and backfill shall be the volume of compacted fill and backfill placed and measured in cubic meters. Measurement shall be made between the original ground surface as determined by surveys in the field or in case of backfill in excavation the foundation lines upon completion of excavation and the lines upon completion of fill and backfill. Allowance for the volume arising from the stripping works shall not be considered nor included in the calculation of fill and backfill measurement. Volumes shall be computed by the average-end-area method with cross sections taken every 5 meters or at such intervals as directed by the Engineer.

No allowance shall be made in measurement for payment for fill and backfill for any settlement of the structure foundations, for internal settlement of the fill and backfill during the construction, or any fill and backfill which is eroded, removed or wasted during construction. All these losses shall be refilled at the Contractor's own expense and it shall not be measured for payment.

Measurement for payment for fill and backfill shall cover the fill and backfill works for inlet and outlet pits, valve boxes, water flow meter box and any other structures which are not covered by earthwork of pipelines.

(32) Payment for fill and backfill will be made under Pay Item 5344 of the Bill of Quantities, and shall cover all kinds of necessary expenses for development of borrow area including the compensation for land and crops, excavation of borrow material, hauling, transportation, spreading, compaction, watering, obtaining and transporting test samples, and any other works related.

(33) (5) of Clause 4110 of the Particular Specifications shall be applied for the measurement for payment for concrete in this Section.

(34) Payment for base concrete Class-D at the Receiving Well, flow meter box, valve boxes, etc. will be made under Item 5345 of the Bill of Quantities, and shall cover concrete works, formworks, reinforcing bar, embedded steel, and any other works related.

(35) Payment for reinforced concrete Class-D for valve boxes, pits, energy dissipator, etc. will be made under Pay Item 5346 of the Bill of Quantities.

(36) Payment for levelling concrete Class-H for valve boxes, pits, energy dissipator, etc. will be made under Pay Item 5347 of the Bill of Quantities.

(37) Measurement for payment for formwork shall be the area, measured in square meters, of concrete surfaces formed, and shall include for the supply of all materials and for all measures necessary for preparation, transportation, placing, supporting scaffolding, removing and any other works related.

No measurement for payment shall be made for formworks to levelling concrete.

(38) Payment for formwork to concrete Pay Item 5346 will be made under Pay Item 5348 of the Bill of Quantities.

(39) Measurement for payment for reinforcing bar shall be the weight of reinforced bars placed in the concrete in metric tons as computed from the approved detail bar bending schedule, using theoretical unit weights, and shall include supply and placing of reinforcing bars, tie wire, metal and concrete supports spacers and other fixing devices, splice coupling or welding, and other works related.

(40) Payment for reinforcing bar to concrte Pay Item 5346 will be made under Pay Item 5349 of the Bill of Quantities.

(41) Measurement for payment for supply and installation of miscellaneous metal shall be the weight in kilograms of miscellaneous metal installed, and shall include the provision of anchor bolts, connectors and any other materials and measures necessary to complete the supply, erection, painting or galvanizing of the miscellaneous metal items. No measurement shall be made for any embedded metal which are required for installation of valves, gates, coverings, etc.

(42) Payment for supply and intallation of miscellaneous metal will be made under Pay Item 5350 of the Bill of Quantities, and shall cover expenses for supply and installation of cast iron covers for manhole, rung, grating metal, checker plate and any other kind of miscellaneous metals.

SECTION 5400. RECEIVING YARD

5401. YARD PREPARATION

(1) The Contractor shall execute stripping works for the Receiving Yard including the areas of Receiving Well, office buildings, camp facilities, yard road and other areas, but excluding the area of Receiving Reservoir.

(2) Stripping works shall be executed prior to excavation and/or fill works. All rubbish, vegetation together with its roots and soil layer with organic matters shall be thoroughly removed. Material stripped shall be transported to the spoil area which shall be proposed by the Contractor to the Engineer for his approval.

(3) The land levelling works shall be performed for the Receiving Yard including the areas of Receiving Well, Receiving Reservoir, office yard, and other areas which may be instructed by the Engineer. The final level shall be EL. 59.00 or as specified by the Engineer.

5402. SODDING

Bermuda grass or approved equal shall be used for sodding. Watering to grass during two months after sodding shall be the obligation of the Contractor.

The area to be covered with grass will be instructed by the Engineer.

5403. BITUMEN SEAL COAT PAVEMENT

(1) Section 2300 of the General Specifications shall apply to the works of bitumen seal cast pavement at the Receiving Yard.

(2) Bitumen seal coat pavement for the area of office yard and 6 m width road shall be as follows:

Foundation	:	Compacted sand
Sub-base	:	15 cm of crushed stone
Prime coating	:	1.2 - 1.4 liter/sq.m
First layer coating	:	1.7 - 2.1 liters/sq.m with 18-22 kg/sq.m of crushed stone
Second layer coating	:	0.6-0.9 liter/sq.m with 8-10 kg/sq.m of crushed stone
Wearing coating	:	0.5-0.6 liter/sq.m with 4-7 kg/sq.m of coarse sand

(3) Bitumen seal coat pavement for the area of 3 m width road shall be as follows:

Foundation	:	Compacted sand
Sub-base	:	15 cm of crushed stone
Prime coating	:	1.2 - 1.4 liter/sq.m
First layer coating	:	0.6 - 0.9 liter/sq.m with 8-10 kg/sq. of crushed stone
Wearing coating	:	0.5 - 0.6 liter/sq.m with 4-7 kg/sq.m of coarse sand

5404. SURFACE DRAINAGE

(1) Open drainage channel made of H-concrete shall be constructed at both sides of 6 m width road.

(2) All the road crossing of the drainage system shall be reinforced concrete pipe 300 mm in diameter, and drainage manhole shall be constructed at both sides of road crossing pipe.

5405. MEASUREMENT AND PAYMENT

(1) (1) of Clause 5205 of the Particular Specifications shall apply to measurement for payment for stripping in this Section.

(2) Payment for stripping will be made under Pay Item 5401 of the Bill of Quantities.

(3) (1) of Clause 5104 of the Particular Specifications shall apply to measurement for payment for common excavation in this Section. Measurement for payment shall not include for excavation for drainage canal, drainage manhole and reinforced concrete pipeline.

(4) Payment for common excavation will be made under Pay Item 5402 of the Bill of Quantities.

(5) (3) of Clause 5104 of the Particular Specifications shall apply to measurement for payment for fill in this Section. Measurement for payment shall not include for fill and backfill for drainage canal, drainage manhole and reinforced concrete pipeline.

(6) Payment for fill will be made under Pay Item 5403 of the Bill of Quantities.

(7) Measurement for payment for sodding shall be the area, measured in square meters, of sodding placed.

(8) Payment for sodding will be made under Pay Item 5404 of the Bill of Quantities.

(9) Measurement for payment for bitumen seal coat paving shall be the area in square meter of bitumen seal coat pavement placed and compacted to the neat lines and shall include compaction of foundation, sub-base preparation, prime coating and layers of base coarse and wearing coating.

(10) Payment for bitumen seal coat paving for 6 m road will be made under Pay Item 5405 of the Bill of Quantities.

(11) Payment for bitumen seal coat paving for 3 m road will be made under Pay Item 5406 of the Bill of Quantities.

(12) Measurement for payment for concrete open drainage channel shall be the length of open channel constructed, measured in meters, and shall cover the works of excavation, fill and backfill, preparation of foundation, concrete works, formworks and any other works related.

(13) Payment for concrete open drainage channel will be made under Pay Item 5407 of the Bill of Quantities.

(14) Measurement for payment for drainage manhole shall be the number of manhole constructed, and shall cover the works of excavation, fill and backfill, preparation foundation, concrete works, formworks, reinforcing bar arrangement and any other works related.

(15) Payment for drainage manhole will be made under Pay Item 5408 of the Bill of Quantities.

