SUSITNA HYDROELECTRIC PROJECT

EBASCO ESTIMATING PACKAGE

REVISION 4

FEBRUARY 12, 1982

Prepared by:

ACRES

ALASKA POWER AUTHORITY

SUSITNA HYDROELECTRIC PROJECT
EBASCO Estimating Package

February 12, 1982

SUSITNA HYDROELECTRIC PROJECT
EBASCO Estimating Package
Revision Four Discussion

February 12, 1982

1.1

The computer listing has revised item listings and quantities to reflect updated design and quantity review. Revised quantities are indicated by a "4" in the remarks column.

SUSITNA HYDROELECTRIC PROJECT
Form Ratios

February 12, 1982

1.2

Devil Canyon Concrete Arch Dam:

Curved Forms	951,500 sf
Flat Forms	722,900 sf
Total	1,674,400 sf

Form Ratio = 1,674,400 sf/1,676,000 cy = .999 1 sf/cy

Description	sf/cy
Powerhouse	5.43
Transformer Gallery	25.86
Spillway	2.64
Auxiliary Spillway Chute	2.78
Emergency Spillway	0.90
Surge Chamber	1.00 (assumed)
Intake	4.00
Portals	4.00
Plugs	0.33

NOTES OF MEETING
Held at the offices of
Acres American Inc.
Friday, February 5, 1982

February 11, 1982
P5700.09

1.3

SUSITNA HYDROELECTRIC PROJECT
Task 09 Cost Estimate

PRESENT:

Mr. J. DeFeis)
Mr. J. Ehasz) EBASCO
Mr. J. Mulvanertou)
Mr. R. Zylman)

Mr. R. Williams) APA

Mr. J. Lawrence)
Mr. D. Meilhede) ACRES
Mr. J. Plummer)
Mr. R. Tilghman)

1 - ESTIMATING PACKAGE-REVISION 4

Acres advised that Revision 4 would be issued February 12. The package should generally reflect final quantities. EBASCO requested an Acres' marked up, current computer printout to indicate quantities that had already been checked. These marked up sheets were handed to EBASCO.

2 - ROADS

Drawings showing camp layouts and site roads were handed to EBASCO and APA. Acres clarified the following points with regard to roads:

- The transdam crossing was the road crossing the Devil Canyon dam and joining the permanent access road constructed for Watana.
- Site roads will be broken down into construction roads and permanent roads.
- Construction roads' widths were 65 feet for Watana and 40 feet for Devil Canyon.
- The six miles of permanent roads at Watana are assumed to be built on top of existing construction roads or a granular surface.
- Acres has assumed that camp roads are not paved.
- It was noted that the paving item for access roads should be kept in the estimate.

3 - AIRSTRIP

Acres confirmed the estimate included two airstrips as follows:

- Temporary Airstrip - 2,500' X 100'
- Permanent Airstrip - 6,000' X 100'

3 - AIRSTRIP (continued)

At present the permanent airstrip is not shown on any drawings. Acres confirmed that no quantities had been developed for either airstrip.

4 - CAMPS

With regard to Account 63, Camps, Acres made the following clarifications:

- o A 25 percent salvage value has been credited for the buildings in the Watana camp.
- o For buildings used at Devil Canyon, Acres assumed the 25 percent salvage value at Watana plus dismantling, transportation, rehabilitation, and erection.
- o Subaccount 63.6 covers the cost of operation and maintenance for the main camps including the costs for feeding and housekeeping but not for buildings.
- o Subaccount 63.3 covers the cost of operation and maintenance for access road and railhead camps including the cost of buildings, feeding, and housekeeping.
- o Subaccount 63.5 covers the cost for a permanent town. EBASCO was referred to information on Plate 36. Acres agreed to provide EBASCO with a breakdown of the facilities included in their estimate for a permanent town.
- o Construction management facilities have been included in camps.
- o Acres noted that they expect to revise the camp sizing downwards following the completion of a revised cash flow.

5 - CONSTRUCTION POWER

Acres has assumed that permanent power will be available at Watana by mid-1987. Prior to that time, power will have to be generated at site and any construction operations will have to include the costs of that power. After mid-1987, power will be available from a 34.5 kV distribution system and supplied to construction operations without cost.

At Devil Canyon permanent power is assumed to be available from the start of construction. Acres advised the following power costs have been assumed:

- o Watana - 10¢/kilowatt hour
- o Devil Canyon - 7¢/kilowatt hour

5 - CONSTRUCTION POWER (continued)

The cost of construction power supplied through the connection intertie has been included in Account 63.7. The breakdown of this will be given in Revision 4. It has been assumed that a 34.5 kV distribution system will be constructed and maintained under this account. The costs of taking power off this system have been included in construction items.

6 - CONSTRUCTION HEATING AND VENTILATING

Acres advised that the costs for construction heating and ventilating for underground work have been included in Subaccount 63.8. This will be shown in Revision 4.

7 - ELECTRICAL SYSTEMS

Acres agreed to provide more information on the electrical systems and, in particular, the 480 volt system with Revision 4.

8 - OUTLET FACILITIES

Drawing No. 523, General Arrangement, Plan and Profile for Watana, was handed to EBASCO. This drawing had been omitted from previous distribution.

9 - MECHANICAL SYSTEMS

Acres confirmed that no piping flow diagrams would be issued.

10 - CONCRETE WORK

Acres agreed to provide whatever formwork quantities or formwork ratios that have been developed to EBASCO.

Acres confirmed the following assumptions for concrete strengths:

- 5,000 psi at 365 days for arch dam
- 4,000 psi at 28 days average for other structures.

EBASCO requested clarification on the assumptions for cooling of concrete.

11 - LAND COSTS

The following land costs were given:

o Account 330	Watana	51×10^6
o Account 330	Devil Canyon	22×10^6
o Account 350	Transmission Lines & Substations	8.26×10^6

11 - LAND COSTS (continued)

Land costs given above in Account 330 include the reservoir flood area and the area affected by construction activities including camps. EBASCO questioned if land costs for access roads had been included. Acres agreed to check and confirm. (Land costs for access main road are included in Account 330 for Watana.)

12 - INDIRECT ACCOUNTS

Acres advised that no entries would be made under Accounts 61, 62, 64, 65, 66, and 69. These costs have been included in the unit prices developed for the various types of work.

13 - CONTINGENCY

APA clarified that Acres and EBASCO should independently estimate project contingencies.

14 - CONSTRUCTION OVERHEADS

Acres advised that engineering and administration costs were being carried as a percentage of construction costs in Account 71. The remaining accounts, 72, 75, 76, 77, and 80, do not have entries.

15 - GROUTING ASSUMPTIONS

Acres clarified grouting assumptions as follows:

- 0.4 cf of cement/lf for curtain grouting
- 1 cf of cement/lf for consolidation grouting

16 - GATES AND HOISTS

Acres agreed to provide a breakdown of the weights for gates and hoists equipment in Revision 4.

17 - RELICT CHANNEL

Acres advised that costs should be developed on the basis that the units of work listed on the computer sheets would be done.

18 - LABOR RATES

Acres provided EBASCO with a copy of the labor rates being used for estimating.

Reported by
James R. Plummer

JRP:dmb

THE FOLLOWING PAGES

7 THROUGH 37

ARE FROM THE FIRST DRAFT

OF THE FEASIBILITY REPORT

1.4 - Description of Electrical and Mechanical Systems

12.15 - Tailrace

Two tailrace pressure tunnels will be provided at Watana to carry water from the surge chamber to the river. The tunnels will have a modified diameter of horse-shoe cross-section with a major internal dimension of 35 feet. For preliminary design they are assumed to be fully concrete-lined throughout, with a minimum concrete thickness of 12 inches and a length of 1,800 feet.

The tailrace tunnels will be arranged to discharge into the river between the main dam and the main spillway. In view of the severe limitations on space in this area, one tailrace tunnel will be designed to discharge through one of the diversion tunnel portals. The cross section of the tailrace tunnel will be modified over the common length of 300 feet to the shape of the diversion tunnel in order not to impair the hydraulic performance of the tailrace tunnel. After commissioning, the diversion tunnel upstream section will be plugged with concrete.

The size of the two tailrace tunnels was selected after an economic study of the cost of construction and the capitalized value of average annual energy losses caused by friction, bends, and changes of section. In an emergency, however, the station can be operated using one tailrace tunnel, with increased head losses. For such an emergency condition, tailrace intake stoplog guides will be provided in the surge chamber. The surge chamber will be designed for full load rejection with either one or two tailrace tunnels in operation.

The tailrace portals will be reinforced concrete structures designed to reduce the outlet flow velocity, and hence the velocity head loss at the exit to the river. The minimum rock cover required above the tunnels will be 1.5 times the major excavated dimension (about 54 feet), and the portals will also provide the necessary transition length to the river where the rock cover would be less than 54 feet.

12.16 - Turbines and Generators

(a) Unit Capacity

The Watana powerhouse will have six generating units with a nominal capacity of 170 MW. This is the available capacity with minimum December reservoir level (El. 2112) and a corresponding gross head of 662 feet on the station.

The head on the plant will vary from 735 feet maximum (724 feet net head) to 595 feet minimum (584 feet net level). Because maximum turbine output varies approximately with the 3/2 power of head, the maximum unit output will change with head, as shown on Figure 12.21.

The rated head for the turbine has been established at 680 feet, which is the weighted average operating head on the station. Allowing for generator losses, the rated turbine output is 250,000 hp (186.5 MW).

The generator rating has been selected as 190 MVA with a 90 percent power factor, which corresponds to a power output of 170 MW. The generators will be capable of a continuous 15 percent overload; this will allow a unit output of 196 MW. At maximum reservoir water level, the turbines will be operated below maximum (full gate) output to avoid overloading of the generators.

(b) Turbines

The turbines will be of the vertical shaft Francis type with steel spiral casing and a concrete elbow-type draft tube. The draft tube will comprise a single water passage without a no center pier.

The rated output of the turbines will be 250,000 hp at 680 feet rated net head. Maximum and minimum heads on the units will be 724 feet and 584 feet respectively. The full gate output of the turbines will be about 275,000 hp at 724 feet net head and 200,000 hp at 584 feet net head. Overgating of the turbines may be possible, providing approximately 5 percent additional power; however, at high heads the turbine output will be restricted to avoid overloading the generators. The best efficiency point of the turbines will be established at the time of preparation of bid documents for the generating equipment and will be based on a detailed analysis of the anticipated operating range of the turbines. For preliminary design purposes, the best efficiency (best gate) output of the units has been assumed as 85 percent of the full gate turbine output. This percentage may vary from about 80 percent to 90 percent; in general, a lower percentage reduces turbine cost.

The full gate and best gate efficiencies of the turbines will be about 91 percent and 94 percent respectively at rated head. The efficiency will be about 0.5 percent lower at maximum head and 1 percent lower at minimum head. The preliminary performance curve for the turbine is shown on Figure 12.22.

A speed of 225 rpm has been selected for the unit for preliminary design purposes. The resulting turbine specific speed (N_s) is 32.4. As shown on Figure 12.23, this is within present day practice for turbines operating under a head of 670 feet. In general, a lower speed machine will increase the cost of the turbines and generators as well as the powerhouse civil cost because of the increased physical size of the generating equipment. A higher speed unit, on the other hand, requires a deeper unit setting and is generally considered to be a less conservative design with increased risk of vibration and rough operation. The difference in efficiency between the higher and lower speed machines at this head range is very small, with the increase in efficiency which is associated with a physically larger (lower speed) runner offset by higher disc friction and seal leakage losses. For an underground powerhouse, the incremental cost of increasing the unit setting is usually relatively inexpensive; therefore, assuming no change in efficiency, the trend in unit selection is to choose as high a speed as possible consistent with satisfactory precedent and good operating experience with similar specific speed turbines. Draft tube vortex and surge

phenomena may also have an influence on the selection of unit speed as discussed below. The turbine data is summarized in Table 12.7.

On the basis of information from turbine manufacturers and the studies on the power plant layout, the centerline of the turbine distributor has been set at 30 feet below minimum tailwater level. The final setting of the unit will be established in conjunction with the turbine manufacturer when the contract for the supply of the turbine equipment has been awarded.

The turbines will be of conventional design, generally of welded or cast steel construction with forged steel shafts and pins. Because of the remote location of the project and the desired high reliability/availability of the equipment, special consideration should be given to reducing cavitation pitting on the turbines. This will include:

- Provision of weldable stainless steel runners;
- Careful profiling and finishing of the water passage surfaces of the runner wicket gates and stay ring;
- A conservative unit setting; and
- Extensive cavitation tests on the turbine model.

Bulkhead domes will be provided with two of the turbines (Units 3 and 4) to be installed at the bottom of the draft tube liner at the time of turbine installation. The domes permit work to continue on turbine installation after the tailrace, surge chamber, and draft tubes are flooded (prior to startup of Unit 1), without installing draft tube gates.

Because of the relatively short length of the intake penstock and a surge tank location immediately downstream of the powerhouse, the hydraulic transient characteristics of the turbines are favorable. Assuming normal generator inertia (H = 3.5 MW-Sec/MVA), a preliminary analysis has indicated the following:

- Water starting time (Tw) ..... 1.6 seconds
- Mechanical starting time (Tm) ..... 6.6 seconds
- Regulating ratio (Tm/Tw) 4.1
- Governor time ..... 6.0 seconds
- Speed rise on full load rejection ..... 42 percent
- Penstock pressure use on full load rejection ..... 30 percent

The regulating ratio is above the minimum recommended by the USBR for good regulating capacity. Also, unit speed rise and penstock pressure rise are all well within normal accepted values. Because of the deep unit setting and the relatively short distance between the turbine and the tailrace surge tank, there will be no problems with draft tube water column separation.

The Watana project will form a large portion of the overall system generating capacity in Alaska; therefore, satisfactory operation of the units over a very wide range of loads will be important. Although there are Francis turbine installations which operate for considerable periods at very small gate openings, operation below about 50 percent load generally becomes increasingly rough because of reduced efficiency of the turbines.

The ability to operate at part load will also depend on the draft tube surge phenomena and associated generator power swings. The surging occurs on many turbines, particularly the Francis type, and normally has a frequency of about 1/3 to 1/5 of the turbine rotational speed. These surges, which may occur from about 30 percent to sometimes as high as 80 percent wicket gate opening, result in pulsating torque on the turbine runner and corresponding generator power fluctuations. The condition becomes more severe when the surge frequency closely corresponds to the natural frequency of the generator. To reduce the possibility of unacceptable power swings and unit vibration, it is desirable to have the surge frequency different from the penstock pressure wave frequency and the generator natural frequency.

The estimated natural frequency of the generators will be about 1.3 cycles/s, which is undesirable when considering a possible surge frequency of about 0.75 to 1.25 cycles/s.

The selection of a lower unit speed would separate the draft tube surge frequency from the generator natural frequency; however, this will increase the generating equipment as well as powerhouse cost. It may be possible to increase the natural frequency of the generator by reducing the generator inertia (WR^2) as much as possible; however, the lower WR^2 has an adverse effect on the transient characteristics of the unit and may affect electrical system stability.

Other measures which may be employed are:

- Careful model studies of the turbine to accurately predict draft tube vortex/surge phenomena. Altering the shape of the draft tube can reduce surge problems; however, a reduction of part-load efficiency may result.

- Provision for air admission to the draft tube. This is done on more or less a trial and error basis and may include injection of air from the station 100 psi compressed air system, special low pressure compressors provided specifically for draft tube air admission, and/or provision of an "air-head" which allows atmospheric air to be drawn down the generator and turbine shaft and through the runner cone.

- Additions of fins to the draft tube cone immediately below the runner. While this has been used on many installations, there have been instances of structural failure of the fins.

Another approach currently under study by the USBR is to damp the power oscillations resulting from the draft tube surges by varying the generator excitation. Computer simulation indicates that is feasible to dampen the large oscillations; however, this has yet to be tested in a prototype unit.

Employing one or more of the above approaches, a design may be achieved that operates satisfactorily without serious generator power swings. The potential problem, however, must be given serious consideration in the design stages.

(c) Generators

(i) Type and Rating

The six generators in the Watana powerhouse will be of the vertical shaft, overhung type directly connected to the vertical Francis turbines. The arrangement of the units is shown in Plates ___ and the single line diagram is shown in Plate ___.

The optimum arrangement at Watana will consist of two generators per transformer bank, with each transformer bank comprising three single-phase transformers. (Development of this scheme is described in Section 12.18). The generators will be connected to the transformers by isolated phase bus through generator circuit breakers directly connected to the isolated phase bus ducts.

Each generator will be provided with a high initial response static excitation system. The units will be controlled from the Watana surface control room, with local control facility also provided at the powerhouse floor. The units will be designed for black start operation.

The generators are rated as follows:

Rated Capacity:	190 MVA, 0.9 power factor
Rated Power:	170 MW
Rated Voltage:	15 kV, 3 phase, 60 Hertz
Synchronous Speed:	225 rpm
Inertia Constant:	3.5 kW-sec/kVA
Transient Reactance:	28 percent (maximum)
Short Circuit Ratio:	1.1 (minimum)
Efficiency at Full Load:	98 percent (minimum)

The generators will be of the air-cooled type, with water-cooled heat exchangers located on the stator periphery. The ratings given above are for a temperature rise of the stator and rotor windings not exceeding 60°C with cooling air at 40°C.

The generators will be capable of delivery 115 percent of rated MVA continuously (195.5 MW) at a voltage of ±5 percent without exceeding 80°C temperature rise in accordance with ANSI Standard C50.10.

The generators will be capable of continuous operation as synchronous condensers when the turbine is unwatered, with an underexcited reactive power rating of 140 MVAR and an overexcited rating of 110 MVAR. Each generator will be capable of energizing the transmission system without risk of self-excitation.

The design data of the generators stated above should be reviewed during the detailed design stage for overall economic and technical design and performance requirements of the power plant and the power system.

(ii) Generator Construction

The generator will be of a modified umbrella type overhung construction, with a combined thrust and guide bearing below the rotor and a guide bearing above the rotor. The lower bearing bracket will support the rotor and turbine runner weights and the unbalanced hydraulic thrust of the runner. All removable parts, including turbine parts, will be designed for removal through the generator stator.

Approximate dimensions and weights of the principal parts of the generator are given below:

Stator pit diameter	36 feet
Rotor diameter	22 feet
Rotor length (without shaft)	7 feet
Rotor weight	385 tons
Total weight	660 tons

It should be noted that these are approximate figures and they will vary between manufacturers, sometimes considerably. However, at this stage of design feasibility and planning, the dimensions and weights are considered appropriate and representative.

The generator stator windings will be insulated with Class B insulation as defined by ANSI Standard C50.10, of epoxy resin bonded type. The stator windings will be wye-connected for grounded operation through a neutral grounding transformer located in the generator neutral cubicle. The stator windings and laminated core will be shop-assembled in three or four sections for facility of transport and erection in the powerhouse.

The rotor will be designed to safely withstand the maximum runaway speed of the turbine. The rotor hub, yoke, and laminated rim will be designed for assembly at the powerhouse. The assembled rotor will be erected in the generator pit without the shaft, thereby requiring minimum crane lift and a considerable reduction of the powerhouse cavern height.

The rotating parts of the generator and turbine will be designed so that the critical speed exceeds the runaway speed of the unit by at least 20 percent. The design of the plant and power system will not require additional inertia in the rotating parts; the inertia constant specified thus will correspond to the "natural" inertia of the machine. Damper windings of low resistance and rugged construction will be provided on the pole shoes and designed to provide adequate damping currents for stabilized operation.

The thrust bearing will be of the adjustable shoe (Kingsbury) or precompressed spring (General Electric) type, oil-cooled, with high pressure oil injection during starting and stopping.

(iii) Generator Excitation System

The generator will be provided with a high initial response type static excitation system supplied with rectified excitation power from transformers connected directly to the generator terminals. The excitation system will be capable of supplying 200 percent of rated excitation field (ceiling voltage) with a generator terminal voltage of 70 percent. The power rectifiers will have a one-third spare capacity to maintain generation even during failure of a complete rectifier module.

The excitation system will be equipped with a fully static voltage regulating system maintaining output from 30 percent to 115 percent, within ±0.5 percent accuracy of the voltage setting. Manual control will be possible at the excitation board located on the powerhouse floor, although the unit will normally be under remote control, as described in Section 12.18 covering the control systems of the plant.

The static excitation system will also include maximum and minimum limiters and reactive current compensator, and will be suitable for parallel joint control of the units. Field flashing during startup will be from the 125 volt dc station battery.

(iv) Erection and Tests

As is normal for large hydroelectric generators, the machines will not be assembled completely and tested in the factory. The erection and tests of the generators at the powerhouse, therefore, will assume greater importance in the successful commissioning of the station and should be carefully coordinated with that of the turbines and civil works.

The assembly of the stator sections will be done in the pit. The rotor will be assembled in the erection bay. The powerhouse crane will be capable of lifting the completed rotor assembly and lowering it into the stator, and onto the thrust bearing and shaft assembly on the bracket supports. Alignment and tests of the rotor, turbine runner, and shaft will be done to tolerances specified in NEMA/ANSI Standards.

The generators will be fully tested after assembly and mechanical run tests, including dielectric tests, saturation tests, heat run, efficiency, and full-load rejection tests. Ceiling voltage and response of the excitation system will be tested. Operation of the unit within specified vibration limits will be checked.

(d) Governor System

The governor system which control the generating unit will include a governor actuator and a governor pumping unit. A single system will be provided

for each unit. The governor system operating pressure will be 600 to 1000 psi, as recommended by the governor system manufacturer.

The governor actuator will be the electric hydraulic type and will be connected to the computerized station control system. The governor pumping unit will include governor pumps, an accumulator tank, and a sump tank. Each unit will have three governor pumps: two main pumps which operate intermittently, and one jockey pump which operates continuously while the turbine wicket gates are open and intermittently when the gates are fully closed.

12.17 - Miscellaneous Mechanical Equipment

(a) Powerhouse Cranes

Two overhead traveling bridge type powerhouse cranes will be installed in the powerhouse. The cranes will be used for:

- Installation of turbines, generators, and other powerhouse equipment; and
- Subsequent dismantling and reassembly of equipment during maintenance overhauls.

The cranes may also be used by the civil construction contractor for powerhouse construction. Alternatively, the civil contractor will provide a separate crane which will use the same runway as for the main powerhouse cranes.

Each crane will have a main and auxiliary hoist. The combined capacity of the main hoist for both cranes will be sufficient for the heaviest equipment lift, which will be the generator rotor, plus an equalizing beam. A tentative crane capacity of 205 tons has been established. The auxiliary hoist capacity will be about 25 tons.

The powerhouse cranes will be cab controlled. Consideration may also be given to providing radio control for the cranes.

(b) Draft Tube Gates

Draft tube gates will be provided to permit dewatering of the turbine water passages for inspection and maintenance of the turbines. The draft tube gate openings (one opening per unit) will be located in the surge chamber. The gates will be of the bulkhead type, installed under balanced head conditions using the surge chamber crane described below. Four gates have been assumed for the six units, with each gate a single leaf, 20 feet by 20 feet.

When Unit 1 is ready for startup, the gates will be installed in Units 2, 5, and 6, with one gate available for Unit 1. Turbine bulkhead domes will be installed in Units 3 and 4.

Domestic water will be supplied from the powerhouse domestic water system, with pumps located in the powerhouse and piping up through the access shaft. Sanitary drainage from the control building will drain to the sewage treatment plant in the powerhouse through piping in the access tunnel.

The standby generator building will have the following services:

- A heating and ventilation system;

- A fuel oil system with buried fuel oil storage tanks outside the building, and transfer pumps and a day tank within the building; and

- A fire protection system of the carbon dioxide or halon type.

(h) Machine Shop Facilities

A machine shop and tool room will be located in the powerhouse service bay area with sufficient equipment to take care of all normal maintenance work at the plant, as well as machine shop work for the larger components at Devil Canyon. For preliminary design purposes, an area of about 1,500 ft^2 has been allocated for the machine shop and tool room. The actual equipment to be installed in the machine shop will be decided during the design stages of the project; however, it will generally include drill presses, lathes, a hydraulic press, power hacksaw, shaper, and grinders.

12.18 - Accessory Electrical Equipment

The accessory electrical equipment described in this section includes the following:

. Main generator step-up 15/345 kV transformers;
. Isolated phase bus connecting the generator and transformers;
. Generator circuit breakers;
. 345 kV oil-filled cables from the transformer terminals to the switchyard;
. Control systems of the entire hydro plant complex; and
. Station service auxiliary AC and DC systems.

Other equipment and systems described include grounding, lighting system, and communications.

The main equipment and connections in the power plant are shown in the single line diagram, Plate 60A. The arrangement of equipment in the powerhouse, transformer gallery, and cable shafts is shown on Plates 57 through 59.

(a) Selection of Transformers and H.V. Connections

(i) General

Nine single-phase transformers and one spare transformer will be located in the transformer gallery. Each bank of three single-phase

transformers will be connected to two generators through generator circuit breakers by isolated phase bus located in individual bus tunnels. The HV terminals of the transformer will be connected to the 345 kV switchyard by 345 kV single-phase oil-filled cable installed in 700-foot-long vertical shafts. There will be two seats of three single-phase 345 kV oil-filled cables installed in each cable shaft. One set will be maintained as a spare three phase cable circuit in the second cable shaft. These cable shafts will also contain the control and power cables between the powerhouse and the surface control room, as well as emergency power cables from the diesel generators at the surface to the underground facilities.

