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April 9, 2012

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Dear Mr. Kean,

Please find attached Validation Estimating LLC's draft report of its review of Nalcor's Lower Churchill Project Gate 3 capex estimate. Given the estimate's status, the report does not include any quantitative analysis. Recommendations are included.

I appreciate your confidence in VE to perform this review. If you have any questions, my number is 1-703-[redacted]483 (mobile) or email me at jhollmann@validest.com.

Best Regards,

John K. Hollmann

John K. Hollmann, PE CCE CEP

Owner/Consultant-Validation Estimating LLC

Attachment: Draft LCP Gate 3 Estimate Review

Review of the Lower Churchill Project

Gate 3 Capital Cost Estimate

Draft

April 9, 2012

By:
John K. Hollmann PE CCE CEP
Owner-Validation Estimating LLC

Table of Contents

Executive Summary including Recommendations.....3

Introduction 5
- Objective
- Scope of Review
- External Basis
- Internal Basis
- Approach

Assessment Findings.....9
- Strategy
- Process and Planning
- Organization and Competencies
- Methods and Tools
- Deliverable Review
- General Quality
- Metrics/Validation
- Other Observations

EXECUTIVE SUMMARY

GENERAL FINDINGS

The findings and recommendations in this Executive Summary are focused on the quality of the deliverable and results at this point in time and recommendations to improve it by Gate 3 and thereafter. While this summary does not focus on the path to the current deliverable, the review did examine how the estimate was prepared; this provided the reviewer with insight as to where to look for potential quality issues. The findings in the full report about past practices will be most useful for future estimates.

The following are general findings in respect to how well the estimate (as of April 2, 2012) meets the objectives of a) meeting industry expectations and requirements for an AACE International Class 3 estimate, b) serving as a basis for Gate 3 decision economic evaluations and c) serving as a basis for control budgeting of the next phase.

First, it should be noted that while not perfect, the LCP Gate 3 estimate in its current state is one of the best mega-project "base" estimates that this reviewer has seen in some time. My conclusion is that this is in large part due to the active involvement of the owner leads in striving for best practices and quality.

The following are the findings as to the key objectives:

- The LCP estimate meets the requirements for an AACE International Class 3 estimate. Note that "Class" designation is determined solely by the status of the deliverables used as a basis for the estimate. This aligns with Nalcor's stage-gate system. AACE Class does not determine estimate accuracy; that must come from risk analysis (see below).

- The LCP estimate is appropriate for use in Gate 3 economic analysis with the following exception:
    - Because estimating by definition deals with quantifying uncertainty (i.e., it is not accounting), a probabilistic estimate distribution of total capital cost is best practice for risk-informed investment decision making. There has been no probabilistic evaluation yet.
        - It is a concern that no such distribution or range was developed at Gate 2.
        - At this time, LCP's tools and practices are incapable of producing a single probabilistic cost distribution and range.
        - Cost and schedule planning and risk practices are not fully integrated.

- The LCP estimate is appropriate for use as an Execution phase project control basis with several exceptions:
    - Cost and schedule planning and risk practices are not integrated (i.e., there has been no overall *Resource Planning* conducted, nor is this in the project planning documents)
    - No Contingency Planning is evident for significant risks. Best practice risk analysis should identify key residual risks for which back-up plans should be in place, including conceptual scope, schedule and cost (i.e., an expected estimate deliverable).
    - The Basis of Estimate and backup documentation is not complete as a guide for Change Management reference going forward.
    - An estimate plan is needed to complete translation to a budgeted control basis, including addressing concerns of this review.

RECOMMENDATIONS

In respect to the above findings, the following recommendations are:

- Implement or acquire capability to produce probabilistic estimates and schedules using practices aligned with AACE International Recommended Practices.
    - i.e., Methods should be explicitly risk-driven, with integrated cost and schedule analysis and considering both systemic and project-specific risks (tactical and strategic language is not aligned with final quantification practices)
- Conduct the appropriate risk analysis and based on the probabilistic outcomes, recommend best practice cost and schedule contingency and reserve allowances prior to Gate 3.
    - If no schedule contingency is allowed, cost contingency will be increased to allow for risk responses driven by the assumed objective of schedule preservation.
- Complete the Basis of Estimate documentation and associated backup materials.
- Perform Resource Planning
    - Include this practice in the Project Management and Control planning documents.
    - The current plan is to resource load the schedule to generate resource curves and cash flow; however, this is not resource planning.
    - Resource planning is an interactive, iterative risk-informed exercise between estimating, planning and scheduling, procurement and construction to develop an optimized, risk-tolerant estimate and schedule that increases the likelihood of achieving objectives. It is unlikely to change the bottom-line, but will reduce the risk. The initial resource loading is the start; this follows through on optimizing the outcome and benefits from integrated cost and schedule risk analysis.
- Develop a "Transition Plan" between Estimating, Planning and Scheduling, and Control to complete the final integrated analyses and deliverables and finalize a basis for control considering outcomes of the Gate 3 decision (i.e., allow time and resources for post-gate modifications and rework).
- No metrics review or validation was done given the incomplete status of the estimate compilation. It is recommended that this be done to assure that the numbers meet Nalcor's strategic objectives. However, those objectives have not been articulated in practical terms.
    - Clarify what a "balance between absolute cost and cost predictability" means (some options for defining what "good" metrics should show are below):
        - Metric is expected to show a tight, competitive "base" cost (aggressive, but reasonably achievable) with overall predictability accommodated in the contingency and escalation. Our base values target competitive bids for each work package, but allow for contractor risk premium through change management.
        - Metric is expected to show our "base" cost is comparable to conservative bids including healthy risk allowance by the bidders. No contingency should be needed to cover the bids received (risk premium is buried in the base). Note that this has been the observed, unspoken practice that should be explicitly considered in upcoming risks analysis; is this what was intended?).