(16) Measurement for payment for supply and installation of reinforcing concrete pipe shall be the length of pipe supplied and installed, measured in meters, and shall cover the works of excavation, preparation of foundation, backfill, supply and installation of reinforced concrete pipe and any other works related.

(17) Payment for supply and installation of reinforced concrete pipe 300 mm in diameter will be made under Pay Item 5409 of the Bill of Quantities.

SECTION 5500. ELECTRIC FACILITIES

5501. SCOPE OF WORKS

The scope of works of electric facilities in this Section shall consist of the following:

(1) Equipment and control panel for 380/220V distribution system and necessary accessories.

(2) DC/AC uninterruptable power source equipment and necessary accessories.

(3) All wire, cable and duct works of the above mentioned equipment.

5502. OPERATION AND CONTROL SYSTEM OF THE ELECTRIC FACILITIES

(1) Operation of flow control valve

The electric motor operated flow control valve shall be controlled by the manual control switch (OPEN-CLOSE) on the metering instrument panel to control the water flow rates based on water demand at the Receiving Facilities.

(2) Operation of standby generator

This packaged type generator shall be started automatically immediately after failure of public power supply. Furthermore, the system shall have manual operation mode. The change over switch for bus transfer magnet switch shall be installed on the distribution panel.

5503. EQUIPMENT OF RECEIVING FACILITIES

Equipment of Receiving Facilities and respective major components of the equipment exclusive of camp facilities shall consist of the following specifications:

(1) 380/220V distribution and valve control cubicle (E-21) 1 unit

- 380V incoming molded circuit breaker unit including potential transformers, current transformers, ammeter and meter change-over switch 1 set
- Reversible motor control unit for water flow control valve 1 set

- 3-phase, 380/220 V outlet molded circuit breaker unit for distribution — 6 sets

- 3-pole commercial-generator change-over switch unit — 1 set

- 2-pole molded circuit breaker unit for U.P.S. bypass — 1 set

(2) Measuring Instrument Panel (E-22)

- Water flow valve control (open/close/hold) switch — 1 set

- Emergency shutdown switch — 1 set

- Water flow control valve opening range indicator — 1 set

- Water inflow rate indicator with recorder and integrator — 1 set

- Meter source unit — 1 lot

- Receiving reservoir water level indicator with alarm system — 1 lot

- Additional panel space for other instrument — 1 lot

(3) DC/AC Uninterruptable Power Soure Cubicle (E-23) — 1 unit

Major components to be mounted shall be the same as item No. E-17. The details of this system shall be in accordance with the Drawings.

(4) Diesel Engine Generator for Receiving Facilities Power Supply (E-24) — 1 unit

Package type engine driven generator set — 1 unit

- Ratings: 3-phase 4 wire, 380/220 V, 50 Hz, 65 KVA

- Time rating: Not less than 48 hours continuously

- Generator control: control system mounted on the generator set

- Engine starting: DC Motor starting and automatic starting equipment for power failure shall be mounted on the generator set.

- DC battery and necesasry accessories

- Other necessary accessories

(5) Cable Connection and Installation (E-25)

a. All wiring, such as power, control and interconnecting, for Receiving Facilities shall be furnished and installed completely through the cable pit and trench. Major cable routes are as follows:

- 380/220V distribution and valve control cubicle to control valve unit.
- 380/220V distribution cubicle to DC/AC uninterruptable power source cubicle.
- AC generator unit to 380/220 V distribution cubicle.
- 220V AC uninterruptable power source cubicle to measuring instrument panel.
- Water level measuring instrument to the control panel.
- Other necessary interconnection cable.

b. All necessary grounding works in the category.

5504. SPARE PARTS AND SPECIAL TOOLS FOR MAINTENANCE

The Contractor shall provide the following necessary spare parts, tools and recommendable spare parts by the Contractor for all electric facilities.

		Quantity	Unit
(1)	For 380/220V Distribution and Valve Control Cubicle		
a.	Fuse element	100	%
b.	Signal lamp bulb	200	%
c.	Signal lamp globe	30	%
d.	Complete signal lamp	10	%
e.	Magnetic contactor (reverse type)	1	No.
f.	Thermal relay	1	No.
g.	Voltmeter switch	1	No.
h.	Ammeter switch	1	No.
(2)	For DC/AC Uninterruptable Power Source		
a.	Control card	1	No.
b.	Signal lamp bulb	200	%
c.	Fuse element	100	%

(3) For 65 KVA Engine Driven Generator Set Engine

a.	Piston ring	1	set
b.	Oil ring	1	set
c.	Nozzle tip	1	set
d.	Fuel injection type	1	No.
e.	Intake valve	1	No.
f.	Exhaust valve	1	No.
g.	Fuel oil filter element	1	pcs.
h.	Lubricating oil filter element (System oil)	1	pcs.
i.	Lubricating oil filter element (Rocker arm)	1	pcs.
j.	Various packing	1	set
k.	Various spring	1	set

5505. MEASUREMENT AND PAYMENT

(1) Measurement for payment for supply of electric equipment for the Receiving Facilities, which consist of 380/220V distribution and valve control cubicle, measuring instrument panel, DC/AC uninterruptable power source cubicle and diesel engine generator, shall be the number of each packaged unit for respective equipment supplied. Necessary instruments, accessories, wiring and cabling in the respective packaged unit for the above mentioned equipment shall be included in the respective items of the equipment.

(2) Payment for supply of the electric equipments for the Receiving Facilities mentioned in above sub-clause (1) will be made under Pay Items 5501 to 5504 of the Bill of Quantities, and shall cover the supply of packaged units of the equipment with shop test charges, shop painting and necessary accessories specified in Clause 5503 of the Particular Specifications, and any other works related.

(3) Measurement for payment for supply of cables and wires for Receiving Facilities shall be on a lump-sum basis, and shall cover all necessary materials of connecting wires and cables between control room in Mab Ta Pud Administration Office and diesel engine generator room, control valve and water level facilities installed except delivery cables to the buildings around the Receiving Facilities.

(4) Payment for supply of the cables and wires for Receiving Facilities will be made under Pay Item 5505 of the Bill of Quantities.

(5) Measurement for payment for supply of the spare parts and tools for Receiving Facilities which are specified in Clause 5504 of the Particular Specifications shall be on a lump-sum basis.

(6) Payment for supply of the spare parts and tools for Receiving Facilities will be made under Pay Item 5506 of the Bill of Quantities, and shall cover the supply of tools and spare parts with shop painting and shop test charges, and any other works related.

(7) Measurement for payment for transportation of all electric equipment, wires, cables and necessary materials for Receiving Facilities shall be on a lump-sum basis.

(8) Payment for transportation of all equipment and materials for Receiving Facilities will be made under Pay Item 5507 of the Bill of Quantities, and shall cover all costs, charges and expenses associated with the transportation of all electric plants, equipment and materials from the shop to the Site including the ocean-freight, insurances, port charges, customs, taxes, demurrage, inland transportation and packing charges.

(9) Measurement for payment for installation works of all electric facilities and appurtenances which are covered in Clause 5503 "Equipment of Receiving Facilities" of the Particular Specifications shall be on a lump-sum basis.

(10) Payment for installation of all electric facilities and appurtenances of the Receiving Facilities will be made under Pay Item 5508 of the Bill of Quantities, and shall cover all kinds of necessary works to complete the installation of the electric facilities and appurtenances and conducting the site tests.

Payment will be made when the relevant test results of all the electric facilities and appurtenance have shown complete compliance with the requirements of the Specifications.

(11) The down payment of the supply items including Pay Items 5501 to 5506 inclusive of the Bill of Quantities will be made as follows:

Fifty (50%) percent of the amount of the supply item will be payable at the time of delivery of the supply materials to the Site.

The remaining fifty (50%) percent of the payment will be made at the time of completion of installation works and relevant site tests have shown complete compliance with the requirements of the Specifications.