A number of considerations led to the choice of the above optimum system of transformation and connections. Different alternative methods and equipment designs were also considered. In summary, these are:

- One transformer per generator vs one transformer for two generators;

- Underground transformers vs surface transformers;

- Direct transformation from generator voltage to 345 kV vs intermediate step transformation to 230 kV or 161 kV, and then to 345 kV;

- Single-phase vs three-phase transformers for each alternative method considered; and

- Oil-filled cable vs solid dielectric cable for SF6 gas-insulated bus.

(ii) Reliability Considerations

Reliability considerations will be based on the general reliability requirements for generation and transmission described in Section 15 regarding the forced outage of a single generator, transformer, bus or cable in addition to planned or scheduled outages in a single contingency situation, or a subsequent outage of equipment in the double contingency situation. The system should be capable of readjustment after the outage for loading within normal ratings and for loading within emergency ratings.

The generators will be rated with a 115 percent continuous overload capability. All main connections and equipment including the transformers, circuit breakers, isolated phase bus, and 345 kV cables will be rated for continuous operation at the 115 percent overload rating of the generators.

Emergency ratings are different for different items of equipment and emergency periods. It generally varies between 110 to 130 percent

in summer to 120 to 140 percent in winter for a 4 to 12 hour period, with somewhat higher values for very short (1 hour) emergency periods.

(iii) Technical and Economic Considerations

The use of surface transformers connected directly to the underground generators by isolated phase bus was ruled out at the outset due to significantly higher costs and higher losses associated with generator isolated phase buses. The incremental cost could be decreased if three units were connected to one transformer, but such a compromise is not acceptable due to reliability considerations.

In general, 3-phase transformers are preferred to single-phase transformers because of their lower overall costs, smaller overall dimensions and smaller underground gallery dimensions. However, transport limitations seriously affect the use of the larger size 3-phase transformers, both in dimensions and weight. The following are the road and rail data available:

- Parks and Denali Highways

  Maximum load - 150,000 lb
  Overweights require special permits.

- Railway

  Maximum Weight - 263,000 lb
  Dimension Limits - 16 feet high, 10 feet wide

A further check of these design limitations for the selected sizes of transformers is recommended during the detailed design stage. A careful route reconnaissance study is also required.

Single-phase transformers are therefore recommended for the 6-unit power plant. The grouped unit arrangement with two generators per transformer will allow a smaller gallery length, with center-to-center spacing comparable to the generator spacing. The grouped unit arrangement is the recommended arrangement. The alternative with one transformer per generator will requie a gallery about 300 feet longer.

One distinct advantage of single-phase transformers is that a spare transformer can be provided at a fairly low incremental cost.

The double-step transformation scheme (15/161 KV generator-transformer, 161 KV cable and 161/345 KV auto-transformer at the switchyard) is economicallly competitive with the direct transformation scheme (15/345 KV), resulting from a number of tradeoffs: cost/MVA per transformer is lower; also dimensions, weights and cavern dimensions are lower; but the intermediate-voltage transformer costs are additional.

Direct transformation (15/345 KV) is better from system transient stability viewpoint since the overall impedance of the generator unit to the 345 KV bus is lower. Furthermore, it has a better overall reliability since there is no one less voltage level and, therefore, less equipment in the generating "chain" of equipment. This scheme costs about $2 million less in overall costs compared to the double-step transformation scheme.

The comparison between 345 KV oil-filled cables and other 345 KV cable and bus system is made in Section 12.18. The SF6 bus is about 5 to 6 times the cost of the oil-filled cables. It also requires a larger diameter cable shaft. The oil-filled cable is well proven at a number of underground power installations and was therefore selected for both technical and economic considerations.

(c) Main Transformers

(i) Rating and Characteristics

The nine single-phase transformers (three transformers per group of two generators) and one spare transformer, will be of the two winding, oil-immersed, forced-oil water-cooled (FOW) type, with rating and electric characteristics as follows:

Rated capacity:	145 MVA
High voltage winding:	345 / 3 kV, Grounded Y
Basin insulation level (BIL) of H.V. winding:	1300 kV
Low voltage winding:	15 kV, Delta
Transformer impedance:	15 percent

The temperature rise above air ambient temperature of 40°C is 55°C for the windings for continuous operation at the rated kVA.

(ii) Construction

The transformers will be of the FOW type with water-cooled heat exchangers which remove the heat from the oil circulating through the windings. A one-third spare cooler capacity will be provided. The transformer will be of the forced oil directed type with a design aimed to achieve minimum dimensions and weight for shipping purposes. The low voltage terminals will be connected to the isolated phase bus, and the high voltage terminals to the 345 kV oil-filled cable box termination at the transformer.

Lightning arresters will be connected directly to the high voltage terminals. The transformer installation in the gallery will be designed to provide the necessary ground and safety clearances from the live 345 kV terminals to all nearby equipment and structures.

The tank underbase will be provided with flanged wheels for transport on rails. The spare single-phase transformer will be exactly identical to the remaining nine single-phase transformers. It will be maintained in a state of maximum readiness, for connection in the shortest practical time to replace any of the main transformers.

The transformers will be fully tested and inspected in the factory according to ANSI/NEMA Standards. They will be shipped without oil and filled with inert gas for protection. At the site, erection would be mainly for external fittings such as bushings, lightning arresters, heat exchangers, piping, and electrical connections.

(iii) Fire Protection

Fire walls will separate each single-phase transformer. Each transformer will be provided with fog-spray water fire protection equipment, automatically operated from heat detectors located on the transformer.

(d) Generator Isolated Phase Bus

(i) Ratings and Characteristics

The isolated phase bus main connections will be located between the generator, generator circuit breaker, and the transformer.

Tap-off connections will be made to the surge protection and potential transformer cubicle, excitation transformers, and station service transformers. Bus duct ratings are as follows:

	Generator Connection	Transformer Connection
Rated current, amps	9,000	18,000
Short circuit current momentary, amps	240,000	240,000
Short circuit current, symmetrical, amps	150,000	150,000
Basic insulation level, kV (BIL)	150	150

The bus conductors will be designed for a temperature rise of 65°C above 40°C ambient temperature.

(ii) Construction

The bus will be of standard self-cooled design with conductor and tubular enclosure of aluminum. The current rating is such that either a self-cooled or forced cooled design will be possible. With a forced cooled design, the size and costs will be lower; however, if the forced-cooling plant fails, the bus would be severely derated to a rating less than 50 percent of the forced cooling rating. The self-cooled designs are used up to 30,000 amps rated current and are therefore recommended for this installation where the ratings will not exceed 18,000 amps.

The enclosure will be of welded construction and each bus will be grounded. The construction is highly reliable; will eliminate phase-to-phase faults, neutralize the magnetic field outside the enclosure, and provide protection against contamination and moisture, with consequent minimum maintenance requirements.

(e) Generator Circuit Breakers

The generator circuit breakers will be of the enclosed air circuit breaker design suitable for mounting in line with the generator isolated phase bus ducts. They are rated as follows:

Rated Current:	9,000 Amps
Voltage:	23 kV class, 3-phase, 60 Hertz
Breaking capacity, symmetrical, amps	150,000

The short circuit rating is tentative and will depend on detailed analysis in the design stage.

The breakers will be designed and constructed with a high degree of reliability. The phase spacing of the breakers will be generally the same as the isolated phase bus duct. The breakers will be mounted on strong foundations on the generator floor designed to absorb the reaction forces when the breaker operates. A separate compressed air plant will be provided for the high reliability compressed air system requirements of the air circuit breakers.

(f) 345 kV Oil-Filled Cable

(i) General

The recommended 345 kV connection is a 345 kV oil-filled cable system between the high voltage terminals of the transformer and the surface switchyard. The cable will be installed in a vertical cable shaft. Cables from two transformers will be installed in a single cable shaft.

This system of 345 kV connection was chosen after a technical and economic analysis of alternative methods of connection, including:

- SF6 isolated bus system;
- High pressure oil pipe cable system; and
- Solid dielectric cable system.

The SF6 bus system is considered to be the best alternative to the oil-filled cable system. Its advantages are a generally better overall reliability, including a low fire hazard. However, it costs approximately 5 to 6 times that of the oil-filled cable installation, and requires almost twice the diameter cable shaft of the cable installation. The overall cost difference is approximately $7,000,000 in direct costs.

The oil pipe cable will consist of three conductors contained within an oil-filled steel pipe. This system has the highest potential fire hazard of all the cable systems and is not recommended for high head vertical cable installations. The solid dielectric (polymeric) cables are still under development at the 345 kV to 500 kV voltage class.

It is recommended that further detailed study of the oil-filled cable in comparison with the SF6 bus and other more recent SF6 cable designs under development be undertaken at the design stage.

By far the greatest number of high voltage, high capacity installations utilize oil-filled cables. A formidable experience record is evident for the oil-filled cable installations associated with large power plants all over the world. Typical installations include the 525 kV/650 MVA units at Grand Coulee III, the 345 kV/550 MVA units at Churchill Falls in Canada, the 400 kV/2640 MVA cables at Severn River crossing in Great Britain, and the 400 kV/2340 MVA cables at Dinorwic pumped storage plant in Great Britain.

(ii) Rating and Characteristics

The cable will be rated for a continuous maximum current of 800 amps at 345 kV ±5 percent. The maximum conductor temperature at the maximum rating will be 70°C over a maximum ambient of 35°C. This rating will correspond to 115 percent of the generator overload rating. The normal operating rating of the cable will be 87 percent, with a corresponding lower conductor temperature which will improve the overall performance and lower cable aging over its project operating life. Depending on the ambient air temperature, a further overload emergency rating of about 10 to 20 percent will be available during winter conditions.

The cables will be of single-core construction with oil flow through a central oil duct within the copper conductor. Cables will have an aluminum sheath and PVC oversheath. No cable jointing will be required for the 700 to 800 feet length cable installation.

(g) Control Systems

(i) General

A Susitna Area Control Center will be located at Watana to control both the Watana and the Devil Canyon power plants as shown in Plate _____. The control center will be linked through the supervisory system to the Central Dispatch Control Center at Willow as described in Section 14.

The supervisory control of the entire Alaska Railbelt system will be done at the Central Dispatch Center at Willow. A high level of control automation with the aid of digital computers will be sought,

but not a complete computerized direct digital control of the Watana and Devil Canyon power plants. Independent operator controlled local-manual and local-auto operations will still be possible at Watana and Devil Canyon power plants for testing/commissioning or during emergencies. The control system will be designed to perform the following functions at both power plants:

- Start/stop and loading of units by operator;
- Load-frequency control of units;
- Reservoir/water flow control;
- Continuous monitoring and data logging;
- Alarm annunciation; and
- Man-machine communication through visual display units (VDU) and console.

In addition, the computer system will be capable of retrieval of technical data, design criteria, equipment characteristics and operating limitations, schematic diagrams, and operating/maintenance records of the unit.

The Susitna Area Control Center will be capable of completely independent control of the Central Dispatch Center in case of system emergencies. Similarly it will be possible to operate the Susitna units in an emergency situation from the Central Dispatch Center, although this should be an unlikely operation considering the size, complexity, and impact of the Susitna generating plants on the system.

The Watana and Devil Canyon plants will be capable of "black start" operation in the event of a complete black out or collapse of the power system. The control systems of the two plants and the Susitna Area Control Center complex will be supplied by a non-interruptible power supply.

(ii) Unit Control System

The unit control system will permit the operator to initiate an entire sequence of actions by pushing one button at the control console, provided all preliminary plant conditions have been first checked by the operator, and system security and unit commitment have been cleared through the central dispatch control supervisor. Unit control will be designed to:

- Start a unit and synchronize it with the system;
- Load the unit;
- Stop a unit;
- Operate a unit as running spare (runner in air with water blown down in turbine and draft tube); and
  Operate as a synchronous condenser (runner in air as above).

Unit control will be essentially possible at four different levels in a hierarchical organization of the control system:

- Local control at the machine floor at individual turbine-generator control boards (primarily designed for commissioning and recommissioning of units). It will be the responsibility of the operator for performing individual control operations in the correct sequence, and monitoring instrumentation during local control operations.

- Automatic or semi-automatic system for start-up and shut-down of generating unit at the local board at the machine floor.

- Fully automatic system at Susitna Area Control (at Watana) for Watana and Devil Canyon power plants. (This will be the normal Susitna operation.)

- Fully automatic system through supervisory control from Central Dispatch Center at Willow. (Abnormal or emergency situations only).

(iii) Computer-Aided Control System

Traditionally, control systems for power plants in general, and hydro plants in particular, have utilized hard-wired switchboard type equipment (such as electro-mechanical relays, instruments, alarm annunciators, signal lamps, mimic diagram and control switches) for the operation, indication, alarm and control of the power plant. Such equipment was installed both at the plant local control area on the machine floor as well as in the control room, with a limited degree of miniaturization of equipment at the control desks in the control room.

While traditional switchboard type equipment is still utilized at the local control level, supplemented with programmable control systems at many plants, the design of control and display equipment at modern central control rooms has been rapidly moving towards computer-aided or fully computer-controlled systems, especially where remote control operations are contemplated. One of the problems encountered by utilities is the necessity for operating personnel familiar with the conventional control systems to adapt to the new computer-aided control systems. In this contect, establishing a modern computer-aided control system in the Alaska Power Authority electrical system for the Susitna Project complex should not pose any special problems for the adaption and training of operators.

The computer-aided control system at the Susitna Area Control Center at Watana will provide for the following:

- Data acquisition and monitoring of unit (MW, MVAR, speed, gate position, temperatures, etc.);

- Data acquisition and monitoring of reservoir headwater and tailwater levels;

- Data acquisition and monitoring of electrical system voltage and frequency;

- Load-frequency control;

- Unit start/stop control;

- Unit loading;

- Plant operation alarm and trip conditions (audible and visual alarm on control board, full alarm details on VDU on demand);

- General visual plant operation status on VDU and on giant wall mimic diagram;

- Data logging, plant operation records;

- Plant abnormal operation or disturbance automatic recording; and

- Water management (reservoir control).

The block diagram of the computer-aided control system is shown in Plate ___. The supervisory control and telemetering system and central dispatch center system details are described in Section 14.

(iv) Local Control and Relay Boards

Local boards will be provided at the powerhouse floor equipped with local controls, alarms, and indications for all unit control functions. These boards will be located near each unit and will be utilized mainly during testing, commissioning, and maintenance of the turbines and generators. It will also be utilized as needed during emergencies if there is a total failure of the remote or computer-aided control systems.

The unit electrical protective relays will be mounted on relay boards, with one board for each generator located near the unit. Differential protection will be provided for each generator and transformer. The differential zones of protection overlap will include all electrical equipment and connections. The 345 kV oil-filled cable to the surface switchyard will be protected by a pilot-wire differential protection relay. The overall differential relay protects the generators, transformers, and 345 kV cable. Sensitive ground fault stator protection will be provided for the generator. Protection will also be provided for negative phase sequence operation, loss of excitation, overvoltage, and under frequency. A phase impedance relay will provide backup protection for the generator. Other protective relays are shown in Plate ___.

(v) Load-Frequency Control (Automatic Generation Control)

The load frequency control system will provide remote control of the output of the generator at Watana and Devil Canyon from the central dispatch control center through the supervisory and computer-aided control system at Watana. The basic method of automatic generation control (AGC) will use the plant error (differential) signals from the load dispatch center and will allocate these errors to the power plant generators automatically through speed-level motors. Provision will be made in the control system for the more advanced scheme of a closed-loop control system with digital control to control generator power.

The control system will be designed to take into account the digital nature of the controller-timed pulses as well as the inherent time delays caused by the speed-level motor run-up and turbine-generator time-constants.

The load set-point for the Susitna area generation will be set at the Central Dispatch Center. The summated power will be telemetered from the Susitna Area Control center to the Central Dispatch Center, from which the required differential plant generation ("error") will be determined and transmitted by the supervisory system to Susitna Area Control Center. From this point, the remaining functions for the automatic generation control will be carried out by the plant supervisory control systems to load the individual generating units at Watana and Devil Canyon.

The unit will be automatically removed from load-frequency control for various conditions including failure of supervisory system, unit controller or computer system, abnormally high plant frequency, unit shut-down, and dc power failure. When the unit is taken off automatic load-frequency control, it will be returned to manual load and frequency control by the operator at Watana Control room.

(h) Station Service Auxiliary AC and DC Systems

(i) Auxiliary AC System

The station service system will be designed to achieve a reliable and economic distribution system for the power plant and switchyard, in order to satisfy the following requirments:

- Station service power at 480 volts will be obtained from two 2,000 kVA auxiliary transformers connected directly to the generator circuit breaker outgoing leads of Units 1 and 3;

- Surface auxiliary power at 34.5 kV will be supplied by two separate 7.5/10 MVA transformers connected to the generator leads of Units 1 and 3;

- Station service power will be maintained even when all the units are shut down and the generator circuit breakers are open;

- 100 percent standby transformer capacity will be available;

- A spare auxiliary transformer will be maintained, connected to Unit 5; and

- "Black start" capability will be provided for the power plant in the event of total failure of the auxiliary supply system, 500 kW emergency diesel generators will be automatically started up to supply the power plant and switchyard with auxiliary power to the essential services to enable startup of the generators.

The main ac auxiliary switchboard will be provided with two bus sections separated by bus-tie circuit breakers. Under normal operating conditions, the station-service load is divided and connected to each of the two end incoming transformers. In the event of failure of one end supply, the tie breakers will close automatically. If both end supplies fail, the emergency diesel generator will be automatically connected to the station service bus.

Each unit will be provided with a unit auxiliary board supplied by separate feeders from the two bus sections of the main switchboard interlocked to prevent parallel operation. Separate ac switchboards will furnish the auxiliary power to essential and general services in the power plant.

The unit auxiliary board will supply the auxiliaries necessary for starting, running, and stopping the generator-turbine unit. These supplies will include those to the governor and oil pressure system, bearing oil pumps, cooling pumps and fans, generator circuit breaker, excitation system, and miscellaneous pumps and devices connected with unit operation.

The station essential service supplies will include powerhouse sump pumps, drainage pumps, compressors for circuit breakers, station air and generator brakes, dc battery chargers, control and metering devices, communications, fire protection pumps, and other miscellaneous essential power requirements.

The station general supplies will include powerhouse lighting, heating, ventilating and air-conditioning, elevators, cranes, machine shop and tools, and other miscellaneous pumps and general requirements.

The 34.5 kV supply to the surface facilities will be distributed from a 34.5 kV switchboard located in the surface control and administration building. Power supplies to the switchyard power intake, and spillway as well as the lighting systems for the access roads and tunnels will be obtained from the 34.5 kV switchboard.

The unit auxiliary board will supply the auxiliaries necessary for starting, running, and stopping the generator-turbine unit. These supplies will include those to the governor and oil pressure system, bearing oil pumps, cooling water pumps and fans, generator circuit breaker, excitation system, and miscellaneous pumps and devices connected with unit operation.

The station essential service supplies will include powerhouse sump pumps, drainage pumps, compressors for circuit breaker, air and generator brakes, dc battery chargers, control and metering devices, communications, fire protection pumps, and other miscellaneous essential power requirements.

The station general supplies will include powerhouse lighting, heating, ventilating and air-conditioning, elevators, cranes, machine shop and tools, and other miscellaneous pumps and general requirements.

The 34.5 kV supply to the surface facilities will be distributed from a 34.5 kV switchboard located in the surface control and administration building. Power supplies to the switchyard power intake, and spillway as well as the lighting systems for the access roads and tunnels will be obtained from the 34.5 kV switchboard.

The two 2000 kVA, 15000/480 volt stations service transformers and the spare transformer will be of the 3-phase, dry-type, sealed gas-filled design. The two 7.5/10 MVA, 15/34.5 kV transformers will be of the 3-phase oil-immersed OA/FA type.

Emergency diesel generators, each rated 500 kW, will separately supply the 480 volt and 34.5 kV auxiliary switchboards during emergencies. Both diesel generators will be located in the surface control building.

An uninteruptible high security power supply will be provided for the computer control system.

(ii) DC Auxiliary Station Service System

The dc auxiliary system will supply the protective relaying, supervisory, alarm, control, tripping and indication circuit in the power plant. The generator static excitation system will be started with "flashing" power from the dc battery. It will also supply the emergency lighting system at critical plant locations.

Separate duplicate lead-acid batteries for 125 volt dc will be provided in the powerhouse. The 48 volt battery supply for the supervisory and computer aided control system and microwave communications will be located in the surface control building.

The main battery system will be supplied by double charging equipment consisting of a full wave rectifier system with regulated output voltage which normally will supply the continuous dc load in the system. The battery capacity will be suitable for an emergency loading based on a failure of ac station service lasting 5 hours.

(iii) "Black Start" Capability

The Watana power plant will have a built-in capability of starting up a completely blacked-out power system in a very short time. Only a few basic requirements will have to be satisfied:

- Sufficient water will be available in the reservoir for the minimum generation required for "black start" operation;
- The governor oil system will have sufficient stored energy capable of operating the turbine wicket gates to full open position;
- The generators wille be equipped with static exciters capable of being flash-started from the station battery system
- Dc control power will be available for the startup circuits.

The above described emergency power requirements will not exceed about 200 kW for one unit and will be easily supplied from the emergency diesel generator. With the startup of a single unit, the complete power plant and switchyard auxiliary power will be immediately available, enabling all the units in the power plant to be started up sequentially within the hour.

(i) Grounding System

The power plant grounding system will consit of one mat under the power plant, one mat under the transformer gallery, risers, and connection ground wires. Grounding grids will also be included in each powerhouse floor. The power plant grounding system will be connected to the switchyard grounding system by three 500 MCM copper ground conductors to minimize the overall resistance to ground. The grounding system will be designed to provide a ground resistance of 1 ohm or lower. All exposed metal part and neutral connections of generators and transformers will be connected to the grounding system for the purpose of protecting personnel and equipment from injury or damage.

(j) Lighting System

The lighting system in the powerhouse will be supplied from 480/208-120 volts lighting transformers connected to the general ac auxiliary station service system. The lighting system will be all fluorescent and incandescent fixtures operating on 120 volts and all outdoor type high pressure sodium fixtures operating on 208 volts. The lighting level varies generally from 20 to 50 foot candles depending upon the powerhouse area; the

higher levels will be at control areas. Adequate illumination will be provided on vertical switchboards with local lighting canopies.

An emergency lighting system will be provided at the power plant and at the control room at all critical operating locations with an illumination level of 2 foot candles. The emergency lighting system will operate from a separate 120 volt ac circuit which, by means of automatic transfer switches, will be automatically connected to the 125 volt dc system upon failure of the ac system.

(k) Communications

The power plant will be furnished with an internal communications system, including an automatic telephone switchboard system. A communication system will be provided at all powerhouse floors and galleries, transformer gallery, access tunnels and cable shafts, and structures at the intake, draft tube chamber, spillway, and dam.

The communications system for the central dispatch control system, telemetering, supervisory and protective relaying system is described in Section 15.

(l) Insulation Coordination and Lightning and Switching Surge Protection

The electrical insulation and protective devices will be selected and coordinated to provide a safe margin of insulation strength above the maximum abnormal voltages permitted during lightning, switching, and short-circuit surges. The 1300 kV basic insulation level (BIL) specified for the transformer and other BIL values stated for the electrical equipment and connections are tentative and are subject to detailed study in the design stage of the project.

In principle, lightning arresters will be mounted on or adjacent to all major electrical equipment having wound-type internal construction, and will be provided at the generator 15 kV terminals and the main transformer 345 kV terminals.

12.19 - Switchyard Structures and Equipment

TO FOLLOW

12.20 - Project Lands

Project lands acquired for the project will be the minimum necessary to construct access and site facilities, construct permanent facilities, to clear the reservoir, and to operate the project.

The tailrace portal site has been located at a prominent steep rock face on the right bank of the river to provide the required tunnel cover (about 60 feet) in as short a distance as possible. The portal provides a gradual transition from the tunnel modified horseshoe shape to a rectangular cross-section at the outlet; it also reduces the maximum outlet velocity to 8 ft/sec, to reduce the velocity head loss at exit. Vertical stoplog guides are provided for closure of the tunnel if required for tunnel inspection and/or maintenance.

13.15 - Turbines and Generators

(a) Unit Capacity

The Devil Canyon powerhouse will have four generating units with a nominal capacity of 150 MW. This is the available capacity with minimum December reservoir level (El. 1393) and a corresponding gross head of 553 feet in the station.

The head on the plant will vary from 605 feet maximum (597 feet net head) to 550 feet minimum (538 feet net head). Because maximum turbine output varies approximately with the 3/2 power of head, the maximum unit output will change with head as shown in Figure 13.2.

The rated head for the turbine has been established at 575 feet, which is the weighted average operating head on the station. Allowing for generator losses, this results in a rated turbine output of 225,000 hp (168 MW).

