13. CONSTRUCTION METHODOLOGY AND ESTIMATES OF COST

The project procurement strategy and contract strategy – based on the project risk profile – have not yet been formulated. For the purposes of completing the construction planning and estimating recorded in Sections 13 and 14, a procurement strategy has been assumed that is a "best estimate" of an appropriate strategy, based on worldwide experience of similar project development of similar size and complexity under a similar risk profile.

13.1. General

During the early part of 2012 – the first year of this feasibility study – a cost estimate was prepared for the project. The estimate was performed based on the concept presented in the Federal Energy Regulatory Commission (FERC) Pre-Application Document (PAD) submitted to FERC in December 2011. The estimate was updated at the end of 2012.

As with all Opinion of Probable Construction Cost (OPCC) prepared by MWH and others, the results are classified according to AACE International – formerly the Association for the Advancement of Cost Engineering (AACE), as discussed below. The PAD estimate is regarded as between Class 5 and Class 4; the current estimate, as discussed below, is considered to be at a Class 4 level, although certain discrete elements of the work have been detailed and estimated using methodology that is more like that used for a Class 3 estimate. The OPCC has been organized in accordance with the FERC Uniform System of Accounts.

Upon completion of the proposed geotechnical site investigations – including adits – sufficient information will be available to the engineering team to clarify and further design and detail key aspects of the project preliminary design, reducing cost uncertainties, such that a Class 3 estimate might be implemented.

The project estimate, submitted to AEA in January 2012, was the subject of an independent check, under a separate contract issued by AEA. Much of that estimate was prepared, under subcontract, by Paul Hewitt of International Project Estimating Ltd. To maintain an independent review of the estimating process, the estimate included in this report also utilized the input of Mr. Paul Hewitt using the joint venture methodology described in Section 13.4.

During the performance of engineering feasibility studies there have been many improvements, refinements, and adjustments made to the project layout and ever more detailed assessment of the construction challenges and logistics. These changes – as well as the ongoing escalation of construction costs according to price inflation – primarily account for the differences between the various estimates.

The estimating tasks consisted of estimating the anticipated total cost of the project, focusing on the construction costs and the OPCC, but also including the estimation of pre-construction project development activities, design and environmental work, various AEA costs, and the cost of construction management and engineering during construction. Licensing, environmental mitigation, owner's management, and land costs were provided by AEA for inclusion in the overall project estimate.

The AACE classification system indicates the expected ranges of costs associated with its classifications. However, for this feasibility study probabilistic estimating practices were used, and an "adjusted" cost estimate was established accounting for possible price, quantity, and work scope variability in estimating. For the current estimate a "management reserve" has been suggested as explained below, but this should be explored in more detail in the future. All costs for the feasibility estimate are expressed in second quarter (Q2) 2014 US$.

The OPCC and project cost estimate described <u>do not include</u> financing costs, interest during construction, or escalation. Those items will be included in separate financial planning documents being prepared by AEA.

The standard term used in the industry for the estimate of construction cost – and used herein – is the OPCC. Normally the OPCC is the estimated construction and equipment procurement cost (i.e., the expected successful bid price, including various allowances a bidder will always include following its pre-bid assessment of "known unknowns").

Separately allowances for events and occurrences affecting cost <u>after</u> the commencement of construction have not been made at this stage. It is prudent to perform a further probabilistic analysis after the results of the current dam site geotechnical investigations and environmental studies are available, to address the possibility of unforeseen events impacting the "as built" project cost.

The term "opinion" is important, as the estimating product represents – in many respects – an opinion based on a broad understanding of the construction industry. OPCCs presented herein, including evaluations of project budgets, and/or funding, represent MWH's best judgment as a design professional familiar with the construction industry. Such opinions or evaluations are based upon current market rates for labor, materials, and equipment. Future costs of labor, materials, or equipment, construction contractor's methods of determining bid prices, competitive bidding environments, unidentified field conditions, market conditions, hyper-inflationary or deflationary price cycles, and other factors may affect the OPCC. It is important to recognize that the OPCC is a "snapshot" in time and that the reliability of a given OPCC will degrade over time. MWH cannot and does not make any warranty, promise, guarantee, or representation, either express or implied that proposals, bids, project construction costs, or cost associated with future operation or maintenance will not vary substantially from MWH's good faith OPCC as presented herein.

For the 2013 round of project estimation, instead of an independent estimate, the methodology of "joint venture" estimating was implemented, using an independent estimator Mr. Paul Hewitt. Each party prepared a construction cost estimate completely independently, before meeting to rationalize their independent estimates, line by line.

Having rationalized their two estimates, a joint agreement was reached for the potential highs and lows for each line item, for the variability analysis.

A key part of the estimating tasks early in the feasibility studies related to comparative cost estimation of the type of dam and the number and capacity of the power plant generating units.

The comparison of three different configurations of the project (based on three possible types of dams considered for this site), was carried out during the first year of studies. A comparison of the three types (Earth Core Rockfill Dam, Concrete Faced Rockfill Dam, and roller-compacted concrete [RCC]) was performed by estimating the construction costs of the facilities that are not common to the dam types. A separate layout was drawn for each type of dam and detailed as necessary to determine the basic unit quantities associated with each development. The most economic dam that performs with the appropriate level of safety was determined to be one constructed of RCC. This exercise is described in more detail in Section 7.

A similar exercise was performed later in the development of the project configuration, based on the comparison of three different potential unit sizes (3 x 200 MW @ water level El. 1950 ft.; and 4 x 150 MW and 6 x 100 MW at the same head, all resulting in a 600 MW nominal capacity plant – also compared was 3 x 200 MW @ normal maximum operating level). In that comparison, also described in Section 7, the common items were not estimated, but all civil and mechanical components associated with each alternative power facilities arrangement were estimated and compared using proprietary MWH software, that prepares designs based on parametric algorithms.

The following discussion is presented as five parts:

- Estimating methodology;
- Adopted construction methodology (forming the foundation of the estimate);
- The construction cost estimate;
- Non-construction costs;

- The total program cost estimate; and,
- The projected construction schedule (addressed in Section 14).

All these aspects of project planning, particularly construction planning, are completely interwoven. The estimating methodology section contains general material with respect to the estimating process. The adopted construction methodology highlights the construction planning, logistics and methodology for the various parts of the work, broken down in the assumed contracts. The construction and project cost estimate sections present the project team's estimate and background on the respective construction costs and the estimated total project cost. Finally, the schedule section highlights the schedule assumptions and the key dependencies of the schedule.

Due to the project scale, the limited amount of design work completed to date, and validation time constraints, the Pareto principle was used to focus the pricing verification effort to the areas of significance, and aspects to which the project costs are particularly sensitive. The Pareto principle simply states that, when analyzing events or populations, approximately 80 percent of the effects will typically arise from just 20 percent of the causes. The 80/20 rule implies that a few (20 percent) drivers are vital and the many (80 percent) are trivial. Hence, typically a small minority of events or results can significantly impact or drive a cost estimate's bottom-line. Consequently, the analysis of the construction methodology and costs has been concentrated on those areas having the greatest likelihood of cost significance and impact on the bottom line project cost.

The principle was applied as a tool to decompose the significant amount of cost estimate detail, thereby expediting the definition and segregation of cost driver elements. Hence, for the purposes of this validation exercise, a project cost driver is defined as a component of the minimum number of elements, within a specific feature of work, that approximate 80 percent of the feature's total costs.

This simplification has allowed the project team to focus on the major items of work or efforts (such as the logistics) that most affect the total cost of the project. These major items were optimized to the greatest extent possible at this stage, and have the greatest potential to reduce overall project cost. These large cost items also will need additional scrutiny in ongoing project development and future reviews of project cost for accuracy.

13.2. Estimating Methodology – Construction

13.2.1. Basis of Pricing

The OPCC reflects the estimator's opinion as to the probable costs that a "prudent" contractor would include in the tender to construct the defined facilities.

Pre-construction activities and expenses related to the management and support of field construction activities are included elsewhere in the reporting of estimated project costs. The estimate of the required overall project investment cost consists of three discrete parts:

1. Construction and equipment procurement (generally these are considered construction costs).
2. Other activities required to implement the project (i.e., land acquisition, engineering services, legal, and project and financial management).
3. An allowance for additional costs arising from uncertainties and unplanned risk events which could occur on the project.

The following sections address the derivation of the "construction cost" together with highlights of allowances applied, followed by a discussion on the derivation of other project costs.

13.2.2. Estimate Classification

As noted above, estimates are usually classified in accordance with the criteria established in AACE's Cost Estimate Classification System, referred to as Recommended Practice 69R-12 (AACE, 2013). The AACE Cost Estimate Classification System maps the various stages of project cost estimating together with a generic maturity and quality matrix, which can be applied across a wide variety of industries and capital infrastructure developments.

This estimate is considered consistent with Class 4 classification criteria described by AACE as:

> *"generally prepared based on limited information, where the preliminary engineering is from 1 to 15 percent complete. A Class 4 estimate is generally used for detailed strategic planning, business development, project screening, alternative project analysis, confirmation of economic and or technical feasibility, and where preliminary budget approvals are needed to proceed. Examples of estimating methods used would be equipment and or system process factors, scale-up factors, and parametric and modelling techniques."*

For comparison, a Class 3 estimate is described by AACE (particularly with reference to hydropower development) as:

> *"typically form the initial control estimate against which all actual costs and resources will be monitored. Typically, engineering is from 10 percent to 40 percent complete, and would comprise at a minimum the following: preliminary general arrangement drawings, powerhouse, intake and spillway drawings and specifications, essentially complete geotechnical investigations and hydrotechnical studies, preliminary earthwork drawings for excavation defining unclassified and rock, rock support and foundation treatment and for embankment complete with definition for various zones, complete one line diagrams, equipment performance specifications complete for turbines, generators, governors, and exciters, preliminary auxiliary mechanical and electrical systems, and preliminary piping and instrument/protection and control/telecom systems. Also, procurement strategy identifying long lead items of equipment."*

It should be noted that – to achieve Class 3 status – "*essentially complete geotechnical investigations*" are necessary, a condition not achieved until the proposed adits and additional drilling are complete.

Although there are many factors – depending on the type and complexity of the project, generally MWH interprets the classes defined by AACE as stated in Table 13.2-1.

Table 13.2-1. AACE Estimate Classes

AACE Class	Development Phase	Design Completion
5	Conceptual Design	0% and 2%
4	Preliminary Design	1% and 15%
3	Design Development	10% and 40%
2	Construction Document	30% to 75%
1	Check Estimate	65% to 100%

The above is illustrated in Figure 13.2-1.

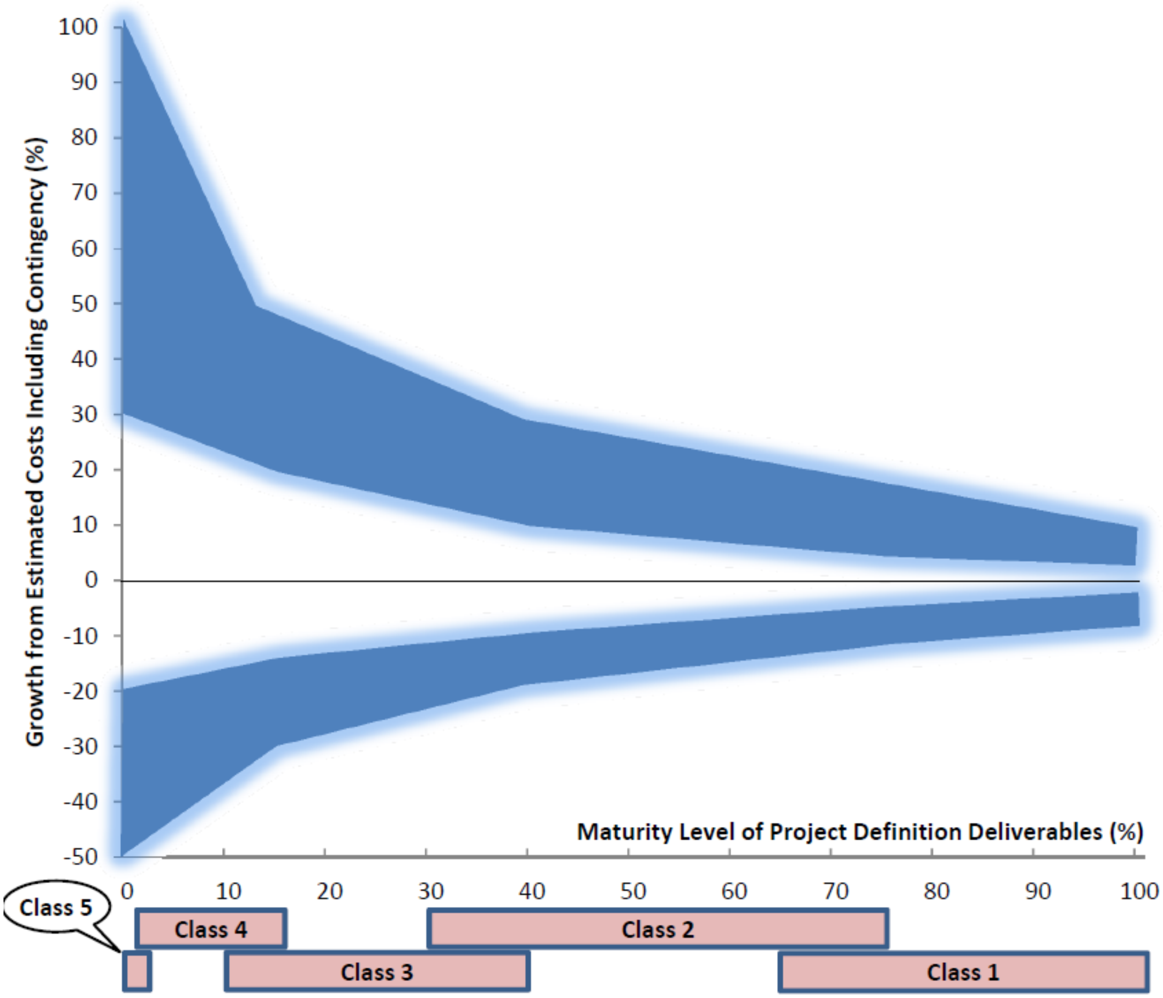

Figure 13.2-1. Variability in accuracy ranges for a Hydropower Estimate – from AACE 69R-12

13.2.3. Estimating / Scheduling Methodology or System

The estimate described relies heavily on a unit pricing methodology using unit prices derived from cost reports and estimates for other major dams in the United States, including Alaska, as well as data from projects of a similar complexity and size around the world.

Some key prices have been derived by considering work cycles, crew analysis, and resources.

Detailed construction schedules have been completed in Primavera P6 project management software as described in Section 14.

Table 13.2-1 below, summarizes the typical estimating methodology employed relative to AACE cost estimate classification.

Table 13.2-2. Typical Estimating Methodology Relative to AACE Cost Estimate Classification

AACE Class	System	Methodology
5	Spreadsheet	Parametric/Stochastic
4	Spreadsheet	Semi-detailed Unit Price
3	IPE**	Detailed Crew Analysis
2	IPE	Detailed Crew Analysis w/ Budget Quotes
1*	IPE	Detailed Crew Analysis w/ Firm Quotes

* Class 1 estimates are reserved for actual contractor proposals that rely on finalized bidding documents and access to all pre-tender addendums.
** International Project Estimating System

13.2.4. Estimating Accuracy and Contingency

AACE provides guidance with respect to estimating accuracy and typical contingencies. Estimating accuracy has been addressed by the probabilistic analysis of the price, quantity and scope variability as described below. Table 13.2-2 provides some basic guidance from AACE regarding contingency level recommendation relative to estimate class and input design.

Table 13.2-3. Estimating Contingency Level Recommendation

AACE Class	Design	Typical Contingency
5	<2%	20% to 40%
4	<15%	10% to 30%
3	10% to 40%	5% to 20%
2	30% to 75%	0% to 10%
1*	65% to 100%	0% to 5%

* Class 1 estimates are reserved for actual contractor proposals that rely on finalized bidding documents and access to all pre-tender addenda.

Based on the level of detail of the design presented in this report, and the required geotechnical investigation, it would be appropriate to allow a contingency in excess of 20 percent – and probably approaching 30 percent – to the estimate for the purposes of financial analysis.

The high and low range of quantities and prices used as input to the probabilistic analysis are presented in Appendix B10.

13.2.5. Quantities

Detailed line item quantities were developed by quantity take-offs from the three dimensional models, from the feasibility drawings and engineering sketches.

13.2.6. Significant Assumptions

Many assumptions of the contracting experience and competency must be made in deriving an estimate such as this. In this case the following have been assumed:

- Competitive bid conditions will prevail at tender.
- Normal and appropriate industry commercial terms will attach to all procurements.
- Stable market conditions will prevail without significant geo-political events or economic disruptions.
- An optimized contracting strategy will be employed by AEA to efficiently sequence and coordinate the work scope.
- No trade discounts were considered.
- Bidders will develop competitive proposals with regards to materials pricing and labor productivity, and will not include allowances for changes, extra work, unforeseen conditions, or any other unplanned costs.
- Estimated costs are based on a minimum of three bidders for each major contract. Actual bid prices may increase if there are fewer bidders or decrease for a greater number of bidders.
- Bonding and Insurance will be available to the contractors.
- Contractors will structure their proposals to promote positive cash flow and to minimize the requirement for them to finance their operations.

13.2.7. Direct Cost Development

Directs costs representing the project's fixed physical scope have been estimated against a work breakdown structure (WBS) to organize the estimate details. Direct cost detail is decomposed to multiple sub-levels, which are referred to as item activities. Class 5 and 4 estimates typically apply all-in unit prices against the line item quantities whereas Class 3 and 2 estimates derive pricing under a crew based productivity analysis per line item.

For the 2013 estimate, crew based productivity analysis has been performed for selective line items based on the construction planning performed to date in the study process – taking the estimate "beyond" a Class 4 estimate towards a Class 3 level. The construction planning is further documented in Section 14.

13.2.8. Indirect Costs

In accordance with normal practice for Class 4 estimates, indirect costs representing the contractor's time related variable field management expenses, or General Conditions costs, have been factored in a top-down approach as a function of running direct costs. The following have generally been used – although variations have been included for some of the packages:

- Contractor General Conditions (Prime) — 20% of running direct costs
- Contractor Design/Detailing — 4% of running direct costs
- Site Demobilization and Clean Up — 3% of running direct costs

13.2.9. Estimate Add-Ons

Similarly, add-ons representing the contractor's allowances for home office overhead expenses, sales taxes, insurance costs, risk provision and fee have been added to the cost estimate as a function of running direct costs. These are often referred to as "Overheads and Profit (OH&P). The following have been used:

- Subcontractor Mark-ups: — included in unit and equipment prices
- Prime Contractor OH&P on Subs: — included in unit and equipment prices
- Prime Contractor OH&P on Self-Perform: — 10% of running direct costs
- Contractor Insurance Program: — 2.0% of running direct costs
- Forex cover (percent of any imported goods): — 0.5% of running direct costs.