DIVISION 6. CONTROL SYSTEM

SECTION 6000. GENERAL

6001. SCOPE OF WORKS

The equipment and facilities to be provided for the control system shall consist of measuring facilities and equipment at Intake Tower, at Head Tank and at Receiving Facilities, and radio communication facilities at Intake Facilities and at Receiving Facilities. The required facilities and equipment are as follows:

(1) Measuring Facilities and Equipment of Intake Tower

Measuring facilities and equipment of Intake Tower shall consist of two units of water level measuring equipment in the pump suction pool at Intake Tower and one unit of water flow measuring equipment at the pipe line on Intake Bridge.

(2) Measuring Facilities and Equipment of Head Tank

Measuring facilities and equipment of Head Tank shall consist of two units of water level measuring equipment including cable works from the measuring equipment to the supervising control panel in the Control House.

(3) Measuring Facilities and Equipment of Receiving Facilities

Measuring facilities and equipment of Receiving Facilities shall consist of one unit of water level measuring equipment in the Receiving Reservoir and one unit of water flow measuring equipment at 5 m upstream of Receiving Well respectively.

(4) Radio Communication Facilities

The radio communication facilities will be established at Dok Krai Administration Office and at Mab Ta Pud Administration Office. The system consists of two radio terminals, including antennas, towers, coaxial feeders and power supply facilities.

6002. DESIGN CONDITIONS

(1) General Conditions

a. The Contractor shall furnish all transmitters, sensing elements, measuring cells, receivers, transducers, signal converters, indicactors, integrators, power supplies, as specified and required for proper operation and complete functioning of the instrumentation system.

b. Input voltage of power source for instruments shall be uninterruptable single phase 220 V, 50 Hz.

c. Transmitter shall have shut-off valves in its primary measuring lines.

d. Transmitter and sensor shall have an automatic temperature compensator.

e. The Contractor shall provide "Two year supply of charts, pens and ink for each recorder and special tools for maintenance.

f. Signal transmitted shall be 4 to 20 mA DC or 1 to 5 V DC.

g. Application liquid is raw water.

(2) Water Level Measuring Equipment

a. The equipment shall have transmitter, relay unit, power source unit, indicator, and related cables.

b. The type of equipment shall be differential pressure type (DPT) and floating type (FT).

c. Measurement conditions of water level at respective station are shown as follows:

- Intake Tower (DPT)

  Highest water level: EL 54.10 m
  Lowest water level: EL 42.00 m
  Installation elevation: EL approx. 39.00 m

- Head Tank (DPT)

  Highest control water level: EL 102.85 m
  Lowest control water level: EL 99.55 m
  Installation elevation: EL approx. 81.00 m

- Receiving Reservoir (FT)

  Highest water level: EL 62.20 m
  Lowest water level: EL 59.20 m
  Installation elevation: EL approx. 58.20 m

- Head Tank (Floating type water level gauge)

  Highest water level: EL 103.40 m
  Lowest water level : EL 82.00 m
  Installation elevation: EL 105.40 m

(3) Water Flow Measuring Equipment

a. The type of equipment to be provided shall be ultra-sonic two-beam type water flow meter.

b. The equipment shall have detection unit, connecting box, transducer with digital indicator, recorder and integrater, and related cables.

c. Measuring condition of water flow shall range from 0.10 m/sec to 3.50 m/sec.

(4) Radio Communication Equipment

a. The distance between both stations where the system will be installed is approximately 20 km, and required height of antenna tower shall be around 30 m.

b. The radio communication system shall, generally, be used in emergency when public telephone lines fail between said two stations.

c. The Contractor shall conduct proper geological investigations on bearing capacity of soil at the foundation of both proposed antenna tower construction point.

d. The equipment shall be designed band with an adjacent channel separation of 20 KHz or 25 KHz.

e. The Contractor shall propose detailed dimension, structural design of the guyed tripole tower and required accessories on Shop Drawings for the Engineer's approval.

6003. MEASUREMENT AND PAYMENT

No separate payment will be made for complying with the provisions of this Section and all costs shall be deemed to be included in the rates for the various Pay Items of the works for control system in the Bill of Quantities.

SECTION 6100. MEASURING FACILITIES

6101. WATER LEVEL MEASURING EQUIPMENT (E-31) AT INTAKE TOWER

The water level measuring Equipment (E-31) at Intake Tower and major components to be supplied and installed are specified as follows, and two (2) units of the equipment shall be supplied and installed.

a. The type of the equipment shall be differential pressure type level transmitter.

b. Moving coil type pointer travelling indicator with adjustable alarm setter shall be equipped and be mounted on the supervising control panel (E-18).

c. All interconnecting wiring between transmitters and instruments shall be supplied and installed.

d. All wires for instrument shall be shielded and installed in suitable conduit pipe to be free from any disturbance of other power cables and/or other control cable lines.

e. Necessary spare parts shall be provided by the Contractor.

6102. WATER FLOW MEASURING EQUIPMENT (E-32) AT INTAKE TOWER

The water flow measuring equipment (E-32) at Intake Tower and major components to be supplied and installed are specified as follows, and one packaged unit of equipment shall be supplied and installed.

a. The type of equipment shall be ultra-sonic two-beam type water flow meter.

b. Materials of measuring pipe is steel with inner diameter of 1,350 mm and thickness of 11.9 mm.

c. The instruments shall be equipped with signal isolator (detection unit) connecting box and local indicator.

d. The instruments including indicator, integrator and automatic balanced type flow recorder shall be mounted on the supervising control panel (E-18).

e. All interconnection wiring between indicator and instruments shall be supplied and installed.

f. All wires for instrument shall be shielded and installed in suitable conduit pipe to be free from any disturbance of power cables and/or other control cable lines.

g. Necessary spare parts shall be provided.

6103. WATER LEVEL MEASURING EQUIPMENT (E-33) AT HEAD TANK

The water level measuring equipment (E-33) at Head Tank and major components to be supplied and installed are specified as follows, and two (2) packaged units of the equipment shall be supplied and installed.

a. The type of equipment shall be differential pressure type level transmitter.

b. The system shall be equipped analogue signal transmission line of approximately 7.6 km in length between Head Tank and supervising control panel (E-18) at Intake Tower.

c. Moving coil type pointer travelling indicator with adjustable alarm setting, signal isolator and changeover switch for selection of level signals with transmission emergency alarm shall be mounted on the supervising control panel (E-18).

d. All interconnecting wiring between transmitter and instruments shall be furnished.

e. All wires for instrument shall be shielded and shall be installed in suitable conduit pipe.

f. Necessary spare parts shall be provided.

6104. WATER FLOW MEASURING EQUIPMENT (E-34) AT RECEIVING FACILITIES

Specifications for the water flow measuring equipment (E-34) at Receiving Facilities and major components to be supplied and installed shall be the same as the Specifications described in Clause 6102 of the Particular Specifications, unless otherwise specially provided hereinafter, and one packaged unit of the equipment shall be supplied and installed.

a. Material of measuring pipe is steel with inner diameter of 1,200 mm and thickness of 11.1 mm.

6105. WATER LEVEL MEASURING EQUIPMENT (E-36) AT RECEIVING FACILITIES

The water level measuring equipment (E-36) at Receiving Facilities and major components are specified as follows, and one packaged unit of the equipment shall be supplied and installed.

a. The type of equipment shall be floating type with level transmitter and local indicator.

b. The system shall be equipped with floater, counterweight, pulley, suspension wire and local level indicator.

c. The alarm setting and transmitter shall be mounted on the measuring instrument panel (E-22).

6106. FLOATING TYPE WATER LEVEL GAUGE AT HEAD TANK

Floating type water level gauge shall be supplied and installed at Head Tank in addition to DPT mentioned above.

The floating level gauge to be installed at the top of the Head Tank shall be such type that the water level of the Head Tank are able to be visibly inspected at the ground.