The generator rating has been selected as 180 MVA with a 90 percent power factor, which corresponds to a power output of 162 MW. The generators will be capable of continuous operation at 115 percent rated power. Because of the high capacity factor for the Devil Canyon station, the units will be operated at or near full load a large percentage of the time. The generators have therefore been sized on the basis of maximum turbine output at maximum head, allowing for a possible 5 percent addition in power from the turbine. This maximum turbine output (250,000 hp) is within the continuous overload rating of the generator.

(b) Turbines

The turbines will be of the vertical shaft Francis type with steel spiral casing and a concrete elbow type draft tube. The draft tube will have a single water passage (no center pier).

The rated output of the turbines will be 225,000 hp at 575 feet rated net head. Maximum and minimum heads on the units will be 597 feet and 538 feet, respectively. The full gate output of the turbines will be about 240,000 hp at 597 feet net head and 205,000 hp at 584 feet net head. Overgating of the turbines may be possible, providing approximately 5 percent additional power. For preliminary design purposes, the best efficiency (best gate) output of the units has been assumed at 85 percent of the full gate turbine output. This will be reviewed at the time of preparation of bid documents for the turbines.

The full gate and best gate efficiencies of the turbines will be about 91 percent and 94 percent, respectively, at rated head. The efficiency will be about 0.2 percent lower at maximum head and 0.5 percent lower at minimum head. The preliminary performance curve for the turbine is shown in Figure 13.3.

A speed of 225 rpm has been selected for the unit for preliminary design purposes. The resulting turbine specific speed (N_s) is 37.9. As shown in Figure 12.23, this is within present day practice for turbines operating under 575 feet head. The considerations for selection of turbine speed are briefly discussed in Section 12.16.

On the basis of information from turbine manufacturers and the studies on the power plant layout, the centerline of the turbine distributor has been set at 30 feet below minimum tailwater level. The final setting of the unit will be established in conjunction with the turbine manufacturer after the contract for the supply of the turbine equipment has been awarded.

The mechanical/structural designs of the turbines will be basically the same as for Watana. Because of the relatively short penstocks and the surge tank location immediately downstream from the powerhouse, the hydraulic transient characteristics of the turbines are favorable. Assuming normal generator inertia (H = 3.5 MW-Sec/MVA), a preliminary analysis has indicated the following:

- Water starting time (Tw) ..... 1.2 sec.
- Mechanical starting time (Tm) ..... 7.6 sec.
- Regulating ratio (Tm/Tw) 6.3
- Governor time ..... 5.0 sec.
- Speed rise on full load rejection ..... 35 percent
- Penstock pressure use on full load rejection ..... 20 percent

The regulating ratio is above the minimum recommended by the USBR for good regulating. Also, unit speed rise and penstock capacity pressure rise are within normal accepted values. Because of the relatively short distance between the turbine and the tailrace surge tank and the deep unit setting, there should not be any problems with draft tube column separation.

As discussed in Section 12.16 for Watana, the units will be capable of operation from about 50 to 100 percent load. Considerations for draft tube surges and corresponding power swings as mentioned for Watana also will apply to Devil Canyon.

As with Watana, the relationship between generator natural frequency and the possible draft tube surge frequency is desirable and will require study in later design stages. Because of the high capacity factor for the Devil Canyon units, part load operation for these turbines is not as critical as at Watana; therefore, the possibility of problems with power swings is somewhat less of a concern than at Watana.

(c) Generators

The four generators in the Devil Canyon powerhouse will be of the vertical shaft, overhung type directly connected to the vertical Francis turbines.

The generators will be similar in construction and design to the Watana generators and the general features described in Section 12.16 for the stator, rotor, excitation system, and other details which apply for the Devil Canyon generators.

The rating and characteristics of the generators are as follows:

Rated Capacity:	180 MVA, 0.9 power factor with overload rating of 115 percent.
Rated Power:	162 MW
Rated Voltage:	15 kV, 3 phase, 60 Hertz
Synchronous Speed:	225 rpm
Inertia Constant:	3.5 kW - Sec/kVA
Short Circuit Ratio:	1.1 (minimum)
Efficiency at Full Load:	98 percent (minimum)

(d) Governor System

A governor system with electric hydraulic governor actuators will be provided for each of the Devil Canyon units. The system will be the same as for Watana.

13.16 - Miscellaneous Mechanical Equipment

(a) Compensation Flow Pumps

The two pumps for providing minimum discharge into the Susitna River between the dam and the tailrace tunnel outlet portal will be vertical mixed flow or axial type located in the powerhouse service bay below the main erection floor, as shown on Plate 87. Each pump will be rated at 250 cfs (115,000 gal/min) at 35 feet total head, and will be driven by 1,400-hp induction motors. The preliminary pump and motor data is summarized in Table 13.3.

A single pump intake will be located in the surge chamber with an 8-foot-diameter intake tunnel leading to the powerhouse. The intake tunnel will bifurcate into individual pump intake conduits within the powerhouse. The pump discharges will converge into a single pump discharge tunnel.

Butterfly type valves will be installed in the intake and discharge lines of each pump to permit isolation of a pump for inspection or maintenance. Trash screen guides and a trash screen will be provided in the surge chamber at the pump intake. It will be possible to remove the trash screen using the draft tube gate crane discussed below. The width of the guides

- A-frame or monorail hoists in other powerhouse areas for handling small equipment.

(f) Elevators

Access and service elevators will be provided for the power plant as follows:

- Access elevator from the control building to the powerhouse;
- Service elevator in the powerhouse service bay; and
- Inspection hoists in cable shafts.

The elevators will be as discussed in Section 12.17 for Watana.

(g) Power Plant Mechanical Service Systems

The power plant mechanical service systems for Devil Canyon will be essentially the same as discussed in Section 12.17 for Watana, except for the following:

- There will be no main generator breakers in the power plant; therefore, circuit breaker air will not be required. The high-pressure air system will be used only for governor as well as instrument air. The operating pressure will be 600 to 1,000 psig depending on the governor system operating pressure. An air-conditioning system will be installed in the powerhouse control room.

- For preliminary design purposes only, one drainage and one dewatering sump have been provided in the powerhouse. The dewatering system will also be used to dewater the intake and discharge lines for the compensation flow pumps.

(h) Surface Facilities Mechanical Service Systems

The entrance building at the top of the power plant will have only a heating and ventilation system. The mechanical services in the standby power building will include a heating and ventilation system, a fuel oil system, and a fire protection system, as at Watana.

(i) Machine Shop Facilities

A machine shop and tool room will be located in the powerhouse service bay area to take care of maintenance work at the plant. The facilities will not be as extensive as at Watana. Some of the larger components will be transported to Watana for necessary machinery work.

13.17 - Accessory Electrical Equipment

(a) General

The accessory electrical equipment described in this section includes the following main electrical equipment:

- Main generator step-up 15/345 kV transformers;
- Isolated phase bus connecting the generator and transformers;
- 345 kV oil-filled cables from the transformer terminals to the switchyard;
- Control systems; and
- Station service auxiliary ac and dc systems.

Other equipment and systems described include grounding, lighting system and communications.

The main equipment and connections in the power plant are shown in the Single Line Diagram, (Plate 88). The arrangement of equipment in the powerhouse, transformer gallery, and cable shafts is shown in Plates 85 to 88.

(b) General Design Considerations for Transformers and HV Connections

(i) General

Twelve single-phase transformers and one spare transformer will be located in the transformer gallery. Each bank of the three single-phase transformers will be connected to one generator by isolated phase bus located in bus tunnels. The HV terminals of the transformer will be connected to the 345 kV switchyard by 345 kV single-phase oil-filled cables installed in 800-foot long vertical shafts. There will be two sets of three single-phase 345 kV oil-filled cables installed in each cable shaft. One additional set will be maintained as a spare three-phase cable circuit in the second cable shaft. These cable shafts will also contain the control and power cables between the powerhouse and the surface control room, as well as emergency power cables from the diesel generators at the surface to the underground facilities.

As described in Section 12.18 for the Watana power plant, a number of considerations led to the choice of the above optimum system of transformation and connections. Different alternative methods and equipment designs were also considered. In summary, these are:

- One transformer per generator versus one transformer for two generators;
- Underground transformers versus surface transformers;
- Direct transformation from generator voltage to 345 kV versus intermediate step transformation to 230 kV or 161 kV, and thence to 345 kV;
- Single phase versus three-phase transformers for each alternative method considered; and
- Oil-filled cable versus solid dielectric cable or SF_6 gas-insulated bus.

Reliability considerations are based on the general reliability requirements for generation and transmission described in Section 15 regarding the forced outage of a single generator, transformer, bus or cable in addition to planned or scheduled outages in a single

contingency situation, or a subsequent outage of equipment in the double contingency situation. In the first case, the system should be capable of readjustment after the outage for loading within normal ratings and, in the second case, within emergency ratings.

The one transformer per generator scheme was selected since the operation of the Devil Canyon power plant will essentially be a continuous base-load type operation; also the smaller number of units at Devil Canyon compared to Watana will allow a transformer gallery of reasonable length for a unit generator-transformer scheme.

As at Watana, transport limitations for both dimensions and weight will preclude the use of the larger size three-phase transformers; hence, single-phase transformers will be used. One distinct advantage of single-phase transformers is that a spare transformer can be provided at a fairly low incremental cost.

For the same reasons as given in Section 12.18 for Watana, surface transformers and the double-step transformation scheme (15/161 kV generator-transformer, 161 kV cable and 161/345 kV auto-transformer at the switchyard) were ruled out. The direct transformation (15/345 kV) scheme with 345 kV oil-filled cables is considered a better overall scheme.

(c) Main Transformers

The transformers will be of the single phase, two-winding, oil-immersed, forced-oil water-cooled (FOW) type. A total of twelve single-phase transformers and one spare transformer will be provided, with rating and characteristics as follows:

Rated capacity:	70 MVA
High Voltage Winding:	345/ 3 kV, grounded Y
Basic Insulation Level (BIL) of HV Winding:	1300 kV
Low Voltage Winding:	15 kV, Delta
Transformer Impedance:	15 percent

The design and construction details are identical to the transformers at Watana as described in Section 12.18.

(d) Generator Isolated Phase Bus

Isolated phase bus connections will be located between the generator and the main transformer. The bus will be of the self-cooled, welded aluminum tubular type with design and construction details generally similar to the bus at the Watana power plant. The rating of the main bus is as follows:

Rated current:	9,000 amps
Short circuit current momentary:	240,000 amps
Short circuit current symmetrical:	150,000 amps
Basic Insulation Level (BIL):	150 kV

(e) 345 kV Oil-Filled Cable

The general design considerations leading to the choice of the 345 kV oil-filled cable for the connections between the transformer HV terminals and the 345 kV switchyard at the surface are the same as described in Section 12.18 for the Watana plant.

The cables will be rated for a continuous maximum current of 400 amps at 345 kV ±5 percent. The cables will be of single-core construction with oil flowing through a central oil duct within the copper conductor. The cables will be installed in the 800-foot cable shafts from the transformer gallery to the surface. No cable jointing will be necessary for this installation length.

(f) Control Systems

(i) General

The Devil Canyon power plant will be designed to be operated as an unattended plant. The plant will be normally controlled through supervisory control from the Susitna Area Control Center at Watana. The plant will, however, be provided with a control room with sufficient control, indication, and annunciation equipment to enable the plant to be operated during emergencies by one operator in the control room. In addition, for the purpose of testing and commissioning and maintenance of the plant, local control boards will be mounted on the powerhouse floor near each unit.

Automatic load-frequency control of the four units at Devil Canyon will be accomplished through the central computer-aided control system located at the Watana Area Control Center.

The power plant will be provided with "black start" capability similar to that provided at Watana, to enable the start of one unit without any power in the powerhouse or at the switchyard, except that provided by one emergency diesel generator. After the start-up of one unit, auxiliary station service power will be established in the power plant and the switchyard; the remaining generators can then be started one after the other to bring the plant into full output within the hour.

As at the Watana power plant, the control system will be designed to permit local-manual or local-automatic starting, voltage adjusting, synchronizing, and loading of the unit from the powerhouse control room at Devil Canyon.

The protective relaying system is shown in the main single line diagram, Plate 88, and is generally similar to that provided for the Watana power plant.

(g) Station Service Auxiliary AC and DC Systems

(i) AC Auxiliary System

The station service system will be designed to achieve a reliable and economic distribution system for the power plant and the switchyard and surface facilities. The auxiliary system will be similar to that in the Watana power plant except that the switchyard and surface facilities power will be obtained from a 4.16 kV system supplied by two 5/7.5 MVA, OA/FA, oil-immersed transformers connected to generators Nos. 1 and 4, respectively. The 4.16 kV double-ended switchgear will be located in the powerhouse. It will have a normally-open tie breaker which will prevent parallel operation of the two sections. The tie breaker will close on failure of one or the other of the incoming supplies. The 1400 hp compensation flow pumps will be supplied with power directly from the 4.16 kV system. Two 4.16 cables installed in the cable shafts will supply power to the surface facilities.

The 480 V station service system will be exactly similar to the Watana system described in Section 12.18, and will consist of a main 480 V switchgear, separate auxiliary boards for each unit, an essential auxiliaries board, and a general auxiliaries board. The main 480 V switchgear will be supplied by two 2000 kVA, 15,000/480 V grounded wye sealed gas dry-type transformers. A third 2000 kVA transformer will be maintained as a spare.

Two emergency diesel generators, each rated 500 kW, will be connected to the 480 V powerhouse main switchgear and 4.16 kV surface switchboard, respectively. Both diesel generators will be located at the surface.

An uninterruptible high-security power supply will be provided for the supervisory computer-aided plant control systems.

(ii) DC Auxiliary Station Service System

The dc auxiliary system will be similar to that provided at the Watana plant and will consist of two 125 V dc lead-acid batteries. Each battery system will be supplied by a double rectifier charging system. A 48 V dc battery system will be provided for supplying the supervisory and communications systems.

(iii) Black Start Capability

As at the Watana power plant, the Devil Canyon power plant will be provided with "black start" capability which will enable the plant to start up in a completely "blacked out" condition of the power plant and/or the power system.

(h) Other Accessory Electrical Systems

The other accessory electrical systems including the grounding system, lighting system, and powerhouse communications system will be similar in general design and construction aspects to the systems described in Section 12.18 for the Watana power plant.

SUSITNA HYDROELECTRIC PROJECT
Watana Gate Equipment Weights

February 12, 1982

2.1	No.	Total Wt. (lb.)
ACCOUNT 331 - POWER PLANT STRUCTURE		
.1 Powerhouse		
.11C Mechanical		
Draft Tube Gates	4	280,000
Draft Tube Guides	6	168,000
ACCOUNT 332 - RESERVOIRS, DAMS & WATERWAYS		
.2 Diversion		
.21C Mechanical		
Upstream Lower Gates		
Gate Equipment	2	1,050,000
Upstream Upper Gates		
Gate Equipment	2	592,000
Trashracks	1	306,000
Downstream Lower Outlet		
Stoplog Guides	1	11,000
Stoplogs Including Follower	1	297,000
Downstream Upper Outlet		
Stoplog Guides	1	18,000
Low Level Release		
Slide Gates Including Steel Liner	9	3,300,000
.5 Tunnel Spillway		
.51C Mechanical		
Inlet		
Trashracks/Guides	1	250,000
Gate Equipment	2	690,000
Stoplog Guides	2	60,000
Outlet		
Fixed Cone Valves (6 plus 1 spare)	1	330,000
Ring Follower Gates	6	960,000
Steel Manifold Liner		
Miscellaneous Mechanical Equipment		
Miscellaneous Electrical Systems		
.52 Main (Chute) Spillway		
.52C Mechanical		
Gate Equipment	3	1,320,000
Stoplog Guides	3	13,000
Stoplogs Including Follower	1	147,000
Miscellaneous Electrical		

SUSITNA HYDROELECTRIC PROJECT
Watana Gate Equipment Weights

February 12, 1982

	No.	Total Wt. (lb.)
ACCOUNT 332 - RESERVOIRS, DAMS & WATERWAYS		
.6 Power Intake		
.61C Mechanical		
Trashracks/Guides	24/6	1,126,000
Gate Equipment	6	1,254,000
Bulkhead Gate Guides	6	186,000
Bulkhead Gates Including Follower	1	105,000
Shutter with Guides	18/6	658,000
Ice Bulkhead with Hoist	6	540,000
Ice Bulkhead Guides	6	360,000
Intake Service Crane		
.7 Surge Chamber		
.71C Mechanical		
Stoplog Guides	2	200,000
Stoplog Including Follower	1	564,000
.9 Tailrace Works		
.91C Mechanical		
Stoplog Guides	1	16,000
Stoplog Including Follower	1	235,000

SUSITNA HYDROELECTRIC PROJECT
Watana Permanent Town Listing

February 12, 1982

2.2

ITEM	UNIT	SIZE & DESCRIPTION	QUANTITY WATANA	QUANTITY DC
Buildings				
Single Family Home 3 BR	ea	1,600 sf	5	1
Single Family Home 4 BR	ea	1,900 sf	5	1
Family Condominium 2 BR	ea	1,200 sf	15	4
Family Condominium 3 BR	ea	1,400 sf	40	9
Family Condominium 4 BR	ea	1,600 sf	5	2
Apartments 1 BR	ea	720 sf	12	3
Apartments 2 BR	ea	1,000 sf	11	2
School	ea	12,000 sf	1	--
Gymnasium	ea	10,000 sf	1	--
Swimming Pool	ea	8,000 sf	1	--
Recreation Center	ea	6,000 sf	1	--
Store	ea	8,000 sf	1	--
Fire Station	ea	1,200 sf	1	--
Communication Building	ea	600 sf	1	--
Generating Station (Emergency)	ea	600 sf	1	--
Dispensary	ea	1,200 sf	1	--
Gas Station	ea	800 sf, 2 bay, 4 pumps	1	--
Site Work				
Roadway-34' W/ Gravel Surface	lf	Gravel surface	5,000	--
Parking Area-Town Center	sf	Gravel surface	90,000	--
Parking Area-Dwellings	sf	Gravel surface	130,000	--
Utilities				
Water Main	lf	6-inch diameter	4,200	--
Water Main, Return	lf	6-inch diameter	4,200	--
Water, Service Connections	lf	Loop connections	6,000	1,400
Sewer Main	lf	12-inch diameter	4,200	--
Sewer, Service Connections	lf		3,000	700
Electric Service	lf		7,000	1,700
Transformers	ea		20	5
Telephone Service	lf	Buried	7,000	
Water Intake, Pump House & Pump	ls	In Tsusena Creek	1	--
Electric Service to Pump House	lf		2,000	--
Transformer at Pump House	ea		1	--
Sewage/Water Treatment Building	ea		1	--
Sewage Treatment Plant	ls	50,000 gpd	1	--
Water Treatment Plant	ls	50,000 gpd	1	--
Sewage Outfall Line	lf	6-inch diameter	2,000	--
Water Supply Line	lf	4-inch diameter	2,000	--

SUSITNA HYDROELECTRIC PROJECT
Devil Canyon Gate Equipment Weights

February 12, 1982

3.1

	No.	Total Wt. (lb.)
ACCOUNT 331 - POWER PLANT STRUCTURE		
.1 Powerhouse		
.11C Mechanical		
Draft Tube Gates	2	206,000
Draft Tube Gate Guides	4	140,000
Draft Tube Crane		
Pump Intake Trashracks & Guides	1	54,000
Pump Outlet Stoplogs/Guides	1	20,000
ACCOUNT 332 - RESERVOIRS, DAMS & WATERWAYS		
.2 Diversion Tunnels/Cofferdams		
.21C Mechanical		
Upstream Gate		
Gate Equipment	2	570,000
Downstream Outlet		
Stoplog Guides	1	11,000
Stoplogs Including Followers	(Same as Permanent Spillway)	
.5 Spillway Valves (In Dam)		
.51C Mechanical		
Trashracks/Guides	1	654,000
Bulkhead Gate Guides	1	386,000
Bulkhead Gates & Followers	2	142,000
Gantry Crane		
Fixed Cone Valves (7 plus 2 spare)	1	
Ring Follower Gates (7)	1	1,175,000
Miscellaneous Mechanical Equipment		
.52 Main (Chute) Spillway		
.52C Mechanical		
Gate Equipment	3	1,248,000
Stoplog Guides	3	42,000
Stoplogs Including Followers	1	167,500
.6 Power Intakes		
.61C Mechanical		
Trashracks & Guides	4	258,000
Bulkhead Gate Guides	4	92,000
Bulkhead Gates & Followers	1	94,000
Intake Gantry Crane		
Intake Gate Equipment	4	784,000
Miscellaneous Electrical		
.9 Tailrace Works		
.91C Mechanical		
Stoplog Guides	1	13,000
Stoplogs Including Follower	(As per Watana)	

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ITEM	DESCRIPTION		QUANTITY	UNITS	UNIT PRICE	AMOUNT	TOTAL	REMARKS
					$	$ 000	$ 000	
PRODUCTION PLANT								
330	LAND & LAND RIGHTS							
.1	LAND							
	LAND		1	LS				
.2	LAND RIGHTS							
	LAND RIGHTS	A	0	LS				
.3	MISC CHARGES & CREDITS							
	MISC CHARGES & CREDITS	A	0	LS				
331	POWERPLANT STRUCTURE IMPROVEMENTS							
.1	POWERHOUSE							
.11	POWERHOUSE & DRAFT TUBE							
.111	EXCAVATION							
	POWERHOUSE VAULT ROCK		122,500	CY				3
	DRAFT TUBE ROCK		25,200	CY				3
.113	SURFACE PREPARATION/GROUTING							
	POWERHOUSE							
	SURFACE PREPARATION		99,000	SF				3/4
	DRAFT TUBE							
	SURFACE PREPARATION		76,500	SF				3/4
	GROUT CURTAIN (U/S OF P-H)							
	DRILL HOLES		43,800	LF				3
	CEMENT		17,500	CF				3
.114	CONCRETE & SHOTCRETE							
	POWERHOUSE							
	CONCRETE		32,600	CY				3/4
	REINFORCING STEEL		1,630	TON				3/4
	4" SHOTCRETE		41,000	SF				3/4
	CONC OVERBREAK 12"H/6"V		2,400	CY				3
	DRAFT TUBE							
	CONCRETE		12,000	CY				3
	REINFORCING STEEL		990	TON				3
	2" SHOTCRETE		6,100	SF				3/4
	CONCRETE OVERBREAK 6"		2,500	CY				3
.115	SUPPORT & ANCHORS							
	POWERHOUSE							
	ROCKBOLTS 1" @ 25' HY		970	EACH				3/4
	ROCKBOLTS 1" @ 15'		1,970	EACH				3/4
	STEEL MESH		44,600	SF				3/4
	STEEL SUPPORT		137	TON				3
	DRAFT TUBE							

LIEN	DESCRIPTION	QUANTITY	UNITS	UNIT PRICE	AMOUNT	TOTAL	REMARKS
				$	$ 000	$ 000	
	ROCKBOLTS 1" @ 25'	150	EACH				3
	ROCKBOLTS 1" @ 12'	390	EACH				3/4
	ROCKBOLTS 1" @ 9'	190	EACH				3/4
	STEEL MESH	18,900	SF				3/4
.117	DRAINAGE						
	HOLES (U/S OF POWERHOUSE)	15,000	LF				3
	HOLES (POWERHOUSE CROWN)	28,500	LF				3
.118	STRUCTURAL - MISC STEELWORK						
	POWERHOUSE & DRAFT TUBE						
	STRUCTURAL STEEL/CRANE RAILS	1	LS				
.11	ARCHITECTURAL						
	POWERHOUSE						
	ARCHITECTURAL	1	LS				
.11C	MECHANICAL						
	DRAFT TUBE GATES	4	SETS				3
	DRAFT TUBE GATE GUIDES	6	SETS				3
	DRAFT TUBE CRANE	1	LS				4
.12	ACCESS TUNNELS & PORTALS						
.121	EXCAVATION						
	TUNNELS - ROCK						
	MAIN TUNNEL	50,250	CY				3
	TRANSFORMER GALLERY TUNNEL	17,750	CY				3
	GROUTING GALLERY TUNNEL	1,900	CY				3
	SURGE CHAMBER ACCESS TUN	7,250	CY				3
	PENSTOCK ACCESS TUNNEL	61,500	CY				3
	PENSTOCK ELBOW ACCESS TUN	15,000	CY				3
	ACCESS SHAFT TUNNEL	1,300	CY				3/4
	CONNECTOR TUNNEL	1,900	CY				3
	PORTALS						
	OVERBURDEN	6,000	CY				4
	ROCK	3,000	CY				
.123	SURFACE PREPARATION						
	TUNNELS						
	MAIN TUNNEL SLAB	53,100	SF				3
	PENSTOCK TUNNEL SLAB	65,200	SF				3
	MAIN PORTAL						
	HORIZONTAL	200	SF				3
	INCLINED	2,100	SF				3/4
.124	CONCRETE & SHOTCRETE						
	MAIN PORTAL						
	CONCRETE SLAB	30	CY				3
	CONCRETE WALLS	570	CY				3
	CONC OVERBREAK 12'H/9"V	50	CY				3
	REINFORCING STEEL	40	TON				3
	TUNNELS						
	CONC SLAB MAIN TUNNEL	1,950	CY				3