13.2.10. Labor Rate

As a Class 4 cost estimate, this estimate relies on all-in historical database prices and does not involve development of hourly rates for labor and equipment resources.

13.2.11. Equipment Rate

In a similar manner to the labor rate development, this estimate has generally relied on all-in historical database prices and has not typically required development of hourly rates for labor and equipment resources, although some key aspects of the work such as RCC prices have been developed in more detail.

13.2.12. Escalation

Estimated costs reflect current (Q2-2014) prices. Unit rates or prices derived from other sources have been escalated to the second quarter 2014. No future escalation has been included in the estimate.

13.2.13. Allowances and Contingency

Allowances have been made in the estimate where there is not a developed conceptual design for a specific feature that is required for construction. These items have been identified as allowances in the estimate. The only specific allowance included in the estimate is an allowance for unlisted items which has been included to cover items that are known to be included in the works but have not been detailed or measured at this early stage of design.

The estimate includes an allowance for an installed price for the major generating equipment, including electrical and mechanical elements of the project. Costs for these components have been determined from a parametric analysis of completed hydro projects (maintained and regularly updated by MWH), as opposed to obtaining pre-construction pricing estimates from prospective equipment suppliers.

13.2.14. Market Conditions

Prior to the global economic downturn in 2008, unprecedented market volatility was a significant unknown in contractor pricing over many years. Current market conditions have shown an aggressive approach to pricing, with contractors assuming more risk to win work. Consequently, while a bid price may be significantly under the reported "fair valuation" of the estimate, there is increased potential for claims and other compensation demands that contractors may employ to offset aggressive bidding strategies. This could affect the final price of the work being performed.

13.2.15. Construction and Contracting Aspects

The following aspects of the contract strategy and administration will affect the bid (and final) price and should be carefully considered:

- Extraordinary phasing constraints or requirements;
- Onerous or unusual contract terms and conditions;
- Any owner reputation for payment and for processing changed conditions claims; and,
- Owner reputation for prompt payment.

The derivation of a procurement and contract strategy has not been a part of the current engineering feasibility studies. AEA is performing internal studies on procurement and contracting strategy, the results of which were not available to the engineering team preparing this estimate and report. For this estimate, the project team has derived a contracting strategy based on the domestic and worldwide experience of MWH, the criticality of the interfaces between contractors and suppliers, a reasonable apportioning of risk between parties, and an assessment of what contract scopes would be performed by Alaskan based local contractors. The OPCC has therefore been derived based on dividing the construction work and the associated support and supply chain into the following twelve separate contracts – each initially executed with AEA, though some would most likely subsequently be assigned to the main contractor as "Nominated Subcontractors" for prudent management and the placing of risk:

- Main Access Road Construction
- Railroad Offloading Facility Construction
- Site Development (for infrastructure)
- Supply and Erect Camp
- Main Civil Works Construction
- Turbine and Generator Supply
- Transmission Line and Interconnection Construction
- Site and Reservoir Clearing
- Air Transport Services
- Railroad Operations
- Camp Operation
- Medical Services

It is assumed that – to ensure a "level playing field" for bidding, and to make sure that the contractor retains control of the various supporting work – the four service contracts below are all let by AEA as "Nominated Subcontracts" at a reasonably early stage, so that all bidders for the Main Civil Contract are aware of the terms of contract, the bidders or even the winning bidder, before submitting their own contract bid:

- Air Transport Services
- Railroad Operations
- Camp Operation

- Medical Services

After the award of the main civil works contract, the service contracts would be assigned to the main contractor to enable appropriate control over scheduling and interacting with the service providers.

Although the approach has not been integrated into the estimating, it is postulated that it would be in AEA's interest to consider a number of subcontracts or supply contracts that could also be let as "Nominated Subcontracts (Suppliers)", in the same way as the service contracts, and assigned to the main contractor for administration and direction. Potential nominated subcontracts could be:

- Supply of cement to the railhead
- Supply of fly ash to the railhead
- Any other particular equipment supply over which AEA would wish to exercise more control, or provide as "Owner Furnished Equipment" – such as gate fabrication; crane fabrication; and instrumentation and controls.

Adopting this approach would ensure competitive bidding and a greater control over costs and logistics.

13.3. Assumed Construction Methodology

13.3.1. General

Detailed construction planning has been executed for the key project tasks such as road construction; bridge construction; river diversion; quarry development; dam foundation excavation; RCC placement; and transmission construction. Key factors are interwoven through the whole construction planning as follows:

1. The short construction season (but with long hours of daylight) factors into many aspects of construction.
2. The remote nature of the site results in logistical planning being a key attribute of all tasks. Although three potential road routes are still under consideration, project estimates were based on a discrete project configuration. For the sole purposes of estimation, planning and scheduling it is assumed that the southern access route will be used, with the consequent reliance on the Alaska Railroad Corporation (ARRC), and the necessary rail offloading facility at Gold Creek. Because of the complexity of this route, the result is judged to be a conservative estimate of the cost of access. No suggestion has been made of which access route to adopt.

3. Similarly, transfer of power can be achieved in three corridors closely aligned with the three access routes. No suggestion of which transmission corridors to adopt has yet been made, but for the purposes of the estimate it has been assumed that two circuits will be placed in the east-west Gold Creek corridor and one circuit will be placed in the north (Denali) corridor.

Construction planning and methodology is addressed below for each projected contract package, and there is a discussion on logistics at the end of this section.

13.3.2. Main Access Road

This report does not recommend an access route. This discussion is based on the route chosen solely for the purposes of estimation of project cost.

13.3.2.1. Contract Description

Construction of the access road, because it is almost independent of other work on the project, could be setup as a design-build or other nontraditional contractual method. For the purposes of estimation, this work has been priced as a traditional Design-Bid-Build project. The costs for design and owner cost are carried in the overall program cost.

Three access routes are under consideration, but as explained above the Gold Creek route has been assumed for estimation, including an access road approximately 48 miles long. This contract does not include the permanent bridge at the site immediately downstream of the dam – which is necessary, in the interest of security, to avoid any public traffic across the dam crest.

13.3.2.2. Contract Scope

This contract would include construction of the main access road from a new rail siding located at Gold Creek to the project site. The contract would include clearing and grubbing, culvert construction and all excavation. It will also include stringing the temporary power line and fiber optics lines alongside the road to provide construction power and the establishment of an interconnection with the Alaska Intertie.

The contract would include the supply and erection of seven permanent bridges – each bridge being 24 ft. wide (sufficient for crossing by a Caterpillar 777 dump truck during delivery) with a capacity for a 190 ton load (such as a generator step up transformer). The permanent bridge downstream of the powerhouse will be constructed under the camp and airstrip civil works contract.

13.3.2.3. Design Assumptions in Pricing

The contract includes the construction of a 30 ft. wide roadway that will have a six inch layer of gravel surfacing. The clearing and grubbing consists of clearing the right of way, 150 ft. wide for 48 miles. Seven of the bridges along the access road will be 24 ft. wide and specified to carry a load of 190 tons.

The drainage across the road was assumed to be at a 300 ft. intervals. This drainage is assumed to be culvert type drainage. Guard rail has been assumed for a distance of 20 percent of the road length.

13.3.2.4. Key Aspects of Construction Methodology

Once the contractor has been given notice to proceed for the construction of the access road, mobilization of equipment, manpower and supplies will be performed in two stages.

The first mobilization will probably be performed via a CAT train, which will deliver some equipment and supplies to the halfway point of the road route, and also to the project site. The second mobilization of equipment and materials will take place, by railroad, to the Gold Creek Siding Area shown on Drawing 03-16C001.

The Gold Creek Railroad Offloading Facility Construction will be mobilized immediately after all approvals and permit issuance. The contracts will need to establish a staging area and temporary camp areas at Gold Creek in order to allow construction to begin.

The main access road construction will proceed on four fronts; from Gold Creek eastwards; from the project site westwards, and from an intermediate location both east and westwards. Once the work fronts are established, clearing and erosion controls will be first on the schedule followed by pioneering along the right of way to allow all fronts to meet up.

Grubbing and stripping and stockpiling of organics will be followed by excavation and embankment construction along the alignment. Rock and common excavation will be balanced to complete embankments. Drainage crews will install culvert drainage along the way. When embankments are completed, topsoil that has been saved and stockpiled will be placed on the slopes for seeding.

Bridge construction will commence at each of the seven bridge locations on the access road as the pioneering of the road reaches it. For ease of construction and an accelerated schedule a pre-engineered bridge system has been assumed. Each of the bridges – projected to be ACROW (or similar) bridges – includes multiple spans, so the immediate task that can be performed from the pioneering road is the construction of the pier foundations, piers, and abutments. It is envisaged that the piers will be space frames, fabricated using large diameter steel pipe, in sections, so that they can be man-handled into place (using winches or helicopter lifts) and bolted together. To facilitate this, concrete pads will be constructed (and anchored into rock) after which the (space frame) piers will be attached, and temporarily guyed or strutted in position. After substructure completion – and when the road construction from Gold Creek has reached a stage of completion such that trucks carrying pre-engineered bridge panels can deliver them – the bridge superstructure will be launched from the west abutment of each location, immediately followed by the decking, after which the launch crew will move eastwards to the next location.

Although the camp at the Railroad offloading facilities will be used for the crews working eastwards from Gold Creek, the contractor will probably elect to create small temporary camps at the other work fronts.

13.3.2.5. Construction Schedule

The schedule for completion is based on a two season construction time frame. This can be accomplished with proper planning and execution of the contract. The project would be scheduled for a seven day work week on a two 10 hour shift basis for five to six months per construction season. The schedule is shown in Figure 14.1-2.

13.3.2.6. Construction Manpower

The peak manpower will be approximately 230, occurring in the first season as shown in Figure 13.3-1.

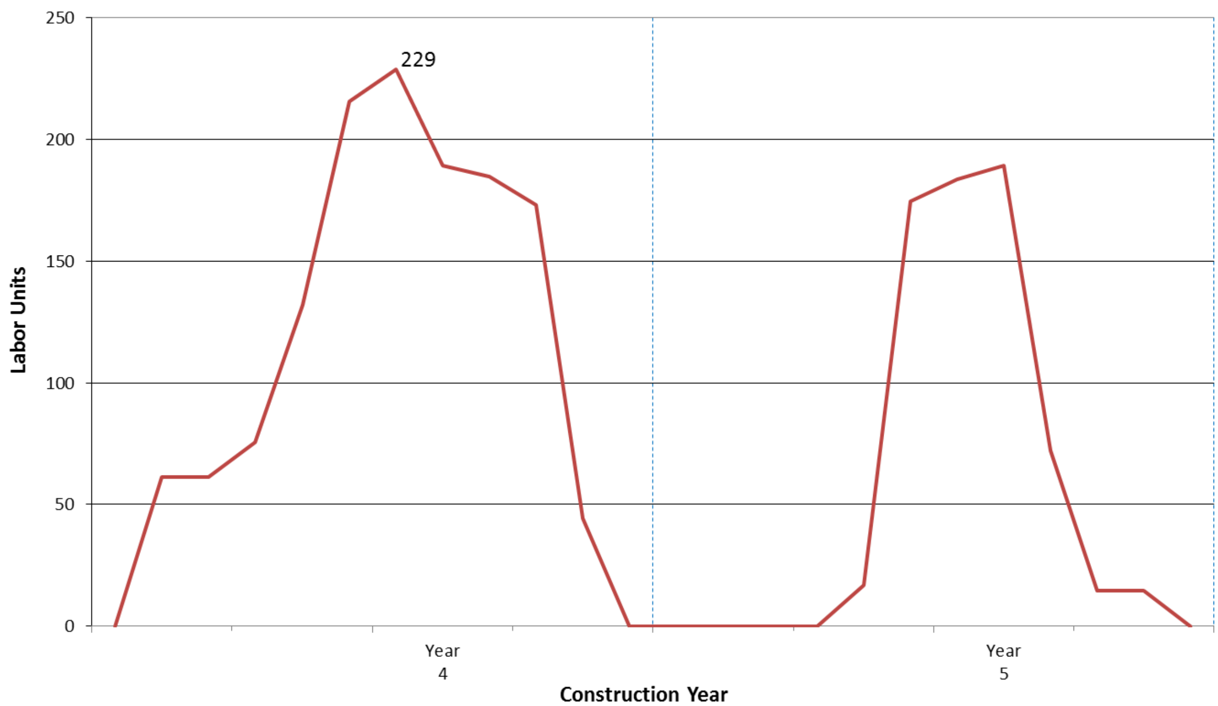

Figure 13.3-1. Permanent Access Road Manpower

13.3.2.7. Key Logistical Aspects

All equipment material and supplies will be transported to the Gold Creek Rail Siding for construction of the permanent access road and much of it will be moved by CAT Train to the east. The construction equipment required is estimated to total approximately 2,400 tons.

Other major materials required for the permanent access road contract is estimated to be:

Fuel	18,000 tons
Food	230 tons
Explosives	700 tons
Cement	900 tons
Fly Ash	500 tons
Reinforcement	500 tons
Structural Steel	4,000 tons
Forms and Misc. Supplies	200 tons
Total	25,030 tons

As noted, helicopter usage would likely be necessary to move (space frame) pier sections across the creeks and canyons and on to the concrete pier foundations.

Prior to the establishment of appropriate borrow sources (or instead of establishing a quarry), there exists material at Curry (created as a byproduct of ARRC ballast production) that might be suitable for use as road surfacing.

13.3.3. Railroad Offloading Facility

13.3.3.1. Contract Description

This contract can be setup as a design build or using other contractual methods. As part of negotiations with ARRC, and because the construction activities are so closely connected with ARRC, the construction could be carried out by ARRC as part of the Railroad Service contract. For the purposes of cost estimation, however, this construction has been priced as a traditional Design-Bid-Build contract. The costs for design and owner cost are carried in the overall program cost.

13.3.3.2. Contract Scope

The scope of this work is the construction of two railroad sidings at Gold Creek, each approximately 4,500 ft. long, together with another shorter spur. It would require clearing and grubbing of the entire area needed for the facilities. Included in the contract work is the creation of storage areas, parking areas, fuel storage areas, concrete hard standing, covered storage areas, offices and maintenance shops (for use during the whole project construction) lighting, temporary and emergency power generation, a permanent connection into the fiber optic cables alongside the ARRC (for the project construction and for permanent use of the finished project) and necessary water supply and sewerage, etc.

The contractor will also prepare the site for the temporary accommodation that will be provided by the Camp Supply and Erect. Part of the initial camp at Gold Creek, used for the road construction and initial site works, will subsequently be relocated to the dam site. The final accommodation (for the duration of the project) at the site after completion of the facility will be enough accommodation for those operating the offloading facilities, for transitory workers and for emergency – for example when inclement weather shuts down the access road or the ARRC, leaving personnel stranded.

The contract scope will not include the installation of any switch on to the ARRC siding at Gold Creek – as ARRC insist that they perform that type of work themselves at all locations on the system.

13.3.3.3. Key Aspects of Construction Methodology

All work under this contract will be supplied via the ARRC, and must be done in close cooperation with the ARRC.

At the same time that the offloading facility is being created, the contractor for the road will be using the facility, and the Camp Supply and Erect contractor will be constructing facilities which will immediately be used for workers for all other concurrent contracts until the facilities are subsequently partially removed.

13.3.3.4. Construction Schedule

The schedule for completion is based on a single season construction time frame. This can be accomplished with proper planning and execution of the contract.

The project would be scheduled for a seven day work week on a two 10-hour shift basis for five months, as shown in the schedule shown in Figure 14.1-3.

13.3.3.5. Construction Manpower

The peak manpower will be approximately 200 as seen in the Figure 13.3-2 below.

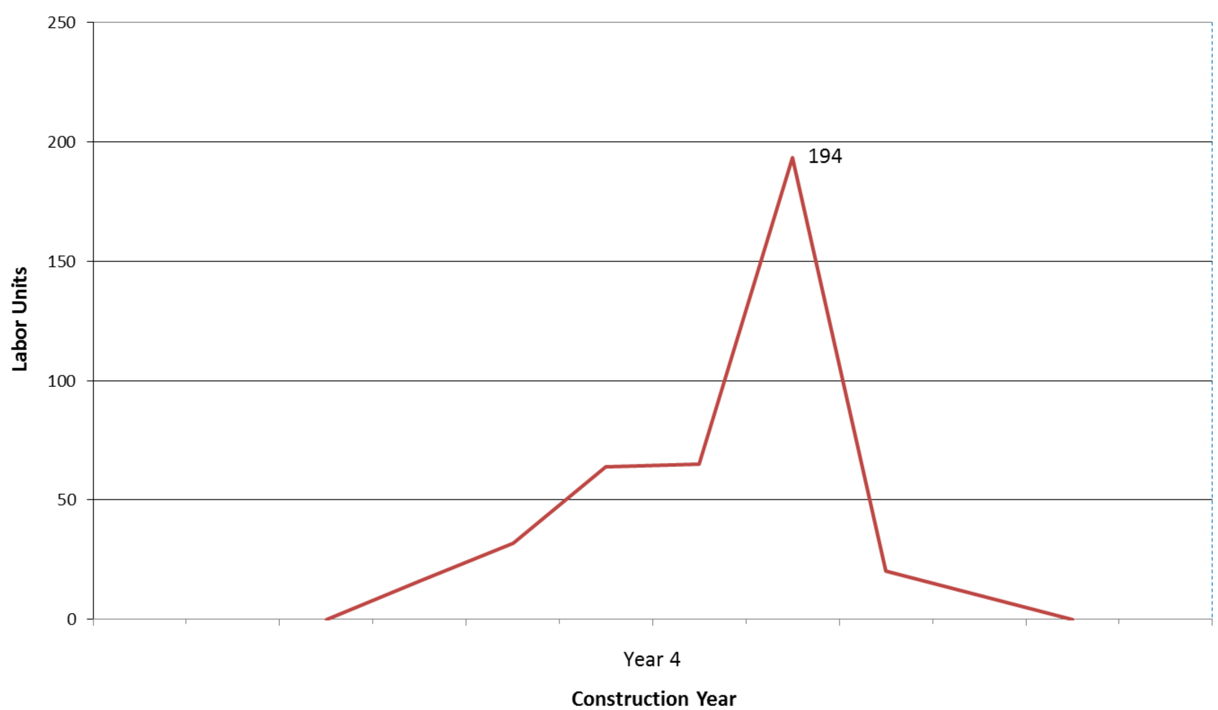

Figure 13.3-2. Rail Siding Construction Manpower

13.3.3.6. Key Logistical Aspects

Almost all significant materials and plant for project construction will be offloaded at the Railroad Offloading Facility. The facility will also provide for utilization of a railroad owned quarry at Curry and the setup of an initial 350 person camp for the construction of rail siding and the permanent access road. It is assumed that a "secondary" mobilizing area will be set up further south on the ARRC by the contractor for loading materials on for the construction of this facility.