Accuracy shall be plus or minus 0.5 percent of scale. The float and cable shall be of corrosion-resistant materials. Instrument case and mounting shall be weatherproof.

Measurement conditions of water level shall be as follows:

Highest water level : MSL 103.40 m
Lowest water level : MSL 82.00 m
Installation elevation: EL 105.40 m

6107. MEASUREMENT AND PAYMENT

(1) Measurement for payment for supply of water level measuring equipment and water flow measuring equipment shall be the number of each packaged units of respective equipment supplied, and shall include all necessary instruments, accessories and any other materials specified in Clauses 6101 to 6105 inclusive of the Particular Specifications.

(2) Payment for supply of water level measuring equipment and water flow measuring equipment shall cover all costs and expenses for supply of packaged unit of the equipment including costs and charges of shop tests, packing, ocean-freight, inland transportation, customs, taxes and any other expenses for supply of the equipment to Site.

(3) Payment for supply of water level measuring equipment for Intake Tower will be made under Pay Item 6001 of the Bill of Quantities.

(4) Payment for supply of water flow measuring equipment for Intake Tower will be made under Pay Item 6002 of the Bill of Quantities.

(5) Payment for supply of water level measuring equipment for Head Tank will be made under Pay Item 6003 of the Bill of Quantities.

(6) Payment for supply of water flow measuring equipment for Receiving Facilities will be made under Pay Item 6004 of the Bill of Quantities.

(7) Payment for supply of water level measuring equipment for Receiving Facilities will be made under Pay Item 6005 of the Bill of Quantities.

(8) Measurement for payment for supply of cables and wires related to the water level measuring equipment and water flow measuring equipment for respective facilities shall be on a lump-sum basis, and shall cover the supply of all necessary materials for connecting wires and cables between the terminals of the control panels and the respective instruments at Intake Tower, Head Tank and Receiving Facilities including conduit pipes.

(9) Payment for supply of cables and wires related to the water level and water flow measuring equipments will be made under Pay Item 6006 of the Bill of Quantities, and shall cover all costs and expenses for supply of cable and wire materials including costs and charges of shop tests, packing, ocean-freight, inland transportation, customs, taxes and any other expenses for supply of materials to Site.

(10) Measurement for payment for installation of measuring equipment, cables and wires for water level measuring equipment and water flow measuring equipment shall be on lump-sum basis.

(11) Payment for installation of measuring equipment, wiring and cabling will be made under Pay Item 6007 of the Bill of Quantities, and shall cover the installation of the water level and water flow measuring equipments with related wiring and cabling and any other kinds of necessary works to complete the measuring equipment and facilities including necessary site testings.

(12) Payment for supply and installation of floating type water level gauge will be made in lump sum under Pay Item 6012 of the Bill of Quantities, and shall cover manufacturing, transportation, installation and any other works related.

(13) Payment for supply of spare parts for measuring equipment will be made in lump sum under Pay Item 6010 of the Bill of Quantities, and shall cover all kinds of necessary requirements specified in Section 6100 of the Particular Specifications. The lump sum shall also include the payment for supply of spare parts for radio communication equipment.

SECTION 6200. RADIO COMMUNICATION FACILITIES

6201. GENERAL REQUIREMENTS AND MAIN CHARACTERISTICS

(1) General Requirements

a. Antennas shall be of YAGI type and shall include all the accessories for fixing on a guyed steel tripole tower.

b. Coaxial feeders shall be RG-S type and N type connectors shall be used.

c. Electrical power to be supplied for radio communication facilities shall be of 220 V AC, 50 Hz single phase.

d. The control unit shall have voice frequency outputs in 2 wires.

e. The control unit shall include 40 V, 20 Hz, signal generator for telephone set ringing.

f. The radio communication system shall be of the solid state and modular type, utilizing advanced technology and high reliability components in order to minimize maintenance and power consumption.

g. Modules shall be of the plug-in type for easy circuit elements inspection and repair.

(2) Main Characteristics

a. The system shall be duplex with a Tx - Rx separation frequency of 4.5 Mllz..

b. Transmitter shall be operated only at the time of requirement of communication, however, equipment shall be designed to allow for continuous operation.

c. The equipment shall be completely covered and no circuit elements shall be exposed except adjustment controls, ON/OFF keys, measuring connectors and optical alarms.

d. Terminal radio equipment shall be of such type as to be mounted in frame and/or on wall, and/or on desk.

6202. PERFORMANCE SPECIFICATIONS

(1) General

- Frequency band: 143 - 174 MHz
- Traffic: Duplex
- Modulation: FM
- Emission: 16F3
- Adjacent channel separation: 20 or 25 KHz
- Tx - Rx frequency channel separation: 4.5 MHz
- Output impedance to antenna: 50 ohms
- Output connector: N type
- Power supply nominal voltage: 220 V AC $\pm$ 10%, 50 Hz
- Local oscillator frequency stability: $\pm$ 10 x 10^{-6}

(2) Transmitter

- Tx power at output connector to antenna: 10 W
- Maximum frequency deviation: $\pm$ 5 KHz
- Spurious and harmonic radiation: Min. 70 dB below carrier

(3) Receiver

- Sensitivity: not more than 0.5 uV for 12 dB SINAD
- Adjacent channel attenuation: more than 70 dB
- Spurious and image attenuation: more than 80 dB
- Squelch level: adjustable for S/N values of 10 20 dB

(4) Characteristics of Voice Frequency Side

- Frequency response of link: within 3/5 of CCITT, G132, Fig. -1,300 3,400 Hz.
- Signal/Noise ratio for 20 uV signal at input connector: more than 40 dB

- Audio frequency distortion of 2/3 of maximum frequency deviations at 1,000 Hz: less than 10%
- Termination (inductive hybrid): 2 wires
- Impedance: 600 ohms
- 2 wire output level: + 3 -10 dBr
- 2 wire input level: 0 -10 dBr
- Signalling frequency: Out-of-band
- 20 Hz ringing voltage: more than 40 V r.m.s.

(5) Yagi Antenna

- Nominal input impedance: 50 ohms
- Maximum input power: 100 W
- Terminating connector: N type
- VSWR: better than 1.5
- Frequency band: 143 - 174 MHz
- Tx - Rx frequency separation: min. 4.5 MHz
- Protection: direct earth
- Gain: more than 11 dBi
- Front-to-back ratio: more than 18 dB
- Polarization: horizontal or vertical
- No. of elements: more than 5
- Wind velocity: 140 km/h
- Antenna weight: less than 5 kg

(6) Coaxial Cables and Connectors

- Type of cable:	RG - 8
- Connector type:	N

(7) Guyed Tripole Tower

- Height:	approximately 30 m
- Materials:	steel
- Design wind velocity:	40 m/sec
- Safety factor:	2.0
- Foundation:	concrete foundation with adequate numbers of piling if necessary

6203. REQUIRED EQUIPMENTS AND SPARE PARTS

(1) The Contractor shall supply, construct and install the following equipments.

- 2 units of transmitter, receiver and necessary accessories
- 2 units of antenna, coaxial cables and guyed tripole towers with foundation and necessary accessories
- One unit of transmitter and receiver unit as standby.

6204. MEASUREMENT AND PAYMENT

(1) Measurement for payment for supply of radio communication equipment shall be the number of packaged units supplied, and shall cover supply of transmitter, receiver, antenna, coaxial cables, all necessary instruments, accessories, and any other materials related.

(2) Payment for supply of radio communication equipment will be made under Pay Item 6008 of the Bill of Quantities, and shall cover all costs and expenses for supply of packaged unit of the equipment including costs and charges of shop tests, packing, ocean-freight, inland transportation, customs, taxes and any other expenses for supply of the equipment to Site.

(3) Measurement for payment for supply of guyed tripole tower to be constructed at the Dok Krai and Mab Ta Pud shall be the number of units supplied, and shall cover supply of tripole tower materials, all necessary accessories, embedded materials, and any other materials related.