INTRODUCTION

Objective

The primary objectives of the review were to qualitatively assure whether the following objectives for the Lower Churchill Project (LCP) Gate 3 estimate have been or are being met:

- meets industry requirements for an AACE International Class 3 estimate,
- serves as a basis for Gate 3 decision economic evaluations, and
- serves as a basis for control budgeting of the next phase.

Another objective was to validate whether the estimate meets quantitative requirements in line with the project's cost strategy (i.e., predictability, competitiveness, or whatever). Because the estimate has not yet been compiled and metrics could not be analyzed, this could not be done at this time. Nalcor is requested to clarify its cost strategy prior to conducting a validation if one is to be done.

The recommendations of this review are focused on potential improvements to the estimate from now to the Gate 3 review. However, the findings will also help improve future Nalcor estimating practices.

Scope of Review

The LCP Gate 3 capital cost estimate as it existed on April 2, 2012 was reviewed. As per the objectives, the review was to be both qualitative and quantitative. The entire cost estimate deliverable including basis, summaries and backup as well as the estimating process and organization were to be reviewed. The exceptions were the EPCM costs (in negotiation) and Exchange rate risks (financial). The cost or time to prepare the estimate were not reviewed.

On April 2, the estimate was still undergoing final changes and corrections so no overall cost summary or compilation was available. Also, the contingency and escalation estimates have not yet been done. Therefore, in addition to the exceptions previously noted, the scope of review was adjusted as follows:

- No quantitative validation was done.
- Traceability checks were performed on the December 15, 2011 estimate which represents the current scope, but was assembled prior to contract packaging.
- Contingency and escalation estimating practices for the Gate 2 estimate were reviewed as proxies for the planned practices for Gate 3.

The estimating process and practices to date were reviewed to provide insight as to where to look for potential quality issues. The findings from the practice review will be most useful for future estimates.

The estimating process interfaces with the project control, planning and scheduling and change management and other practices. These were reviewed with respect to the interfaces. In some cases, observations of potential improvements to non-estimating products were made and are noted in the report.

External Basis

A review is done to assure that requirements were met. The basis of any review is the requirements. The main requirement was that the estimate was to be Class 3 per AACE International Recommended Practices (RPs). For this, AACE's 18R-97 was the basis of review. Otherwise, there were no definitive requirements other than a general expectation that "best practices" were to be used.

Qualitatively, the Consultant assumed that best practices are represented by AACE RPs where applicable. The following RPs were considered:

- 10S-90: Cost Engineering Terminology
- 18R-97: Cost Estimate Classification System: As Applied in Engineering, Procurement, and Construction for the Process Industries
- 31R-03: Reviewing, Validating, and Documenting the Estimate
- 34R-05: Basis of Estimate
- 36R-08: Development of Cost Estimate Plans - As Applied in Engineering, Procurement, and Construction for the Process Industries
- 40R-08: Contingency Estimating: General Principles
- 41R-08: Risk Analysis and Contingency Determination Using Range Estimating
- 42R-08: Risk Analysis and Contingency Determination Using Parametric Estimating
- 44R-08: Risk Analysis and Contingency Determination Using Expected Value
- 57R-09: Integrated Cost and Schedule Risk Analysis Using Monte Carlo Simulation of a CPM Model
- 58R-10: Escalation Principles and Methods Using Indices
- 65R-11: Integrated Cost and Schedule Risk Analysis and Contingency Determination Using Expected Value
- 68R-11: Escalation Estimating Using Indices and Monte Carlo Simulation

Some other primary sources of practice basis information include:

- AACE's Skills and Knowledge of Cost Engineering, 5th edition
- Chapter 2, "Estimating Methodology" by John Hollmann in *The Engineer's Cost Handbook*, Marcel Dekker, 1996.