13.3.4. Camp and Airstrip Civil Works

13.3.4.1. Contract Description

This is essentially the basic site infrastructure contract. It cannot be set up as a design build or other alternative contractual methods because the work being performed is essentially the civil works for another contract and significant integration between the designs for each contract are required. Thus this has been estimated as a traditional Design-Bid-Build contract.

The costs for design and owner cost are carried in the overall program cost.

13.3.4.2. Contract Scope

The scope of this work is implementation of the civil works necessary for the site temporary and permanent infrastructure on the north side of the dam site. The contract scope includes:

- Clearing and grubbing for the site infrastructure works as necessary;
- Site access roads around the camp and permanent village, to the airstrip, and to the contractors area;
- Earthworks associated with the permanent village, the camp, and recreational facilities (both permanent and temporary);
- Construction of a temporary airstrip, followed by the construction of the permanent airstrip, apron, turning areas and foundations for the associated buildings;
- Raw water intake, pipeline and treatment facilities (including the permanent protective buildings) and distribution lines to the sites of the various accommodation and project buildings, also included is the fire water system;
- Sewerage from the site of the various accommodation and project buildings;
- Wastewater treatment plant, permanent protective buildings, and outfall;
- Float plane dock;

- The electrical distribution system and fiber optic cabling around the site from the emergency power facilities;
- All fencing around the camp, airstrip, permanent accommodation and facilities, and the various infrastructure buildings and facilities; and,
- Permanent bridge at the site (28 ft. wide).

Although the construction cost estimate has assumed that the first (temporary) airstrip will be constructed at the site of the permanent airstrip, at a later stage of project development, the use of the airstrip at Stephan Lake should be considered. Upgrading of that airstrip – and the construction of a pioneering access road of about three miles (from Stephan Lake to the access road corridor) might be a more appropriate way of initiating site work at the dam site. If that were to be the case – the work associated with Stephan Lake would replace some of the scope of this contract.

13.3.4.3. Key Aspects of Construction Methodology

Once the contractor has been given a notice to proceed for the contract, mobilization of equipment, manpower and supplies will be performed so that movement to the site can be undertaken by CAT train.

The CAT train will transport all equipment and supplies to the north bank of the site from Cantwell – and no other significant mobilization will be possible for this contract as all contract tasks must be completed before the completion of the access road.

A first task of the contractor will be to doze a 3,500 ft. long pioneer strip so that L-100 planes can land and take off, servicing the site before the access road is complete. The subsequent extension to form the permanent airstrip, while not interrupting the use of the temporary strip, will be a logistical challenge which might indicate the preferential use of the Stephen Lake airstrip, discussed above.

A temporary camp will be required while this contract is being executed, which would be serviced by air.

If the Stephan Lake option is found to be more efficient and economic, then the logistics – and the CAT train, would all be based on transporting equipment from Gold Creek, and upgrading of the Stephan Lake strip instead of bulldozing a new strip at the site.

The permanent long span bridge at the site will also be pre-engineered, but as presently designed, cannot be launched. It is assumed that the abutments and piling will be constructed using the materials and equipment moved to site by the CAT train, and the span will be assembled in the following winter, using the frozen river as construction access across the entire span. If the river ice needs thickening, or smoothing, to facilitate construction, it is expected that the contractor will do so using conventional "ice road" methods.

13.3.4.4. Construction Schedule

The schedule for completion is based on a single season construction time frame. This can be accomplished with proper planning and execution of the contract.

The project would be scheduled for a seven day work week on a two 10-hour shift basis for the six month season per the schedule which is shown in Figure 14.1-4.

13.3.4.5. Construction Manpower

The peak manpower will be approximately 150 as seen in Figure 13.3-3 below.

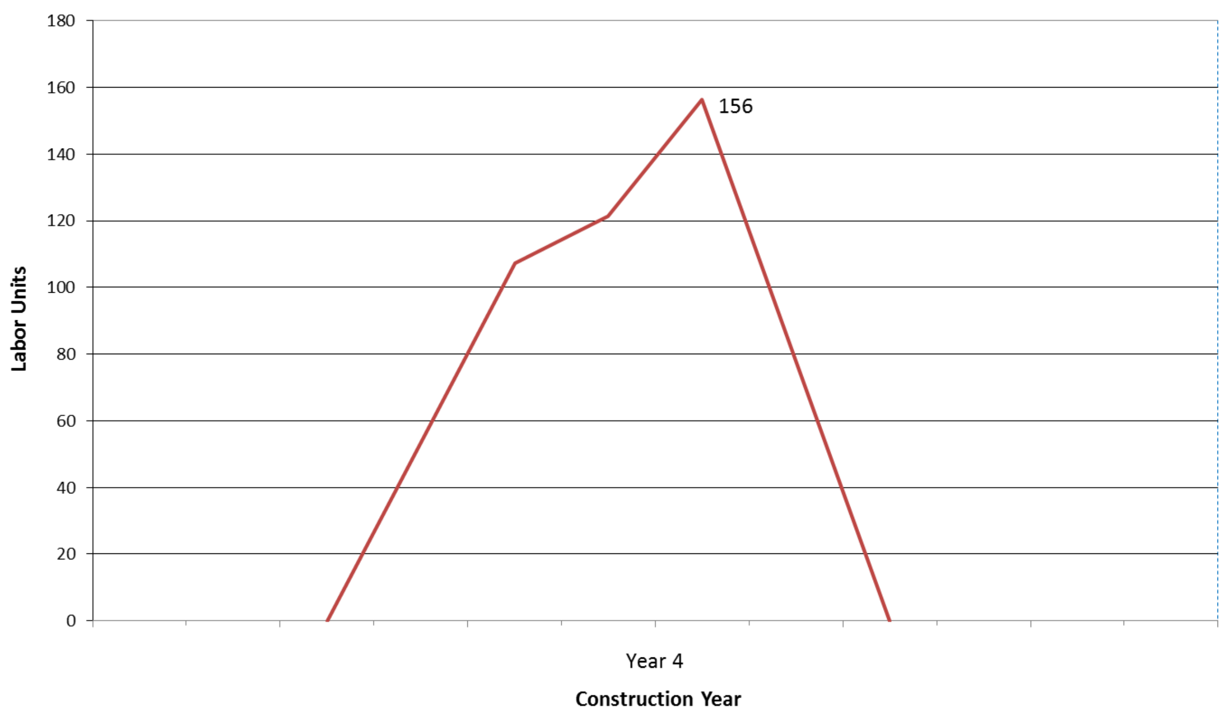

Figure 13.3-3. Camp and Airstrip Civil Works Manpower

13.3.4.6. Key Logistical Aspects

This contract must be completed using equipment and materials brought in by the initial CAT train, or as supplied by an L-100 plane (or similar) using the temporary airstrip (or extension upgrade of Stephan Lake strip) that will be constructed.

13.3.5. Supply and Erect Camp

13.3.5.1. Contract Description

This contract could be setup as a Design/Build or other alternative contractual method. For the purposes of cost, this work has been priced as a traditional Design-Bid-Build execution. The design and owner costs are carried in the overall program cost.

13.3.5.2. Contract Scope

This contract would essentially be a building and building supply contract, albeit using prefabricated (factory preassembled) items. All site works ready for the building will have been performed by another contractor, and this contract will include the supply and construction of:

- Camp accommodation at Gold Creek, and the relocation of part of that camp to the main site.
- Camp and recreation buildings at the main site for both workers and management staff including the temporary accommodation for construction management, AEA and engineering staff.
- Completion of sports fields, etc.
- Construction of airport buildings.
- Permanent houses at the main site.
- Connection of water supply, sewerage, power, fiber optic cables, etc. to all buildings constructed under this contract.
- Removal of temporary accommodation at the end of the project and refurbishment of permanent buildings. This aspect of the contract scope can be the subject of debate when final contract packages are chosen – depending on discussions with potential contractors with respect to salvage value.

13.3.5.3. Key Aspects of Construction Methodology

It is assumed that the temporary camp will largely be constructed using prefabricated modular components – approximately the same size as a container – so that the components can be transported in the proposed supply chain via the ARRC.

The temporary buildings and permanent buildings (such as houses, airport buildings, permanent recreational buildings, etc.) are expected to be manufactured in sizeable components off site, and finally assembled on site.

13.3.5.4. Construction Schedule

The schedule for completion is based on a single on-site season for construction assembly. This can be accomplished with proper planning and execution of the contract. However, prior to shipping to the site, a full year has been allowed for construction of the modules within a factory setting.

The project would be scheduled for a seven day work week on a two 10 hour shift basis for five to six month construction season. The schedule is shown in Figure 14.1-5.

13.3.5.5. Construction Manpower

Much of the manpower associated with the assembly of the temporary camp would be employed off site at the factory of the contractor. However there will be craftsmen on site and several managing personnel.

The peak manpower on site will be approximately 340 as seen in Figure 13.3-4 below.

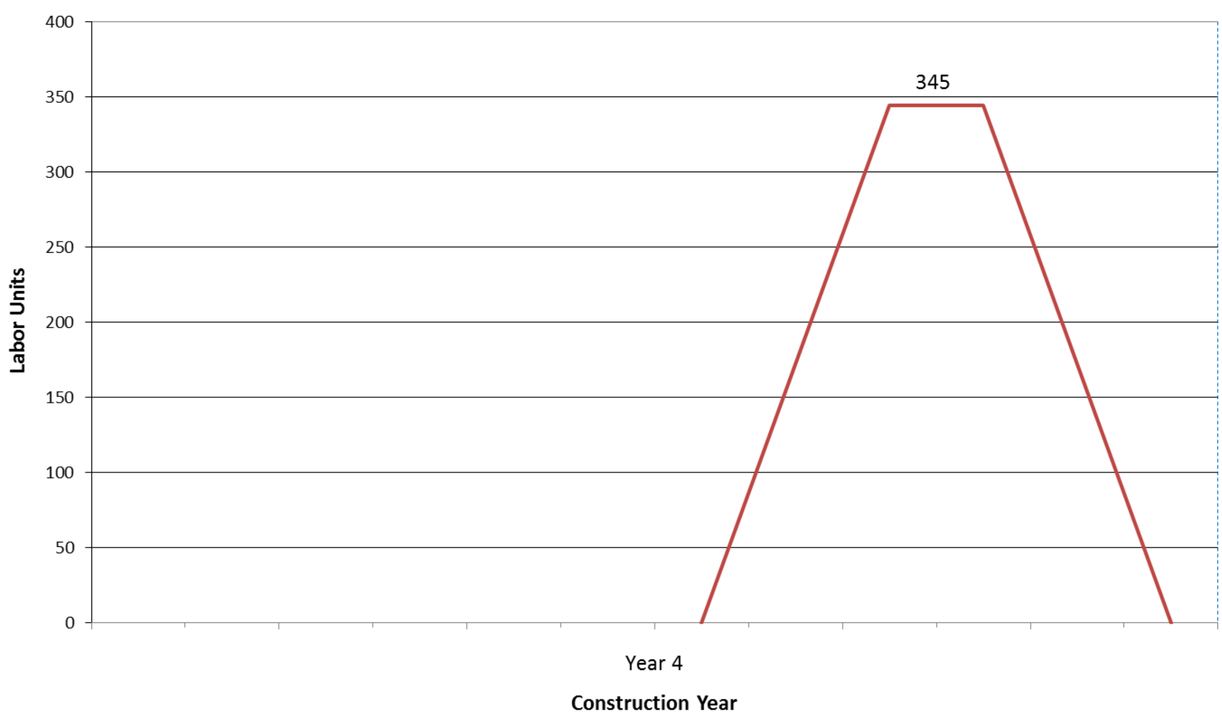

Figure 13.3-4. Camp and Airstrip Building Manpower

13.3.5.6. Key Logistical Aspects

The substantial amount of material that is required for all the temporary and permanent infrastructure is such that it is not feasible to move it all to site early by CAT train.

However the short period on site allowed for assembly of all the prefabricated buildings will require very careful and organized logistics to ship by rail and deliver to the site. All will be in sizes that can be handled by container handling units, and at this stage of construction, the very large numbers of shipments of cement and flyash will not have commenced. Nevertheless coordinating the building process will be a challenge.

13.3.6. Main Civil Works Construction

13.3.6.1. Contract Description

The scope of the main civil works contract is such that it will need to be completed by an experienced dam contractor, or a consortium of experienced contractors. This effectively rules out local Alaskan (headquartered) companies as the lead participant in the group – although significant Alaskan participation is expected. It is possible for this contract to be offered as a Design/Build execution, but the size of the project works, and the consequent expected interest by FERC in the detailed design – as well as procedural constraints of the FERC process – render this a less favorable option that exhibits more risk. For the purposes of cost estimation, this contract has reasonably been assumed to be a traditional Design-Bid-Build contract and has been estimated thus. Much of the scope will be performed by subcontractors, either selected by the contractor based on the specifications, or as nominated subcontractors and suppliers assigned to the contract. The costs for design and owner cost are carried in the overall program cost.

13.3.6.2. Contract Scope

This contract will be the largest of all entered into by AEA for the Susitna-Watana Project and will include in its scope:

- Temporary roads around the site;
- Development of the quarry, and installation of the crushing and batching plant;
- Portals, diversion tunnel, cofferdams, etc.;
- Foundation excavation, and construction of the RCC dam and spillway;
- Construction of all power facilities, including access tunnel, powerhouse, and supply and installation of all electrical, mechanical and electrical equipment – except the main equipment supplied under the Turbine-Generator Supply contract;

- Supply and installation of all gates, cranes, valves, penstocks, pipes, etc.;
- Supply and installation of all switchgear including all equipment in the switchyard;
- Obtaining all needed materials both for construction and for permanent installation;
- Creation of all temporary works needed for completion of the project, on site, as well as off-site storage and loading areas as required;
- Provision of security and general maintenance of site infrastructure, access road, etc.;
- Removal of all unused construction materials and the reinstatement of all disturbed site areas;
- Removal of any infrastructure at site and at Gold Creek not removed under other contracts;
- Commissioning of the project; and,
- Administration of any (nominated sub contract) let by AEA and subsequently assigned to the Main Civil Works contract.

13.3.6.3. Key Aspects of Construction Methodology

To enable the earliest possible construction start, the draft feasibility report schedule is based on certain assumptions. These include making use of CAT trains for prepositioning of some initial construction and site preparation materials and supplies during the winter prior to a construction road being completed to the site.

One or more CAT trains would transport equipment and supplies to the north bank of the site from Cantwell so as to stockpile materials and supplies for the purposes of establishing the contractors’ work area on the north bank. Early delivery of materials and supplies will make it easier to create access roads to the upstream and downstream portals of the diversion tunnel as soon as regulatory authorization is granted (and other permits obtained) to more efficiently be able to start establishing the portals and to commence the excavation of the diversion tunnel.

One or more other CAT trains will be mobilized to move, to the south bank of the site from Gold Creek, all material and equipment necessary to commence the opening of the quarry and the establishment of the crushing and batch plants.

Temporary camps will be set up and the contractor will perform the following tasks concurrently with the construction of the access road, site civil infrastructure, and Gold Creek Offloading tasks:

- Construction of a temporary bridge across the river sufficient for personnel and nominal vehicles such as quad bikes and trailers;
- Excavation and lining of the diversion tunnel;
- Creation of site construction roads;
- Excavation of the dam foundation on the left and right banks; and,
- Development of the quarry and the crushing and batch plants.

Once the access road from Gold Creek has been completed by another contractor, and the supply chain has been established, further equipment can be mobilized for the full project construction.

To facilitate the earliest possible connection of the first unit on line, high productivity will be required in all areas of construction, but most particularly in RCC mixing and placement. It has been assumed that RCC placement will occur over five seasons – including a season before the diversion has been achieved, and the last season while the reservoir is filling. Seasons have been assumed to be five or six months long, with at least 1,000,000 yds^3 being placed each season and – governed by the following requirements and constraints:

- Placement on the right bank to a level that allows for the subsequent construction of the spillway using conventional concrete (CVC) as soon as possible;
- Placement in the center (river bed) to a level both upstream and downstream to facilitate the use of a sluice through the left side of the dam for ice passage during breakup, and so that CVC placement for the powerhouse substructure can be commenced as soon as possible;
- Placement in the center (river bed) to a level at the upstream to allow for the commencement of the power intakes in CVC as soon as possible; and,
- Placement of the remainder of the RCC such that the height of the dam is raised as quickly as possible and so that – at the time of closing the diversions – the reservoir can be safely filled to allow for the turbine-generating units to be commissioned, with reservoir level control undertaken by the low level outlets and the emergency release.

Figure 13.3-5 shows the anticipated placement sequence.