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ITEM	DESCRIPTION	QUANTITY	UNITS	UNIT PRICE $	AMOUNT $ 000	TOTAL $ 000	REMARKS
	CONC OVERBREAK MAIN TUN 6'	1,000	CY				3
	CONC PLUGS PENS ELBOW ACC	15,000	CY				3/4
	REINFORCING STEEL	70	TON				3/4
	MAIN TUNNEL 2' SHOTCRETE	20,100	SF				3
	TRANSF GAL 2' SHOTCRETE	7,100	SF				3
	SURGE CHAM ACC 2' SHOTCRETE	3,900	SF				3
	PENSTOCK ACC 2' SHOTCRETE	24,700	SF				3
	PENS ELBOW ACC 2' SHOTCRETE	7,100	SF				3
	ACCESS SHAFT 2' SHOTCRETE	300	SF				3
	GROUTING GAL 2' SHOTCRETE	800	SF				3/4
	CONNECTOR TUN 2' SHOTCRETE	800	SF				3/4
.125	SUPPORT & ANCHORS						
	MAIN TUNNEL						
	ROCKBOLTS 1' @ 12'	1,200	EACH				3
	ROCKBOLTS 1' @ 9'	250	EACH				3
	STEEL SUPPORT	66	TON				3
	STEEL MESH	83,000	SF				3
	MAIN TUNNEL PORTAL						
	ROCKBOLTS 1' @ 15'	50	EACH				3
	TRANSFORMER GALLERY TUNNEL						
	ROCKBOLTS 1' @ 12'	410	EACH				3
	ROCKBOLTS 1' @ 9'	70	EACH				3
	STEEL SUPPORT	24	TON				3/4
	STEEL MESH	22,500	SF				3
	GROUTING GALLERY TUNNEL						
	ROCKBOLTS 3/4' @ 6'	160	EACH				3
	STEEL SUPPORT	2	TON				3
	STEEL MESH	160	SF				3/4
	SURGE CHAMBER TUNNEL						
	ROCKBOLTS 1' @ 12'	230	EACH				3
	ROCKBOLTS 1' @ 9'	50	EACH				3
	STEEL SUPPORT	14	TON				3
	STEEL MESH	12,050	SF				3
	PENSTOCK ACCESS TUNNEL						
	ROCKBOLTS 1' @ 12'	1,430	EACH				3
	ROCKBOLTS 1' @ 9'	240	EACH				3
	STEEL SUPPORT	58	TON				3
	STEEL MESH	77,500	SF				3
	PENSTOCK ELBOW ACCESS TUN						
	ROCKBOLTS 1' @ 12'	420	EACH				3
	ROCKBOLTS 1' @ 9'	120	EACH				3
	STEEL SUPPORT	30	TON				3
	STEEL MESH	22,500	SF				3
	ACCESS SHAFT TUNNEL						
	ROCKBOLTS 1' @ 12'	20	EACH				3
	ROCKBOLTS 1' @ 9'	20	EACH				3

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ITEM	DESCRIPTION	QUANTITY	UNITS	UNIT PRICE $	AMOUNT $ 000	TOTAL $ 000	REMARKS
	STEEL SUPPORT	8	TON				3
	STEEL MESH	930	SF				3
	CONNECTOR TUNNEL						
	ROCKBOLTS 1" @ 9'	160	EACH				3
	STEEL SUPPORT	2	TON				3
	STEEL MESH	160	SF				3/4
.129	ARCHITECTURAL						
	PORTAL DOORS (2 SETS)	2	EACH				
.12C	MECHANICAL						
	VENTILATING SYSTEM (INCL IN 335.16)						
.13	ACCESS SHAFT						
.131	EXCAVATION						
	ROCK	13,700	CY				3/4
.133	SURFACE PREPARATION						
	SHAFT	64,000	SF				3
.134	CONCRETE & SHOTCRETE						
	CONCRETE LINING	3,350	CY				3
	CONCRETE OVERBREAK 6"	1,220	CY				3
.135	SUPPORT & ANCHORS						
	ROCKBOLTS 3/4" @ 6'	1,050	EACH				3
.138	STRUCTURAL - MISC STEELWORK						
	MISC STEELWORK	50	TON				3
.139	ARCHITECTURAL						
	CONTROL BUILDING (INC IN 331.2 CONT BLDG)						
.13C	MECHANICAL						
	ELEVATORS	1	LS				
.14	FIRE PROTECTION HEADTANK						
.141	EXCAVATION						
	ROCK	1,150	CY				3
.143	SURFACE PREPARATION						
	HEADTANK	2,800	SF				3
.144	CONCRETE & SHOTCRETE						
	CONCRETE	250	CY				3
	CONC OVERBREAK 6"	45	CY				3
	REINFORCING STEEL	10	TON				3
.145	SUPPORT & ANCHORS						
	ROCKBOLTS 1" @ 12'	25	EACH				3/4
	ROCKBOLTS 1" @ 9'	10	EACH				3/4
	STEEL MESH	1,200	SF				3
	STEEL SUPPORT	2	TON				3
.148	STRUCTURAL - MISC STEELWORK						
	MISC STEELWORK	5	TON				3
.14C	MECHANICAL						
	PIPING & VALVES-SEE 335.12						

ITEM	DESCRIPTION	QUANTITY	UNITS	UNIT PRICE $	AMOUNT $ 000	TOTAL $·000	REMARKS
.15	BUS TUNNELS						
.151	EXCAVATION						
	ROCK HORIZONTAL	2,700	CY				3
	ROCK INCLINED	1,300	CY				3
.153	SURFACE PREPARATION						
	TUNNELS	7,100	SF				3/4
.154	CONCRETE & SHOTCRETE						
	CONCRETE SLAB	350	CY				3/4
	2" SHOTCRETE	2,200	SF				3/4
	CONCRETE OVERBREAK 12"	250	CY				3/4
	REINFORCING STEEL	18	TON				3/4
.155	SUPPORT & ANCHORS						
	ROCKBOLTS 1" @ 25'	60	EACH				3
	ROCKBOLTS 1" @ 12'	140	EACH				3/4
	ROCKBOLTS 1" @ 9'	50	EACH				3/4
	STEEL MESH	8,800	SF				3/4
	STEEL SUPPORT	11	TON				3
.16	TRANSFORMER GALLERY						
.161	EXCAVATION						
	ROCK	30,250	CY				3
.163	SURFACE PREPARATION						
	TRANSFORMER GALLERY	19,700	SF				3/4
.164	CONCRETE & SHOTCRETE						
	CONCRETE BASE SLAB	2,600	CY				3/4
	REINFORCING STEEL	145	TON				3
	CONC OVERBREAK 12"W/6"V	700	CY				3
.165	SUPPORT & ANCHORS						
	ROCKBOLTS 1" @ 25' HY	570	EACH				3
	ROCKBOLTS 1" @ 15'	260	EACH				3
	STEEL MESH	19,800	SF				3
	STEEL SUPPORT	28	TON				3
.167	DRAINAGE						
	HOLES (IN GALLERY CROWN)	8,300	LF				3
.17	CABLE SHAFTS						
.171	EXCAVATION						
	ROCK	3,400	CY				3
.173	SURFACE PREPARATION						
	SHAFTS	41,400	SF				3/4
.174	CONCRETE & SHOTCRETE						
	CONCRETE LINING	1,040	CY				3/4
	CONCRETE OVERBREAK 6"	800	CY				3/4
.175	SUPPORT & ANCHORS						
	ROCKBOLTS 3/4" @ 6'	650	EACH				3/4
.178	STRUCTURAL - MISC STEELWORK						
	MISC STEELWORK	18	TON				3

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				$	$ 000	$ 000	
	.179. ARCHITECTURAL ENCLOSURES	1	LS				3
	.17C. MECHANICAL MANHOIST	2	EACH				3
	.18 DEWATERING (DURING CONSTRUCT)						
	.181 DEWATERING (POWER FACE) DEWATERING	1	LS				
	.19 INSTRUMENTATION						
	.191. INSTRUMENTATION INSTRUMENTATION	1	LS				
	.2 MISC. BUILDINGS & STRUCTURES CONTROL BUILDING	1	LS				
	.3 PERMANENT VILLAGE (INCLUDED IN 63.5)						
332	RESERVOIR, DAMS & WATERWAYS						
	.1 RESERVOIR						
	.11 CLEARING CLEARING	37,500	ACRE				3
	.2 DIVERSION TUNNELS/COFFERDAMS						
	.21 DIVERSION TUNNELS/PORTALS - (INCL COMBINED TAILRACE/DIVERSION TUNNEL & PORTAL - SEE 332.9)						
	.211 EXCAVATION						
	UPPER TUNNEL						
	ROCK	221,000	CY				3
	LOWER TUNNEL						
	ROCK	208,000	CY				3
	EXC CONC FOR PLUG	700	CY				3
	UPSTREAM UPPER PORTAL						
	ROCK USEABLE (FACE ONLY)	11,200	CY				3
	UPSTREAM LOWER PORTAL (INCL MOST EXC FOR UPPER PORTAL)						
	ROCK USEABLE	96,300	CY				3
	ROCK WASTE	21,200	CY				3
	DOWNSTREAM PORTALS						
	OVERBURDEN-DRY	17,000	CY				3/4
	ROCK USEABLE	120,000	CY				3/4
	ROCK WASTE	28,000	CY				3/4
	EMERGENCY RELEASE CHAMBERS						
	EXC CONC FOR PLUGS	1,800	CY				3
	GATE CHAMBER	4,700	CY				3/4
	ACCESS TUN TO GATE CHAMBER						
	ROCK	19,100	CY				3

ITEM	DESCRIPTION	QUANTITY	UNITS	UNIT PRICE $	AMOUNT $ 000	TOTAL $ 000	REMARKS
.212	FILL						
	TEMPORARY COFFERAM TO CONSTRUCT UPSTREAM PORTALS	23,000	CY				3
.213	SURFACE PREP/GROUTING						
	UPSTREAM UPPER PORTAL						
	HORIZONTAL	3,200	SF				3
	INCLINED	8,600	SF				3
	UPSTREAM LOWER PORTAL						
	HORIZONTAL	1,300	SF				3
	INCLINED	14,900	SF				3
	DOWNSTREAM UPPER PORTAL						
	HORIZONTAL	6,100	SF				3
	INCLINED	20,500	SF				3
	DOWNSTREAM LOWER PORTAL						
	HORIZONTAL	600	SF				3
	INCLINED	5,600	SF				3
	GROUT UPPER TUNNEL PLUGS						
	DRILL HOLES	4,100	LF				3
	CEMENT	820	CF				3
	GROUT LOWER TUN PERM PLUG						
	DRILL HOLES	2,050	LF				3
	CEMENT	410	CF				3
.214	CONCRETE & SHOTCRETE						
	UPPER TUNNEL						
	CONCRETE LINING	42,400	CY				3
	CONC LINING OVERBREAK 6"	10,200	CY				3
	2" SHOTCRETE	56,000	SF				3
	REINFORCING STEEL	24	TON				3
	LOWER TUNNEL						
	CONCRETE LINING	37,600	CY				3
	CONC LINING OVERBREAK 6"	10,000	CY				3
	2" SHOTCRETE	57,900	SF				3
	CONCRETE FOR PLUG	6,200	CY				3
	REINFORCING STEEL	24	TON				3/4
	UPSTREAM UPPER PORTAL						
	CONCRETE HEADWALL	3,200	CY				3
	CONCRETE LINING	1,300	CY				3
	CONCRETE SLAB	750	CY				3/4
	CONCRETE PIERS	800	CY				3
	CONCRETE OVERBREAK 12"H/8"V	300	CY				3
	REINFORCING STEEL	400	TON				3/4
	UPSTREAM LOWER PORTAL						
	CONCRETE HEADWALL	4,500	CY				3
	CONCRETE LINING	3,000	CY				3/4
	CONCRETE SLAB	300	CY				3
	CONCRETE PIERS	700	CY				3

ITEM	DESCRIPTION	QUANTITY	UNITS	UNIT PRICE $	AMOUNT $ 000	TOTAL $ 000	REMARKS
	CONCRETE OVERBREAK 12'H/6'V	350	CY				3
	REINFORCING STEEL	600	TON				3/4
	DOWNSTREAM UPPER PORTAL						
	CONCRETE HEADWALL	500	CY				3
	CONCRETE SLAB	100	CY				3
	CONCRETE OVERBREAK 12'H/6'V	100	CY				3
	REINFORCING STEEL	40	TON				3
	DOWNSTREAM LOWER PORTAL						
	CONCRETE HEADWALL	2,500	CY				3
	CONCRETE SLAB	100	CY				3
	CONCRETE OVERBREAK 12'H/6'V	150	CY				3
	REINFORCING STEEL	170	TON				3
	DOWNSTREAM FLIP BUCKET						
	CONCRETE SLAB	800	CY				3
	CONCRETE WALLS	2,300	CY				3
	CONCRETE INVERT	1,200	CY				3
	CONCRETE OVERBREAK 12'H/6'V	410	CY				3/4
	REINFORCING STEEL	280	TON				3
	DOWNSTREAM RETAINING WALL						
	CONCRETE SLAB	200	CY				3
	CONCRETE WALLS	2,000	CY				3
	CONCRETE OVERBREAK 12'H/6'V	110	CY				3
	REINFORCING STEEL	90	TON				3
	EMERGENCY RELEASE CHAMBERS						
	CONCRETE PLUG	15,300	CY				3
	4" SHOTCRETE	2,790	SF				3
	ACCESS TUNNEL TO GATE CHAMB						
	2" SHOTCRETE	12,800	SF				3
.215	SUPPORT & ANCHORS						
	LOWER TUNNEL						
	ROCKBOLTS 1" @ 12'	3,650	EACH				3/4
	ROCKBOLTS 1" @ 9'	620	EACH				3
	STEEL MESH	217,100	SF				3
	STEEL SUPPORT	220	TON				3
	UPPER TUNNEL						
	ROCKBOLTS 1" @ 12'	3,530	EACH				3/4
	ROCKBOLTS 1" @ 9'	600	EACH				3/4
	STEEL MESH	210,200	SF				3
	STEEL SUPPORT	213	TON				3
	UPSTREAM LOWER PORTAL						
	ROCKBOLTS 1" @ 15'	240	EACH				3/4
	ANCHORS 1" @ 25'	1,600	EACH				3
	UPSTREAM UPPER PORTAL						
	ROCKBOLTS 1" @ 15' (INCL IN LOWER PORTAL)						
	ANCHORS 1" @ 25'	700	EACH				3

ITEM	DESCRIPTION	QUANTITY	UNITS	UNIT PRICE	AMOUNT	TOTAL	REMARKS
				$	$ 000	$ 000	
	DOWNSTREAM LOWER PORTAL						
	ROCKBOLTS 1" @ 15'	200	EACH				3
	DOWNSTREAM UPPER PORTAL						
	ROCKBOLTS 1" @ 15'	100	EACH				3
	RETAINING WALL -						
	ANCHORS - 1" @ 25'	100	EACH				3
	EMERGENCY RELEASE CHAMBERS						
	ROCKBOLTS 1" @ 25' HY	100	EACH				3
	ROCKBOLTS 1" @ 15' HY	125	EACH				3
	STEEL MESH	3,600	SF				3
	STEEL SUPPORT	14	TON				3
	METAL ROOF ANCH. 3/4" @ 6'	20	EACH				3
	ACCESS TUN TO GATE CHAMBER						
	ROCKBOLTS 1" @ 12'	775	EACH				3
	ROCKBOLTS 1" @ 9'	240	EACH				3
	STEEL SUPPORT	55	TON				3
	STEEL MESH	39,900	SF				3/4
.218	STRUCTURAL - MISC STEELWORK						
	SUSPENDED METAL ROOF						
	EMERGENCY RELEASE CHAMBERS	2,775	SF				3
.21C	MECHANICAL						
	UPSTREAM LOWER GATES						
	GATE EQUIPMENT	2	EACH				3
	UPSTREAM UPPER GATES						
	GATE EQUIPMENT	2	EACH				3
	TRASHRACKS	1	LS				3
	DOWNSTREAM LOWER OUTLET						
	STOPLOG GUIDES	1	LS				3
	STOPLOGS INC FOLLOWER	1	LS				3
	DOWNSTREAM UPPER OUTLET						
	STOPLOG GUIDES	1	LS				3
	LOW LEVEL RELEASE						
	SLIDE GATES INC STL LINER	9	EACH				3
.22	UPSTREAM COFFERDAM						
.221	EXCAVATION						
	OVERBURDEN REMOVAL	1,000	CY				3
.222	FILL						
	ROCK FILL	38,400	CY				3
	FINE FILTER	16,600	CY				3
	COARSE FILTER	15,900	CY				3
	ROCK SHELL	196,500	CY				3
	CLOSURE DIKE	58,500	CY				3
	RIP RAP	21,200	CY				3
.223	CUTOFF						
	SLURRY WALL						
	EXCAVATION	4,850	CY				4

ITEM	DESCRIPTION	QUANTITY	UNITS	UNIT PRICE $	AMOUNT $ 000	TOTAL $ 000	REMARKS
	SLURRY WALL	43,600	SF				3
.22D	DEWATERING						
	INITIAL DEWATERING	1	LS				4
	MAINTENANCE	1	LS				4
.23	DOWNSTREAM COFFERDAM						
.231	EXCAVATION						
	OVERBURDEN	5,000	CY				3
	ROCK	500	CY				3
	REMOVAL OF COFFERDAM	14,500	CY				3
.232	FILL						
	RIP RAP	1,800	CY				3
	CLOSURE DIKE	15,200	CY				3
.233	CUTOFF						
	SLURRY WALL						
	EXCAVATION	1,830	CY				4
	SLURRY WALL	16,500	SF				3
.3	MAIN DAM						
.31	MAIN DAM						
.311	EXCAVATION						
	OVRBRDN - ABOVE EL 1470	2,026,000	CY				2
	OVRBRDN-ALLUV-BELOW 1470	5,320,000	CY				2/3
	ROCK USEABLE - ABOVE 1470	1,289,000	CY				2/4
	ROCK WASTE - ABOVE 1470	1,950,000	CY				2/4
	ROCK USEABLE - BELOW 1470	478,000	CY				2/4
	ROCK WASTE - BELOW 1470	869,500	CY				4
.312	FILL						
	RIP RAP (UPSTREAM)	1,542,000	CY				2/3
	GRAVEL (UPSTREAM)	25,194,000	CY				2/3
	COARSE FILTER (UPSTREAM)	1,646,000	CY				2/3
	FINE FILTER (UPSTREAM)	2,011,000	CY				2/3
	CORE (IMPERVIOUS)	8,254,000	CY				2/3
	FINE FILTER (DOWNSTREAM)	2,253,000	CY				2/3
	COARSE FILTER (DOWNSTREAM)	1,910,000	CY				2/3
	SHELL - ROCK & GRAVEL (D/S)	11,342,000	CY				2/3/4
	SHELL-ROCK FR OTHER SOURCES	5,418,000	CY				4
	COBBLES (DOWNSTREAM FACE)	2,003,000	CY				2
	ROAD BASE	12,000	CY				2
	FROST PROTECTION						
	PROCESS PROTECTION	960,000	CY				2/4
	PLACE PROTECTION	960,000	CY				4
	REMOVE 1' PROTECT & WASTE	93,000	CY				2
	SCARIFY CORE SURFACE	193	ACRE				2/3
	FILTER FABRIC						
	FILTER FABRIC	740,000	SF				4
.313	SURFACE PREP/GROUTING						
	SURFACE PREPARATION						

ITEM	DESCRIPTION	QUANTITY	UNITS	UNIT PRICE $	AMOUNT $ 000	TOTAL $ 000	REMARKS
	UNDER CORE/FILTERS						
	ABOVE EL 1500	1,675,000	SF				2/4
	BELOW EL 1500	613,000	SF				4
	UNDER SHELL						
	ABOVE EL 1500	3,186,000	SF				2/4
	BELOW EL 1500	2,584,000	SF				4
	CONSOLIDATION GROUT						
	DRILL HOLES	687,000	LF				2
	CEMENT	687,000	CF				2
	GROUT CURTAIN						
	DRILL HOLES	465,000	LF				2
	CEMENT	186,000	CF				2
	DENTAL CONCRETE						
	DENTAL CONCRETE	85,000	CY				2
.317	DRAINAGE						
	HOLES	136,000	LF				2
.32	GROUT GALLERIES/PORTALS						
.321	EXCAVATION						
	TUNNELS/SHAFTS - CORE AREA						
	ROCK HORIZONTAL	10,100	CY				2
	ROCK INCLINED	11,300	CY				2
	ROCK VERTICAL	2,000	CY				2
	TUNNELS/SHAFTS - ACCESS						
	ROCK HORIZONTAL	13,000	CY				3
	ROCK INCLINED	2,000	CY				3
	PORTALS						
	OVERBURDEN	3,600	CY				3
	ROCK	1,000	CY				3
.323	SURFACE PREPARATION						
	PORTALS						
	HORIZONTAL	30	SF				3
	INCLINED	200	SF				3
.324	CONCRETE & SHOTCRETE						
	TUNNELS - CORE AREA						
	CONCRETE PLUGS	1,000	CY				2
	CONCRETE SLAB	2,300	CY				2
	REINFORCING STEEL	80	TON				2/3
	CONCRETE OVERBREAK 6"	1,150	CY				3/4
	2" SHOTCRETE	15,000	SF				2/3
	TUNNELS - ACCESS						
	CONCRETE SLAB	1,600	CY				3
	REINFORCING STEEL	60	TON				3
	CONCRETE OVERBREAK 6"	800	CY				3
	2" SHOTCRETE	54,000	SF				3/4
	SHAFTS - CORE AREA						
	2" SHOTCRETE	5,000	SF				2/3

ITEM	DESCRIPTION	QUANTITY	UNITS	UNIT PRICE $	AMOUNT $ 000	TOTAL $ 000	REMARKS
	PORTALS (2 PORTALS)						
	CONCRETE	20	CY				3
	REINFORCING STEEL	2	TON				3
.325	SUPPORT & ANCHORS						
	TUNNELS - CORE AREA						
	ROCKBOLTS 3/4" @ 6'	1,800	EACH				2/3
	STEEL SUPPORT	20	TON				2/3
	STEEL MESH	3,000	SF				3
	TUNNELS - ACCESS						
	ROCKBOLTS 3/4" @ 6'	1,200	EACH				3
	STEEL SUPPORT	20	TON				3
	STEEL MESH	1,100	SF				3/4
	SHAFTS - CORE AREA						
	ROCKBOLTS 3/4" @ 6'	330	EACH				2/3
	STEEL MESH	1,000	SF				4
	PORTALS						
	ROCKBOLTS 1" @ 15'	30	EACH				3
.329	ARCHITECTURAL						
	PORTAL DOORS	2	EACH				3
.32D	MECHANICAL						
	DEWATERING	1	LS				
	VENT. SYS. (INC W/331,12C)						
.33	INSTRUMENTATION						
.331	INSTRUMENTATION (POWER FACS)						
	INSTRUMENTATION	1	LS				
.4	RELICT CHANNEL						
.41	SHORE PROTECTION						
.411	EXCAVATION						
	OVERBURDEN STRIPPING-2' THK	2,200	CY				3
.412	FILL						
	DUMP & SPREAD						
	FILTER MAT'L - 2' LAYER	2,200	CY				3
	ROCK SPALLS/RIP RAP-3' AVE	3,300	CY				3
	SHORE PROTECTION						
	RIP RAP	24,000	CY				
	WASTE ROCK	24,000	CY				
.44	CHANNEL FILTER BLANKET						
.442	FILL						
	COARSE FILTER	2,900,000	CY				3
	FINE FILTER	2,180,000	CY				3
	RIP RAP	182,000	CY				3
.443	SURFACE PREPARATION						
	FOUNDATION PREP						
	CLEARING & GRUBBING	460	ACRE				3/4
	EXCAVATION	2,236,000	CY				3/4

ITEM	DESCRIPTION	QUANTITY	UNITS	UNIT PRICE	AMOUNT	TOTAL	REMARKS
				$	$ 000	$ 000	
.5	TUNNEL SPILLWAY						
.51	TUNNEL SPILLWAY - (INTAKE CIVIL WORK INCL IN POWER INTAKE - SEE 332.6; OUTLET CIVIL WORK INCL IN 332.51)						
.511	EXCAVATION						
	INLET (SEE 332.611)						
	OUTLET (SEE 332.521)						
	TUNNELS						
	ROCK HORIZONTAL	83,000	CY				3
	ROCK INCLINED	9,000	CY				3
.513	SURFACE PREP/GROUTING						
	SURFACE PREPARATION						
	INLET (SEE 332.613)						
	OUTLET (SEE 332.523)						
	TUNNELS	323,500	SF				3
.514	CONCRETE & SHOTCRETE						
	INLET (SEE 332.614)						
	OUTLET (SEE 332.524)						
	TUNNELS						
	CONCRETE LINING	27,200	CY				3
	CONCRETE OVERBREAK 6"	6,200	CY				3
	2" SHOTCRETE	12,000	SF				3
	3" SHOTCRETE	19,400	SF				3/4
.515	SUPPORT & ANCHORS						
	INLET (SEE 332.615)						
	OUTLET (SEE 332.525)						
	TUNNELS						
	ROCKBOLTS 1" @ 8'	2,400	EACH				3/4
	STEEL MESH	94,500	SF				3
.51C	MECHANICAL						
	INLET						
	TRASH RACKS/GUIDES	1	LS				3
	GATE EQUIPMENT	2	EACH				3
	STOPLOG GUIDES	2	SETS				3
	OUTLET						
	FIXED CONE VALVES-6+1SPARE	1	LS				3
	RING FOLLOWER GATES	6	EACH				3
	STEEL MANIFOLD LINER	1,950	TON				3/4
	MISC MECH EQUIPMENT	1	LS				3
	MISC ELEC SYSTEMS	1	LS				4
.52	MAIN (CHUTE) SPILLWAY (INCL CIVIL WORKS FOR TUNNEL SPILLWAY OUTLET - SEE 332.51)						
.521	EXCAVATION						
	APPROACH						