(4) Payment for supply of guyed tripole tower will be made under Pay Item 6009 of the Bill of Quantities, and shall cover all costs and expenses for supply of packaged unit of the materials including costs and charges of shop tests, packing, ocean-freight, inland transportation, customs, taxes and any other expenses for supply of the materials to the Site.

(5) Payment for supply of spare parts for radio communication equipment will be made in lump sum under Pay Item 6010 of the Bill of Quantities, and shall cover all kinds of necessary requirements specified in Section 6200 of the Particular Specifications. The lump sum shall also include the payment for supply of spare parts for measuring equipments.

(6) Payment for installation of radio communication equipment will be made in lump sum under Pay Item 6011 of the Bill of Quantities, and shall cover all kinds of required installation works for radio communication system including installation works of radio equipment, selection of guyed tripole tower, all kinds of necessary site tests and any other works related.

(7) Measurement for payment for tripole tower foundation shall be the number of the foundation supplied and constructed and shall cover excavation, fill and backfill concrete works, formworks, reinforcing bar arrangements, embedded steel works, piling works if necessary, and any other works related.

(8) Payment for tripole tower foundation will be made under Pay Item 6013 of the Bill of Quantities.

DIVISION 7. BUILDINGS

SECTION 7000. GENERAL

7001. SCOPE OF WORKS

The scope of works of the Buildings consist of the following schedules:

(1) Building Works at Dok Krai

a. Dok Krai Control House: 562.99 sq.m, 1 unit
b. Dok Krai Substation: 102.06 sq.m, 1 unit
c. Dok Krai Administration Office: 97.20 sq.m, 1 unit
d. Garage and Warehouse at Dok Krai: 79.38 sq.m, 1 unit
e. Dok Krai Compressor Room: 21.87 sq.m, 1 unit
f. Dok Krai Camps: Grade 2, 93.03 sq.m, 2 units
Grade 3, 85.50 sq.m, 2 units
Grade 4, 126.87 sq.m, 3 units
Grade 5, 218.40 sq.m, 1 unit

(2) Building Works at Head Tank

a. Head Tank Maintenance Hute: 29.16 sq.m, 1 unit
b. Head Tank Camps: Grade 4, 126.87 sq.m, 4 units
Grade 5, 163.80 sq.m, 1 unit

(3) Building Works at Mab Ta Pud

a. Mab Ta Pud Administration Office: 213.84 sq.m, 1 unit
b. Repairing Shop, Warehouse and Garage at Mab Ta Pud: 124.74 sq.m, 1 unit
c. Mab Ta Pud Diesel Engine Generator Room: 21.87 sq.m, 1 unit
d. Mab Ta Pud Camps: Grade 1, 187.10 sq.m, 1 unit
Grade 2, 93.03 sq.m, 5 units
Grade 3, 85.50 sq.m, 9 units
Grade 4, 126.87 sq.m, 11 units
Grade 5, 218.40 sq.m, 2 units

7002. DEFINITION

(1) Measurement of floor area indicated in each building shall be the area in square meters enclosed by the center line of the outside columns of the building.

(2) The paving stone around and eaves of the buildings shall not be included into the square meter mentioned in above item (1) of this Clause.

(3) The closet, which will be constructed contiguous to the outside of building, and other similar structures shall not be included into the square meters mentioned in item (1) above of this clause.

(4) Measurement of area of mezzanine floor shall be included into the square meters of total floor area of building and shall be computed in the same manner as mentioned in item (1) above of this Clause.

7003. TEMPORARY WORKS

(1) The Contractor shall submit to the Engineer for approval the full details of the Contractor's temporary arrangement for construction of all the Building Works prior to commencement of the Works.

7004. DRAWINGS AND SPECIFICATIONS WRITTEN IN THAI

(1) The Drawings for Camp Facilities including Dok Krai Camp, Head Tank Camp and Mab Ta Pud Camp are the standard drawings of the Employer and are written in Thai language. Those standard drawings for Camp Facilities shall be deemed as a part of the Contract Drawing.

(2) The Specifications for construction of Camp Facilities including Dok Krai Camp, Head Tank Camp and Mab Ta Pud Camp are the standard specifications of the Employer and are written in Thai language.

These standard specifications for Camp Facilities shall be deemed as a part of the Particular Specifications.

(3) If any discrepancy arises between the drawings and/or the specifications written in Thai language and those written in English language, the Drawings and/or the Specifications written in English language are to be deemed as prevailing.

7005. MEASUREMENT AND PAYMENT

(1) Measurement for payment for temporary works of the entire building works shall be on a lump-sum basis.

(2) Payment for temporary works of the entire building works will be made under the Item 7001 of the Bill of Quantities, and shall cover the requirements described in Clauses 7003 and 7004 of the Particular Specifications.

SECTION 7100. BUILDING WORKS AT DOK KRAI

7101. DOK KRAI CONTROL HOUSE

(1) General

a. The structure of main body of the Dok Krai Control House shall be of the reinforced concrete rahmen structure with steel frame construction of roof truss. Wall of the building shall be of concrete hollow block with sprayed cement mortar and roofings shall be of the asbestos corrugated cement board.

b. The buildings consist of main pumps and motors room, control room, electric room, equipment room and other miscellaneous compound resting on the intake tower.

c. The building construction works shall include reinforced concrete works of main structure on the top of the slab of the caisson body, roof truss, roofings, wall with doors and windows, cable trenches on the fourth floor, water supply and sewage facilities, lightning rods, lighting facilities in and around the building including lighting facilities at the first, second and third floors of the caisson, supply and installation of oxygen shortage detector in first floor of the caisson, supply and installation of fire distinguisher in each floor of the caisson, interphone system connecting the administration office to each floor of the caisson, and other necessary facilities of the building shown on the Contract Drawings.

d. The following items of works are not included in this Clause:

All concrete works of the fourth floor's slab with catwalk outside of the building and handrail installation, intake bridge construction, supply and installation of pumping plants, electric facilities and cabling and wiring for pumping plants.

(2) Concrete Works

a. The classes of concrete of the building works are as follows:

- Structural concrete of building: F-concrete
- Cinder concrete : G-concrete
- Filling concrete : E-concrete

b. Finishing of concrete surface for the column and the beam, which will remain to be exposed after completion of building works, shall conform to the "Finish F3" of 3018 FINISHING of the General Specifications, applying the method of fair face concrete.

c. Materials of hollow concrete block to be used for the wall construction shall conform to the "Concrete Block Materials" of 9003 BLOCK AND BRICK WORK of the General Specifications and thickness of the block shall be 15 cm.

(3) Steel Frame Works

a. All steel frame truss works shall be constructed to conform to the Contract Drawing No. 7107 and "Metal Works" of Division 6 of the General Specifications.

b. The Contractor shall submit to the Engineer for approval the proposal containing details of the painting method and materials to be prepared based on Section 9400 "Painting" of the General Specifications.

(4) Roofings

a. Roofings of the Control House shall be constructed to conform to the Contract Drawing No. 7103 and the item (4) of Section 9201 "Roofing" in the General Specifications and materials of the roofings for the Control House shall be of the asbestos corrugated cement board conforming to the item (3) of Section 9201 "Roofing" of the General Specifications.

(5) Finishings

a. Finishings of the outside wall of the Control House shall be of the sprayed cement mortar finish, and the manner of finishing shall be subject to the Engineer's approval.

b. Finishings of interior of the Control House shall be specified as follows:

i) Pump and motor room

- Floor: Cement mortar
- Skirt: Cement mortar up to 20 cm above the floor level
- Wall: Plaster paint finish

ii) Control room and electric room

- Floor: Cement mortar
- Skirt: Cement mortar up to 20 cm above the floor level
- Wall: Plaster paint finish
- Ceiling: Asbestos cement board with painting finish

iii) Toilet

- Floor: Mosaic tiles
- Skirt: Ceramic tiles, 100 mm x 100 mm
- Wall: Ceramic tiles, 100 mm x 100 mm
- Ceiling: Asbestos cement board with painting finish

iv) The manner and color of plaster paint finish works for the respective wall mentioned above are to be proposed by the Contractor for the Engineer's approval.

v) The manner and color of painting finish for the respective ceiling mentioned above are subject to instruction by the Engineer and/or the Engineer's approval for the Contractor's proposal.

vi) The color and design of ceramic tiles for the toilet room are subject to instruction by the Engineer.

vii) The Contractor shall submit to the Engineer for approval the Shop Drawings and the Contractor's proposal on finishing works other than the items i) to vi) mentioned above of this sub-clause (5).