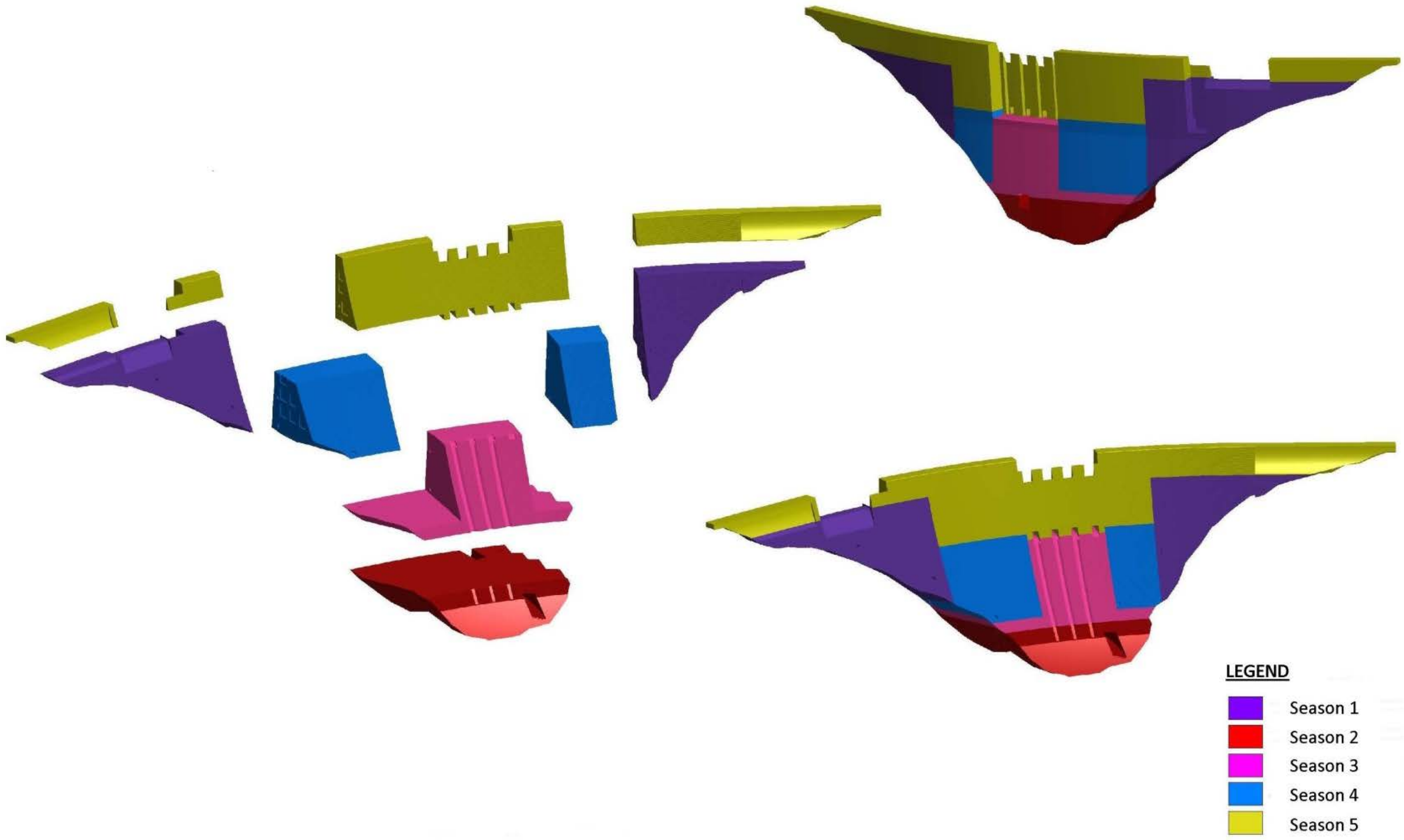

Figure 13.3-5. Seasonal Sequence of RCC Placement

To perform this RCC placement during the summer and fall seasons, the contractor will need to install sufficient conveying equipment to reliably deliver at rates exceeding 380 yds^3 per hour, allow for breakdowns, provide insulation of completed RCC, provide insulation of joints as the layers are completed and extend the placement season as long as possible. It is anticipated that the contractor will place by sloping layers, and will establish insulation and heating for many, if not all-aspects of storage of materials, batching, mixing and transport.

It is anticipated that fly ash and cement will be delivered to site in tank containers to facilitate speed in the supply chain, and that buffer storage will be established by storage of such tank containers at the top of the left abutment so that their content can be blown out direct to the batch plant.

The contractor is expected to draft a detailed construction schedule that will facilitate, as soon as reasonable, the all-weather construction of as many parts of the project as possible. Under cover, permanent or temporary, placement of structural concrete can be continued throughout the year. The intake, for example, is compact and easy to weatherproof temporarily for construction. The powerhouse can be designed to include a structural steel framework from the lowest level – together with infill concrete panels – so that a weatherproof enclosure is constructed very early in the powerhouse construction sequence, and substructure concrete can be placed year round. These techniques – of using steel frames and precast panels – have been pioneered in Quebec and is illustrated in Figure 13.3-6 which shows a framed weatherproof (with concrete precast panels) structure erected from the lowest levels of the powerhouse, and the substructure being completed within the protected environment.

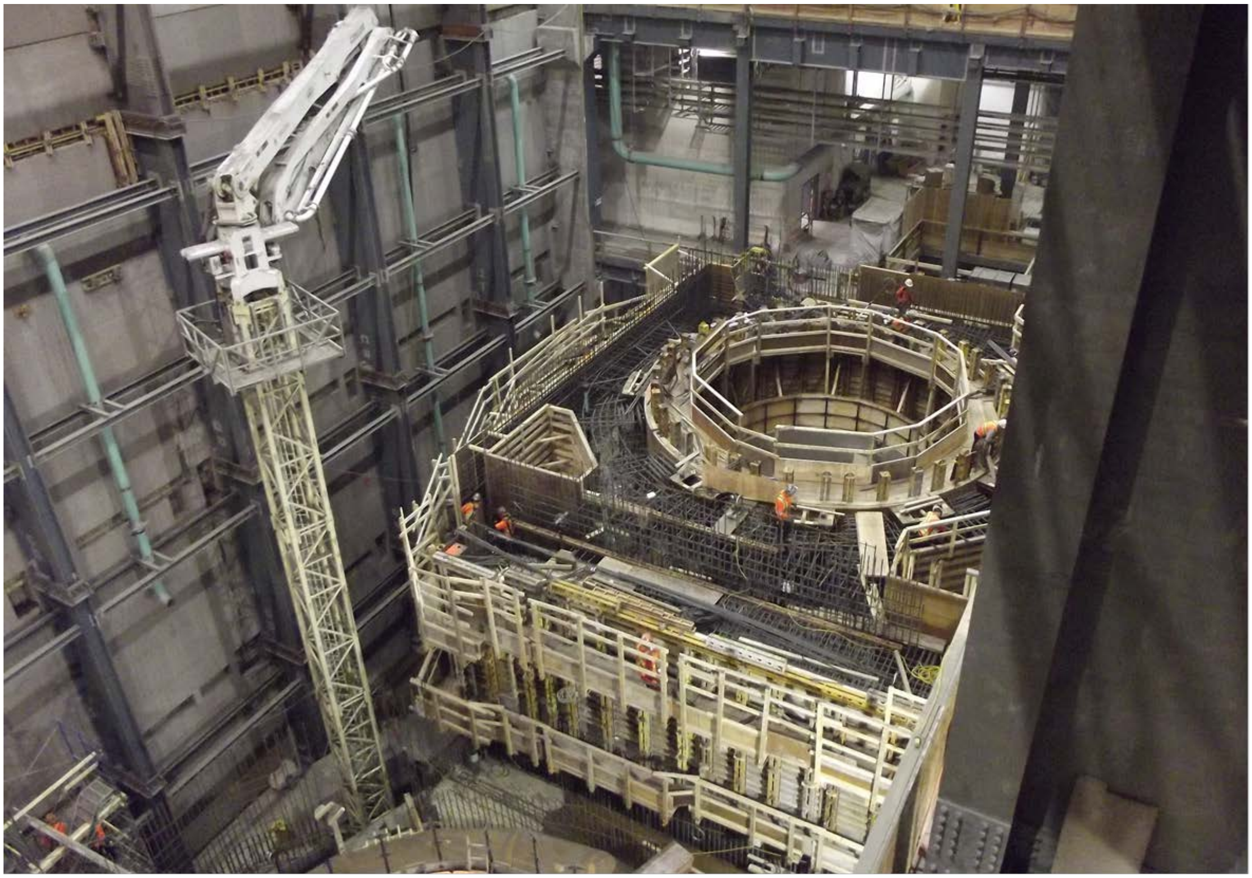

Figure 13.3-6. Construction of Powerhouse Substructure within a Protected Environment (*acknowledgements Hydro Quebec*)

13.3.6.4. Construction Schedule

The schedule for completion is based on a seven season construction time frame. RCC placement will only be performed during the summer seasons, but as much construction as possible will be continued throughout the year as discussed above. This schedule can be accomplished with proper planning and execution of the contract.

The project would be scheduled for a seven day work week on a two 10-hour shift basis. Construction workers would be rotated out as discussed below, and as much work as possible would be prefabricated off site and brought to site in pieces as large as feasible to maintain productivity. The schedule for the main civil works is shown in Figure 14.1-6.

13.3.6.5. Construction Manpower

The peak manpower will be approximately 960 as seen in Figure 13.3-7 below.

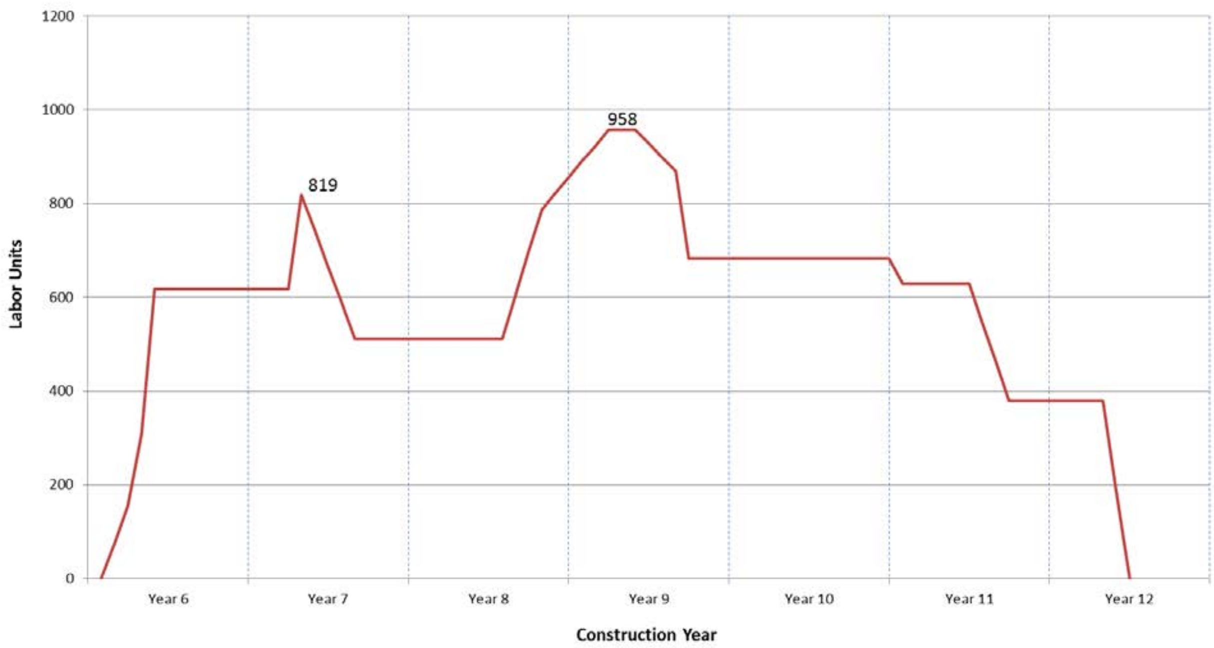

Figure 13.3-7. Main Civil Works Manpower

13.3.6.6. Key Logistical Aspects

The most challenging aspect of the logistics for this contract is the volume and weight of materials and equipment that will be shipped along the ARRC to the Gold Creek siding, and hereafter along the road.

It is assumed that as far as possible the contractor will containerize the deliveries and will move as much material directly from Anchorage and the selected port (expected to be Whittier) to the site without double handling.

Typical large loads that cannot be containerized for transportation are shown in Table 13.3-1 below.

Table 13.3-1. Large Loads and Approximate Dimensions

Equipment	Length (ft.)	Height (ft.)	Width (ft.)	Weight (ton)	Notes
Main Crane Beam	80	8	8		A full length crane beam is preferred, but it can be split down to shorter lengths.
Power Intake	22	11.5	4	32	Each gate will be in two sections, numbers shown are for one section.
Lower Level Outlet	24	11.5	4	35	
Spillway Gates	50.5	21	6	70	The 21 ft. dimension can be reduced if necessary.

Equipment	Length (ft.)	Height (ft.)	Width (ft.)	Weight (ton)	Notes
Draft Tube Bulkheads	23	12	3	25	Each bulkhead will be in two sections. Dimensions and weight are for one section.
Penstock Cans	30	19 ft. diameter		54	
Butterfly Valves	18 ft. diameter		6 ft. (thickness)	70	

13.3.7. Turbine and Generator Supply Contract

13.3.7.1. Contract Description

The design and manufacture/fabrication of the turbines, governors, generators, exciters, generator step up transformers, etc. constitutes specialist manufacturing. The supply contract is expected to be a traditional design, manufacture and deliver contract. Usually the supplier delivers the equipment to the site, but does not install it. Installation is performed by the main contractor (or a subcontractor) under the direction of installation supervisors provided by the manufacturer. Such a contractual arrangement minimizes the possibility of claims because of competing use of space in the powerhouse. The main civil contractor often (but not always) subcontracts installation back to the turbine generator supplier.

The costs for preparing the specifications for the supply contract, and the owners cost are carried in the overall program cost.

13.3.7.2. Contract Scope

The contract scope will include the following:

- Design, model testing and manufacture of the turbines;
- Design and manufacture of the generators;
- Supply of the governors;
- Supply of the exciters;
- Supply of generator step up transformers;
- Delivery of all supplied equipment to site; and,
- Provision of installation supervisors at site.

13.3.7.3. Key Aspects of Construction Methodology

The key logistical challenge for this supply contract is the size and weights of the individual items of equipment to be supplied – and in some cases the delicate nature of the equipment. Most of the supplied equipment can be shipped in pieces, but it is preferable to minimize the on-site welding of equipment so the maximum size parts should be shipped, even if it results in oversized loads on the ARRC. To accommodate oversized loads, some of them may have to be moved by road to the siding at McKinley before loading on the ARRC.

At the time of writing this report, a list of the large items associated with this contract to be shipped is given in Table 13.3-2 below.

Table 13.3-2. Large Turbine Loads and Approximate Dimensions

Equipment	Length (ft.)	Width (ft.)	Height (ft.)	Weight (tons)	Notes
Turbine Runner	14	14	7	40	
Stay Rings	24	24	5	72	Can be detailed to be lesser dimensions than runner.
Spiral Case	44	45	13	140	Can be detailed to be lesser dimensions than runner.
Draft Tube	18	18	28	24	Can be detailed to be lesser dimensions than runner.
Step-up Transformer	30	12	15	140	

Transformers will be the largest items to be transported from a manufacturing facility to the project site and will require special treatment. They will be shipped either on a Schnabel rail car or a multi-axle trailer as shown in Figure 13.3-8 and Figure 13.3-9 below:

Figure 13.3-8. Transformer Transport by Rail

Figure 13.3-9. Transformer Transport by Road

13.3.7.4. Supply and Installation Schedule

The schedule for fabrication, supply and installation of the turbines, generators and associated equipment is usually dependent on the turbine testing required by the owner. In-house models can be accepted, but particularly for larger units, owners often prefer to use an independent testing laboratory to perform runner design modeling which adds time. This aspect will be discussed with AEA at the appropriate time, and the decisions made will affect the commencement date for the preparation of the Turbine and Generator supply contract. Completion of on-site work is expected to take approximately 18 months – but the sequencing of the work is completely dependent on the Main Civil Works contractor because of the second stage concrete that is an integral part of installing the major equipment. At this stage a detailed installation schedule has not been prepared, but 36 months has been allowed for manufacture, delivery and installation of the turbines, generators, and other major equipment, although the turbine supplier will continue to be involved for a few more months for testing and commissioning.

The project would be scheduled for a seven day work week on a two 10-hour shift basis full time throughout the year. This will be possible because the main contractor is expected to complete the powerhouse superstructure as quickly as possible – even using temporary weather proofing – to allow work in the powerhouse to continue throughout the year unaffected by the weather.

13.3.7.5. Construction Manpower

The peak manpower on site will just be the supervisors – approximately three as seen in Figure 13.3-10 below.

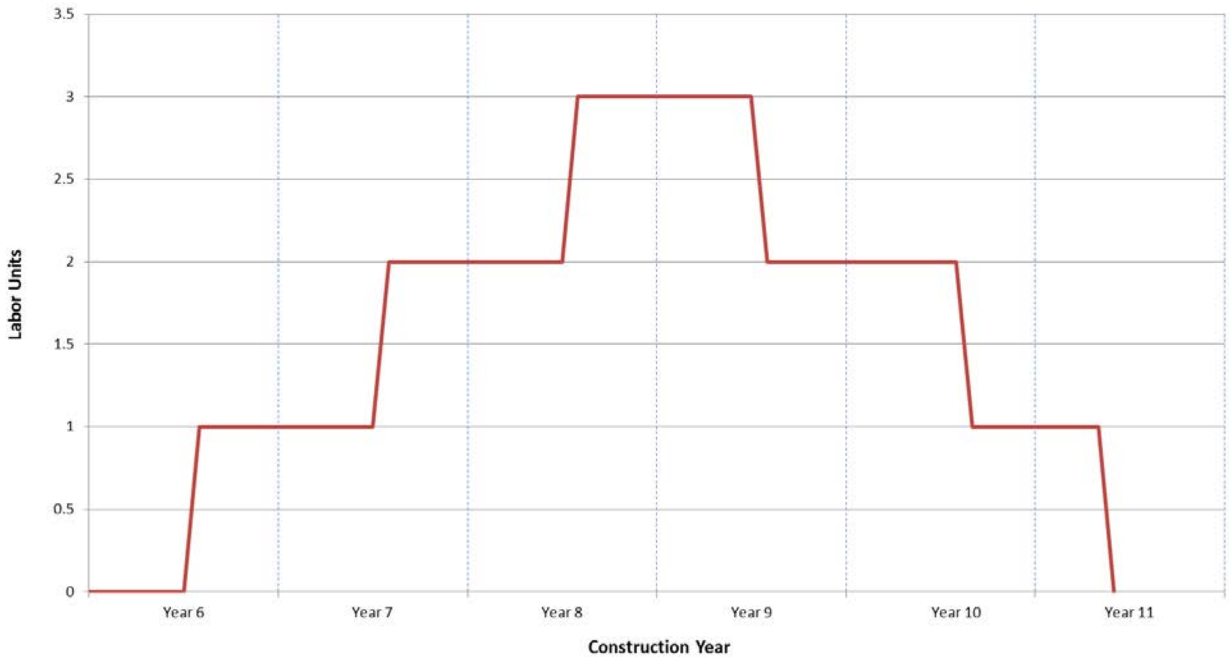

Figure 13.3-10. Turbine and Generator Manpower

13.3.8. Transmission Line and Interconnection

This report does not recommend a transmission configuration. The discussion is based on the corridors chosen solely for the purposes of estimation of project cost.

13.3.8.1. Contract Description

This Contract can be set up as a design build contract or use other contractual methods. For the purposes of cost estimating, this project has been priced as a traditional Design-Bid-Build project. The costs for design and owner cost are carried in the overall program cost.