ITEM	DESCRIPTION	QUANTITY	UNITS	UNIT PRICE	AMOUNT	TOTAL	REMARKS
				$	$ 000	$ 000	
	OVERBURDEN	64,000	CY				3
	ROCK USEABLE	318,500	CY				3
	ROCK WASTE	64,000	CY				3
	CONTROL STRUCTURE (TO END OF ROLLWAY)						
	OVERBURDEN	8,500	CY				2/3
	ROCK WASTE	18,500	CY				2/3
	ROCK USEABLE (INCLINED)	37,500	CY				2/3
	ROCK USEABLE (VERTICAL)	76,500	CY				2/3
	UPPER CHUTE (END ROLLWAY TO STA 11+00)						
	OVERBURDEN	104,500	CY				2/3
	ROCK WASTE	77,500	CY				2/3
	ROCK USEABLE (INCLINED)	215,000	CY				2/3
	ROCK USEABLE (VERTICAL)	134,000	CY				2/3
	LOWER CHUTE (STATION 11+00 TO 17+00)						
	OVERBURDEN	29,500	CY				2
	ROCK WASTE	43,500	CY				2
	ROCK USEABLE (INCLINED)	107,500	CY				2
	ROCK USEABLE (VERTICAL)	45,000	CY				2
	VALVE BLOCK/FLIP & OUTFALL (FROM STA 17+00 TO END FLIP)						
	OVERBURDEN	52,000	CY				2
	ROCK WASTE	71,000	CY				2/3
	ROCK USEABLE (INCLINED)	316,000	CY				2/3
	ROCK USEABLE (VERTICAL)	58,000	CY				2/3
	DRAIN TUNNEL						
	ROCK HORIZONTAL	4,500	CY				2/3
	ROCK INCLINED	3,000	CY				2
	RIVER CHANNEL						
	ALLUVIUM EXCAVATION	1,060,000	CY				3/4
.522	FILL						
	GRANULAR BACKFILL	5,000	CY				2
	IMPERVIOUS	1,000	CY				2
.523	SURFACE PREP/GROUTING						
	FOUNDATION PREP						
	SPILLWAY						
	ROCK HORIZONTAL	240,000	SF				2
	ROCK INCLINED	166,000	SF				2/4
	CONSOLIDATION GROUTING						
	DRILL HOLES	54,000	LF				2
	CEMENT	54,000	CF				2
	GROUT CURTAIN (SEE 332.313)						
.524	CONCRETE & SHOTCRETE						
	CONC APPROACH & STRUCTURE						

SUSITNA HYDROELECTRIC PROJECT
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ITEM	DESCRIPTION	QUANTITY	UNITS	UNIT PRICE	AMOUNT	TOTAL	REMARKS
				$	$ 000	$ 000	
	CONCRETE OUTERWALLS	20,500	CY				2
	CONC PIERS (FULL LENGTH)	8,000	CY				2
	CONCRETE DECK	1,600	CY				2/3
	CONCRETE ROLLWAY SLABS	19,500	CY				2
	CONC OVERBREAK 12"H/6"V	1,300	CY				3/4
	REINFORCING STEEL	2,700	TON				3
	CONCRETE CHUTE (INCL BOX DRAIN GALLERIES) (FROM END OF ROLLWAY)						
	CONCRETE SLAB	22,000	CY				2/3
	CONCRETE WALLS	10,500	CY				2/3
	CONC OVERBREAK 18"H/6"V	11,000	CY				2/3/4
	REINFORCING STEEL	1,300	TON				
	CONCRETE VALVE BLOCK/FLIP - & OUTFALL						
	CONCRETE BLOCK/BUCKET	29,500	CY				2/3
	CONCRETE OUTFALL LINING	2,500	CY				2/3
	CONC OVERBREAK 12"H/6"V	2,400	CY				2/3/4
	REINFORCING STEEL	1,300	TON				3
	CONCRETE DRAIN GALLERY						
	CONCRETE SLAB	1,000	CY				2/3
	2" SHOTCRETE DOME	5,000	SF				2/3
	REINFORCING STEEL	30	TON				3
	CONC OVERBREAK 6"	500	CY				3
.525	SUPPORT & ANCHORS						
	DRAINAGE TUNNEL						
	STEEL SUPPORT	7	TON				2
	STEEL MESH	1,000	SF				2/3
	ROCKBOLTS APPROACH						
	1" @ 15'	275	EACH				4
	ROCKBOLTS DRAINAGE GALLERY						
	3/4" @ 6'	576	EACH				2/3
	ROCKBOLTS CHUTE & STRUCTURE						
	1" @ 15'	112	EACH				2
	ROCKBOLTS VALVE BLOCK/BUCKET						
	1" @ 15'	46	EACH				2
	SLAB/WALL ANCHORS						
	1" @ 10'	9,300	EACH				2/3
.527	DRAINAGE						
	DRILL HOLES						
	BOX DRAINS (TO DRAIN TUNNEL)	54,000	LF				2
	3" RELIEF	640	LF				2
.52C	MECHANICAL						
	GATE EQUIPMENT	3	EACH				3
	STOPLOG GUIDES	3	SETS				3
	STOPLOGS INC FOLLOWER	1	SET				3

ITEM	DESCRIPTION	QUANTITY	UNITS	UNIT PRICE $	AMOUNT $ 000	TOTAL $ 000	REMARKS
	MISC ELECTRICAL	1	LS				4
.53	EMERGENCY SPILLWAY						
.531	EXCAVATION (INCLUDING BRIDGE & FUSE PLUG)						
	OVERBURDEN	4,440,000	CY				2/4
	ROCK USEABLE	2,893,000	CY				2/4
	ROCK WASTE	543,000	CY				2/4
.532	FILL						
	FUSE PLUG	29,400	CY				2/3/4
.533	SURFACE PREP/GROUTING						
	SURFACE PREP (UNDER - FUSE PLUG)						
	INCLINED	5,200	SF				2/4
	HORIZONTAL	46,100	SF				2/3/4
	CONSOLIDATION GROUTING						
	DRILL HOLES	15,400	LF				2/4
	CEMENT	15,400	CF				2/4
.535	SUPPORT & ANCHORS						
	ROCKBOLTS * @ 15'	730	EACH				2/4
.53R	BRIDGE						
	BRIDGE	1	LS				3
.6	POWER INTAKE (INCL INLET & INLET STRUCTURE CIVIL WORKS FOR TUNNEL SPILLWAY - SEE 332.5)						
.61	INTAKE STRUCTURE						
.611	EXCAVATION						
	OVERBURDEN	524,000	CY				3
	ROCK USEABLE	1,306,000	CY				3
	ROCK WASTE	138,000	CY				3
.613	SURFACE PREPARATION						
	HORIZONTAL	25,600	SF				3/4
	INCLINED	88,300	SF				3/4
.614	CONCRETE & SHOTCRETE STRUCTURE						
	CONCRETE STRUCTURE	121,000	CY				3/4
	REINFORCING STEEL	7,870	TON				3/4
	CONC OVERBREAK 12'H/6'V	2,600	CY				3
.615	SUPPORT & ANCHORS STRUCTURE						
	ROCKBOLTS 1" @ 15'	400	EACH				3
.61C	MECHANICAL						
	TRASH RACKS/GUIDES	6	SETS				3
	GATE EQUIPMENT	6	EACH				3
	BULKHEAD GATE GUIDES	6	SETS				3
	BULKHEAD GATES INC FOLLOWER	1	SET				3
	SHUTTER WITH GUIDES	6	SETS				3

ITEM	DESCRIPTION	QUANTITY	UNITS	UNIT PRICE $	AMOUNT $ 000	TOTAL $ 000	REMARKS
	ICE BULKHEAD WITH HOIST	6	SETS				3
	ICE BULKHEAD GUIDES	6	SETS				3
	INTAKE SERVICE CRANE	1	EACH				3
	BUBBLER SYSTEM	1	LS				3
	MISC ELECTRICAL	1	LS				4
.61D	INTAKE BUILDING						
	INTAKE BUILDING	1	LS				3
.7	SURGE CHAMBER						
.71	SURGE CHAMBER						
.711	EXCAVATION						
	CHAMBER ROCK	101,000	CY				3
	VENT SHAFT ROCK	2,200	CY				3
.713	SURFACE PREPARATION						
	SURFACE PREPARATION	29,700	SF				3/4
.714	CONCRETE & SHOTCRETE						
	CHAMBER						
	CONCRETE	6,000	CY				3
	4" SHOTCRETE	38,400	SF				3
	REINFORCING STEEL	300	TON				3
	CONCRETE OVERBREAK	1,000	CY				3
	VENT SHAFT						
	2" SHOTCRETE	5,900	SF				3
.715	SUPPORT & ANCHORS						
	CHAMBER						
	ROCKBOLTS 1" @ 25'	570	EACH				3
	ROCKBOLTS 1" @ 15'	2,110	EACH				3
	STEEL SUPPORT	66	TON				3
	STEEL MESH	28,900	SF				3
	VENT SHAFT						
	ROCKBOLTS 3/4" @ 6'	370	EACH				3
	STEEL MESH	1,200	SF				3
.717	DRAINAGE						
	HOLES (IN CHAMBER CROWN)	15,500	LF				3/4
.71C	MECHANICAL						
	STOPLOG GUIDES	2	SETS				3
	STOPLOG INC FOLLOWER	1	SET				3
.8	PENSTOCKS						
.81	PENSTOCKS						
.811	EXCAVATION						
	TUNNELS						
	ROCK HORIZONTAL	53,400	CY				3
	ROCK INCLINED	54,000	CY				3
.813	SURFACE PREP/GROUTING						
	SURFACE PREPARATION						
	TUNNELS	378,000	SF				3/4
	CONTACT GROUTING						

ITEM	DESCRIPTION	QUANTITY	UNITS	UNIT PRICE	AMOUNT	TOTAL	REMARKS
				$	$ 000	$ 000	
	CONTACT GROUTING	1	LS				3
	CONSOLIDATION GROUTING						
	CONSOLIDATION GROUTING	1	LS				3
.814	CONCRETE & SHOTCRETE						
	CONCRETE LINER	37,200	CY				3
	REINFORCING STEEL	34	TON				3
	3" SHOTCRETE	34,000	SF				3/4
	2" SHOTCRETE	20,800	SF				3/4
	CONC OVERBREAK 6"	10,600	CY				3/4
.815	SUPPORT & ANCHORS						
	ROCKBOLTS 1" @ 25'	150	EACH				3
	ROCKBOLTS 1" @ 8'	4,200	EACH				3/4
	STEEL MESH	193,000	SF				3/4
.818	STRUCTURAL - MISC STEELWORK						
	STEEL LINER	2,400	TON				3
.9	TAILRACE WORKS (1 PORTAL WITH TUNNEL COMBINED TAILRACE/DIVERSION INCL IN DIVERSION WORKS 332.21)						
.91	TAILRACE TUNNELS/PORTALS						
.911	EXCAVATION						
	TUNNELS						
	ROCK	135,000	CY				3
	PORTALS						
	OVERBURDEN	3,200	CY				3
	ROCK USEABLE	46,000	CY				3
	ROCK WASTE	14,500	CY				3
.913	SURFACE PREPARATION						
	PORTALS						
	HORIZONTAL	600	SF				3
	INCLINED	6,000	SF				3
	TUNNELS						
	TUNNELS	266,000	SF				3/4
.914	CONCRETE & SHOTCRETE						
	TUNNELS						
	CONCRETE LINING	14,500	CY				3
	CONCRETE OVERBREAK 6"	7,500	CY				3
	2" SHOTCRETE	45,600	SF				3/4
	REINFORCING STEEL	22	TON				3
	PORTAL						
	CONCRETE BASE SLAB	100	CY				3
	CONCRETE WALLS	2,900	CY				3
	CONC OVERBREAK 12"H/6"V	110	CY				3
	REINFORCING STEEL	195	TON				3
.915	SUPPORT & ANCHORS						
	TUNNELS						

ITEM	DESCRIPTION	QUANTITY	UNITS	UNIT PRICE $	AMOUNT $ 000	TOTAL $ 000	REMARKS
	ROCKBOLTS 1" @ 12'	2,750	EACH				3/4
	ROCKBOLTS 1" @ 9'	480	EACH				3/4
	STEEL SUPPORT	132	TONS				4
	STEEL MESH	133,000	SF				3/4
	PORTAL						
	ROCKBOLTS 1" @ 15'	110	EACH				3/4
.91C	MECHANICAL						
	STOPLOG GUIDES	1	SET				3
	STOPLOG INC FOLLOWER	1	SET				3
333	WATERWHEELS, TURBINES & GENERATORS						
.1	TURBINES & GOVERNORS						
.11	TURBINES & GOVERNORS						
.111	SUPPLY	6	EACH				3
.112	INSTALL	6	EACH				3
.2	GENERATORS & EXCITERS						
.21	GENERATORS & EXCITERS (SUPPLY & INSTALL)						
.211	GENERATORS & EXCITERS	6	EACH				3
334	ACCESSORY ELECTRICAL EQUIPMENT						
.1	CONNECTION, SUPPORTS & STRUCT.						
.11	STRUCTURES (SUPPLY & INSTALL)						
.12	CONDUCTORS & INSULATORS						
.121	GENERATO ISOLATED PHASE BUS	1	LS				
.122	HV POWER CABLES & ACC	1	LS				
.123	LV POWER CABLES & ACC	1	LS				
.124	CONDUCT CABLES & ACC	1	LS				
.125	GROUNDING SYSTEM	1	LS				
.13	CONDUITS & FITTINGS						
.131	CONDUITS & FITTINGS	1	LS				
.2	SWITCHGEAR & CONTROL EQUIPMENT						
.21	AUXILIARY TRANSFORMERS						
.211	AUXILIARY TRANSFORMERS	4	EACH				3
.22	CIRCUIT BREAKERS GEN						
.221	CIRCUIT BREAKERS GEN	6	EACH				3
.23	SURGE PROT & GEN CUBICLES						
.231	SURGE PROT & GEN CUB	1	LS				
.24	SWITCHBOARDS						
.241	SWITCHBOARDS	1	LS				
.25	AUX. POWER EQPT-INCL BAT						
.251	AUX. POWER EQUIPMENT	1	LS				
.3	CUBICLES & APPURTENENCES						
.31	CONTROL,RELAY & METER. BRDS						
.311	CONTROL,RELAY & METER. BOARD	1	LS				

ITEM	DESCRIPTION	QUANTITY	UNITS	UNIT PRICE	AMOUNT	TOTAL	REMARKS
				$	$ 000	$ 000	
	.32 COMPUTER CONTROL SYSTEM						
	.321 COMPUTER CONTROL SYSTEM						INCL IN TRANS-EMS
	.33 SUPERVIS. & TELEMETER. SYS.						
	.331 SUPERVIS & TELEMETER SYS						INCL IN TRANS-EMS
	.4 POWER TRANSFORMERS						
	.41 POWER TRANSFORMERS						
	.411 POWER TRANSFORMERS	10	EACH				3
	.5 LIGHTING SYSTEM						
	.51 POWERHOUSE & TRANS. GALLERY						
	.511 POWERHOUSE & TRANS. GALLERY	1	LS				
	.52 ACCESS TUNNELS & ROADS						
	.521 ACCESS TUNNELS & ROADS	1	LS				
	.6 MISC. ELECTRICAL EQUIPMENT						
	.61 MISC. ELECTRICAL EQUIPMENT						
	.611 MISC. ELECTRICAL EQUIPMENT	1	LS				
	.7 SURFACE ACCESSORY ELEC EQPMT						
	.71 34.5 KV & LV EQUIPMENT						
	.711 SWITCHBOARD	1	LS				4
	.712 CABLES	1	LS				4
	.713 AUX TRANSFORMERS	1	LS				4
	.73 DIESEL GENERATORS - STANDBY						
	.731 DIESEL GENERATORS - STANDBY	2	EACH				4
	.74 EXTERIOR LIGHTING						
	.741 EXTERIOR LIGHTING	1	LS				
	.75 MIMIC BOARD - CONTROL BLDG						
	.751 MIMIC BOARD - CONTROL BLDG	1	LS				
335	MISCS. POWERPLANT EQUIPMENT						
	.1 AUXILIARY SYSTEMS - UNDERGROUND						
	.11 STATION WATER SYSTEMS						
	.111 STATION WATER SYSTEMS	1	LS				
	.12 FIRE PROTECTION SYSTEMS						
	.121 FIRE PROTECTION SYSTEMS	1	LS				
	.13 COMPRESSED AIR SYSTEMS						
	.131 COMPRESSED AIR SYSTEMS	1	LS				
	.14 OIL HANDLING SYSTEMS						
	.141 OIL HANDLING SYSTEMS	1	LS				
	.15 DRAINAGE & DEWATERING						
	.151 DRAINAGE & DEWATERING	1	LS				
	.16 HEAT., VENT. & COOLING SYS.						
	.161 HEAT., VENT. & COOLING SYS.	1	LS				
	.17 MISCELLANEOUS						
	.171 MISCELLANEOUS	1	LS				
	.2 AUXILLIARY SYS - SURFACE FACS						
	.21 AUX SYS - SURFACE FACS						
	.211 AUX SYS - SURFACE FACS	1	LS				

ITEM	DESCRIPTION	QUANTITY	UNITS	UNIT PRICE	AMOUNT	TOTAL	REMARKS
				$	$ 000	$ 000	
.3	AUXILIARY EQUIPMENT						
.31	POWERHOUSE CRANES						
.311	POWERHOUSE CRANES	2	EACH				3
.32	ELEVATORS						
.321	ELEVATORS	1	LS				
.33	MISC. CRANES & HOIST						
.331	MISC. CRANES & HOIST	1	LS				
.34	MACHINE SHOP EQUIPMENT						
.341	MACHINE SHOP EQUIPMENT	1	LS				
.4	GENERAL STATION EQUIPMENT						
	GENERAL STATION EQUIPMENT	1	LS				
.5	COMMUNICATIONS EQUIPMENT						
	COMMUNICATIONS EQUIPMENT	1	LS				
336	ROADS, RAIL & AIR FACILITIES						
.1	ROADS						
.11	PIONEER ROADS & BRIDGES						
.111	GOLD CREEK-DEVIL CANYON						
	ROAD (12.31 MILES)						
	CLEARING	113	ACRE				3
	WASTE EXCAVATION	324,996	CY				3
	COMMON EXCAVATION	291,163	CY				3
	ROCK EXCAVATION	0	CY				
	BORROW	0	CY				
	18" CULVERTS	3,460	LF				
	36" CULVERTS	1	LS				3
	BRIDGES	0	SF				
	D-1 BASE MATERIAL	66,444	TON				3
	FABRIC	3,192	SY				3
	MAINTENANCE						
	MAINTENANCE	25	MI/YRS				3
.112	DEVIL CANYON-WATANA						
	ROAD (41.25 MILES)						
	CLEARING	369	ACRE				3
	WASTE EXCAVATION	855,321	CY				3
	COMMON EXCAVATION	819,500	CY				
	ROCK EXCAVATION	0	CY				
	BORROW	0	CY				
	18" CULVERTS	9,200	LF				
	36" CULVERTS	1	LS				3
	BRIDGES	0	SF				
	D-1 BASE MATERIAL	222,640	TON				3
	FABRIC	14,946	SY				3
	MAINTENANCE						
	MAINTENANCE	83	MI/YRS				3

ITEM	DESCRIPTION	QUANTITY	UNITS	UNIT PRICE $	AMOUNT $ 000	TOTAL $ 000	REMARKS
.113	DEVIL CANYON LOW LEVEL CROSS-CROSSING (7.88 MILES)						
	CLEARING	170	ACRE				3
	WASTE EXCAVATION	498,845	CY				3
	COMMON EXCAVATION	549,417	CY				3
	ROCK EXCAVATION	749,641	CY				3
	BORROW	0	CY				
	18" CULVERTS	5,100	LF				3
	36" + CULVERTS	1	LS				
	BRIDGE	1	LS				
	D-1 BASE MATERIAL	36,966	TON				3
	FABRIC	0	SY				
	MAINTENANCE						
	MAINTENANCE	118	MI/YRS				
.12	PERMANENT ROADS & BRIDGES						
.121	PARKS HWY-GOLD CREEK R & M SEGMENT B-1 13.26 MILE						
	CLEARING	210	ACRE				
	WASTE EXCAVATION	575,480	CY				
	COMMON EXCAVATION	570,180	CY				
	ROCK EXCAVATION	35,850	CY				
	BORROW	126,800	CY				
	NFS SUBBASE MATERIAL	138,500	CY				
	GRADE "A" BASE MATERIAL	24,480	CY				
	D-1 BASE MATERIAL	31,080	TON				
	A. C. SURFACING	28,462	TON				
	GUARDRAIL	9,800	LF				
	18" CULVERTS	7,055	LF				
	36" + CULVERTS	1	LS				
	FABRIC	18,844	SY				
	THAW PIPES	7,555	LF				
	TOPSOIL & SEED	130	ACRE				
	TRAFFIC CONTROL DEVICES	13.3	MILE				
	BRIDGES	90,440	SF				
	MAINTENANCE						
	MAINTENANCE	13.3	MI/YRS				3
.122	GOLD CREEK -DEVIL CANYON R & M SEGMENT B-2 12.31 MILE						
	MAIN ROAD						
	CLEARING	28	ACRE				3
	WASTE EXCAVATION	97,892	CY				3
	COMMON EXCAVATION	44,772	CY				3
	ROCK EXCAVATION	23,625	CY				
	BORROW	416,311	CY				3
	NFS SUBBASE MATERIAL	126,750	CY				
	GRADE "A" BASE MATERIAL	69,160	CY				

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	D-1 BASE MATERIAL	28,860	TON				
	A. C. SURFACING	26,429	TON				
	GUARDRAIL	6,700	LF				
	18" CULVERTS	4,950	LF				3
	36" + CULVERTS	1	LS				
	FABRIC	5,585	SY				3
	THAW PIPES	8,845	LF				3
	TOPSOIL & SEED	86	ACRE				
	TRAFFIC CONTROL DEVICES	12	MILE				
	BRIDGES	0	SF				
	MAINTENANCE						
	MAINTENANCE	160	MI/YRS				3
.123	DEVIL CANYON - WATANA						
	R & M SEGMENT A-2 41.25 MILE						
	MAIN ROAD						
	CLEARING	207	ACRE				3
	WASTE EXCAVATION	881,179	CY				3
	COMMON EXCAVATION	984,473	CY				3
	ROCK EXCAVATION	146,527	CY				
	BORROW	73,145	CY				3
	NFS SUBBASE MATERIAL	424,710	CY				
	GRADE 'A' BASE MATERIAL	231,739	CY				
	D-1 BASE MATERIAL	96,704	TON				
	A. C. SURFACING	88,557	TON				
	GUARDRAIL	6,050	LF				
	18" CULVERTS	13,840	LF				3
	36" + CULVERTS	1	LS				3
	FABRIC	34,874	SY				3
	THAW PIPES	24,335	LF				
	TOPSOIL & SEED	326	AC				
	TRAFFIC CONTROL DEVICES	41	MILE				3
	BRIDGES	0	SF				
	MAINTENANCE						
	MAINTENANCE	248	MI/YRS				3
.13	SITE ROADS						
.131	CONSTRUCTION ROADS						
	SITE ROADS	20	MILE				4
	MAINTENANCE	141	MI/YRS				4
.132	PERMANENT ROADS						
	PERMANENT ROADS	8	MILE				4
.2	RAIL FACILITIES						
.21	RAILHEAD-GOLD CREEK						
	RAILHEAD						
	CLEARING	25	ACRE				3
	WASTE EXCAVATION	78,000	CY				3
	COMMON EXCAVATION	505,000	CY				3