(6) Doors and Windows

a. All door and window works shall be made based on the Contract Drawing Nos. 7101 to 7104, and the frame materials of all the doors and windows shall be of steel.

b. The thickness of glass shall be 3.0 mm.

c. Steel shutter of entrance of the Control House shall be equipped with motor operated system, and the Contractor shall submit to the Engineer for approval the Shop Drawing of the equipments.

d. The painting color of all doors, window frames and steel shutters will be instructed by the Engineer.

(7) Partition Wall

a. All partition walls of the control and electric rooms shall be made by hollow concrete block with thickness of 15 cm. The color of finish painting of the walls will be directed by the Engineer.

b. The frame materials of the fixed type doors and windows in the control and electric rooms shall be wooden with necessary hardwares, and color to be painted to the wooden frames shall be instructed by the Engineer.

(8) Cable Trench

a. The depth of cable trench to be constructed on the fourth floor shall be 30 cm, unless directed otherwise. The widths of the cable trenches vary depending upon the requirements and are shown on the Contract Drawing Nos. 7101 and 7104.

b. Materials of the covered trench shown on the Contract Drawing No. 7104 shall be expanded metal EXH-11, and detailed structures shall conform the Contract Drawing No. 7104.

c. The color to be painted to the expanded metal shall be directed by the Engineer. All fabrications of the checker plate and appurtenances shall conform Section 6200 "Metal Fabrication" of the General Specifications.

(9) Electric Facilities

a. All power supply to the electric facilities relating to the facilities in the Control House, such as all lighting facilities, sump pump for sewage and exhaust fan, etc. shall be made from terminal of the Station Supply Changeover Cubicle (E-15) which is described in Section 2500 "Electric Facilities" of the Particular Specifications.

b. All lighting facilities in the Control House including first, second and third floors of the Intake Tower shall be constructed to conform to the Contract Drawing Nos. 7108 and 7109 and Division 8 "Electric Facilities" of the General Specifications. The electric works shall cover all necessary materials such as lighting fixtures, tumbler switch, receptacles, lights, switch board, wires and cables and their installation. Twenty (20%) percent of the proposed quantities of the lighting facilities, exclusive of cables and wires, shall be provided as the spare parts.

c. The Contractor shall provide two units of the lightning rods with necessary accessories. The Contractor shall submit to the Engineer for approval details of lightning rod and method of installation prior to commencement of the works.

(10) Water Supply Works

a. Water supply to toilet room shall directly be made from the main pipeline with diameter of 1,350 mm through galvanized zinc steel pipe of 40 mm in diameter and approximately 30 m in length.

b. The Contractor shall submit to the Engineer for approval details of the water supply system and installation method and distribution pipelines to the respective inlets of the facilities as shown on the Contract Drawing No. 7104 and of wash stand and stool to be proposed prior to commencement of the works.

(11) Sewerage Facilities

a. Sewerage facilities consist of sewerage tank with capacity 2.0 cu.m, submerged type sump pump unit and cabling, and delivery pipeline from the pump to the septic tank to be installed at the Dok Krai Administration Office.

b. The concrete works wtih waterproofing membrane shall be included in these works. All concrete works shall be made based on the Contract Drawings No. 7104 and 7110. The Contractor shall submit to the Engineer for approval details of the method on waterproofing and materials to be used prior to commencement of the works.

c. The Contractor shall make a proposal for the Engineer's approval by submitting Shop Drawings, detailed calculation data and specifications of sewerage pump equipments and cables required.

The Contractor shall not commence the equipment supply and installation for the sewerage pump before getting approval of the Engineer. The terminal point of power supply for the pump is indicated in the Contract Drawing No. 7110. Specifications required for the pump are summarized as follows:

- Bore of pump: 65 mm
- Design discharge: 0.2 cu.m per minute
- Length of delivery pipe: approximately 500 m
- Diameter of delivery pipe: 65 mm steel pipe

d. The delivery pipes shall be installed from the delivery point specified in the Contract Drawing No. 7110 to septic tank at the Administration Office along the Intake Bridge. The Contractor shall provide the steel pipe with 65 mm diameter conforming to the JIS C 3452 and/or equivalent, and with screwed joint. The Contractor shall submit to the Engineer for approval details of internal and external coating method and installation prior to commencement of the works.

(12) Exhaust Fan

a. The inspiration of fresh air will be made from window installed on the fourth floor and grilles to the respective rooms through the opening of the respective slab and stairway. All exhaust of respective rooms will be operated by the exhaust fan to be installed in the mezzanine floor through exhaust duct as shown in the Contract Drawing No. 7110.

b. The Contractor shall submit to the Engineer for approval details of Shop Drawing of exhaust fan, electric motor, materials of the duct, and installation details of all necessary equipments and duct works prior to commencement of the works.

7102. MEASUREMENT AND PAYMENT FOR DOK KRAI CONTROL HOUSE

(1) Measurement for payment for the building works of Dok Krai Control House shall be on the lump-sum basis.

(2) Payment for the building works of Dok Krai Control House will be made under Pay Item No. 7101 of the Bill of Quantities, and shall cover the following items:

a. All concrete works including supply and works of reinforcing bars, formworks, and all other related materials.

b. Hollow concrete block works including supply and works of reinforcing bars, sprayed mortar, plaster paint, and all other related materials.

c. Supply and works of steel frame truss, steel purline and all other related materials including welding, riveting, painting, etc.

d. Roofing works including supply of all other related materials.

e. All finishing works including supply and works of cement mortar, plaster paint, asbestos cement board, mosaic tiles, ceramic tiles and all other materials.

f. Door and window works including supply and installation of motor operated steel shutter and all other related materials.

g. Partition wall works including supply and works of all related materials.

h. Cable trench works with checker plates and metal work including paintings and supply and installation of other related materials.

i. Supply and installation of all electric works in the Control House and the exhaust fan facilities with duct, and other related materials.

j. Supply and installation of oxygen shortage detector, fire extinguishers and interphone system between the Intake Tower and Administration Office.

k. Supply and installation of all water supply works in the Control House and other related materials.

l. Supply and installation of all sewage treatment works with sewage tank and sump pump facilities except the works of delivery piping from the flange end of the pumping unit to the septic tank at the Dok Krai Administration Office, and other related materials.

m. All other necessary works for Dok Krai Control House unless otherwise separately itemized in the Bill of Quantities shall be included in this Clause.

(3) Payment for supply and installation of the sewage drainage pipe from the flange end of the pumping unit to the septic tank at the Dok Krai Administration Office will be made in lump sum under Pay Item 7102 of the Bill of Quantities, and shall cover manufacturing, coating, testing, transportation, all kinds of earthworks, installation of pipes and any other works related.

7103. DOK KRAI SUBSTATION

(1) General

a. The main body of the Dok Krai Substation shall be of the reinforced concrete rahmen structure with steel frame construction of roof truss. Wall of the building shall be of concrete hollow block with sprayed cement mortar and roofings shall be of the asbestos corrugated cement board.

b. This building works shall cover the construction of building and its incidental facilities, such as the foundation of main transformer to be installed outside of the building, yard preparation and barbed wire fence, and cable duct works.

c. The building construction works shall include main structure of the building and cable trench works with reinforced concrete, roof truss, roofings, wall with doors and windows, and lighting facilities.