13.3.8.2. Contract Scope

The scope of the contract includes for the supply of all towers, insulators and conductors, the installation of towers and stringing of the line, the construction of the interconnections at the Alaska Intertie and the connection of the circuits to the switchyard on site. The work will involve the creation of some access road spurs to the towers from the access road, and some construction by helicopter.

13.3.8.3. Key Aspects of Construction Methodology

As with all transmission line construction, a key element will be the setting up of interim storage areas on the transmission route from which work will be performed both ways. The line is typical of many such lines in Alaska so the contractor will be familiar with the moving and erection of the towers and of the helicopter construction methods required at various locations.

13.3.8.4. Construction Schedule

The schedule for completion is based on a three and a half season construction time frame. This can be accomplished with proper planning and execution of the contract.

The project would be scheduled for a seven day work week on a two 10-hour shift basis for five to six months per construction season. The schedule is not critical and the work can be commenced at any time during the whole project implementation, though it may be affected by the migratory bird nesting constraints.

13.3.8.5. Construction Manpower

The peak manpower will be approximately 43 as seen in Figure 13.3-11 below. Workers will sometimes be housed at the Railroad camp and sometimes at the main site temporary camp.

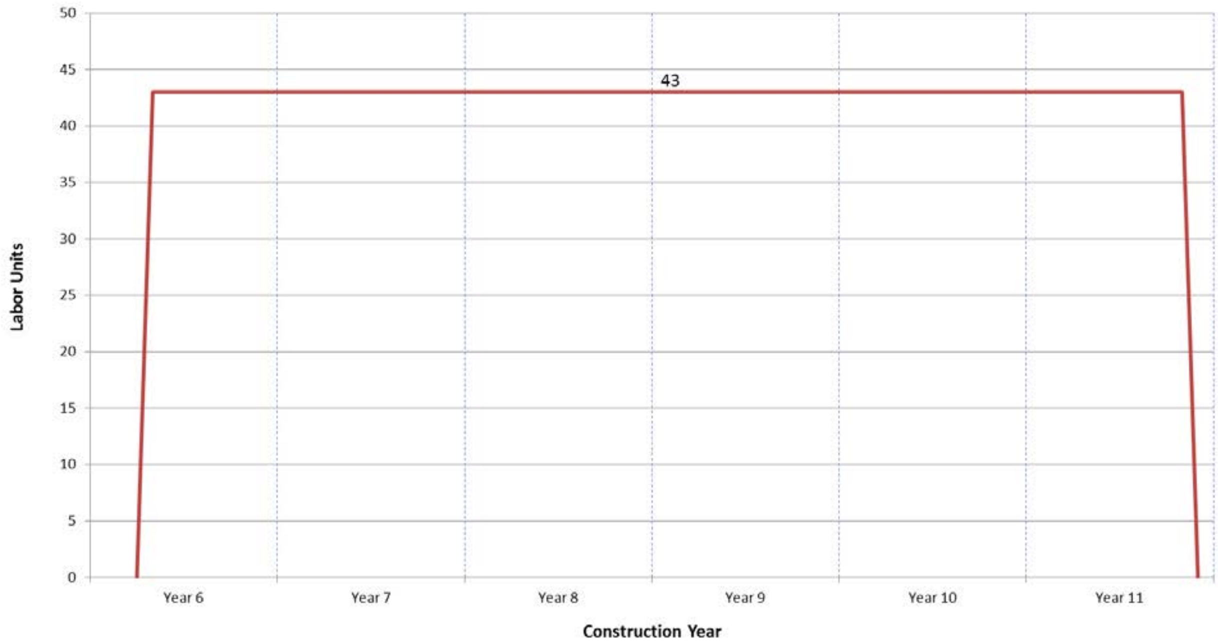

Figure 13.3-11. Transmission Line and Interconnection Manpower

13.3.9. Site and Reservoir Clearing

13.3.9.1. Contract Description

This Contract can be set up as a single (or multiple small) project(s) if desired. For the purposes of cost, this project has been priced as a traditional Design-Bid-Build project; however very little design is required and input is more related to contract terms.

13.3.9.2. Contract Scope

This contract includes the clearing of certain elements of the project that have not been included in other contracts. This contract includes clearing all of the dam footprint, quarry area, camp, airstrip, and a portion of the reservoir area. The construction of the main access road has clearing included in that contract.

For this estimate it is assumed that burning of trees and brush will be allowed with an appropriate burn permit. AEA may however consider performing a reconnaissance study which considers various types of biomass facilities that could use the cleared trees.

13.3.9.3. Key Aspects of Construction Methodology

Once the contractor has been give the notice to proceed for the Clearing Contract, mobilization of equipment, manpower and supplies will be by rail to the Gold Creek Siding Area or a CAT train from the north to the site.

Once the site is established, clearing and erosion controls for the camp areas and airstrip will be first on the schedule followed by clearing of access roads and quarry area.

The higher elevations on the project require very light clearing. This would be the camp area, airstrip and the top of the quarry area. The heavy tree cover is located in the valley along the river bank in the reservoir area. Clearing will be done with dozers, backhoes and chainsaw clearing methods. The trees and brush will be piled for burning.

13.3.9.4. Construction Schedule

The schedule for completion is based on an aggressive schedule for the clearing of the sites at and around the dam site so that work can be started on construction. The only clearing that could affect the overall project schedule is the camp and dam footprint and any site access roads which make up approximately 15 percent of the clearing. The clearing of the reservoir area can be performed over the following years as there are no other tasks dependent on completion. No clearing can be done during the migratory bird season.

The project would be scheduled for a six or seven day work week on a two 10-hour shift basis for the summer season. The schedule is illustrated on Figure 14.1-1.

13.3.9.5. Construction Manpower

The peak manpower will be approximately 103 as seen in Figure 13.3-12 below.

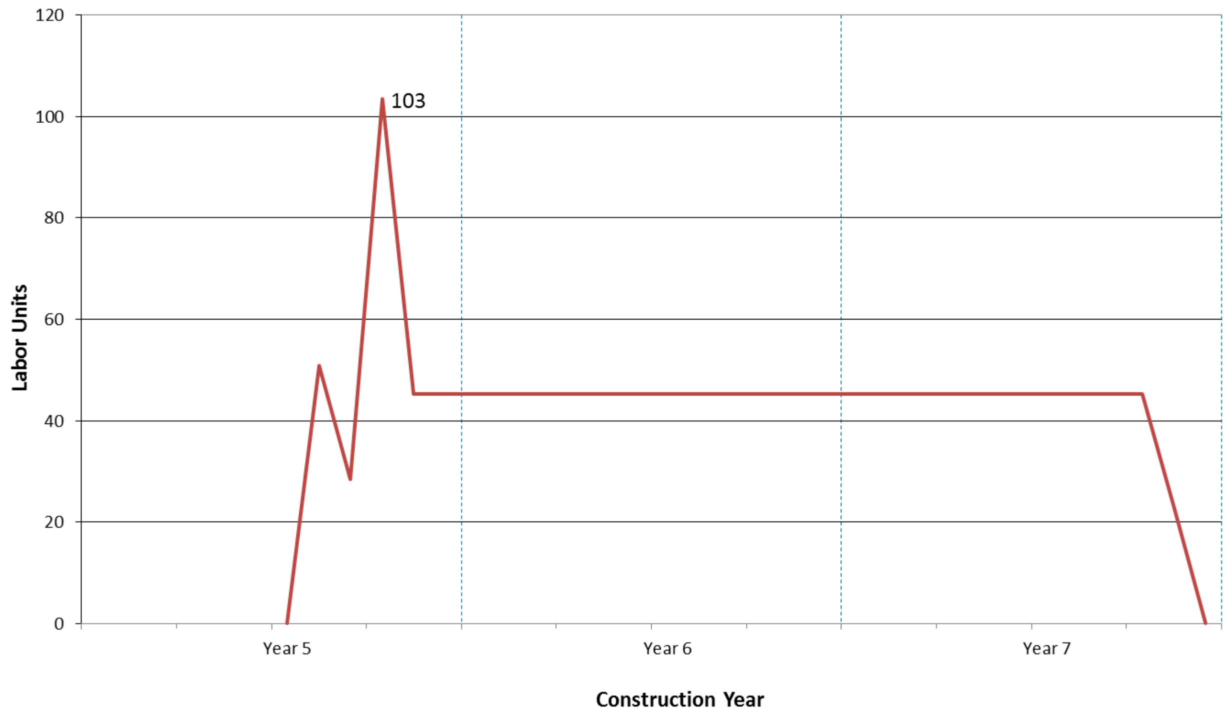

Figure 13.3-12. Clearing Manpower

13.3.9.6. Key Logistical Aspects

Equipment could be mobilized from the north and other supplies could be by rail to the Gold Creek Siding. The construction equipment list is approximately 450 tons.

Other major materials would include:

Fuel .... 2,600 tons
Food and Misc............................ <u>100 tons</u>
Total .... 2,700 tons

13.3.10. Air Transport Services

13.3.10.1. Contract Description

As noted, construction is expected to be performed based on rotation of workers on and off site. Workers retained for tasks that continue throughout the year are expected to rotate off site on a regular basis, while those tasks that are seasonal – such as the RCC placement – would probably necessitate worker movement on a semi regular basis. This service contract would be negotiated by AEA with agreed rates that would apply to any selected contractor for the Main Civil Works contract through the mechanism of assigning the contract.

The costs for preparing the contract and owner costs are carried in the overall program cost.

13.3.10.2. Contract Scope

The scope of the contract would be to supply the following (all navigation, safety and fueling equipment would be refurbished at the completion of the project construction and remain as part of the permanent installation):

- Supply and install any and all landing and navigation aids at the airstrip, together with all necessary equipment for expected servicing of the proffered planes;
- Supply and install all necessary fixed equipment for airport operation such as radar, lighting, radio, passenger and cargo tracking facilities tugs, steps, etc.;
- Arrange for delivery of required aviation fuel, install and maintain necessary facilities;
- Operate regular and irregular fixed wing passenger flights to and from Anchorage, Talkeetna and Fairbanks as well as helicopter services and emergency evacuation services; and,
- Operate regular and irregular cargo flights to and from Anchorage and Fairbanks.

The cost of extra services that each contractor might want would be fixed in the contract documents for this service – apart from provisions for fuel variations etc.

13.3.10.3. Key Aspects of Construction Methodology

A key component of the air service methodology will be the choice between letting the service contract to a "Part 135" company that can transport passengers and cargo in the same aircraft, compared to a "Part 121" operating company with more extensive restrictions and higher weather minimums.

A Part 135 company will probably be more economic and would have greater flexibility to change schedules and react to weather issues. The extent of airport infrastructure required at Anchorage, Fairbanks and Palmer will also be a factor to be investigated to accommodate connections (principally at Anchorage) and the loading of freight.

13.3.10.4. Construction Schedule

The Air Transport services contract would last from when the airport at the project site is put into service until the end of construction.

13.3.11. Railroad Operations

13.3.11.1. Contract Description

As noted, for the purposes of planning and estimating, the construction and use of the Gold Creek (southern) access route has been assumed. Thus the ARRC would form a vital part of the supply chain. It is suggested that AEA negotiate a basic contract with ARRC for the transport of materials to Gold Creek, with agreed rates that would apply to any selected contractor for the Main Civil Works contract through the mechanism of assigning the contract. The cost of extra services that each contractor might want would be pre-agreed – apart from provisions for fuel variations, etc.

13.3.11.2. Contract Scope

The exact service contract scope remains to be determined, but it is envisaged that it would include for operations of at least three dedicated (minimum) 55 car trains (or similar) per week from Whittier to Gold Creek during the construction period; operation of a dedicated train from (say) McKinley siding semi-regularly to Gold Creek; and delivery of other freight within the standard loading gauge from Anchorage, Whittier, or Point Mackenzie to Gold Creek.

The service contract might also include, leasing of land at McKinley siding or Port Mackenzie, and possibly the replacement of the Talkeetna Bridge, and excavation of some rock slopes on the east side of the track as necessary for wide loads. It is also possible that the most efficient way to construct the railroad offloading facilities at Gold Creek (or any selected location) could be by the ARRC under this contract.

13.3.11.3. Key Aspects of Construction Methodology

Some aspects of the use of the railroad are yet to be determined as follows:

- *Southern port* – There are offloading facilities at Whittier, and Anchorage. In addition, in Mat-Su Borough on the north side of the Knik arm, Port MacKenzie has been under development, and currently includes a deep draft dock as well as nearly 15 acres of barge dock. There are plans to create – by 2016 and thus in time for the project – a spur of the ARRC some 32 miles from the main railroad near Houston to Port Mackenzie, thus rendering it the closest port to the project. It is possible that transshipment will be through Port Mackenzie for non-containerized materials and equipment sourced from outside the State of Alaska that are not brought up in railcars.

- Port Mackenzie has a significant disadvantage in that the railroad does not extend down to the dock, but ends in a loop at the top of the bluff. Thus unloaded goods must be trucked up the bluff and then loaded on the ARRC. Thus the barge service from Seattle operated by Alaska Rail Marine will not bring railcars directly to Port Mackenzie. It should be noted that the use of such a service in the lower 48 will demand that all loads be within loading gauges and so they would be expected to be able to be transported through the whole ARRC system from Whittier.
- *Barge vs. freighter shipment* – In discussions with ARRC and significant suppliers (of fly ash), the overall supply chain was explored. Alaska Rail Marine operates a regular "rail-water-rail" service through Seattle to Whittier using barges on which rail cars can be transported. This remains a method by which certain items might suitably be moved (such as the four Generator Step-Up transformers on a Schnabel car or similar). Canadian National Aquatrain also operates a similar service to Whittier from Prince Rupert.
- Although the rail-to-rail convenience is attractive, the necessity to offload material at Gold Creek for transfer onto road vehicles renders full containerization as a more attractive alternative. Bulk materials such as fly ash, cement, fuel oil, etc. can be containerized – in tank containers that allow more dense "packing" on barges and freighters than railcars, so it appears to be more attractive to move as much material as possible using standard containers. Estimates have been based on this choice of shipment, and allowances made for container transfer equipment at the Gold Creek offloading facility.
- *Provision for wide or high loads* – The project team has visited the railroad between Talkeetna and Gold Creek. There are three potential restrictions on wide or high loads (apart from those that might be imposed by ARRC with respect to stability and or speed of transport).
    - The Talkeetna River Bridge is located at ARRC milepost 227.1 and is shown below in Figure 13.3-13. The bridge is a through truss structure which represents the most significant width restriction between Talkeetna and Gold Creek – and the sole height limit. The ARRC clearance diagram gives a limit of 15 ft.-5 inch width at walking speed, and a height of 10 ft.-0 inch CDNX. Approaches to the bridge are straight, and the bridge includes two spans of 200 ft.
    - Eight tenths of a mile north, at milepost 227.9 is the Billion Slough Bridge. Although this is a straight over bridge it has side structural members supported by angled webs. The width at about 4 ft. above rail is 19 ft. This bridge includes one span of 120 ft. with the side members and a 22 ft. span at grade.

— A third restriction – at various points on the line – are locations at which the rock cuts on the east of the track are close; the excavated rock wall can sometimes be as close as 9 ft., 6 inches from the track centerline (although 12 ft. is more normal in these particular locations). However, the total length of line between Talkeetna and Gold Creek subject to these limited clearances is less than 500 ft.

- During detailed design, and logistical planning, the extent to which the three potential restrictions need to be mitigated must be discussed with ARRC. Replacement of the Talkeetna Bridge is a possibility, and normal maintenance work on the railroad could be expanded to remove the rock in the cuts that is too close. It is understood that these cuts are regularly trimmed and cleaned by ARRC maintenance crews. While formal discussions have not taken place, ARRC may be able to remove additional material during the next few years to improve clearance. Modifications to Billion Slough Bridge will be dependent on the exact dimensions of any wide load.

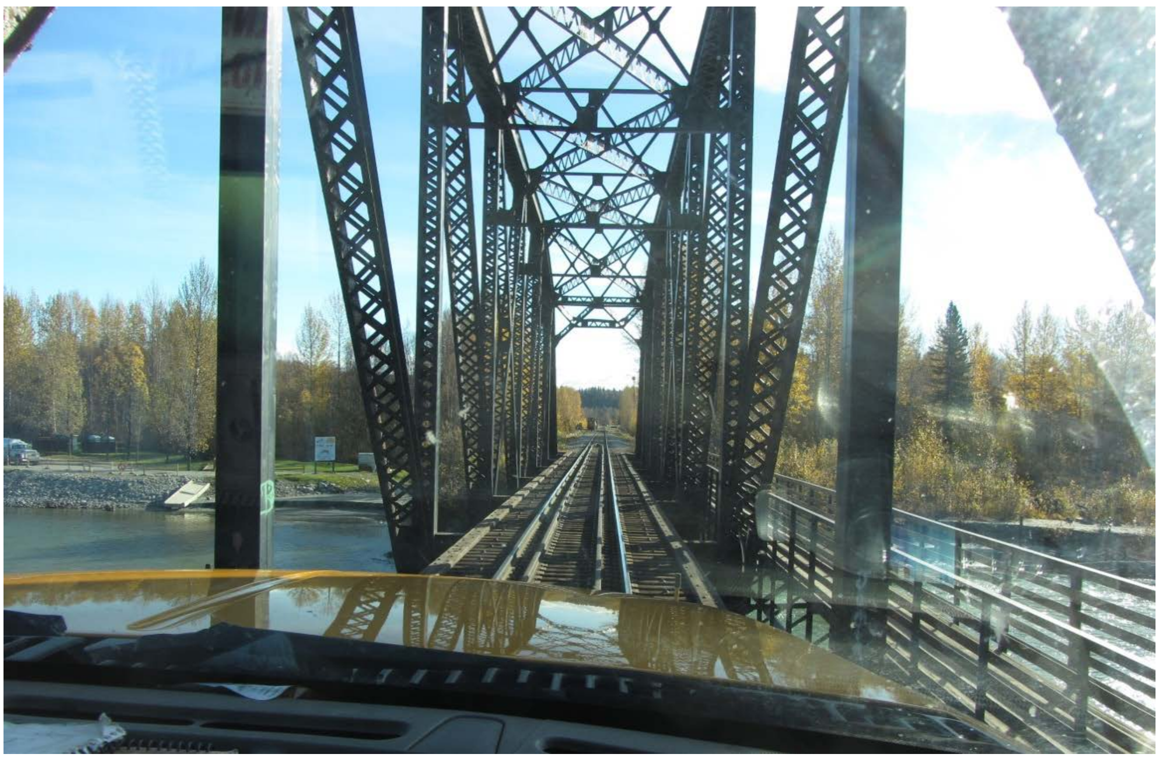

Figure 13.3-13. Talkeetna River Bridge

- *Laydown and loading areas alongside the ARRC* – During detailed construction planning, staging and storage areas will need to be established next to the ARRC in addition to the Gold Creek Offloading area discussed above. A staging area with security will need to be established at the main port (Whittier or Port Mackenzie) and at a location for transfer of truck loads onto the ARRC. Such staging areas may be on ARRC property, and this contract will need to include leasing.