ITEM	DESCRIPTION	QUANTITY	UNITS	UNIT PRICE $	AMOUNT $ 000	TOTAL $ 000	REMARKS
	GRADE 'A' BASE MATERIAL	4,900	CY				3
	D-1 BASE MATERIAL	2,400	TON				3
	A.C. SURFACING	2,200	TON				3
	TOPSOIL & SEED	15	ACRE				3
	RAILYARD CONTROL DEVICES	1	LS				3
	SUBBALLAST	25,800	CY				3
	TRACKAGE	19,700	LF				3
	DOCK LUMBER	16	MBF				3
	MAINTENANCE						
	MAINTENANCE	15	YEARS				3
.3	AIRSTRIP						
.31	AIRSTRIP						
	PERMANENT AIRSTRIP	.1	LS				
	TEMPORARY AIRSTRIP	1					
	TRANSMISSION PLANT						
350	LAND & LAND RIGHTS						
	LAND & LAND RIGHTS						
	TRANSMISSION	179	MILE				2/3
	SUBSTATIONS (4 SITES)	1	LS				2
352	SUBSTATION & SWITCHING STATION						
	SUBSTATION & SWITCHING STATION						
	STRUCTURES & IMPROVEMENTS						
.1	SWITCHYARD						
.11	SWITCHYARD	1	LS				
353	SUBSTATION/SWITCHING STA EQUIP						
	SUBSTATION/SWITCHING STA EQUIP						
	ESTER	1	LS				
	WILLOW	1	LS				
	KNIK ARM	1	LS				
	UNIVERSITY	1	LS				
	DEVIL CANYON	1	LS				
	WILLOW ENERGY MNGMT SYS (EMS)						
	EQPMT & SYSTEM COSTS	1	LS				
	MICROWAVE COMMUN EQPMT	1	LS				
	EMS CONTROL CENTER BLDG &	1	LS				
	WATANA & DEV CAN (IN-PLANT MONTR & CNTRL EQPMT)	1	LS				

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				$	$ 000	$ 000	
354	STEEL TOWERS & FIXTURES						
	STEEL TOWERS & FIXTURES						
	TOWERS (INCLUDING FOUNDATION & HARDWARE)	2,447	EACH				3
356	OVERHEAD CONDUCTORS & DEVICES						
	OVERHEAD CONDUCTORS & DEVICES						
	CNDCTRS 2 x 954 kcmil/phase	556	MILE				
	SHIELD WIRE (3/8", 2 CIRCUIT)						
	SUBMARINE CABLES (8)	1	LS				
359	ROADS & TRAILS						
	ROADS & TRAILS						
	ROADS & TRAILS	200	MILE				
	CLEARING & ROADS	170	MILE				
	GENERAL PLANT						
389	LAND & LAND RIGHTS						
	LAND & LAND RIGHTS						
	INCLUDED IN 330						
390	STRUCTURES & IMPROVEMENTS						
	STRUCTURES & IMPROVEMENTS						
	INCLUDED IN 331.2						
391	OFFICE FURNITURE/EQUIPMENT						
	OFFICE FURNITURE/EQUIPMENT	B					
392	TRANSPORTATION EQUIPMENT						
	TRANSPORTATION EQUIPMENT	B					
393	STORES EQUIPMENT						
	STORES EQUIPMENT	B					
394	TOOLS SHOP & GARAGE EQUIPMENT						
	TOOLS SHOP & GARAGE EQUIPMENT	B					
395	LABORATORY EQUIPMENT						
	LABORATORY EQUIPMENT	B					

ITEM	DESCRIPTION	QUANTITY	UNITS	UNIT PRICE	AMOUNT	TOTAL	REMARKS
				$	$ 000	$ 000	
396	POWER OPERATED EQUIPMENT						
	POWER OPERATED EQUIPMENT	B					
397	COMMUNICATIONS EQUIPMENT						
	COMMUNICATIONS EQUIPMENT	B					
398	MISCELLANEOUS EQUIPMENT						
	MISCELLANEOUS EQUIPMENT	B					
399	OTHER TANGIBLE PROPERTY						
	OTHER TANGIBLE PROPERTY						
	OTHER TANGIBLE PROPERTY	1	LS				
	INDIRECT COSTS						
61	TEMPORARY CONSTRUCTION FACILITIES						
	TEMPORARY CONSTRUCTION FACILITIES						
	(INCLUDED IN DIRECT COSTS)						
62	CONSTRUCTION EQUIPMENT						
	CONSTRUCTION EQUIPMENT						
	(INCLUDED IN DIRECT COSTS)						
63	MAIN CONSTRUCTION CAMP						
.1	MAIN CONSTRUCTION CAMP						
.11	SITE PREPARATION						
	CLEAR, STRIP & FINE GRADING	163	ACRE				
	INSTALL GRANULAR PAD	885,000	CY				3
	CONSTRUCT ROADWAYS						
	MAIN ROADS IN CAMP [34']	10,200	LF				
	CONNECT. RD. TO ACCESS RD.	1,800	LF				
	DRAINAGE						
	DITCHING	27,000	LF				
	CULVERTS	1,200	LF				
	PERIMETER FENCING						
	PERIMETER FENCING	11,000	LF				
	PARKING AREAS						
	PARKING AREAS-IN CAMP	1	LS				
	PARK.LOT-OUT CAMP(500 CARS)	4	ACRES				
	PLUG-INS	500	EACH				3
.12	BUILDINGS						
	BACHLR DORMS-108 MAN CMPLX	48	EACH				26' X 224'
	BACHELOR DORMS-MGMNT-TYPE A	10	EACH				28' X 120'

ITEM	DESCRIPTION	QUANTITY	UNITS	UNIT PRICE $	AMOUNT $ 000	TOTAL $ 000	REMARKS
	BACHELOR DORMS-MGMNT-TYPE B	14	EACH				24' x 120'
	GUEST HSS-1 EA OWN/MGR/CON	3	EACH				28' x 120'
	CAMP MANAGER'S OFFICES	3	EACH				30' x 40'
	STAFF CLUBHOUSE	1	EACH				50' x 80'
	DINING HALL	1	EACH				120' x 150'
	DINING HALL	1	EACH				120' x 220'
	RECREATION BLDG.	1	EACH				120' x 160'
	RECREATION BLDG.	1	EACH				120' x 200'
	GYMNASIUM	1	EACH				200' x 200'
	SECURITY OFFICE	1	EACH				4 60' x 60'
	SOILS/MATERIALS LAB.	1	EACH				4 50' x 100'
	MAINTENANCE BLDG.	1	EACH				80' x 100'
	WAREHOUSE - MANAGERS	1	EACH				120' x 160'
	WAREHOUSE - FOOD SERVICE	1	EACH				100' x 120'
	COMMUNICATION BLDG.	1	EACH				20' x 30'
	HOSPITAL	1	EACH				140' x 160'
	ICE RINK	1	EACH				140' x 300'
	BANK	1	EACH				50' x 60'
	STORE	1	EACH				30' x 60'
	LAUNDRY	1	EACH				20' x 80'
	SWIMMING POOL	1	EACH				100' x 120'
	PERMAWALK						
	6 FEET WIDE	1,000	LF				
	10 FEET WIDE	3,000	LF				
	16 FEET WIDE	1,300	LF				
.13	UTILITIES						
	WATER						
	SUPPLY SYSTEM						
	INTAKE - 3.4 MG POND	1	LS				
	PUMP STA - 1200 GPM	1	LS				
	BOOSTER PUMP STA - 1200GPM	1	LS				
	SUPPLY LINES						
	PIPES						
	8" DI	10,000	LF				4
	6" DI	10,000	LF				4
	HEAT TRACING AND INSUL						
	8" PIPE	10,000	LF				4
	6" PIPE	10,000	LF				4
	UTILIDOR						
	UTILIDOR	10,000	LF				4
	TREATMENT PLANT - 1.7 MGD	1	LS				
	BACK-UP WELLS	1	LS				
	DISTRIBUTION						
	LINE TO CAMP						
	PIPE						
	8" DI	3,500	LF				

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	6" DI	3,500	LF				
	HEAT TRACING AND INSUL						
	8" PIPE	3,500	LF				
	6" PIPE	3,500	LF				
	UTILIDOR						
	UTILIDOR	3,500	LF				
	RESERVOIRS-1EA 1.7 MG/1.4 MG	1	LS				
	PUMP STATION - 3500GPM	1	LS				
	DISTRIBUTION SYSTEM						
	DISTRIB LINES-BURIED						
	12"	2,700	LF				
	6"	300	LF				
	DISTRIBUT LINE UTLDR						
	12" DIAMETER	3,100	LF				
	8" DIAMETER	4,300	LF				
	4" DIAMETER	960	LF				
	HYDRANTS	15	EACH				3
	HEAT TRACING & INSUL						
	12" PIPE	5,800	LF				
	6" PIPE	4,600	LF				
	4" PIPE	960	LF				
	VALVES						
	VALVES	1	LS				
	UTILIDORS						
	UTILIDORS	8,400	LF				
	SEWAGE						
	COLLECTION SYSTEM						
	4" PIPE	1,900	LF				
	6" PIPE	1,600	LF				
	8" PIPE	3,300	LF				
	12" PIPE	2,300	LF				
	16" PIPE	1,200	LF				
	HEAT TRACING						
	4"	1,900	LF				
	6"	1,600	LF				
	8"	3,300	LF				
	12"	2,300	LF				
	16"	1,200	LF				
	UTILIDORS						
	UTILIDORS	1,200	LF				
	TREATMENT PLANT						
	SKIMMING TANK	1	EACH				
	LAGOONS - 1 @ 385' x 205'	5	EACH				& 4 @ 280' x 155']
	RBC's	9	EACH				
	PHYS/CHEM UNIT	1	EACH				
	CLARIFIER	1	EACH				

ITEM	DESCRIPTION	QUANTITY	UNITS	UNIT PRICE $	AMOUNT $ 000	TOTAL $ 000	REMARKS
	DISINFECTION	1	EACH				
	HEAT PUMP	1	EACH				
	THICKENER	1	EACH				
	FILTER PRESS	1	EACH				
	DRYING BEDS	2	EACH				
	OUTFALL LINE (10")	2,000	LF				
	OUTFALL	1	EACH				
	BUILDING	1	EACH				3
	CONTROLS/INSTRUMENTATION	1	LS				3
	PIPING, VALVES, FITTINGS	1	LS				3
	LABORATORY	1	EACH				3
	ELECTRICAL						
	GENERATING STATIONS						
	BUILDINGS	1	EACH				3
	GENERATORS (850 KW)	3	EACH				3
	DAY TANK	1	EACH				3
	FUEL STORAGE TANK	1	EACH				3
	SUBSTATION	1	EACH				3
	DISTRIBUTION	1	LS				3
	FUEL OIL DISTRIBUTION	1	LS				
	LIGHTING						
	POLE MOUNTED LUMINAIRS	70	EACH				
	FLOOD LIGHTS	25	EACH				
	FIRE PROTECTION						
	FIRE HOUSE	1	LS				40' X 80'
	ALARM SYSTEM	1	LS				
	SPRINKLER SYSTEM						
	MESS HALLS	1	LS				4 DRY TYPE
	REC HALLS	1	LS				4 DRY TYPE
	HOSPITAL	1	LS				4 DRY TYPE
	SCHOOL	1	LS				4 DRY TYPE
	TELEPHONE SYSTEM						
	CAMP (WIRE)	1	LS				
	MICROWAVE	1	LS				
	TV/RADIO STATION						
	TV/RADIO STATION	1	LS				
	SOLID WASTE FACILITY						
	SOLID WASTE FACILITY	1	LS				
	POL						
	GARAGE/MAINTENANCE BLDG	1	EACH				50' x 60'
	TANKS						
	50,000 GAL	4	EACH				
	100,000 GAL	36	EACH				
	EARTHWORK						
	CLEARING & GRUBBING	14	ACRE				
	BERMS	45,000	CY				

ITEM	DESCRIPTION	QUANTITY	UNITS	UNIT PRICE	AMOUNT	TOTAL	REMARKS
				$	$ 000	$ 000	
	PIPING	1	LS				
	FUEL STATION	1	LS				
.2	MAIN CONSTRUCTION VILLAGE						
.21	SITE PREPARATION						
	CLEAR,STRIP & FINE GRADING	130	ACRE				TOTAL A=5,636,000 SF
	INSTALL GRANULAR PAD	835,000	CY				DEPTH 8'
	CONSTRUCT ROADWAYS						
	ROADWAYS IN VILLAGE						
	MAIN ROAD 34' WIDE	2,200	LF				ASPHALT PVMT
	SECONDARY ROADS 24' WIDE	22,000	LF				ASPHALT PVMT
	CONNECTION TO ACC RD 34'	1,600	LF				VIL LMT-MN ACC A/C P
	DRAINAGE						
	DITCHING	51,600	LF				RDWY TOT'S (%) 2
	CULVERTS = 560 LOTS	13,200	LF				@ 20' & 40' XINS
	PERIMETER FENCING						
	PERIMETER FENCING	12,000	LF				
	PARKING AREAS						
	PARKING AREAS	6,000	SF				GRANULAR SURFACE
.22	BUILDINGS						
	SINGLE FAMILY UNIT - 2 BDRM	72	EACH				14' x 60'
	SINGLE FAMILY UNIT - 3 BDRM	200	EACH				14' x 60'
	SINGLE FAMILY UNIT - 2 BDRM	16	EACH				24' x 50'
	SINGLE FAMILY UNIT - 3 BDRM	16	EACH				24' x 50'
	SINGLE FAMILY UNIT - 4 BDRM	16	EACH				28' x 50'
	SCHOOL - 34,000 SF	1	LS				
	GYMNASIUM	1	LS				100' x 100'
	SWIMMING POOL	1	LS				100' x 100'
	RECREATION CENTER	1	LS				80' x 100'
	STORE	1	LS				100' x 160'
	FIRE STATION	1	LS				30' x 40'
	GAS STATION (6 PUMP,3-BAY	1	LS				W/ 2-10,000 GAL TANK
.23	UTILITIES						
	WATER						
	SUPPLY LINE 6"	8,300	FT				TRTMT PLA TO VIL STA
	PUMP STATION	1	LS				@ VILLAGE LIMIT
	WATER STOR TANK - 1.4 MG	1	EACH				
	DISTRIBUTION LINES						
	6" DI	13,200	LF				
	8" DI	1,500	LF				
	10" DI	1,000	LF				
	12" DI	1,300	LF				
	HEAT TRACING AND INSUL						
	6" PIPE	21,500	LF				(INCL SUPPLY RUN
	8" PIPE	1,500	LF				FROM VIL TO TREAT-
	10" PIPE	1,000	LF				MENT PLANT)
	12" PIPE	1,300	LF				

ITEM	DESCRIPTION	QUANTITY	UNITS	UNIT PRICE	AMOUNT	TOTAL	REMARKS
				$	$ 000	$ 000	
	VALVES						
	6"	20	EACH				EST 1 VALVE/2000LF
	8"	2	EACH				OF PIPE MIN.- 2 EA
	10"	2	EACH				FOR EA SIZE PIPE
	12"	2	EACH				
	HYDRANTS						
	[VALVES & STUBS INC - 1 EA	20	EACH				@ APPROX 400']
	SEWERAGE						
	COLLECTION SYSTEM						
	6" PIPE	7,800	LF				
	8" PIPE	6,500	LF				
	10" PIPE	1,100	LF				
	12" PIPE	800	LF				
	14" PIPE	700	LF				
	HEAT TRACING AND INSUL						
	6" PIPE	21,600	LF				[INCL FORCE MAIN
	8" PIPE	6,500	LF				FROM VIL TO MAIN
	10" PIPE	1,100	LF				CAMP WATER TREAT-
	12" PIPE	800	LF				MENT PLANT]
	14" PIPE	700	LF				
	PUMPING SYSTEM						
	PUMP STATION	1	LS				VILLAGE TO MAIN CAMP
	BOOSTER PUMP STATION	1	LS				
	6" FORCE MAIN	13,800	LF				TREATMENT PLANT
	UTILIDORS						
	MAIN RUNS IN VILLAGE	18,900	LF				
	STREET CROSSING 50 LF EA	1,000	LF				
	PUMP STA TO TREATMT PLANT	8,300	LF				
	STUBS TO HSE 560 LOTS @ 20'	11,200	LF				INCL 4" SVC, ETC.
	STUBS TO BLDGS - 10 @ 25'	250	LF				
	INTEGRATED OFC AREA						
	OWNER/HDRS OFFICE	1	EACH				120' x 180'
	ELECTRICAL						
	GENERATING STATIONS						
	BUILDING	1	EACH				INCLUDES DRIVEWAYS
	GENERATORS - 850 KW	4	EACH				
	GENERATORS - 500 KW	2	EACH				
	DAY TANKS	2	EACH				
	FUEL STORAGE TANKS	1	EACH				
	SUBSTATIONS WITH WIRING	1	EACH				
	DISTRIBUTION						
	DISTRIBUTION	1	LS				
	FIRE ALARM SYSTEM						
	FIRE ALARM SYSTEM	1	LS				
	TELEPHONE SYSTEM						
	TELEPHONE SYSTEM	1	LS				

ITEM	DESCRIPTION	QUANTITY	UNITS	UNIT PRICE	AMOUNT	TOTAL	REMARKS
				$	$ 000	$ 000	
.3	ACCESS ROAD CAMPS						
.31	PIONEER ROAD CAMP						
	FACS, CATERING & OPER SPRT	21,100	MANDAY				3
.32	ACCESS ROAD/RAILHEAD CAMP						
	FACS, CATERING & OPER SPRT	70,900	MANDAY				3
.4	CAMP BUILDINGS CREDIT						
	25% OF LUMP SUM COST	1	LS				3
.5	PERMANENT TOWN						
	PERMANENT TOWN	1	LS				
.6	MAIN CONSTR CATERING & SUPPORT						
	CATERING & SUPPORT	5,750,000	MANDAY				
.7	ELECTRIC POWER						
.71	34.5 KV SYSTEM						
.711	TRANSFORMER STATION	1	LS				4
.712	DISTRIBUTION SYSTEM (9 MI)	1	LS				4
.72	CONSTRUCTION CAMP						
.721	DIESEL GENERATION	8,879	MWhr				4
.722	INTERTIE POWER	158,469	MWhr				4
.73	CONSTRUCTION POWER						
.731	DIESEL GENERATION (INCL IN CONSTRUC COSTS)						
.732	INTERTIE POWER	81,000	MWhr				4
.8	CONSTRUCTION HEATING & VENTIL.						
.81	HEAT. & VENTILATION PLANT						
.811	HEAT. & VENT. PLANT	1	LS				4
.82	HV OPERATION						
.821	HV OPERATION	0	DAY				4
64	LABOR EXPENSE						
	LABOR EXPENSE (INCLUDED IN DIRECT COSTS)						
65	SUPERINTENDENCE						
	SUPERINTENDENCE (INCLUDED IN DIRECT COSTS)						
68	INSURANCE						
	INSURANCE						
69	FEES						
	FEES						

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ITEM	DESCRIPTION		QUANTITY	UNITS	UNIT PRICE	AMOUNT	TOTAL	REMARKS
					$	$ 000	$ 000	
	PRODUCTION PLANT							
330	LAND & LAND RIGHTS							
.1	LAND							
	LAND		1	LS				
.2	LAND RIGHTS							
	LAND RIGHTS	A	1	LS				
.3	MISC CHARGES & CREDITS							
	MISC CHARGES & CREDITS	A	1	LS				
331	POWERPLANT STRUCTURE IMPROVEMENTS							
.1	POWERHOUSE							
.11	POWERHOUSE & DRAFT TUBE							
.111	EXCAVATION							
	POWERHOUSE VAULT ROCK		90,000	CY				3
	DRAFT TUBE ROCK		18,800	CY				3
.113	SURFACE PREPARATION/GROUTING							
	POWERHOUSE							
	SURFACE PREPARATION		73,800	SF				3/4
	DRAFT TUBE							
	SURFACE PREPARATION		51,300	SF				3
	GROUT CURTAIN-(U/S OF P-H)							
	DRILL HOLES		43,800	LF				3
	CEMENT		17,520	CF				3
.114	CONCRETE & SHOTCRETE							
	POWERHOUSE							
	CONCRETE		23,800	CY				3/4
	REINFORCING STEEL		1,200	TON				3
	2" SHOTCRETE		1,500	SF				3/4
	3" SHOTCRETE		3,100	SF				3/4
	CONC OVERBREAK 12"H/6"V		1,800	CY				3
	DRAFT TUBE							
	CONCRETE		8,000	CY				3
	REINFORCING STEEL		660	TON				3
	2" SHOTCRETE		800	SF				3
	CONCRETE OVERBREAK 6"		1,650	CY				3
.115	SUPPORT & ANCHORS							
	POWERHOUSE							
	ROCKBOLTS 1" @ 25' HY		700	EACH				3/4
	ROCKBOLTS 1" @ 15'		390	EACH				3/4
	STEEL MESH		28,200	SF				3/4
	STEEL SUPPORT		102	TON				3
	DRAFT TUBE							

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	ROCKBOLTS 1" @ 25' HY	100	EACH				3
	ROCKBOLTS 1" @ 12'	140	EACH				3
	ROCKBOLTS 1" @ 9'	70	EACH				3
	STEEL MESH	12,600	SF				3/4
.117	DRAINAGE						
	HOLES (U/S OF POWERHOUSE)	15,000	LF				3
	HOLES (POWERHOUSE CROWN)	21,960	LF				3
.118	STRUCTURAL - MISC STEELWORK						
	POWERHOUSE & DRAFT TUBE						
	STRUCTURAL STEEL/CRANE RAILS	1	LS				
	STEEL COMP. WATER PIPE(8')	1	LS				3/4
.119	ARCHITECTURAL						
	POWERHOUSE						
	ARCHITECTURAL	1	LS				
.11C	MECHANICAL						
	DRAFT TUBE GATES	2	SETS				3
	DRAFT TUBE GATE GUIDES	4	SETS				3
	DRAFT TUBE CRANE	1	EACH				3
	PUMP INTAKE TRSHRKS & GDS	1	LS				3
	PUMP OUTLET STOPLOGS/GUIDES	1	LS				3
.12	ACCESS TUNNELS & PORTALS						
.121	EXCAVATION						
	TUNNELS - ROCK						
	MAIN TUNNEL	106,000	CY				3
	TRANSFORMER GALLERY TUNNEL	17,000	CY				3
	GROUTING GALLERY TUNNEL	2,300	CY				3
	SURGE CHAMBER ACCESS TUN	7,800	CY				3
	PENSTOCK ACCESS TUNNEL	50,000	CY				3
	PENSTOCK ELBOW ACCESS TUN	10,000	CY				3
	ACCESS SHAFT TUNNEL	3,300	CY				3
	CONNECTOR TUNNEL	1,600	CY				3
	COMP. WATER TUNNEL 10'D	2,200	CY				3
	COMP. WATER TUNNEL 35'D	27,000	CY				3
	MAIN PORTAL						
	ROCK	5,000	CY				3
	COMP. WATER PORTAL						
	ROCK	300	CY				3
.123	SURFACE PREPARATION						
	TUNNELS						
	MAIN TUNNEL SLAB	112,000	SF				3
	COMP. WATER TUN 35'D SLAB	28,400	SF				3
	PENSTOCK ACC TUNNEL SLAB	52,560	SF				3
	MAIN PORTAL						
	HORIZONTAL	200	SF				3
	INCLINED	2,100	SF				3/4
	COMP. WATER PORTAL						

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	HORIZONTAL	200	SF				3
	INCLINED	2,100	SF				3/4
.124	CONCRETE & SHOTCRETE						
	MAIN PORTALS						
	CONCRETE SLAB	30	CY				3
	CONCRETE WALLS	570	CY				3
	CONC OVERBREAK 12'W/6'V	40	CY				3
	REINFORCING STEEL	40	TON				3
	CONP. WATER PORTAL						
	CONCRETE SLAB	30	CY				3
	CONCRETE WALLS	570	CY				3
	CONC OVERBREAK 12'W/6'V	30	CY				3
	REINFORCING STEEL	40	TON				3
	TUNNELS						
	CONC. SLAB MAIN TUNNEL	4,030	CY				3
	CONC OVERBREAK MAIN TUN 6'	2,130	CY				3
	REINFORCING STEEL MAIN TUN	140	TON				4
	CONC PLUGS PENS ELBOW ACC	10,000	CY				3
	CONC. COMP WATER SLAB 35'D	1,030	CY				3
	CONC COMP WATR SLAB 6'D/D	340	CY				3
	COMP WAT SLAB REINF STEEL	40	TON				4
	MAIN TUNNEL 2" SHOTCRETE	7,950	SF				3
	TRANSF GAL 2" SHOTCRETE	1,260	SF				3
	SURGE CHAM ACC 2"SHOTCRETE	800	SF				3
	PENSTOCK ACC 2" SHOTCRETE	3,750	SF				3/4
	PENS ELBOW ACC 2"SHOTCRETE	3,750	SF				3
	ACCESS SHAFT 2"SHOTCRETE	750	SF				3
	GROUTING GAL TUN SHOTCRETE	470	SF				3
	CONNECTOR TUN 2" SHOTCRETE	330	SF				3
	COMP.WATER 35'D 2" SHTCRT	2,050	SF				3/4
	COMP.WATER 10'D 2" SHTCRT	450	SF				3
.125	SUPPORT & ANCHORS						
	MAIN TUNNEL						
	ROCKBOLTS 1" @ 12'	1,440	EACH				3/4
	ROCKBOLTS 1" @ 9'	190	EACH				3
	STEEL SUPPORT	120	TON				3
	STEEL MESH	132,500	SF				3
	MAIN TUNNEL PORTAL						
	ROCKBOLTS 1" @ 15'	50	EACH				3
	TRANSFORMER GALLERY TUNNEL						
	ROCKBOLTS 1" @ 12'	230	EACH				3
	ROCKBOLTS 1" @ 9'	30	EACH				3
	STEEL SUPPORT	20	TON				3
	STEEL MESH	20,940	SF				3
	GROUTING GALLERY TUNNEL						
	ROCKBOLTS 3/4" @ 6'	220	EACH				3