(2) Concrete Works

a. The classes of concrete of the building works are as follows:

- Structural concrete of building: F-concrete
- Foundation concrete : D-concrete

b. Materials of hollow concrete block to be used in this work shall be the same as described in (2) of Clause 7101 "Bok Krai Control House" in the Particular Specifications.

(3) Steel Frame Works

a. All steel frame truss works shall conform to the Contract Drawing No. 7204 and "Metal Works" of Division 6 in the General Specifications.

b. The Contractor shall submit to the Engineer for approval the samples of steel frame materials and paintings which shall be performed based on Section 9400 "Painting" of the General Specifications.

(4) Roofings

a. Roofings of the Substation shall be constructed to comply with the Contract Drawing Nos. 7202 and 7203 and the item (4) of the Clause 9201 "Roofing" in the General Specifications. Materials of the roofing for the Substation shall be of asbestos corrugated cement board conforming to the item (3) of Clause 9201 "Roofing" in the General Specifications.

(5) Finishings

a. Finishing of concrete works for the beam of which concrete surface will be exposed shall conformed to "Finish F3" of 3018 "Finishing" in the General Specifications.

b. Finishing of concrete works and outside wall of the building shall be of sprayed cement mortar placing. The manner of finishing works is subject to the Engineer's approval.

c. Finishing of the inside of the Substation shall be specified as follows:

- Floor: Cement mortar
- Skirt: Cement mortar up to 20 cm height from top of the floor level
- Wall: Plaster paint finish

The manner and color of plaster paint finish works are to be proposed by the Contractor and approved by the Engineer.

(6) Doors and Windows

a. All door and window works shall be made based on the Contract Drawing Nos. 7202 and 7203 and frame material of all doors and windows shall be steel.

b. The thickness of glass shall be 3.0 mm.

c. The painting color of the frames will be instructed by the Engineer.

(7) Cable Trench

a. Cable trench works shall be made based on the Contract Drawing Nos. 7201 to 7204 and width will range from 50 to 70 cm depending upon the requirements.

b. Materials of trench covers as shown in the Contract Drawings shall be hard-wood and the size of each cover shall be (50-70) x 25 x 3 cm.

(8) Manhole

a. Manhole of the cable duct shall be made based on the Contract Drawing No. 7201 and materials of manhole covers shall be checker plate 3.2 mm thick.

(9) Electric Facilities

a. Power supply for the lightings of the Substation shall be made from the terminal of the Station Supply Changeover Cubicle (E-15) installed at the Control House.

b. All lighting works in the Substation shall be constructed based on the Contract Drawing No. 7205 and Division 8 "Electric Facilities" of the General Specifications. The works shall cover supply of all necessary materials, such as lights, lighting fixtures, tumbler switch receptacles, switch board, wires and cables and their installation. Twenty (20%) percent of the proposed quantities of the lighting facilities, exclusive of cables and wires, shall be provided as the spare parts.

(10) Miscellaneous Works

a. Cable trench, base concrete of main transformer and base concrete around the transformer shall be made based on the Contract Drawing No. 7204.

b. Fencing works which consist of steel mesh fence of 2.0 m height, barbed wire fence of 2.0 m height and entrance gate of 2.0 m in height and 4.0 m in width shall be constructed by the Contractor. The Contractor shall submit to the Engineer for approval the Shop Drawing on the gate and fencing work prior to commencement of the works.

7104. MEASUREMENT AND PAYMENT FOR DOK KRAI SUBSTATION

(1) Measurement for payment for the building works of Dok Krai Substation shall be the area, measured in square meters.

(2) Payment for the building works of Dok Krai Substation will be made under the Pay Item 7103 of the Bill of Quantities, and shall cover the following items:

a. All kinds of foundation works including excavation, fill and backfill, gravel foundation works, etc. for the buildings and for the transformer stations.

b. All concrete works including supply and works of reinforcing bars, formworks, and all other related materials.

c. Hollow concrete block works including supply and works of reinforcing bars, sprayed mortar, plaster paint, and all other related materials.

d. Supply and works of steel frame truss and all other related materials including welding, riveting, painting, etc.

e. Roofing works including supply of all other related materials.

f. All finishing works including supply and works of cement mortar, plaster paint, and all other related materials.

g. Door and window works.

h. Cable trench works inside and outside of the building, manhole, hard wood cover of the trench, and supply and installation of other related materials.

i. All electric works in the building.

j. All kinds of concrete and metal works outisde of the building including concrete and metal works for main transformer base, aprons, pavements, cable trenches and other related works.

(3) Payment for power supply system for Dok Krai Substation will be made in lump sum and shall cover all kinds of power supply works to Dok Krai Substation including supply and installation of power line cables, conduit pipe, wires, etc. The payment will be made under Pay Item 7104 of the Bill of Quantities.

(4) Measurement for payment for supply and installation of fence with gates around Dok Krai Substation shall be the length in meters of fence and gates installed.

(5) Payment for supply and installation of fencing with gates around Dok Krai Substation will be made under Pay Item 7105 of the Bill of Quantities, and shall cover the manufacturing and supply of fence, earth works, concrete works, installation works of fence and any other works related.

7105. DOK KRAI ADMINISTRATION OFFICE

(1) General

a. The structure of main body of the Dok Krai Administration Office shall be of the reinforced concrete rahmen structure with steel frame construction of roof truss. Wall of the building shall be of concrete hollow block with sprayed cement mortar and roofings shall be of the asbestos corrugated cement board.

b. The building consists of main staff room, meeting room, entrance hall, spare room and toilet. The building construction works shall include main body of concrete with reinforcing bar, roof truss, roofings, wall with doors and windows, water supply and sewerage facilities, air conditioning facilities and power supply with lightings and preparation works around the building.

(2) Concrete Works

a. The classes of concrete of the building works are as follows:

- Structural concrete of building: F-concrete
- Foundation concrete : D-concrete

b. Materials of hollow concrete block to be used in these works shall be the same as described in (2) of Clause 7101 "Dok Krai Control House" in the Particular Specifications.

(3) Steel Frame Works

a. All steel works for purline shall conform to the Contract Drawing No. 7302 and "Metal Works" of Division 6 in the General Specifications.

b. The Contractor shall submit to the Engineer for approval the Shop Drawings of steel frameworks, and material and manner for painting shall comply with Section 9400 "Painting" of the General Specifications.

(4) Roofings

a. Roofings of the building shall be constructed to conform to the Contract Drawing Nos. 7302 and 7303, and the item (4) of Clause 9201 "Roofing" in the General Specifications. Materials of the roofing shall be the asbestos corrugated cement board conforming to the item (3) of Clause 9201 "Roofing" in the General Specifications.

(5) Finishings

a. Finishing of concrete works of the beam which concrete surface will be exposed shall conform to "Finish F3" of Clause 3018 "Finishing" in the General Specifications. Finishings of concrete surface for concrete column shall be of the pea gravel wash finished.

b. Finishing of outside wall for the building shall be sprayed cement mortar placing. Manner of finishing shall be proposed by the Contractor for the Engineer's approval.

c. Finishing of the inside of the building shall be specified as follows:

i) Office room, entrance hall and spare room

- Floor: Vinyl tiles
- Skirt: Cement mortar up to 20 cm height from top of the floor level.
- Wall: Plaster paint finish
- Ceiling: Gypseous acoustic board

ii) Toilet room

- Floor: Mosaic tiles
- Skirt: Ceramic tiles, 100 mm x 100 mm
- Wall: Ceramic tiles, 100 mm x 100 mm
- Ceiling: Gypseous acoustic board

iii) The manner and color of plaster paint are to be proposed by the Contractor for the Engineer's approval.

iv) The color and design of mosaic tiles, ceramic tiles, and gypseous acoustic board to be used in the building shall be proposed by the Contractor for the Engineer's approval.