A candidate for a staging area was found at McKinley siding, which is at milepost 223 – a few miles south of Talkeetna and away from the town. This siding is used during the summer as a loading point for coach trips from Anchorage (cruise boats, etc.) so that tourists can board the railway for a trip to Cantwell, etc. The siding is 2,300 ft. long, but of interest is an associated pit for which ARRC has built a spur. The spur is at significant grade – and moving a train out of the area could require extra assistance – but the pit could easily be used by a contractor as a storage area/transshipment area to load trains after bringing material by road from the south. ARRC could easily include in the track a derailing switch under their control so that a contractor could work within the area without ARRC supervision until ready to move out. The land is all owned by ARRC but the area is used as a "bone yard" so is probably available. The area available is estimated to be 12 acres or more.

13.3.11.4. Construction Schedule

The Railroad Operations services contract would begin when the railroad is put into service until the end of the project.

13.3.11.5. Construction Manpower

The consolidated peak manpower of all service contracts will be approximately 155 as seen in Figure 13.3-15.

13.3.11.6. Key Logistical Aspects

The key logistical aspects of the use of the ARRC must be discussed in great detail with ARRC. It seems from early discussion that the (minimum) 55 car trains being considered (even if the number were increased somewhat during peak construction) would not put undue strain on the railroad system, and the modifications to cuts and or bridges could be successfully arranged with ARRC, with enough "lead time'.

13.3.12. Camp Operation

13.3.12.1. Contract Description

The camp operation contract can be set up as a service contract. The costs for preparing and negotiating the contract and owner cost are carried in the overall program cost.

13.3.12.2. Contract Scope

The scope of the contract will be the operation of the camp, including meals, cleaning, recreation facilities, maintenance, etc. The occupancy of the camp will be in accordance with Figure 13.3-14, which shows the summation of all construction manpower onsite throughout the construction period. The construction camp will have a peak capacity of up to 1,200 people and will normally house approximately 800 persons.

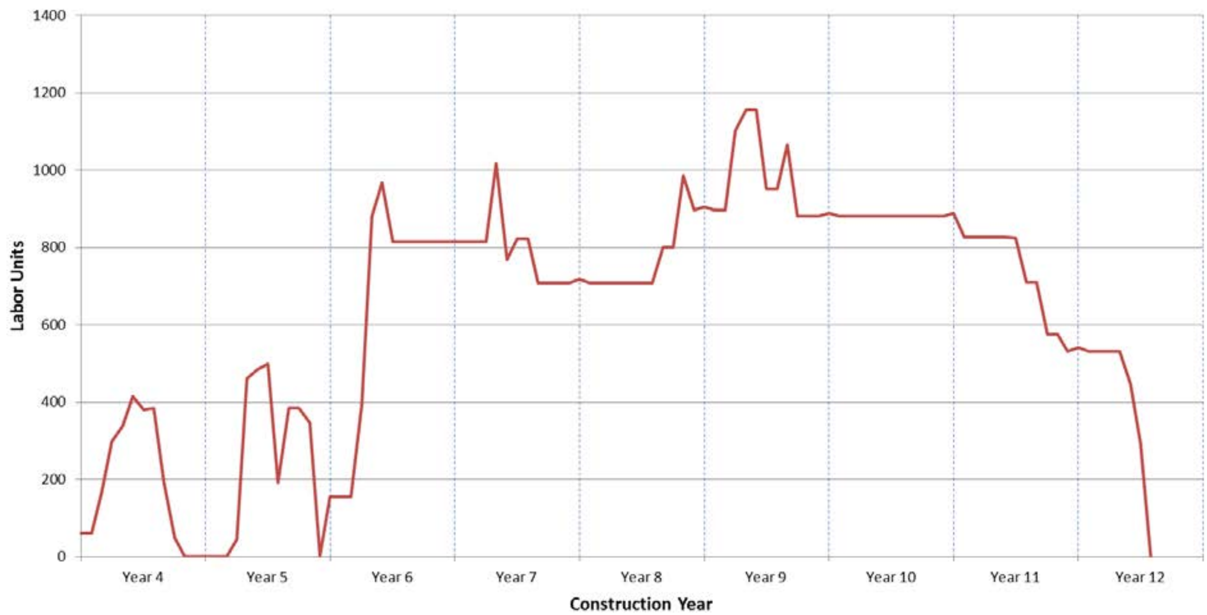

Figure 13.3-14. Total Construction Manpower All Projects

13.3.12.3. Key Aspects of Construction Methodology

A key aspect to remember when planning construction in more detail is the extent that the camp operator will want to use air transport for perishable food items, etc.

13.3.12.4. Construction Schedule

The Camp Operation services contract would begin when the camp building is complete until the end of the project, although once the RCC placement in the dam is complete; the main work still continuing would be the turbine and generator commissioning. This would allow a partial but significant demobilization to be carried out.

13.3.12.5. Construction Manpower

The consolidated peak manpower of all service contracts will be approximately 155 as seen in Figure 13.3-15.

13.3.13. Medical Services

13.3.13.1. Contract Description

This Contract can be tendered to a private organization or possibly to any State or regional health care body. The costs for drafting and agreeing on a contract, and owner cost are carried in the overall program cost.

13.3.13.2. Contract Scope

The contract scope includes the operation of the medical facility on site including the supply of the continuous presence of a doctor and paramedical staff. It is envisaged that minor surgery would be included, stabilization before emergency evacuation, occasional dentistry (by a visiting dentist) and isolated or non-isolated care for patients requiring short bed rest. The scope also includes for the provision of medical equipment and supplies – and pharmaceutical services as necessary – throughout the implementation of the project, and the organization of emergency evacuation by air.

13.3.13.3. Schedule

The Medical Services contract would begin when the camp building is complete until the end of the project construction and commissioning.

13.3.13.4. Construction Manpower

The consolidated peak manpower of all service contracts will be approximately 155 as seen in Figure 13.3-15.

13.3.14. Service Contracts – Manpower

Rather than examine the peak manpower of each service contract, a consolidated assessment has been made as shown in Figure 13.3-15. The total will peak at approximately 155 encompassing Air Transport, Railroad Operations, Camp Operations, and Medical Services Contracts.

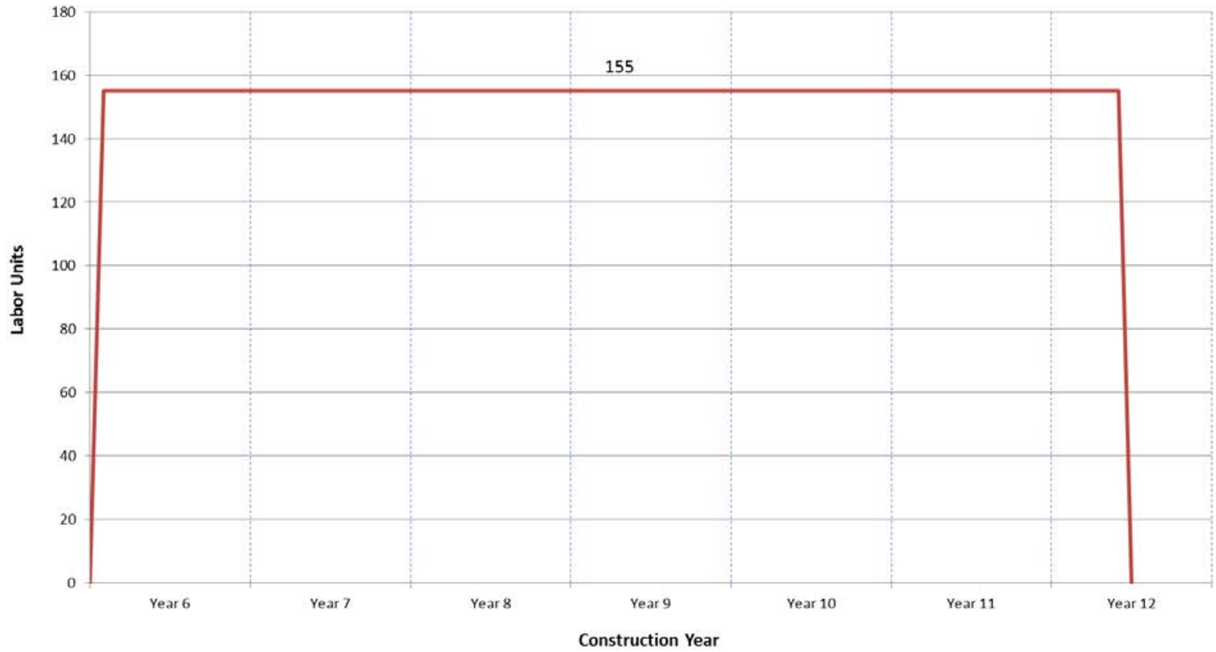

Figure 13.3-15. All Services Contracts Manpower

13.3.15. Construction Manpower – All Contracts

Total construction manpower onsite throughout the construction period is shown in Figure 13.3-14, and will peak at approximately 1,200 persons.

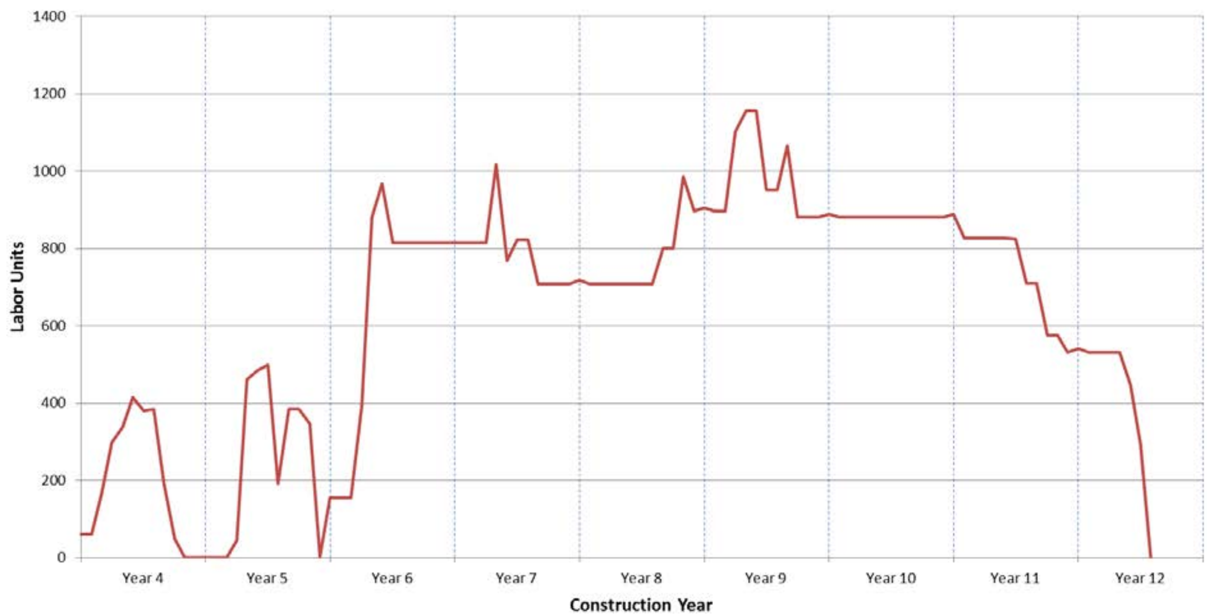

Figure 13.3-16. Total Construction Manpower All Contracts

13.3.16. Logistics

As discussed at various points in the above analysis of the projected contracts, the logistics of delivery of materials, equipment, consumables and workers to the site is a significant challenge in this construction, principally because everything will need to be shipped along the ARRC in an ordered manner, and shipped through the Gold Creek Offloading area with the minimum of double handling. Permanent equipment has been highlighted in the various contract discussions, but there is a greater tonnage of consumables and general materials.

As far as construction equipment is concerned Table 13.3-3 indicates some typical (but not exhaustive) large loads representing some of the largest equipment that will be moved. Multiple units of some of this equipment (such as the Caterpillar 777 trucks) will need to be moved, depending on the construction planning of the selected contractors. Plant and machinery can be broken down, but the contractor (or supplier of the equipment) will undoubtedly wish to move the equipment in the largest convenient pieces due to time and cost considerations.

There are many other items of equipment that will need to be moved along the same supply chain.

Table 13.3-3. Typical Large Construction Items (and approximate dimensions) to be moved to and from Site

Items	Approx. Number	Length (ft.)	Width (ft.)	Height (ft.)	Weight (lbs.)	Notes
Caterpillar D 10/11	7	36	12.5	15.25	248,600	Blade and cab can be removed to reduce dimensions slightly
Caterpillar 992	2	51.5	18	18.5	214,948	Blade and cab can be removed to reduce dimensions slightly
Caterpillar 385	2	44.2	11.2	15.7	185,474	Shipping dimensions
Semi-trailer (road)	25	40	8	4		Flat-bed for normal ISO containers
Caterpillar D 350	19	34.9	10.7	11.5	66,560	Articulated dump truck – can drive on/drive off
Caterpillar 777	6	34.6	21.3	17	163,090	
Caterpillar 825	2	27.7	12	12.3	72,166	
Concrete agitator	23	30	10	12		
Truck-mounted concrete pump	2	39.1	8.2	12.10		
Linkbelt 228 crane	2	24	19	13.3		
American 9260 crane	8	24	18.7	14.6		
Container handler	3	44	16.5	13.5	230,000	
5,000 gallon water tanker	2	40	8	10	125,000	Weight includes (5,000 gal) water weight

Note: A more complete list is shown in Appendix B10
ISO – International Standards Organization

Actual equipment will be selected by each contractor and it is expected that there will be some cross sales.

It is expected that during the first mobilization season, some 5,000 tons of equipment will need to be mobilized.

Total quantities of selected materials that will need to be transported – as far as possible in containers or container sized shipping structures – are shown in Table 13.3-4.

Table 13.3-4. Key Materials to be Shipped through Supply Chain

Key Material	Weight (tons)	Note
Initial Mobilization Construction Plant	10,000	Containers
Fuel/Oil	7,500	Tank Containers
Equipment Parts	1,100	Containers
Permanent Equipment	1,500	Individual
Food	8,000	Containers
ANFO	3,000	Containers
Misc.	15,000	Containers
RCC 5,215,000 CY		
RCC Cement	342,248	Tank Containers
RCC Pozzolan	547,575	Tank Containers
Structural Concrete		
Cement	89,375	Tank Containers
Fly Ash	48,125	Tank Containers
Reinforcement	41,250	Railcars
Demobilization	10,000	Containers
TOTAL	1,124,673	
	1,200,000	

In general, it is assumed that transport by air will mainly be used for personnel, perishable food, key repair parts that are required for disabled or damaged plant, pharmaceuticals, documents and cash, etc.

13.4. Construction Cost Estimate Derivation

As noted above, previously AEA had commissioned an independent construction cost estimate for the project. That estimate was substantially compiled by Mr. Hewitt of International Project Estimating Limited.

In deriving the estimate for the feasibility report, the construction planning and estimating was performed throughout a period from December 2013 through July 2014, so the initial estimating was performed using quantities derived in January 2014 and corrected by adjusting the material quantities as necessary to incorporate the design development from January 2014 to July 2014.

For the initial basic January 2014 estimate which forms the basis of at least 85 percent of the current Q2 2014 estimate, it was decided that a joint venture type estimate would be performed, using Mr. Hewitt as the second party, to take advantage of the experience of another estimator and his familiarity with the project. Mr. Hewitt was engaged as a subcontractor to MWH, and was given the same drawings and quantity take offs as the internal MWH estimator.

MWH created a WBS for the construction pricing, to be estimated by both parties. This breakdown is more normally used to itemize the bid items for the project; however (as in this case) it can be used in a slightly different format to reflect "costs" rather than "bid prices". Direct costs are estimated for each line item and at the end of the sheet indirect costs are added to the breakdown of direct costs facilitating detailed estimate comparison.

Direct costs are the actual items of work and/or the features of the project or specific items relating to the contract.

Typical indirect costs are contractor costs that are add-ons to the work items such as:

- Contractor's Project Management
- Contractor's Project Engineering
- Surveying
- Safety
- Quality Control
- Equipment Management
- Administration Cost
- Office and Shop Setup
- Contractor Consultant Cost
- Plant Setup Costs
- Camp setup and Operation
- Power Distribution or Operation
- Equipment Mobilization and Demobilization
- Other (as specified for the particular project)

Mr. Hewitt used the same estimating sheet (breakdown) as the MWH estimator, separated into "contracts" as discussed below.

Once the work breakdown was established for all the contracts, MWH populated each contract with material quantities based on the current stage of feasibility design. MWH also established the labor cost for the various labor classifications to include, base wages, fringes, and labor burdens for an overall hourly labor rate reflecting Alaskan conditions. Overtime rates were also established from these base rates. The following steps were then followed.

- Inquiries were made of Alaskan equipment suppliers and hourly equipment rates were established and agreed upon for the estimate.
- Allowances, job material, permanent materials, and subcontract unit rates were established for major items, subject to adjustment during the review comparison for any quotes or opinions.
- Once all these steps were completed each party completed an independent cost estimate, using the items provided above.
- During the preparation of the estimates, identical clarifications were given to each party by the engineering team as requested.
- Upon completion of the estimates, comparisons were initiated in an organized manner to achieve an acceptable estimate.

13.4.1. First Read of Estimate

After MWH and Mr. Hewitt completed their estimates, the two estimating sheets were combined to initiate a line-by-line comparison and to highlight key differences. For joint venture estimating, this is typically referred to as the “first read.” Table 13.2-1 shows the summary result for construction costs from the first read of the estimate:

Table 13.4-1. First Read of Two Comparative Estimates

Main Cost Items	MWH	Hewitt
	Total Price (US$)	Total Price (US$)
Main Civil Works Contract	2,861,321,989	2,777,892,732
Reservoir Clearing	48,670,308	30,409,202
Turbine, Generator and Transformer Supply	187,713,673	222,080,752
Permanent Access Road	228,388,128	186,220,854
Rail Facilities and Storage Construction	33,770,632	23,898,495
Camp and Airstrip Civil Works Contract	33,761,641	19,003,721
Transmission Contract	176,917,469	243,339,977
Camp and Airstrip Buildings Construction Contract	163,159,200	170,612,524
Airport Operation Contract	45,638,816	168,576,407
Railroad (ARRC) Operation Contract	206,976,056	73,198,689
Medical and Evacuation Contract	48,421,330	15,138,568
Camp Operation and Security Contract	242,216,035	175,106,498
TOTAL	$ 4,276,955,275	$ 4,105,478,420

The first read comparison indicated a difference of just over 4.0 percent which is regarded as well within the bounds of estimating error, and – in a commercial construction bidding situation – would probably be acceptable for a joint venture bid.