ITEM	DESCRIPTION	QUANTITY	UNITS	UNIT PRICE $	AMOUNT $ 000	TOTAL $ 000	REMARKS
	SUPPORT STEEL	3	TON				3
	STEEL MESH	100	SF				3
	SURGE CHAMBER TUNNEL						
	ROCKBOLTS 1" @ 12'	150	EACH				3
	ROCKBOLTS 1" @ 9'	30	EACH				3
	STEEL SUPPORT	13	TON				3
	STEEL MESH	13,200	SF				3
	PENSTOCK ACCESS TUNNEL						
	ROCKBOLTS 1" @ 12'	680	EACH				3
	ROCKBOLTS 1" @ 9'	90	EACH				3
	STEEL SUPPORT	60	TON				3
	STEEL MESH	62,150	SF				3
	PENSTOCK ELBOW ACC TUN						
	ROCKBOLTS 1" @ 12'	280	EACH				3
	ROCKBOLTS 1" @ 9'	80	EACH				3/4
	STEEL SUPPORT	20	TON				3
	STEEL MESH	14,760	SF				3
	ACCESS SHAFT TUNNEL						
	ROCKBOLTS 1" @ 12'	50	EACH				3
	ROCKBOLTS 1" @ 9'	50	EACH				3
	STEEL SUPPORT	20	TON				3
	STEEL MESH	2,500	SF				3
	CONNECTOR TUNNEL						
	ROCKBOLTS 3/4" @ 6'	160	EACH				3
	STEEL SUPPORT	2	TON				3
	STEEL MESH	70	SF				3
	COMP. WATER TUNNEL 35' D						
	ROCKBOLTS 1" @ 12'	370	EACH				3
	ROCKBOLTS 1" @ 9'	50	EACH				3
	STEEL SUPPORT	30	TON				3
	STEEL MESH	33,600	SF				3
	COMP. WATER TUNNEL PORTAL						
	ROCKBOLTS 1" @ 15'	40	EACH				3
	COMP. WATER TUNNEL 10' D						
	ROCKBOLTS 3/4" @ 6'	210	EACH				3
	STEEL SUPPORT	3	TON				3
	STEEL MESH	90	SF				3
.129	ARCHITECTURAL						
	MAIN PORTAL DOORS (2 SETS)	1	LS				3
	COMP. WATER PORTAL DOOR	1	LS				3
.12C	MECHANICAL						
	VENTILATING SYSTEM (INCL IN 63.61 & 63.62)						
.13	ACCESS SHAFT						
.131	EXCAVATION						
	ROCK	14,500	CY				3

ITEM	DESCRIPTION	QUANTITY	UNITS	UNIT PRICE $	AMOUNT $ 000	TOTAL $ 000	REMARKS
.133	SURFACE PREPARATION						
	SHAFT	70,200	SF				3
.134	CONCRETE & SHOTCRETE						
	CONCRETE LINING	3,600	CY				3
	CONCRETE OVERBREAK 6"	1,300	CY				3
.135	SUPPORT & ANCHORS						
	ROCKBOLTS 3/4" @ 6'	1,120	EACH				3
.138	STRUCTURAL - MISC STEELWORK						
	MISC. STEELWORK	50	TON				3
.139	ARCHITECTURAL						
	(INCL IN 331.2 CONT. BLDG)						3
.13C	MECHANICAL						
	ELEVATORS	1	LS				
.14	FIRE PROTECTION HEADTANK						
.141	EXCAVATION						
	ROCK	1,150	CY				3
.143	SURFACE PREPARATION						
	HEAD TANK	2,800	SF				3
.144	CONCRETE & SHOTCRETE						
	CONCRETE	250	CY				3
	CONC. OVERBREAK 6"	45	CY				3
	REINFORCING STEEL	10	TON				3
.145	SUPPORT & ANCHORS						
	ROCKBOLTS 1" @ 12'	15	EACH				3
	ROCKBOLTS 1" @ 9'	5	EACH				3
	STEEL MESH	1,200	SF				3
	STEEL SUPPORT	2	TON				3
.148	STRUCTURAL - MISC STEELWORK						
	MISC STEELWORK	1	LS				
.14C	MECHANICAL						
	PIPING & VALVES-SEE 335)						3
.15	BUS TUNNELS						
	(TOTALS FOR 4 BUS TUNNELS)						
.151	EXCAVATION						
	ROCK HORIZONTAL	3,600	CY				3/4
	ROCK INCLINED	1,740	CY				3/4
.153	SURFACE PREPARATION						
	TUNNEL	9,450	SF				3/4
.154	CONCRETE & SHOTCRETE						
	CONCRETE SLAB	470	CY				3/4
	2" SHOTCRETE	600	SF				3/4
	CONCRETE OVERBREAK 12"	310	CY				3/4
	REINFORCING STEEL	24	TON				4
.155	SUPPORT & ANCHORS						
	ROCKBOLTS 1" @ 25'	80	EACH				3/4
	ROCKBOLTS 1" @ 12'	110	EACH				3/4

ITEM	DESCRIPTION	QUANTITY	UNITS	UNIT PRICE $	AMOUNT $ 000	TOTAL $ 000	REMARKS
	ROCKBOLTS 1" @ 9'	30	EACH				3/4
	STEEL MESH	9,000	SF				3/4
	STEEL SUPPORT	13	TON				4
.16	TRANSFORMER GALLERY						
.161	EXCAVATION						
	ROCK	22,000	CY				3
.163	SURFACE PREPARATION						
	TRANSFORMER GALLERY	14,850	SF				3
.164	CONCRETE & SHOTCRETE						
	CONCRETE BASE SLAB	9,400	CY				3/4
	REINFORCING STEEL	120	TON				3/4
	3" SHOTCRETE	800	SF				3
	CONC OVERBREAK 12"H/8"V	530	CY				3
.165	SUPPORT & ANCHORS						
	ROCKBOLTS 1" @ 25' HY	110	EACH				3
	ROCKBOLTS 1" @ 15'	60	EACH				3
	STEEL MESH	14,400	SF				3
	STEEL SUPPORT	14	TON				3
.167	DRAINAGE						
	HOLES (IN GALLERY CROWN)	9,200	LF				3
.17	CABLE SHAFTS						
	(TOTALS FOR 2 SHAFTS)						
.171	EXCAVATION						
	ROCK	3,000	CY				3/4
.173	SURFACE PREPARATION						
	SHAFTS	36,000	SF				3/4
.174	CONCRETE & SHOTCRETE						
	CONCRETE LINING	920	CY				3/4
	CONCRETE OVERBREAK 6"	670	CY				3/4
.175	SUPPORT & ANCHORS						
	ROCKBOLTS 3/4" @ 6'	570	EACH				3/4
.178	STRUCTURAL - MISC STEELWORK						
	MISC STEELWORK	13	TON				
.179	ARCHITECTURAL						
	ENCLOSURES	1	LS				
.17C	MECHANICAL						
	MANHOIST	2	EACH				3
.18	DEWATERING						
.181	DEWATERING (POWER FACS)						
	DEWATERING	1	LS				
.19	INSTRUMENTATION						
.191	INSTRUMENTATION						
	INSTRUMENTATION	1	LS				3
.2	MISC. BUILDINGS & STRUCTURES						
	MISC. BUILDINGS & STRUCTURES	1	LS				

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332	RESERVOIR, DAMS & WATERWAYS						
.1	RESERVOIR						
.11	CLEARING						
	CLEARING	6,350	ACRE				3
.2	DIVERSION TUNNELS/COFFERDAMS						
.21	DIVERSION TUNNELS/PORTALS						
.211	EXCAVATION						
	TUNNELS						
	ROCK	48,300	CY				3
	EXC. CONC. FOR PLUG	450	CY				3
	PORTAL UPSTREAM						
	OVERBURDEN	1,950	CY				3
	ROCK	50,200	CY				3/4
	PORTAL DOWNSTREAM						
	OVERBURDEN	6,600	CY				3/4
	ROCK	54,000	CY				3
.213	SURFACE PREP/GROUTING						
	PORTAL UPSTREAM						
	HORIZONTAL	4,400	SF				3
	INCLINED	15,300	SF				3
	PORTAL DOWNSTREAM						
	HORIZONTAL	1,300	SF				3
	INCLINED	2,900	SF				3
	GROUT TUNNEL PLUG						
	DRILL HOLES	2,050	LF				3
	CEMENT	410	CF				3
.214	CONCRETE & SHOTCRETE						
	TUNNEL						
	CONCRETE LINING	8,100	CY				3
	CONCRETE OVERBREAK 6"	3,200	CY				3
	2" SHOTCRETE	4,400	SF				3
	CONCRETE PLUG	3,000	CY				3
	REINFORCING STEEL	15	TON				3/4
	PORTAL UPSTREAM						
	CONCRETE HEADWALL	2,800	CY				3
	CONCRETE LINING	1,550	CY				3
	CONCRETE PIER	400	CY				3
	REINFORCING STEEL	310	TON				3
	OVERBREAK 12"H/6"V	500	CY				3
	PORTAL DOWNSTREAM						
	CONCRETE HEADWALL	1,000	CY				3
	OVERBREAK 12"H/6"V	100	CY				3
	REINFORCING STEEL	65	TON				3/4
.215	SUPPORT & ANCHORS						
	TUNNELS						

ITEM	DESCRIPTION	QUANTITY	UNITS	UNIT PRICE	AMOUNT	TOTAL	REMARKS
				$	$ 000	$ 000	
	ROCKBOLTS 1" @ 12'	800	EACH				3
	ROCKBOLTS 1" @ 9'	90	EACH				3
	STEEL MESH	76,900	SF				3
	STEEL SUPPORT	90	TON				3
	PORTAL UPSTREAM						
	ROCKBOLTS 1" @ 15'	80	EACH				3
	ROCK ANCHORS 1" @ 25'	40	EACH				3
	ROCK DOWELS	60	EACH				3
	PORTAL DOWNSTREAM						
	ROCKBOLTS 1" @ 15'	120	EACH				3
	ROCK ANCHORS 1" @ 25'	30	EACH				3
	ROCK DOWELS 1" @ 10'	0	EACH				
.21C	MECHANICAL						
	UPSTREAM GATE						
	GATE EQUIPMENT	2	EACH				3
	DOWNSTREAM OUTLET						
	STOPLOG GUIDES	1	SET				3
	STOPLOGS INCL. FOLLOWERS	1	LS				3
.22	UPSTREAM COFFERDAM						
.222	FILL						
	CORE	4,600	CY				3
	FINE/FILTER	2,800	CY				3
	COARSE FILTER	2,700	CY				3
	ROCK SHELL	19,800	CY				3
	CLOSURE DIKE	41,900	CY				3
	RIP RAP	7,000	CY				3
.223	SURFACE PREP/GROUTING						
	CUTOFF & GROUT						
	HOLES	1,600	LF				3
	GROUT	256,000	CF				3
.22D	DEWATERING						
	DEWATERING	1	LS				
.23	DOWNSTREAM COFFERDAM						
.231	EXCAVATION						
	REMOVAL OF CO ERDAM	42,000	CY				3
.232	FILL						
	RIP RAP	1,650	CY				3
	CLOSURE DIKE	47,000	CY				3
.233	SURFACE PREP/GROUTING						
	CUTOFF & GROUT						
	HOLES	2,300	LF				3
	CEMENT	368,000	CF				3
.3	MAIN DAM						
.31	MAIN DAM						
.311	EXCAVATION						
	OVERBURDEN	35,600	CY				3

ITEM	DESCRIPTION	QUANTITY	UNITS	UNIT PRICE $	AMOUNT $ 000	TOTAL $ 000	REMARKS
	ROCK	320,700	CY				3
.313	SURFACE PREP/GROUTING						
	SURFACE PREPARATION						
	UNDER DAM/THRUST BLOCKS	171,000	SF				
	CONSOLIDATION GROUT						
	DRILL HOLES	176,900	LF				3
	CEMENT	176,900	CF				2/3
	GROUT CURTAIN						
	DRILL HOLES	259,000	LF				2/3
	CEMENT	103,600	CF				2/3
.314	CONCRETE & SHOTCRETE						
	DAM						
	CONCRETE	1,281,000	CY				3
	REINFORCING STEEL	9,500	TON				3
	CONCRETE OVERBREAK	10,400	CY				3
	THRUSTBLOCKS						
	CONCRETE	105,500	CY				3
	REINFORCING STEEL	375	TON				3
	CONCRETE OVERBREAK	1,100	CY				3
	JOINT GROUTING						
	GROUTING	1	LS				
.315	SUPPORT & ANCHORS						
	ROCKBOLTS 1" @ 25'	500	EACH				4
	STEEL MESH (ON SLOPES)	275,000	SF				4
.317	DRAINAGE						
	HOLES	85,800	LF				2
.32	GROUT GALLERIES/PORTALS						
.321	EXCAVATION						
	TUNNELS/SHAFTS - CORE AREA						
	ROCK HORIZONTAL	13,100	CY				2
	ROCK INCLINED	5,300	CY				2
	ROCK VERTICAL	3,400	CY				2
	TUNNELS/SHAFTS ACCESS						
	ROCK HORIZONTAL	12,400	CY				2
	PORTALS						
	OVERBURDEN	28,700	CY				2
	ROCK	16,500	CY				2
.323	SURFACE PREPARATION						
	PORTALS						
	HORIZONTAL	50	SF				3
	INCLINED	410	SF				3
.324	CONCRETE & SHOTCRETE						
	TUNNELS - CORE AREA						
	CONCRETE SLAB	1,800	CY				2
	REINFORCING STEEL	62	TON				2/3
	CONCRETE OVERBREAK 6"	900	CY				3

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ITEM	DESCRIPTION	QUANTITY	UNITS	UNIT PRICE	AMOUNT	TOTAL	REMARKS
				$	$ 000	$ 000	
	2" SHOTCRETE	5,300	SF				2/3/4
	TUNNELS - ACCESS						
	CONCRETE SLAB	1,400	CY				2
	REINFORCING STEEL	50	TON				2/3
	CONCRETE OVERBREAK 6"	700	CY				3
	2" SHOTCRETE	2,500	SF				2/3/4
	SHAFTS - CORE AREA						
	2" SHOTCRETE	6,500	SF				2/3
	PORTALS (4 PORTALS)						
	CONCRETE	40	CY				3
	REINFORCING STEEL	3	TON				3
.325	SUPPORT & ANCHORS						
	TUNNELS - CORE AREA						
	ROCKBOLTS 1" @ 12'	150	EACH				3/4
	ROCKBOLTS 1" @ 9'	30	EACH				3/4
	ROCKBOLTS 3/4" @ 6'	1,250	EACH				2/3
	STEEL SUPPORT	27	TON				2/3/4
	STEEL MESH	12,200	SF				3
	TUNNELS ACCESS						
	ROCKBOLTS 3/4" @ 6'	1,200	EACH				2
	STEEL SUPPORT	12	TON				2/3
	STEEL MESH	500	SF				3/4
	SHAFTS - CORE AREA						
	ROCKBOLTS 3/4" @ 6'	300	EACH				2
	STEEL MESH	1,300	SF				3
	PORTALS						
	ROCKBOLTS 1" @ 15'	150	EACH				2
.329	ARCHITECTURAL						
	PORTAL DOORS	4	EACH				3
.32D	DEWATERING						
	DEWATERING MAINTENANCE	1	LS				3
	VENTILATION SYSTEM (INCLUDED W/ 331.12C)						
.33	INSTRUMENTATION						
.331	INSTRUMENTATION						
	INSTRUMENTATION	1	LS				
.4	SADDLE DAM						
.41	MAIN SADDLE DAM						
.411	EXCAVATION						
	OVERBURDEN	1,145,000	CY				3
	ROCK	301,000	CY				3
.412	FILL						
	IMPERVIOUS CORE	313,500	CY				3
	FINE FILTER	231,000	CY				3
	COARSE FILTER	193,000	CY				3
	ROCK SHELL (UPSTREAM)	534,000	CY				3

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				$	$ 000	$ 000	
	RIP RAP	174,500	CY				3
	ROCK SHELL (DOWNSTREAM)	345,000	CY				3
	ROAD BASE	3,500	CY				3
	ROCKFILL	127,000	CY				3
	FILTER FABRIC						
	FILTER FABRIC	190,000	SF				4
.413	SURFACE PREP & GROUTING						
	SURFACE PREPARATION						
	UNDER DAM CORE	191,500	SF				3
	UNDER DAM SHELL	432,500	SF				3
	DENTAL CONCRETE						
	DENTAL CONCRETE	7,100	CY				3/4
	CONSOLIDATION GROUT						
	DRILL HOLES	57,500	LF				3
	CEMENT	57,500	CF				2/3
	GROUT CURTAIN (SEE 332.313)						
.417	DRAINAGE (SEE 332.317)						2/3
.5	SPILLWAY VALVES (IN DAM)						
.51	SPILLWAY VALVES						
.519	VALVE CONTROL STR (IN DAM)						
	MISC. ELECT	1	LS				3
.51C	MECHANICAL						
	TRASHRACKS/GUIDES	1	LS				3
	BULKHEAD GATE GUIDES	1	LS				3
	BULKHEAD GATES & FOLLOWERS	2	EACH				3
	GANTRY CRANE	1	LS				3
	FIX CONE VALVES(7 PLUS 2 SPARE)	1	LS				3
	RING FOLLOWER GATES (7)	1	LS				
	MISC. MECHANICAL EQUIPMENT	1	LS				
.52	MAIN (CHUTE) SPILLWAY						
.521	EXCAVATION						
	APPROACH						
	OVERBURDEN	44,000	CY				2
	ROCK USEABLE	80,000	CY				2/3/4
	ROCK WASTE	17,000	CY				4
	CONTROL STRUCTURE (TO END OF ROLLWAY)						
	OVERBURDEN	21,500	CY				2
	ROCK USEABLE	87,000	CY				2/4
	ROCK WASTE	15,000	CY				4
	CHUTE & FLIP (END ROLLWAY TO END FLIP)						
	OVERBURDEN	128,300	CY				2
	ROCK USEABLE (INCLINED)	38,000	CY				2/3/4
	ROCK USEABLE (VERTICAL)	401,000	CY				2

ITEM	DESCRIPTION	QUANTITY	UNITS	UNIT PRICE	AMOUNT	TOTAL	REMARKS
				$	$ 000	$ 000	
	ROCK WASTE	93,500	CY				4
	OUTFALL						
	(FROM END OF BASIN)						
	OVERBURDEN	44,500	CY				2
	ROCK USEABLE	141,500	CY				2/4
	ROCK WASTE	41,500	CY				4
	DRAIN TUNNEL						
	ROCK HORIZONTAL	1,500	CY				3
	ROCK INCLINED	2,300	CY				3
	RIVER CHANNEL						
	ALLUVIUM EXCAVATION	67,000	CY				3
.523	SURFACE PREP/GROUTING						
	SURFACE PREPARATION						
	SPILLWAY						
	ROCK HORIZONTAL	108,000	SF				2
	ROCK INCLINED	41,500	SF				2/3
	CONSOLIDATION GROUT						
	DRILL HOLES	22,000	LF				2
	CEMENT	22,000	CF				2
	GROUT CURTAIN						
	(SEE 332.313)						
.524	CONCRETE & SHOTCRETE						
	CONCRETE STRUCTURE						
	(TO END OF ROLLWAY)						
	(INCLUDING STORAGE AREAS)						
	CONC OUTER WALLS	15,500	CY				2
	CONC PIERS (FULL LENGTH)	7,700	CY				2
	CONC DECK	1,600	CY				2
	CONC ROLLWAY SLAB	33,000	CY				2
	CONC OVERBREAK 12'H/8'V	1,400	CY				2
	REINFORCING STEEL	2,300	TON				3
	CONCRETE CHUTE & FLIP						
	(END ROLLWAY TO END FLIP)						
	(INCL BOX DRAIN GALLERIES)						
	CONCRETE SLAB	13,000	CY				2
	CONCRETE WALLS	20,500	CY				2
	CONC OVERBREAK 18'H/8'V	8,300	CY				2
	REINFORCING STEEL	1,300	TON				
	CONCRETE DRAIN GALLERY						
	CONCRETE SLAB	400	CY				3
	2" SHOTCRETE DOME	2,500	SF				3
	REINFORCING STEEL	14	TON				3/4
	CONC OVERBREAK 6"	200	CY				3
.525	SUPPORT & ANCHORS						
	DRAINAGE TUNNEL						
	STEEL SUPPORT	4	TON				3

ITEM	DESCRIPTION	QUANTITY	UNITS	UNIT PRICE	AMOUNT	TOTAL	REMARKS
				$	$ 000	$ 000	
	STEEL MESH	500	SF				4
	ROCKBOLTS DRAINAGE GALLERY						
	3/4" @ 6'	400	EACH				3
	ROCKBOLTS APPROACH						
	1" @ 15'	140	EACH				2
	ROCKBOLTS CHUTE & STRUCTURES						
	1" @ 15'	85	EACH				2
	SLAB/WALL ANCHORS						
	1"@ 10'	3,700	EACH				2
.527	DRAINAGE						
	DRILL HOLES						
	BOX DRAINS-TO DRAIN TUNNEL	28,000	LF				3
	3" RELIEF	300	LF				3
.52C	MECHANICAL						
	GATE EQUIPMENT	3	EACH				3
	STOPLOG GUIDES	3	SETS				3
	STOPLOGS INCL FOLLOWER	1	SET				3
	MISC. ELECT.	1	LS				4
.53	EMERGENCY SPILLWAY						
.531	EXCAVATION (INCLUDING - BRIDGE & FUSE PLUG)						
	OVERBURDEN	281,500	CY				2/3
	ROCK USEABLE	1,019,000	CY				2/3
	ROCK WASTE	213,500	CY				2/3/4
.532	FILL						
	FUSE PLUG	26,000	CY				3
.533	SURFACE PREP/GROUTING						
	SURF. (PREP UNDER FUSE PLUG)						
	HORIZONTAL	75,500	SF				2/3/4
	INCLINED	2,500	SF				2/3/4
	CONSOLIDATION GROUTING						
	DRILL HOLES	23,000	LF				2/3
	CEMENT	23,000	CF				2/3
	GROUT CURTAIN (SEE 332.313)						
.534	CONCRETE						
	GROUND SLAB	6,000	CY				3
	REINFORCING STEEL	210	TON				3
	CONC OVERBREAK 12"H/12"V	3,000	CY				3
.535	SUPPORT & ANCHORS						
	ROCKBOLTS 1" @ 15'	300	EACH				2/3
	ROCK ANCHORS 1" @ 25'	760	EACH				2/3
.538	STRUCTURAL-MISC. STEELWORK						
	GUARD RAILS,PADS,ETC	650	LF				2/3
.53B	BRIDGE						
	BRIDGE	1	LS				3

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ITEM	DESCRIPTION	QUANTITY	UNITS	UNIT PRICE $	AMOUNT $ 000	TOTAL $ 000	REMARKS
.6	POWER INTAKES						
.61	POWER INTAKE STRUCT & APP						
.611	EXCAVATION						
	OVERBURDEN	99,000	CY				3/4
	ROCK	201,600	CY				3/4
.613	SURFACE PREPARATION						
	HORIZONTAL	12,100	SF				3/4
	INCLINED	50,000	SF				3/4
.614	CONCRETE & SHOTCRETE STRUCTURE						
	CONCRETE STRUCTURE	14,500	CY				3/4
	REINFORCING STEEL	940	TON				3/4
	CONC OVERBREAK 12'H/8'V	1,530	CY				3/4
.615	SUPPORT & ANCHORS APPROACH						
	ROCKBOLTS 1" @ 15'	140	EACH				3
.61C	MECHANICAL						
	TRASHRACKS & GUIDES	4	SETS				3
	BULKHEAD GATE GUIDES	4	SETS				3
	BULKHEAD GATES & FOLLOWERS	1	SET				3
	INTAKE GANTRY CRANE	1	EACH				3
	INTAKE GATE EQUIPMENT	4	EACH				3
	MISC. ELECT.	1	LS				
.610	INTAKE BUILDING						
	INTAKE BUILDING	1	LS				3/4
.7	SURGE CHAMBER						
.71	SURGE CHAMBER						
.711	EXCAVATION						
	CHAMBER ROCK	59,000	CY				3
	VENT SHAFT ROCK	2,300	CY				3
.713	SURFACE PREPARATION						
	SURFACE PREP	16,200	SF				3/4
.714	CONCRETE & SHOTCRETE CHAMBER						
	CONCRETE CHAMBER	3,200	CY				3
	3" SHOTCRETE	1,400	SF				3
	2" SHOTCRETE	1,300	SF				3
	REINFORCING STEEL	160	TON				3
	CONCRETE OVERBREAK	500	CY				3
	VENT SHAFT						
	2" SHOTCRETE	6,300	SF				3
.715	SUPPORT & ANCHORS CHAMBER						
	ROCKBOLTS 1" @ 25'	320	EACH				3
	ROCKBOLTS 1" @ 15'	330	EACH				3
	STEEL SUPPORT	66	TON				3