(6) Doors and Windows

a. All door and window works shall be made based on the Contract Drawing Nos. 7301, 7302, and 7303 and the frame materials of all the doors and windows shall be steel.

b. The thickness of glass shall be 3.0 mm.

c. The painting color of all doors and window frames will be instructed by the Engineer.

(7) Partition Wall

a. All partition wall works in the building shall be the same as described in (7) of Clause 7101 "Dok Krai Control House" of the Particular Specifications.

(8) Electric Facilities

a. All power supply to the electric facilities relating to the Dok Krai Administration Office, such as to air conditioners and lightings, shall be made from the terminal of the Station Supply Changegear Cubicle (E-15) which is described in Section 2500 "Electric Facilities" of the Particular Specifications.

b. All lighting works in the building shall be constructed based on the Contract Drawing No. 7305 and Division 8 "Electric Facilities" of the General Specifications. The works shall include supply of all necessary materials such as lighting fixture, tumbler switch, receptacles, switch board, wires and cables, and their installation. Twenty (20%) percent of the proposed quantities of the lighting facilities, exclusive of cables and wires, shall be provided as the spare parts.

c. The Contractor shall supply and install 3 units of air conditioner facilities (two units of 3.0 HP capacity and one unit of 4.0 HP capacity). Type of each air conditioner shall be of floor stand type with packaged necessary appurtenances. The Contractor shall submit to the Engineer for approval detail of the design data, Shop Drawings, shop tested data, instruction book and any other necessary information prior to commencement of the works.

d. The Contractor shall supply and install the power-meter (KWH-meter) which shall be the acceptable type of the Provincial Electric Authority.

(9) Water Supply Works

a. Water supply to the spare room and toilet shall be made from the main pipeline with diameter of 1,350 mm through galvanized zinc steel pipe of 40 mm in diameter and approximately 30 m in length.

b. The Contractor shall submit to the Engineer for approval the Shop Drawings and installation method about distribution pipelines to the respective inlet of the facilities, based on the Contract Drawing No. 7306 and proposed wash stand, flush toilet set, shower set and wall hanging urinal prior to commencement of the works.

(10) Sewerage Facilities

a. Sewerage facilities consist of septic tank with 3.7 cu.m capacity and concrete drainage pipes 150 mm in diameter, and cast iron pipe 100 mm in diameter. The pipe work of drainage shall be made based on the Contract Drawing No. 7306. The Contractor shall submit to the Engineer for approval the Shop Drawing on the septic tank and necessary appurtenances.

7106. MEASUREMENT AND PAYMENT FOR DOK KRAI ADMINISTRATION OFFICE

(1) Measurement for payment for the building works of Dok Krai Administration Office shall be the area, measured in square meters.

(2) Payment for the building works of Dok Krai Administration Office will be made under Pay Item 7106 of the Bill of Quantities, and shall cover the following items:

a. All kinds of foundation works including excavation, fill and backfill, gravel foundation works, sodding, etc. for the building.

b. All concrete works including supply and works of reinforcing bars, formworks, and all other related materials.

c. Hollow concrete block works including supply and works of reinforcing bars, sprayed mortar, plaster paint, and all other related materials.

d. Supply and works of steel frame truss and all other related materials including welding, riveting, painting, etc.

e. Roofing works including supply of all related materials.

f. All finishing works including supply and works of cement mortar, plaster paint, gypseous acoustic board, mosaic tiles, ceramic tiles, vinyl tiles, and all other related materials.

g. Door and window works.

h. Partition wall works.

i. Supply and installation of 3 units of air conditioners (two units with 3.0 HP capacity and one unit with 4.0 HP capacity) and other related materials.

j. All electric works in the Administration Office.

k. All water supply works in the Administration Office.

l. All sewerage works with septic tank and the delivery piping from the toilet room to the septic tank at the Dok Krai Administration Office.

m. All kinds of necessary works outside of the building including earth works, sodding works, paving stone works, fairface concrete works, stair works, etc., and any other works related to Dok Krai Administration Office.

(3) Payment for water supply system for Dok Krai Administration Office will be made in lump sum under Pay Item 7107 of the Bill of Quantities, and shall cover all kinds of necessary works to complete outdoor water supply system for Dok Krai Administration Office including supply and installation of pipes and valves.

(4) Payment for sewerage and drainage system for Dok Krai Administration Office will be made in lump sum under Pay Item 7108 of the Bill of Quantities and shall cover all kinds of necessary works to complete outdoor sewerage and drainage system for Dok Krai Administration Office including supply and installation works of pipelines.

(5) Payment for power supply system for Dok Krai Administration Office will be made in lump sum under Pay Item 7109 of the Bill of Quantities, and shall cover all kinds of outdoor power supply system for Dok Krai Administration Office including supply and installation of power line cables, conduit pipe, wires, etc. and any other works related.

7107. GARAGE AND WAREHOUSE AT DOK KRAI

(1) General

a. The main body of the Garage and Warehouse at Dok Krai shall be of the reinforced concrete rahmen structure with steel frame construction of roof truss. Wall of the building shall be of concrete hollow block with sprayed cement mortar, and roofings shall be of the asbestos corrugated cement board.

b. The building consists of warehouse and garage with space of two units car parking. The building construction works shall include main body concrete with reinforcing bar, roof truss, roofings, wall with door and power supply with lighting works.

(2) Concrete Works

a. All concrete works and hollow concrete block works of this building shall be the same as described in (2) of Clause 7105 "Dok Krai Administration Office" in the Particular Specifications.

(3) Steel Frame Works

a. All steel works for purline shall conform to the Contract Drawing Nos. 7401 and 7402 and "Metal Work" of Division 6 in the General Specifications.

b. The Contractor shall submit to the Engineer for approval the Shop Drawing of steel frame works and material and manner for painting shall comply with Section 9400 "Painting" of the General Specifications.

(4) Roofings

a. Roofings of the building shall be constructed to conform to the Contract Drawing Nos. 7401 and 7402, and the item (4) of the Clause 9201 "Roofing" in the General Specifications. Materials of the roofing shall be of the asbestos corrugated cement board conforming to the item (3) of Clause 9201 "Roofing" in the General Specifications.

(5) Finishings

a. All finishing works inside and outside of the building shall be the same as described in (5) of Clause 7103 "Dok Krai Substation" in the Particular Specifications.

(6) Doors

a. Entrance door of the warehouse shall be a hanging door with steel structures. Door of the closet shall be of steel structure. The Contractor shall submit to the Engineer for approval the Shop Drawings for hanging door and door of the closet with hardwares, and its paintings.

(7) Electric Facilities

a. Electric power supply of the garage shall be made from the distribution board terminal at the Dok Krai Administration Office.

b. All lighting works in the Garage shall be constructed based on the Contract Drawing No. 7405 and Division 8 "Electric Facilities" of the General Specifications. The work shall include supply of all necessary materials, such as lights, lighting fixture, tumbler switch receptacles, switch board and their installation, and supply and installation of wires and wiring required from the circuit breaker of the Dok Krai Administration Office.

(8) Water Supply Works

a. Water supply of the building shall be made from the branch pipe to be installed for the Dok Krai Administration Office. One utility wash basin with accessories as shown in the Contract Drawing No. 7401 shall be provided.

7108. MEASUREMENT AND PAYMENT FOR GARAGE AND WAREHOUSE AT DOK KRAI

(1) Measurement for payment for the building works of Garage and Warehouse at Dok Krai shall be the area, measured in square meters.

(2) Payment for the building works of Garage and Warehouse at Dok Krai will be made under Pay Item 7110 of the Bill of Quantities, and shall cover the following items:

a. All kinds of foundation works including excavation, fill and backfill, gravel foundation works, etc. for the building.

b. All concrete works including supply and works of reinforcing bars, formworks, and all other related materials.

c. Hollow concrete block works including supply and works of reinforcing bars, sprayed mortar, plaster paint, and all other related materials.