However for this project, at this stage of development, it was considered worthwhile to continue to compare based on some of the important differences between individual “contracts” such as the permanent access road, and airport operations etc.

After a telephone discussion that included both estimators and the design team – during which each line item of each estimate was discussed – each estimator made adjustments to their estimates for a second read. One of the larger adjustments was the allowance for unlisted items, profit, bond, insurances and contingency. These percentage amounts were agreed upon.

13.4.2. Second Read of Estimate

After making adjustments based on the first read comparison, and the agreements for the percentage add-ons the resulting adjusted estimates were as shown in Table 13.4-2.

Table 13.4-2. Second Read of Two Comparative Estimates

Main Cost Items	MWH (US$)	Hewitt (US$)
TOTAL	4,188,755,166	4,482,072,850

This represents a seven percent difference – greater than the earlier difference, but still, at this level of design, an acceptable accuracy for an OPCC.

It was however considered appropriate to abandon portions of Mr. Hewitt's estimate – in favor of the MWH estimate – for four specific contract packages:

- **Turbine, Generator and Transformer Supply** – MWHs estimate was used for the turbine/generator supply contract, which includes the Generator step up transformers etc. MWH maintains a database of all bids for such equipment around the world and regularly updates it with the latest bids and awards, adjusting it to market sentiment. In the absence of calling for direct estimates from turbine/generator manufacturers, this database is considered to be more accurate than Hewitt's estimate and was therefore applied to both estimates.
- **Transmission** – The transmission line costs were provided by Electric Power Systems, Inc. (EPS), subcontractor to MWH – an Alaskan consultant that is one of the leading transmission consultants in the State. The "all in" cost that they provided was de- aggregated to fall in line with the general format of the estimate, and with EPS agreement an item for unlisted items was included. The resulting contract estimate was used for both MWH and Hewitt's estimates.
- **ARRC** – MWH have had considerable interaction with ARRC exploring the pricing and logistics of freight operations to Gold Creek, whereas Mr. Hewitt was using a more generic number for this contract. It was decided that both parties should use the ARRC cost derived by MWH after the detailed discussions.
- **Airport Operation** – The original estimate for airport operation – including provision of flights – provided by each party was grossly different because of the completely different methodologies. The two estimators therefore discussed their assumptions for the rotational nature of the worker inputs, and agreed the number of workers to be transported each week. MWH then re estimated from first principles – using input from Alaskan air transport operators – the cost of aircraft operations to facilitate the agreed rotation. During this examination, it became apparent that the airstrip that had been proposed was in excess of requirements. The original estimate assumed 737 operations, but by the time the project is constructed, there will be no 737s flying that can operate from gravel strips. The aircraft operation has therefore

been estimated using different turbo prop planes (CASA CN 235) and the design of the airstrip has been adjusted to incorporate a required airstrip of 5,550 ft. length.

It was evident that, after incorporation of these four items into both estimates, the remaining differences centered on the Main Civil Contract, Permanent Access Road, and Camp Operation. No agreement was made at this time on the cost of the item; each estimator just explained their reasoning behind their estimate, considered each other's position, and then adjusted their estimates accordingly.

13.4.3. Final Draft Construction Cost Estimate

After re-examination of the 2013 estimate in the light of the second read, the MWH OPCC was within 3.3 percent of that of the corresponding OPCC by Mr. Hewitt – but higher. The higher figure from MWH was selected as the base OPCC for the estimate, and the foundation for the final OPCC for this feasibility study.

During 2014 – since the completion of the OPCC – the final analyses of the feasibility study have been completed. As a result of the design development and finalization of the report recommendations, the following actions have been taken to modify the initial work on the construction cost estimate:

- Re-measurement of the quantities for the spillway, which has been modified to include four gates after the selection of the PMP and the calculation of the PMF inflow.
- Re-measurement of dam quantities to reflect the adjustment of the dam configuration.
- Re-measurement of the diversion tunnel and emergency outlet quantities to reflect the revised design.
- Separation of the left and right abutment consolidation grouting to accommodate the costs of preparatory work.
- Reassessment of the costs of the service contracts dependent on the construction schedule (which has been modified to reflect the reduction in RCC volumes for Watana Dam.

These changes to the estimated quantities were incorporated into the OPCC together with escalation to calculate the base OPCC for second quarter 2014.

The derived base OPCC is US$ 4.096 billion, is shown in Table 13.4-3. Details of the estimate are attached as Appendix B10.

Table 13.4-3. Opinion of Probable Construction Cost

Main Cost Items	MWH
	Total Price (US$)
Main Civil Works Contract	2,878,841,278
Reservoir Clearing	45,297,999
Turbine, Generator and Transformer Supply	201,792,198
Permanent Access Road	192,031,833
Rail Facilities and Storage Construction	34,068,783
Camp and Airstrip Civil Works Contract	30,049,914
Transmission Contract	165,743,940
Camp and Airstrip Buildings Construction Contract	178,400,154
Airport Operation Contract	130,361,141
Railroad (ARRC) Operation Contract	59,508,577
Medical and Evacuation Contract	20,721,785
Camp Operation and Security Contract	159,115,083
TOTAL	$4,095,932,685

13.5. Non Construction Costs

13.5.1. General

The following non-construction costs have been estimated in discussion with AEA:

- FERC Licensing Costs post January 2012
- AEA Administration and Legal Costs
- Engineering Design for License Application – includes amounts paid to other (non-AEA) companies, firms, or individuals engaged by the owner to plan, conduct pre-design studies, prepare estimates, or give general advice and assistance to the owner in connection with feasibility and FERC Licensing phase work.
- Geotechnical Investigations during License Application preparation
- Logistics for Geotechnical Investigations
- Engineering Final Design
- Engineering During Construction

- Construction Management
- Environmental Monitoring During Construction
- Quality Control and Inspection
- Environmental Mitigation
- Land and Land Rights
- Permit Fees
- Owner Insurance

13.5.2. Cost Items

The following constitute the cost items included:

- **Legal Costs** – includes the general legal expenditures incurred in connection with project construction and the court and legal costs directly related thereto, other than legal expenses included as part of insurance costs to cover injuries and damages.
- **General Owner's Administration** – includes the portion of the pay and expenses of general officers, project and administrative staff time and expenses applicable to the construction work.
- **Engineering Design Services** – for Detailed Design and for Engineering Services During Construction – includes amounts paid to other (non-owner) companies, firms, or individuals engaged by the owner to plan, design, prepare estimates, supervise, inspect, or give general advice and assistance in connection with project design (final design and contract documents).
- **Construction Supervision** – includes labor and expenses of engineers, surveyors, draftsmen, inspectors, superintendents and their assistants applicable to project construction (construction monitoring).
- **Insurance Costs** – refers to owner All-Risks Project insurance.
- **Taxes** – includes taxes on physical property (including land) during the period of construction and other taxes properly includible in construction costs before the facilities become available for service.

13.5.3. Derivation of Non-Construction Costs

Program costs used for the feasibility cost estimate update were derived in 2011 from a discussion with AEA management. Up to December 2012, no escalation was included for those estimated program cost, although the first line item, FERC Licensing, was increased by about 14 percent prior to the December 2012 estimate. Because of the previous large increase, from 2012 to January 2014 (the commencement of the estimate in this report) the FERC licensing cost estimate was held steady, but all other non-construction program costs were escalated by 2.75 percent (the figure agreed for use in the earlier financial analysis). The originally estimated costs of site investigation were divided into two separate components – site investigation and logistics support for site investigation – as requested by AEA.

During further examination of the non-construction program costs, the original decision to apply no escalation from December 2011 to December 2012, was judged unrealistic. However, for this estimate, a "catch-up" percentage of 1.5 percent was initially judged reasonable to attempt to realistically address previous escalation.

Finally in applying the corrections for the design development from January 2014 to July 2014 a further escalation of 0.025 percent was included, and Land and Land Rights costs suggested by AEA were added to the Environmental Mitigation Measures budget estimate.

With regard to the line items for FERC licensing budget and the engineering design for licensing, the recent projected budget adjustments (of plus 30 percent and minus 4 percent respectively) were included.

Based on this analysis, the base estimated non construction costs are shown in Table 13.5-1.

Table 13.5-1. Non-Construction Costs

Non-Construction Items	US$ (2Q 2014)
FERC Licensing	267,253,000
Owner Cost Administration and Legal	184,664,354
Initial Camp and Access	Inc. in Licensing Cost
Engineering Design for Licensing	20,573,000
Engineering Detailed Design	184,664,354
Engineering During Construction	92,385,641
Construction Management	153,869,141
Environmental Monitoring During Construction	57,420,242
Geotechnical Investigations	28,870,513
Logistics for Site Investigation	8,554,226
Quality Control And Inspection	92,385,641
Environmental Mitigation (Summary, inc. Land Costs)	407,738,281
Owner Insurance	61,590,428
TOTAL Non-Construction Costs	$1,559,968,821

Note: Non-Construction Costs as agreed with AEA based on typical similar projects.

Not included in Table 13.5-1 are Permits and Fees; Interest during construction; future project escalation; and financing costs, all of which will be determined by AEA for use in the financial models.

Of particular interest are the environmental mitigation measures. The project construction cost estimate includes assumed environmental restrictions on construction activities (together with mitigations), but the above non construction cost items are, essentially, placeholders related to possible environmental mitigation programs that might result from the consultation and reviews in the FERC licensing procedure and USACE Section 404 permitting processes. The amounts included are based on similar project mitigation. This is somewhat speculative since feasibility engineering tasks are ongoing and environmental studies and stakeholder consultations have not yet been completed. Those activities will assist in definition of the final environmental measures to be proposed in the future FERC License Application.

It should be noted that the environmental mitigation budget above does not include for specific individual mitigation actions but at this time the feasibility level construction cost estimates include some structural measures that contribute to the overall Environmental Mitigation Program. These include the use of up to eight low level outlet valves for discharging water for instream flow. The OPCC does include for a multi-level intake to enable water to be drawn from varying reservoir levels as the operating level changes month by month (similar to what is done at other large reservoir projects such as Lake Oroville in California). They also include some limited clearing of the reservoir upstream of the dam site as needed from a project construction standpoint; this will provide environmental benefits as well.

However, it should be noted that the basic construction cost does not include any costs for possible future fish passage provisions.

Extra facilities to those shown on the drawings would be regarded as mitigation, and are deemed to be included in the budgeted amount for “Environmental Mitigation Measures Summary” above.

13.6. Total Project Cost Estimate

The total program base cost estimate is shown below in Table 13.6-1.

Table 13.6-1. Program Base Cost Estimate – 2Q 2014

Program Cost (Reservoir TWL 2,050)	US$ (2Q 2014)
Non-Construction Costs (exc. Env. Mitigation and Insurance)	1,090,640,112
Main Civil Construction	2,878,841,278
Environmental Mitigation (Summary inc. Land Costs)	407,738,281
Permanent Access Road	192,031,833
Railhead Improvements	34,068,783
Camp and Airstrip Buildings	178,400,154
Turbine, Generator and Transformer Supply	201,792,198
Transmission and Interconnection	165,743,940
Clearing	45,297,999
Airport Civil Construction	30,049,914
Airport Operation	Inc. in Air Service cost
Air Service	130,361,141
Railroad Operation	59,508,577
Camp Operation	159,115,083
Medical and Evacuation	20,721,785
Owners Insurance	61,590,428
TOTAL PROGRAM COST	$5,655,901,506

The estimate has been subject to probabilistic analysis as described below.

It should be noted that, depending on the choice of procurement/contract strategy the construction cost could be up to 25 percent higher.

13.7. Cashflow

Cash flow has been derived for the construction and supply contracts.

The cumulative value of all construction and service contracts has been derived from the base cost estimate and the base schedule shown in Appendix B11 and is shown in Figure 13.7-1 below.

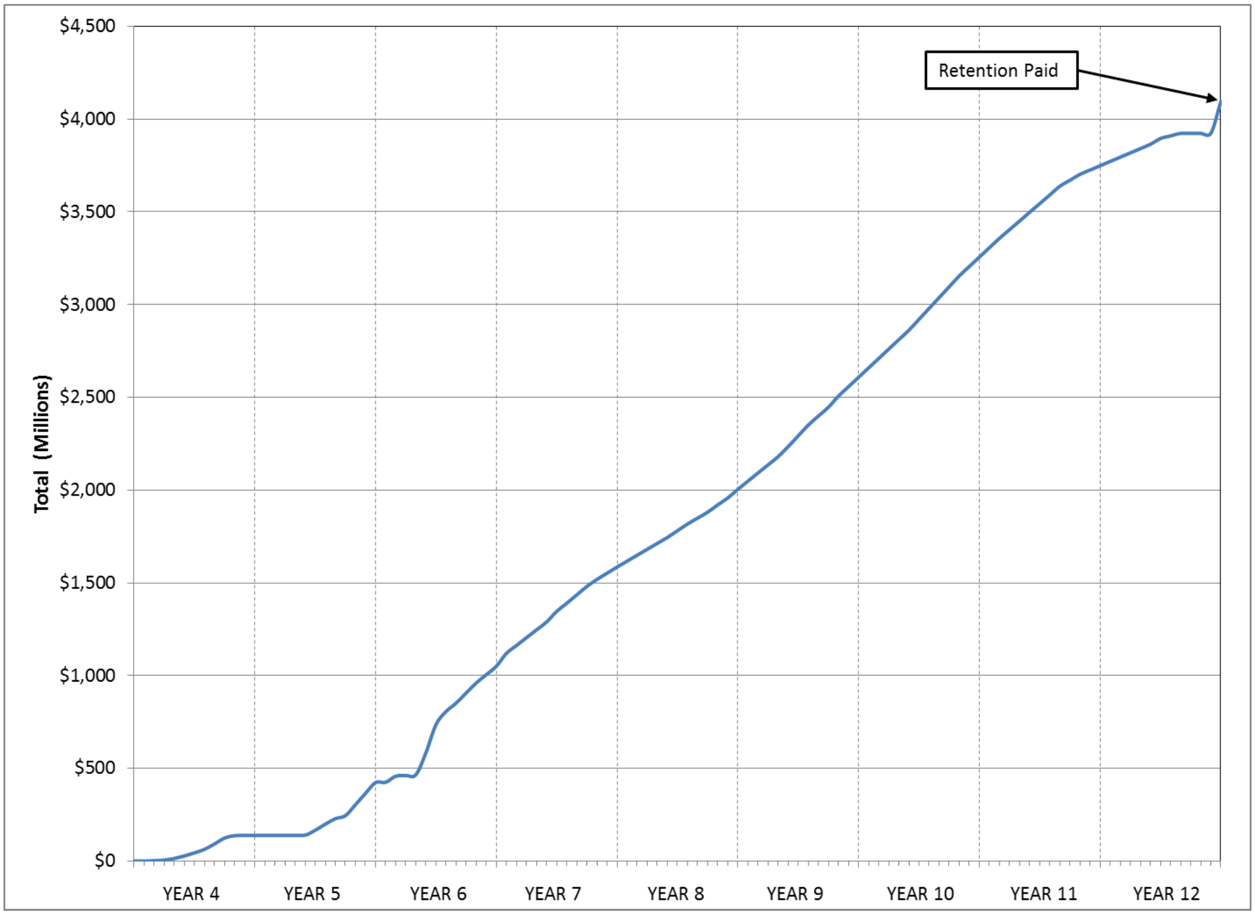

Figure 13.7-1. Cash flow of Construction and Service Contracts

This cash flow does not include any items from the non-construction costs and therefore commences at year four when the first construction contract is let. Non-construction costs have not been included, because the exact time of expenditure is not known, and a substantial percentage of the non-construction costs have already been spent.

The first somewhat slow rate of expenditure is explained by the very limited amount of work performed during the early winter season on the project.

The cash flow includes payment delay of 60 days, retention of five percent, and final payment 12 months after contract completion. Non-construction costs such as construction supervision/ management are not included.

13.8. Cost Variability Analysis

To derive a risk-adjusted estimate for a project, two different assessments must be completed, the first of which – an uncertainty evaluation – can be completed at this stage of feasibility.

Uncertainty refers to a range of unit costs and quantities that create a distribution of likely costs for each planned construction line item.

The effects of uncertainty in planned cost line items were explored using a probabilistic approach and modeling processes. The model was created using the Palisade @RISK software, and involved generating tens of thousands of realizations giving a probability distribution of the overall adjusted cost, which reflects the uncertainty of the estimating process.

For each uncertain variable in the model the possible values were defined using probability distributions. The type of distribution used in uncertainty analysis depends on the factors surrounding the variable and the methods used in determining the upper and lower limiting values of costs and quantities. Some of the commonly used distributions are triangular, trigen, uniform or program/project evaluation and review technique. A combination of trigen and triangular distributions were used to characterize the variability in the construction costs; consistent with the estimators approach to determining the minimum, best estimate and maximum costs and quantities (as extended).

@RISK uses these probability distributions to define the range of uncertainties associated with the construction line items and calculates many thousands of predicted values (simulations) of the overall construction cost, each time sampling values from the input distributions.

The estimated range of possible values for the unit prices and quantities of each item was based on the previous experience of MWH, the history of estimating of the Susitna-Watana project in the last three years, and in particular by a comparison with other projects designed, estimated and/ or supervised by MWH. Attention was focused on cost drivers, and consideration was given to the various factors that might drive the possible spread of costs. The final input values were modelled in the @RISK tool and can be defined as:

- **Expected Probable Estimate [Most Probable] or Best Estimate.** The unit price/ quantity cost of an item based on realistic effort assessment for the required work and any predicted expenses.
- **Expected Probable Low Estimate [Most Probable Low], a five percentile lower estimate.** The unit price/quantity cost of an item based on analysis of best-case scenario for the item.
- **Expected Probable High Estimate [Most Probable High], a 95 percentile upper estimate.** The unit price/quantity cost of an item based on analysis of the worst-case scenario for the item.

The result of the uncertainty analysis of quantities and unit prices is shown below in Figure 13.8-1 for the construction costs, Figure 13.8-2 for the non-construction costs, and Figure 13.8-3 for the total costs.

As can be seen in Figure 13.8-3, the 50th percentile for the total project cost is US$ 5.655 billion, while the 75th percentile is US$ 5.872 billion.