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ITEM	DESCRIPTION	QUANTITY	UNITS	UNIT PRICE $	AMOUNT $ 000	TOTAL $ 000	REMARKS
	STEEL MESH	12,900	SF				3
	VENT SHAFT						
	ROCKBOLTS 3/4" @ 6'	400	EACH				3
	STEEL MESH	1,300	TON				3
.717	DRAINAGE						
	HOLES (IN CHAMBER CROWN)	13,650	LF				3
.8	PENSTOCKS						
.81	PENSTOCKS						
.811	EXCAVATION						
	TUNNELS						
	ROCK HORIZONTAL	19,800	CY				3/4
	ROCK INCLINED	25,000	CY				3/4
.813	SURFACE PREP/GROUTING						
	SURFACE PREPARATION						
	TUNNELS	141,300	SF				3/4
	CONTACT GROUTING						
	CONTACT GROUTING	1	LS				3
	CONSOLIDATION GROUTING						
	CONSOLIDATION GROUTING	1	LS				
.814	CONCRETE & SHOTCRETE						
	CONCRETE LINER	14,400	CY				3/4
	REINFORCING STEEL	4	TON				3
	2" SHOTCRETE	15,400	SF				3/4
	CONCRETE OVERBREAK 6"	3,800	CY				3/4
	CONCRETE PLUG	10,000	CY				4
	CONC OVERBREAK PLUG	860	CY				3/4
.815	SUPPORT & ANCHORS						
	ROCKBOLTS 1" @ 25'	100	EACH				3
	ROCKBOLTS 1" @ 6'	1,100	EACH				3/4
	STEEL MESH	70,200	SF				3/4
.818	STRUCTURAL - MISC STEELWORK						
	STEEL LINER	1,600	TON				3
.9	TAILRACE WORKS						
.91	TAILRACE TUNNELS/PORTALS						
.911	EXCAVATION						
	TUNNELS						
	ROCK	329,300	CY				3/4
	PORTAL						
	OVERBURDEN	42,000	CY				
	ROCK	15,000	CY				
.913	SURFACE PREPARATION						
	PORTAL						
	HORIZONTAL	2,500	SF				4
	INCLINED	1,000	SF				4
	TUNNEL						
	TUNNEL	582,000	SF				3/4

ITEM	DESCRIPTION	QUANTITY	UNITS	UNIT PRICE	AMOUNT	TOTAL	REMARKS
				$	$ 000	$ 000	
	.914 CONCRETE & SHOTCRETE						
	TUNNEL						
	CONCRETE LINING	31,700	CY				3/4
	CONC OVERBREAK 6"	16,200	CY				3/4
	2 " SHOTCRETE	17,500	SF				3/4
	REINFORCING STEEL	13	TON				3
	PORTAL						
	CONCRETE BASE SLAB	100	CY				
	CONCRETE WALLS	650	CY				
	CONC OVERBREAK 12'H/6'V	50	CY				3
	REINFORCING STEEL	30	TON				
	.915 SUPPORT & ANCHORS						
	TUNNEL						
	ROCKBOLTS 1" @ 12'	3,160	EACH				3/4
	ROCKBOLTS 1" @ 9'	490	EACH				3/4
	STEEL MESH	291,000	SF				3/4
	STEEL SUPPORT	232	TON				3
	PORTAL						
	ROCKBOLTS 1" @ 15'	50	EACH				3/4
	.91C MECHANICAL						
	STOPLOG GUIDES	1	LS				3
	STOPLOGS INCL. FOLLOWER	1	LS				3
333	WATERWHEELS, TURBINES & GENERATORS						
	.1 TURBINES & GOVERNORS						
	.11 TURBINES & GOVERNORS						
	.111 SUPPLY	4	EACH				
	.112 INSTALL	4	EACH				
	.2 GENERATORS & EXCITERS						
	.21 GENERATORS & EXCITERS (SUPPLY & INSTALL)						
	.211 GENERATORS & EXCITERS	4	EACH				3
334	ACCESSORY ELECTRICAL EQUIPMENT						
	.1 CONNECTION, SUPPORTS & STRUCT.						
	.11 STRUCTURES						
	.111 STRUCT (INCL BELOW)						3
	.12 CONDUCTORS & INSULATORS						
	.121 GNRTR ISOLATED PHASE BUS	1	LS				
	.122 HV POWER CABLES & ACCESS.	1	LS				
	.123 LV POWER CABLES & ACCESS.	1	LS				
	.124 CONTROL CABLES & ACCESSORIES	1	LS				
	.125 GROUNDING SYSTEM	1	LS				
	.13 CONDUITS & FITTINGS						
	.131 CONDUITS & FITTINGS	1	LS				

ITEM	DESCRIPTION	QUANTITY	UNITS	UNIT PRICE	AMOUNT	TOTAL	REMARKS
				$	$ 000	$ 000	
.2	SWITCHGEAR & CONTROL EQUIPMENT						
.21	AUXILIARY TRANSFORMERS						
.211	AUXILIARY TRANSFORMERS	4	EACH				3
.22	CIRCUIT BREAKERS						
.221	CIR BRKRS (NOT REQ'D)						3
.23	SURGE PROT & GEN CUBICLES						
.231	SURGE PROT & GEN CUBICLES	1	LS				3
.24	SWITCHBOARDS						
.241	SWITCHBOARDS	1	LS				
.25	AUX. POWER EQPT-INCL BAT						
.251	AUX. POWER EQPT INCL BAT	1	LS				3
.3	CUBICLES & APPURTENENCES						
.31	CNTRL,RELAY & METER. BRDS.						
.311	CONTROL,RELAY & METER. BRD	1	LS				
.32	COMPUTER CONTROL SYSTEM						
.321	COMPUTER CONTROL SYS						3 INCL IN 353
.33	SUPERVIS. & TELEMETER. SYS						
.331	SPVSRY & TELEMETER SYS						3 INCL IN 353
.4	POWER TRANSFORMERS						
.41	POWER TRANSFORMERS						
.411	POWER TRANSFORMERS	13	EACH				3
.5	LIGHTING SYSTEM						
.51	LGT, P/H & TRANS GAL						
.511	LIGHTING P/H & TRANS GAL	1	LS				
.52	ACCESS TUNNELS & ROADS						
.521	ACCESS TUNNELS & ROADS	1	LS				
.6	MISC. ELECTRICAL EQUIPMENT						
.61	MISC. ELECTRICAL EQUIPMENT						
.611	MISC. ELECTRICAL EQUIPMENT	1	LS				
.7	SURF. ACCESS. ELEC. EQUIP.						
.71	4.16 KV & LV EQUIPMENT						
.711	SWITCHBOARD	1	LS				4
.712	CABLES	1	LS				4
.713	AUX TRANSFORMER	1	LS				4
.73	DIESEL GENERATORS - STANDBY						
.731	DIESEL GENERATORS - STANDBY	2	EACH				4
.74	EXTERIOR LIGHTING						
.741	EXTERIOR LIGHTING	1	LS				4
335	MISCS. POWERPLANT EQUIPMENT						
.1	AUXILIARY SYSTEMS - UNDERGROUND						
.11	STATION WATER SYSTEMS						
.111	STATION WATER SYSTEMS	1	LS				
.12	FIRE PROTECTION SYSTEMS						
.121	FIRE PROTECTION SYSTEMS	1	LS				
.13	COMPRESSED AIR SYSTEMS						

ITEM	DESCRIPTION	QUANTITY	UNITS	UNIT PRICE	AMOUNT	TOTAL	REMARKS
				$	$ 000	$ 000	
	.131 COMPRESSED AIR SYSTEMS	1	LS				
	.14 OIL HANDLING SYSTEMS						
	.141 OIL HANDLING SYSTEMS	1	LS				
	.15 DRAINAGE & DEWATERING						
	.151 DRAINAGE & DEWATERING	1	LS				
	.16 HEAT, VENT & COOLING SYS						
	.161 HEAT, VENT & COOLING SYS	1	LS				
	.17 MISCELLANEOUS						
	.171 MISCELLANEOUS	1	LS				
	.2 AUX. SYST. - SURFACE FAC.						
	.21 AUX. SYST.-SURFACE FAC.	1	LS				3
	.3 AUXILIARY EQUIPMENT						
	.31 POWERHOUSE CRANES						3
	.311 POWERHOUSE CRANES	2	EACH				3
	.32 ELEVATORS						
	.321 ELEVATORS	1	LS				
	.33 MISC. CRANES & HOIST						
	.331 MISC. CRANES & HOIST	1	LS				
	.34 COMPENSATION PUMPS						
	.341 PUMPS AND MOTORS	2	EACH				3
	.342 VALVES	4	EACH				3
	.35 MACHINE SHOP FAC.						
	.351 MACHINE SHOP FAC.	1	LS				4
	.4 GENERAL STATION EQUIPMENT						
	GENERAL STATION EQUIPMENT	1	LS				
	.5 COMMUNICATIONS EQUIPMENT						
	COMMUNICATIONS EQUIPMENT	1	LS				
336	ROADS						
	.1 ROADS						
	.12 SITE ROADS						
	SITE ROADS	9	MILE				3
	MAINTENANCE	12	MILE				3
	.13 TRANS DAM CROSSING						
	CONSTRUCTION	7	MILE				3
	.14 PARKS HWY - DEVIL CANYON						
	MAINTENANCE	212	MI/YRS				3
	TRANSMISSION PLANT						
350	LAND & LAND RIGHTS						

ITEM	DESCRIPTION	QUANTITY	UNITS	UNIT PRICE	AMOUNT	TOTAL	REMARKS
				$	$ 000	$ 000	
	LAND & LAND RIGHTS						
352	SUBSTATION & SWITCHING STATION						
	SUBSTATION & SWITCHING STATION						
	STRUCTURES & IMPROVEMENTS						
.1	SWITCHYARD						
.11	SWITCHYARD						
	SWITCHYARD	1	LS				
353	SUBSTATION/SWITCHING STA EQUIP						
	SUBSTATION/SWITCHING STA EQUIP						
	ESTER	1	LS				
	WILLOW	1	LS				
	KNIK ARM	1	LS				
	UNIVERSITY	1	LS				
	WILLOW ENERGY MANAGE SYS (EMS)						
	WATANA & DEVIL CANYON IN-						
	PLANT MONITOR & CNTRL EQPMT	1	LS				
354	STEEL TOWERS & FIXTURES						
	STEEL TOWERS & FIXTURES						
	TOWERS (INCLUDING FOUND-						
	ATION & HARDWARE)	546	EACH				3
356	OVERHEAD CONDUCTORS & DEVICES						
	OVERHEAD CONDUCTORS & DEVICES						
	CNDTRS 2 x 954 kcmil/phase	124	MILE				3
	SUBMARINE CABLES (3)	1	LS				
359	ROADS & TRAILS						
	ROADS & TRAILS						
	GENERAL PLANT						
389	LAND & LAND RIGHTS						
	LAND & LAND RIGHTS						
	(INCLUDED IN 330)						
390	STRUCTURES & IMPROVEMENTS						
	STRUCTURES & IMPROVEMENTS						
	(INCLUDED IN 331.2)						

ITEM	DESCRIPTION	QUANTITY	UNITS	UNIT PRICE	AMOUNT	TOTAL	REMARKS
				$	$ 000	$ 000	
391	OFFICE FURNITURE/EQUIPMENT						
	OFFICE FURNITURE/EQUIPMENT B						
392	TRANSPORTATION EQUIPMENT						
	TRANSPORTATION EQUIPMENT B						
393	STORES EQUIPMENT						
	STORES EQUIPMENT B						
394	TOOLS SHOP & GARAGE EQUIPMENT						
	TOOLS SHOP & GARAGE EQUIPMENT B						
395	LABORATORY EQUIPMENT						
	LABORATORY EQUIPMENT B						
396	POWER OPERATED EQUIPMENT						
	POWER OPERATED EQUIPMENT B						
397	COMMUNICATIONS EQUIPMENT						
	COMMUNICATIONS EQUIPMENT B						
398	MISCELLANEOUS EQUIPMENT						
	MISCELLANEOUS EQUIPMENT B						
399	OTHER TANGIBLE PROPERTY						
	OTHER TANGIBLE PROPERTY						
	OTHER TANGIBLE PROPERTY	1	LS				
	INDIRECT COSTS						
61	TEMPORARY CONSTRUCTION FACILITIES						
	TEMPORARY CONSTRUCTION FACILITIES (INCLUDED IN DIRECT COSTS)						
62	CONSTRUCTION EQUIPMENT						
	CONSTRUCTION EQUIPMENT (INCLUDED IN DIRECT COSTS)						
63	MAIN CONSTRUCTION CAMP						
.1	MAIN CONSTRUCTION CAMP						
.11	SITE PREPARATION						
	CLEARING & STRIPPING	83	ACRE				
	INSTALL GRANULAR PAD	439,400	CY				3

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ITEM	DESCRIPTION	QUANTITY	UNITS	UNIT PRICE	AMOUNT	TOTAL	REMARKS
				$	$-000	$-000	
	CONSTRUCT ROADWAYS						
	MAIN ROADS IN CAMP [34']	6,100	LF				
	CONNECT. RD. TO ACCESS RD.	7,200	LF				
	SECONDARY RD [24']	400	LF				
	DRAINAGE						
	DITCHING	31,400	LF				
	CULVERTS	640	LF				
	PERIMETER FENCING						
	PERIMETER FENCING	7,850	LF				
	PARKING AREAS						
	PARKING AREAS	37,000	SF				
.12	BUILDINGS						
	BACHLR DORMS-108 MAN CMPLX	28	EACH				28' x 224'
	BACHLR DORMS-MGMNT-TYPE A	6	EACH				28' x 120'
	BACHLR DORMS-MGMNT-TYPE B	9	EACH				24' x 120'
	GUEST HSES-1 EA DWN/MGR/CON	3	EACH				28' x 120'
	CAMP MANAGER'S OFFICES	3	EACH				30' x 40'
	STAFF CLUBHOUSE	1	EACH				50' x 80'
	DINING HALL	1	EACH				120' x 80'
	DINING HALL	1	EACH				150' x 120'
	RECREATION BLDG.	1	EACH				120' x 160'
	RECREATION BLDG.	1	EACH				10[illegible]' x 120'
	GYMNASIUM	1	EACH				200' x 200'
	SECURITY OFFICE	1	EACH				50' x 60'
	FIRE STATION	1	EACH				40' x 80'
	SOILS/MATERIALS LAB.	1	EACH				40' x 80'
	MAINTENANCE BLDG.	1	EACH				80' x 100'
	WAREHOUSE - MANAGERS	1	EACH				100' x 120'
	WAREHOUSE - FOOD SERVICE	1	EACH				100' x 120'
	COMMUNICATION BLDG.	1	EACH				20' x 30'
	HOSPITAL	1	EACH				120' x 140'
	ICE RINK	1	EACH				150' x 300'
	BANK	1	EACH				50' x 60'
	STORE	1	EACH				30' x 60'
	LAUNDRY	1	EACH				20' x 30'
	SWIMMING POOL	1	EACH				100' x 100'
	PERMAWALK						
	6 FEET WIDE	800	LF				
	10 FEET WIDE	2,250	LF				
	16 FEET WIDE	1,000	LF				
.13	UTILITIES						
	WATER						
	SUPPLY SYSTEM						
	INTAKE POOL & CRIB-IN	1	LS				SUSITNA RIVER
	PUMP STA - 720 GPM	1	LS				
	BOOSTER PUMP STA - 720 GPM	1	LS				

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ITEM	DESCRIPTION	QUANTITY	UNITS	UNIT PRICE	AMOUNT	TOTAL	REMARKS
				$	$ 000	$ 000	
	SPLY LINES (2EA) 1-4" &	4,500	LF				1-6",UTILDR,HT
	TREATMENT PLANT - 1.0 MGD	1	LS				
	RESERVOIR	2	LS				800,000 GAL
	DISTRIBUTION SYSTEM						
	DISTRIB LINES - BURIED						
	1"	800	LF				
	6"	240	LF				
	6"	100	LF				
	DISTRIB LINE UTLDR						
	10" DI	1,800	LF				
	8" DI	2,500	LF				
	6" DI	2,000	LF				
	4" DI	1,800	LF				
	HEAT TRACING & INSUL						
	10" PIPE	2,600	LF				
	8" PIPE	2,740	LF				
	6" PIPE	2,100	LF				
	4" PIPE	1,800	LF				
	PIPE FITTINGS						
	VALVES	1	LS				
	HYDRANTS	12	EA				3
	UTILIDORS						
	UTILIDORS	8,100	LF				
	SEWAGE						
	COLLECTION SYS CUTLDRS						
	4" PIPE	2,000	LF				
	6" PIPE	3,000	LF				
	8" PIPE	2,400	LF				
	10" PIPE	800	LF				
	12" PIPE	2,800	LF				
	HEAT TRACING & INSUL						
	4"	2,000	LF				
	6"	3,000	LF				
	8"	2,400	LF				
	10"	800	LF				
	12"	2,800	LF				
	TREATMENT PLANT						
	SKIMMING TANK	1	EACH				
	LAGOONS (1 @ 385' x 205' &	3	EACH				@ 280' x 155')
	RBC's	5	EACH				
	PHYS/CHEM UNIT	1	EACH				
	CLARIFIER	1	EACH				
	DISINFECTION	1	EACH				
	HEAT PUMP	1	EACH				
	THICKENER	1	EACH				
	FILTER PRESS	1	EACH				

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ITEM	DESCRIPTION	QUANTITY	UNITS	UNIT PRICE	AMOUNT	TOTAL	REMARKS
				$	$ 000	$ 000	
	DRYING BEDS	2	EACH				
	OUTFALL LINE (10")	4,200	LF				
	UTILIDOR	1,100	LF				
	OUTFALL	1	EACH				
	ELECTRICAL						
	GENERATING STATIONS						
	BUILDINGS	1	EACH				3/20' x 20'
	GENERATORS (850 KW)	3	EACH				3
	DAY TANK	1	EACH				3
	FUEL STORAGE TANK	1	EACH				3
	SUBSTATION	1	EACH				3
	LIGHTING						
	POLE MOUNTED LUMINAIRS	44	EACH				
	FLOOD LIGHTS	15	EACH				
	DISTRIBUTION	1	LS				
	FIRE ALARM SYSTEM						
	FIRE ALARM SYSTEM	1	LS				
	TELEPHONE SYSTEM						
	TELEPHONE SYSTEM	1	LS				
	TV/RADIO STATION						
	TV/RADIO STATION	1	LS				
	SOLID WASTE FACILITY						
	SOLID WASTE FACILITY	1	LS				
	POL						
	GARAGE/MAINTENANCE BLDG	1	EACH				50' x 60'
	TANKS						
	50,000 GAL	4	EACH				
	100,000 GAL	20	EACH				
	EARTHWORK						
	CLEARING & GRUBBING	9	ACRE				
	BERMS	30,000	CY				
	PIPING	1	LS				
	FUEL STATION	1	LS				
.2	MAIN CONSTRUCTION VILLAGE						
.21	SITE PREPARATION						
	CLEARING & STRIPPING	95	ACRE				3
	INSTALL GRANULAR PAD	459,800	CY				3/ DEPTH 8'
	CONSTRUCT ROADWAYS						
	ROADWAYS IN VILLAGE						
	MAIN ROAD 34' WIDE	2,300	LF				ASPHALT PVMT
	SECONDARY ROADS 24' WIDE	19,600	LF				ASPHALT PVMT
	CONNECTION TO ACCESS RD 34'	4,000	LF				VIL LHT-HN ACS A/C P
	DRAINAGE						
	DITCHING	51,600	LF				RDWY-TOT's (R) 2
	CULVERTS - 320 LOTS	7,440	LF				@ 20' & 40' XING (26
	PERIMETER FENCING						

ITEM	DESCRIPTION	QUANTITY	UNITS	UNIT PRICE	AMOUNT	TOTAL	REMARKS
				$	$ 000	$ 000	
	PERIMETER FENCING	9,100	LF				
	PARKING AREAS						
	PARKING AREAS	37,500	SF				GRANULAR SURFACE
.22	BUILDINGS						
	SINGLE FAM UNIT - 2 BDRM	72	EACH				14' x 60'
	SINGLE FAM UNIT - 3 BDRM	200	EACH				14' x 60'
	SINGLE FAM UNIT - 2 BDRM	16	EACH				24' x 50'
	SINGLE FAM UNIT - 3 BDRM	18	EACH				24' x 50'
	SINGLE FAM UNIT - 4 BDRM	16	EACH				28' x 50'
	SCHOOL (22,750 SF)	1	LS				(12 CLASSROOMS)
	GYMNASIUM	1	LS				100' x 100'
	SWIMMING POOL	1	LS				100' x 100'
	RECREATION CENTER	1	LS				80' x 100'
	STORE	1	LS				100' x 150'
	FIRE STATION	1	LS				30' x 40'
	GAS STA (6 PUMP,3-BAY	1	LS				2-10,000 GAL TANKS
.23	UTILITIES						
	WATER						
	SUPPLY LINE 8"	4,900	FT				
	RESERVOIR (850,000 GAL)	1	EACH				
	PUMP STATION 4500 GPM	1	EACH				
	DISTRIBUTION SYSTEM						
	DISTRIBUT LINE-BURIED						
	10" DI	850	LF				
	8" DI	305	LF				
	6" DI	280	LF				
	DISTRIBUT LINE-UTLDR						
	10"	7,650	LF				
	8"	2,750	LF				
	6"	2,350	LF				
	HEAT TRACING						
	10" PIPE	8,500	LF				
	8" PIPE	3,050	LF				
	6" PIPE	2,600	LF				
	VALVES						
	10", 8", & 6"	1	LS				
	HYDRANTS						
	(VALVES & STUBS INC = 1 EA	21	EACH				@ APPROX 400')
	SEWAGE						
	COLLECTION SYSTEM						
	6" PIPE	5,450	LF				
	8" PIPE	3,000	LF				
	10" PIPE	2,350	LF				
	12" PIPE	100	LF				
	HEAT TRACING						
	6" PIPE	5,450	LF				(INCL FORCE MAIN

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ITEM	DESCRIPTION	QUANTITY	UNITS	UNIT PRICE	AMOUNT	TOTAL	REMARKS
				$	$ 000	$ 000	
	8" PIPE	3,000	LF				FROM VIL TO MAIN CAMP WATER TREAT- MENT PLANT
	10" PIPE	2,350	LF				
	12" PIPE	100	LF				
	PUMPING SYSTEM						
	PUMP STATION	1	LS				VILLAGE TO MAIN CAMP TREATMENT PLANT
	6" FORCE MAIN	11,000	LF				
	ELECTRICAL						
	GENERATING STATIONS						
	BUILDINGS	1	EACH				3/INCLUDES DRIVEWAYS
	GENERATORS 650 KW	2	EACH				3
	DAY TANKS	1	EACH				3
	FUEL STORAGE TANKS	1	EACH				3
	SUBSTATIONS	1	EACH				3
	DISTRIBUTION						
	DISTRIBUTION	1	LS				
	FIRE ALARM SYSTEM						
	FIRE ALARM SYSTEM	1	LS				
	TELEPHONE SYSTEM						
	TELEPHONE SYSTEM	1	LS				
	UTILIDORS						
	MAIN RUNS IN VILLAGE	11,800	LF				
	STREET CROSSING 50 LF EA	1,200	LF				
	PUMP STA TO TREATMT PLANT	5,500	LF				
	STUBS TO HSE LOTS 320 @ 20'	6,400	LF				INCL 4" SVC, ETC.
	STUBS TO BLDGS - 6 @ 25'	150	LF				
	INTEGRATED OFC AREA						
	OWNER/MGRS OFFICE	1	LS				120' x 160'
.3	CREDIT FOR CAMP						
	LUMP SUM CREDIT FOR BLDGS	1	LS				3
.4	CATERING & SUPPORT						
	CATERING & SUPPORT	2,450,000	MANDAY				
.5	ELECTRIC POWER						
.51	34.5 KV SYSTEM						
.511	TRANSFORMER STATION	1	LS				4
.512	DISTRIBUTION SYSTEM	1	LS				4
.52	CONSTRUCTION CAMP POWER						
.521	CONSTRUCTION CAMP POWER	0	KWH				4
.53	CONSTRUCTION POWER						
.531	CONSTRUCTION POWER	0	KWH				4
.6	CONSTRUCTION HEAT AND VENT.						
.61	HEATING AND VENTIL. PLANT						
.611	HEATING AND VENTIL. PLANT	1	LS				4
.62	HEATING AND VENTIL. OPERATION						
.621	HEATING AND VENTIL. OPERAT.	0	DAY				4

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ITEM	DESCRIPTION	QUANTITY	UNITS	UNIT PRICE	AMOUNT	TOTAL	REMARKS
				$	$ 000	$ 000	
64	LABOR EXPENSE LABOR EXPENSE (INCLUDED IN DIRECT COSTS)						
65	SUPERINTENDENCE SUPERINTENDENCE (INCLUDED IN DIRECT COSTS)						
66	INSURANCE INSURANCE (INCLUDED IN DIRECT COSTS)						
69	FEES FEES (INCLUDED IN DIRECT COSTS)						