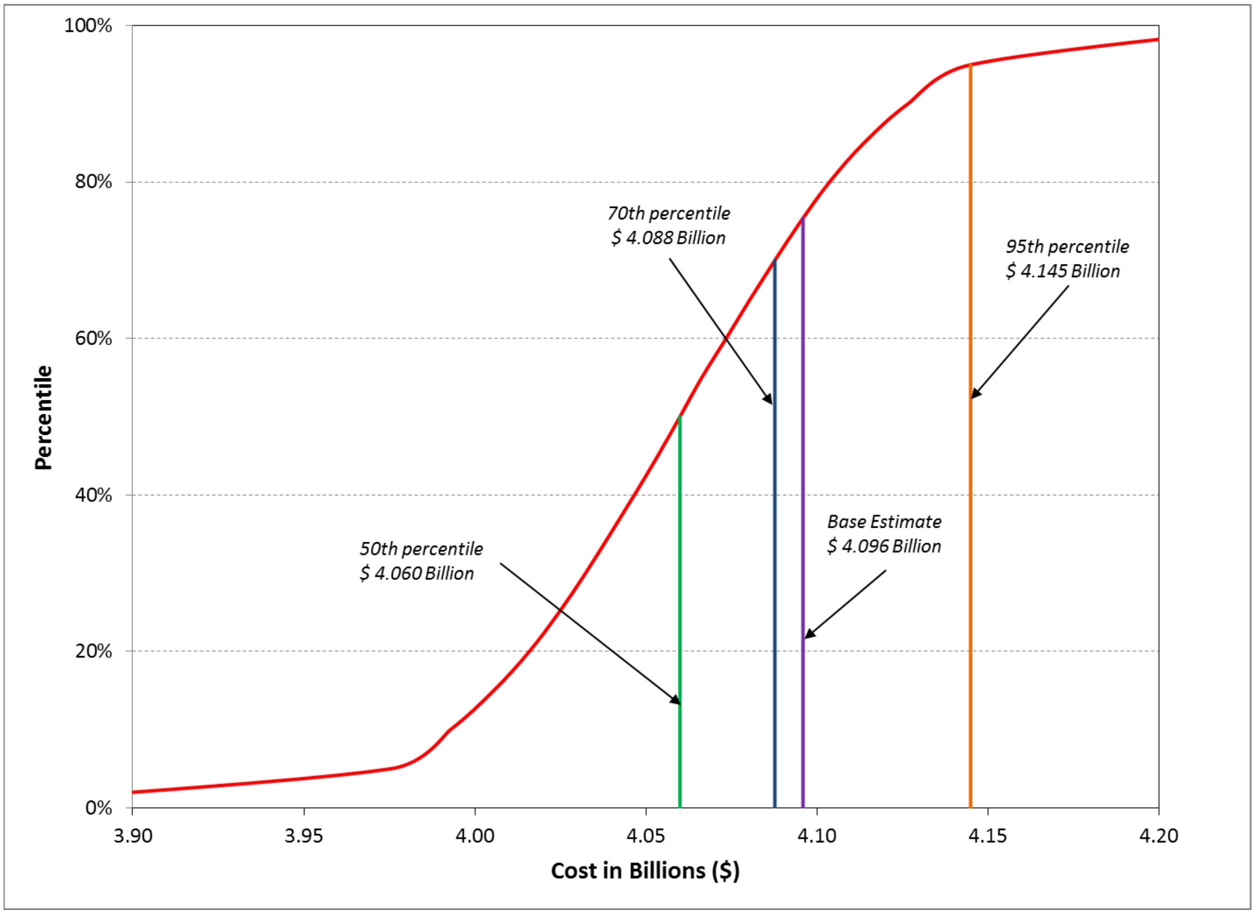

Figure 13.8-1. Construction Cost S Curve

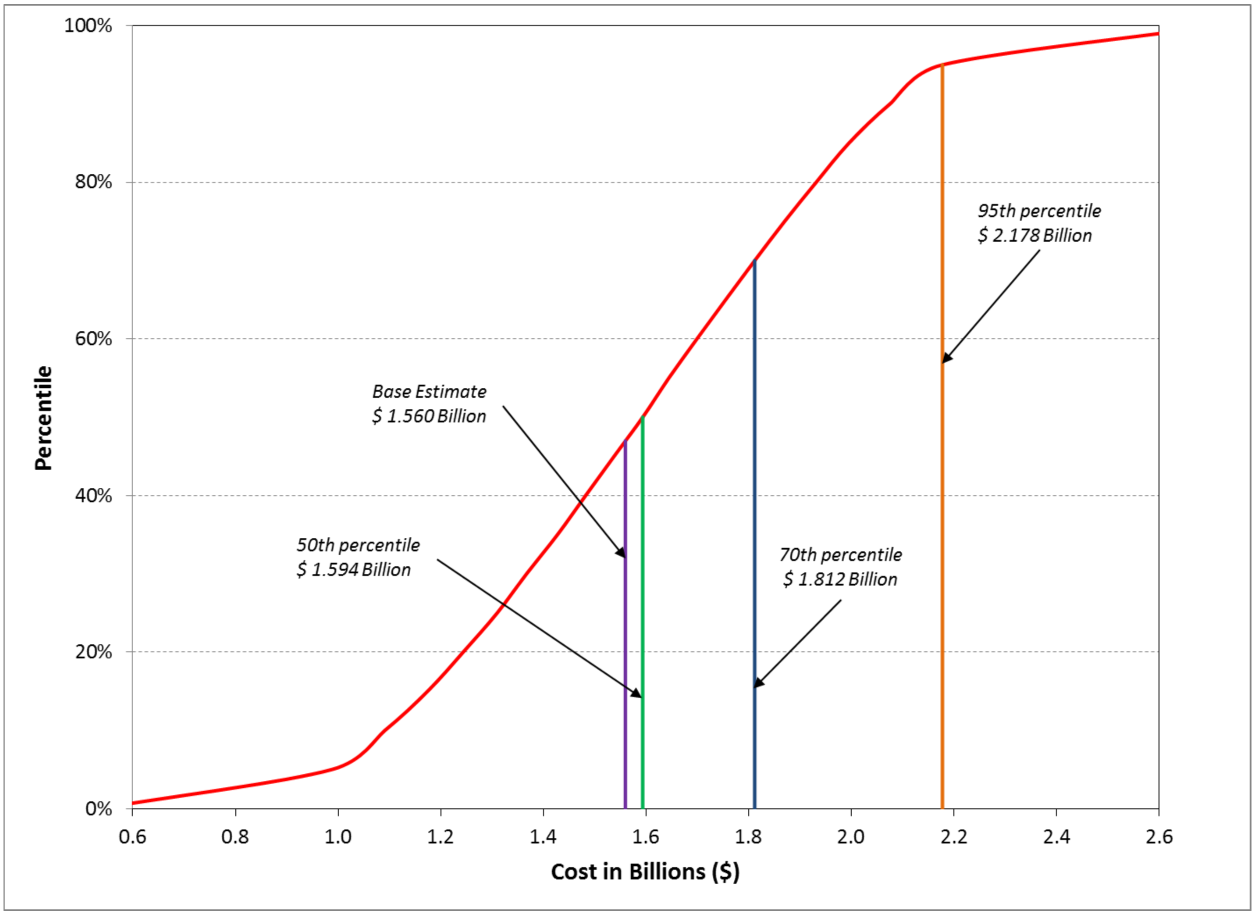

Figure 13.8-2. Non-Construction Cost S Curve

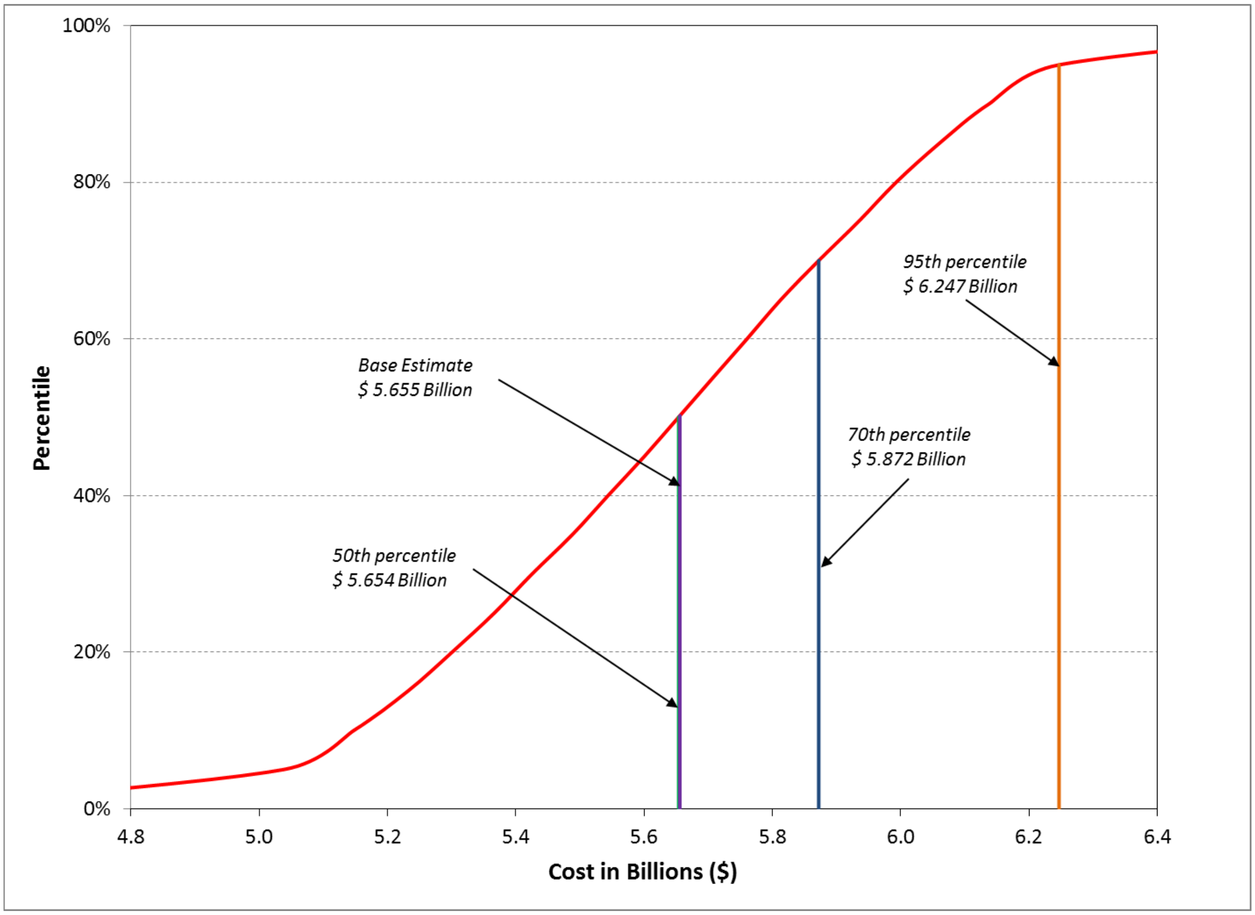

Figure 13.8-3. Total Project Cost S Curve

13.9. Risk Analysis

A formal risk analysis has not been performed for this feasibility study, but when there is more project definition – of foundations and environmental mitigation in particular – it would be prudent to perform a risk analysis of cost and schedule. At the present time the reader is referred to the AACE ranges for a Class 4 estimate shown in Table 13.2-2 which indicates recommended contingency (or management reserve) of between 10 percent and 30 percent (a Class 3 contingency would be five percent to 20 percent).

13.10. Operation and Maintenance Plan and Budget

AEA has not yet developed a detailed organization plan for the operating phase of the project. As such, only a general description of the likely operation and maintenance program requirements can be provided for this report based on experience gained by AEA and the Railbelt Utilities at Bradley Lake, and by other large utility organizations at remote large-scale hydro projects in North America. Therefore, an estimated annual operation and maintenance

(O&M) budget for the project must be derived through parametric means, using data on similar projects to make a provisional estimate for economic and financial modeling to be performed by AEA.

In developing this estimate, data from a variety of sources were analyzed and compared. These include data from: (1) a 2011 U.S. Energy Information Administration publication for power plants owned by major U.S. investor-owned utilities; (2) historical information gathered by Canadian investigators from plants in the Canada and the United States and published in 1987 by "Water Power and Dam Construction" – updated by MWH using appropriate indices; (3) a Federal Columbia River Power System Asset Management Study conducted by Harza Engineering Co. in 1998-9; (4) a detailed O&M program and budget estimate prepared by MWH for FERC License Application for the 762 MW Oroville Hydroelectric Project for which there is significant operating history and publicly-available cost information; and (5) a 2008 Summary of FERC Form 1 filings by major U.S Investor Owned Utilities, published in FERC's eLibrary.

The cost information presented below includes some provision for periodic "Renewals and Replacements", but not for major generating equipment overhauls, which would typically be funded out of a Capital Budget account. It also does not include the owner's "General and Administrative" costs, which typically add in the range of 35 percent to 40 percent to the base annual O&M costs. Annual costs for such things as insurance, environmental monitoring and other owner costs associated with managing this and other system generation and/or transmission assets are also not included.

13.10.1. Operation and Maintenance Plan

The following assumptions have been made in developing a preliminary operating plan and annual budget estimate for the project for the feasibility phase:

- AEA's O&M strategy will be developed jointly with the Railbelt Utilities as part of a future phase of project development, in concert with power sales contract formulation, dispatch agreements, and financing arrangements.
- O&M plans will be formulated loosely along the same lines as those implemented for the successful Bradley Lake.
- Tentative plans would envision a facility staffed by personnel located on-site, with operational capability by the on-site staff; but with primary dispatch and load settings coming from new remote control centers to be established in both Anchorage and Fairbanks.

- Routine maintenance, condition and performance monitoring, inspection, adjustment and minor repairs will be performed by AEA or contracted staff working at the facilities, or – for larger tasks – flown in from the Railbelt.
- Major maintenance and repair, specialized inspections, tests, and adjustments will be performed by specialty contractors or participating utilities through various contracting arrangements depending on the service to be provided.
- Support services including technical, special inspection, environmental monitoring and reporting, accounting, budgeting, financial reporting, procurement, human resources, legal, etc. will be provided from AEA headquarters in Anchorage.

13.10.2. Site Staffing

A site staff of between 24 to 28 is assumed. Potential positions include: Plant Manager; Plant Engineer/Asset Specialist; Technical Supervisor – Electrical; Technical Supervisor – Mechanical; Operators (between two and five); Maintenance Trade Workers (Electrical/ Mechanical/Civil; Planner; Environmental Coordinator; Administrative Assistants/Office Clerks; and Security personnel. Because of the remote nature of the site, and the significant infrastructure (roads, airstrip and accommodation) with requirements for snow clearance, etc. there will be some additional civil and general labor tradesmen required.

13.10.3. Power Dispatch Arrangements and Staffing

The addition of a Susitna-Watana Project resource intended to serve the total Railbelt system, together with sufficient transmission to incorporate it into that system will almost certainly result in a re-evaluation of generating unit commitments and dispatch practices as part of future planning and design work on the project. The production modeling demonstrates that maximum benefits from the project would be realized through a centralized commitment and dispatch process. The system modeling work (PROMOD) carried out thus far has been set up to simulate a centralized dispatch of the Railbelt system resources according to assumed operating rules, with the objective of minimizing total variable production costs for the utility participants. Therefore, the current estimate of annual operating costs assumes centralized dispatch from a remote control center – costs of which have not been included in this estimate.

It is expected that as FERC licensing and final design work on the facilities is completed, more details regarding specific O&M requirements will be developed by AEA, a project-specific staffing plan will be established in collaboration with the utilities, and a more detailed O&M Program developed. That will enable a more detailed project-specific O&M budget to be prepared to support financial planning.

13.10.4. Annual Operation and Maintenance Budget

A provisional O&M budget is presented below, suitable for use in AEA's current Plan of Finance for the project. Annual costs for O&M would include:

- Operating costs
- Maintenance costs
- Contracted specialty services
- Interim replacements

Values for these items for the feasibility studies were developed in concert with AEA based on an assumed level of required operation and staffing, AEA's own experience with operating and maintaining the Bradley Lake Hydropower project, and considering that this a large, remote site with difficult access. As noted earlier, to develop budgetary pricing for this study, industry databases were examined to determine historical O&M cost values for comparable large-scale, remote hydro projects in North America as a guide.

Current-year annual O&M costs are estimated to be on the order of $14,500,000. For economic and financial modeling purposes, this value will need to be increased to cover expected labor and material price escalation between now and the projected on-line date of the project. This early estimate will be refined and updated as FERC licensing and design work progress, and a project-specific operating plan developed in concert with the utilities.

13.10.5. Annual General and Administrative Budget

As noted above, without a specific plan for operating the project, a general assessment of likely Owner costs for administering the project O&M activities can only be provided at this early stage of study. Based on parameters provided in several documents outlining general and administrative (G&A) costs for large hydro projects in North America it is recommended that AEA assume a value equal to 40 percent of the basic annual O&M expenditure for planning an annual G&A budget. This would be approximately $5,800,000 per year.

A full-time staff of from 12 to 15 people is assumed, covering a wide variety of management, technical and financial specialists and support staff. Potential positions include: managers; engineers; financial/accounting specialists; environmental specialists; project controls specialists; administrative assistants/office clerks; and support personnel.

13.10.6. Environmental Monitoring and Compliance

Environmental studies, monitoring and FERC license compliance work can be expected to continue for the life of the project. For large hydro projects of the scale of Susitna-Watana this could be a significant program, and due to the size and large footprint of the project, combined with the remoteness the project site, annual costs for these ongoing elements of work are expected to be significant – more so than for other large-scale projects in North America which have more direct access.

For the current studies it is recommended that a target budget allowance shown in Table 13.10-1 for these elements of work be established as follows:

Table 13.10-1. Budget Allowances for Environmental

Target Budget for Environmental and Regulatory Compliance	Annual Amount
Year 1	$15 million
Year 2	$15 million
Year 3	$15 million
Year 4	$10 million
Year 5	$10 million
Year 6 and beyond	$ 5 million

13.10.7. Special Considerations in the Early Years

During the early years of operation there are additional maintenance tasks beyond routine project O&M that might need to be carried out. One principal example is a possible continuation of construction-period grouting of the left abutment (from the galleries) as the abutment bedrock warms up under the influence of the reservoir. It is considered prudent to make an allowance, during the first five years, for regrouting – from the galleries – of the left abutment in case any ice melts in postulated ice filled features. For this and other potential short-term initial operation period needs, it is suggested that for the first five years that the project budget include an annual allowance on the order of US$ 2 to 3 million.