Where there was no applicable RP or text, the review is based on the Consultant's many years of hands-on, benchmarking and consulting experience with major process industry owner companies. In addition, the Consultant has performed research of project control practices. The Consultant interprets "*best practice*" to mean "practices most likely to achieve the desired objective under the circumstances"; it does not mean the most new, rigorous or popular practice. Best practices are also open to inspection so there is no question as to what they are doing.

Quantitatively, the basis of validation is industry quantity, hour and cost metrics. For this review, the metrics were to come from the Consultant's experience (it is assumed that Nalcor will also have IPA review the Gate 3 products). The metrics need to be adjusted to the project

location, strategy and conditions, and also to align with the Owner's objectives. The stated objective was to achieve a "balance between absolute cost and cost predictability". This leaves a lot of room for interpretation for the estimator who has to make many decisions about prices, rates, productivities and other inputs. Nalcor needs to better define this objective in practical terms (the Recommendations include several examples).

Internal Basis

Discussions of estimating practices were held primarily with Mr. Jason Kean (Deputy Project Director) and Mr. Mark Turpin (Sr. Estimator) of Nalcor. Mr. Kean explained general strategy, process, organization, estimate roll-ups and presentation, and owner's cost estimating, and Mr. Turpin explained most of the remainder. Other individuals were briefly consulted on specific topics.

The following are the primary documents reviewed (various non-core documents were also reviewed):

- Basis of Estimate: (LCP-PT-MD-0000-PC-ES-0001-01; draft)
  - August 2011 Estimate Plans
  - Current estimating plan punch-lists and open-item lists
- HCSS Estimate Binders set; December 15, 2011 including backup binders:
  - Material Price Quotes
  - Back-up estimate worksheets
- HCSS system screens (viewed sample)
- Quantity Take-off Binders (by package)
  - Packaging Strategy
- Mass Excavation, Concrete and other Check estimates (Mulcahy and Hewitt)
- Labor Rates Study: (LCP-PT-MD-0000-PM-RP-0001-01; B1)
- Escalation Estimate, Gate 2 (LCP-PT-ED-0000-EP-RP-0001-01)
- Project Risk Analysis, Gate 2 (LCP-PT-ED-0000-RI-RP-0001-01)
- Contract Strategy: (LCP-PT-MD-0000-PM-SY-0002-01; B1)
- Execution Plan (PEP): (LCP-PT-MD-0000-PM-PL-0001-01; B2)
- Planning and Scheduling Plan (PEP): (LCP-PT-ED-0000-EP-SH-0003-01; B1)
  - Master Summary Schedule
- Project Management Plans, Gate 3 (ID not noted)
  - Project Control Plan (included in PMP above)
  - Change Management Plan (included in PMP above) and sample forms
- Constructability session records
- Owner's Cost Access screens (viewed sample)
- Project Indirect estimate summaries and backup
- Estimating document control index

Approach

The qualitative review approach included the following steps:

- Kickoff briefings with Mr. Kean and Mr. Turpin on strategy objectives, status, organization, and an overview of the estimating process and deliverables
- Review Project Execution and Contracting Strategies
- Review of Project Management Plans including Project Control and Schedule
- Review Estimate Plan
- Review Basis of Estimate
- Review Estimate Tabulation (in this case December 15, 2011)
- Review Estimate Backup and trace to above
- Review Risk Estimates (contingency and escalation; in this case Gate 2)
- Review document and change control practices
- Initial onsite briefing on Findings and Recommendations
- Draft and Final (tbd) Reports

Each was document was reviewed for the following:

- Alignment with stated strategy, objectives, requirements and planning guidelines
- Demonstrate discipline (document control/change control)
- Demonstrate Best Practice
- Errors and Omissions
- Traceability

ASSESSMENT FINDINGS

GENERAL

First, it should be noted that while not perfect, the LCP Gate 3 estimate in its current state is one of the best mega-project "base" estimates that this reviewer has seen in some time. My conclusion is that this is in large part due to the active involvement of the owner leads in striving for best practices and quality within the construct of a solid phase-gate system. They have made the most of the workmanlike contractor resources. The typical case in Industry is minimal owner guidance and oversight of an often disjointed estimating process and team. The critiques below should be read in the light of the estimate being of generally good to high quality. Everyone was cooperative and helpful.

STRATEGY

Positives:

- Striving for best practices, quality and discipline in practice at working level.
- The vehicles are in place to communicate strategy if it were articulated.
- Estimating is involved in overall planning process (e.g., participated in constructability).
- Both value and risk are considered.
- Phase-gate process results in AACE Class 3 (and FEL 3) which is a stated objective.

General Critique:

- Strategic objective stated in planning documents are prone to motherhood statements like "cost effectiveness", "holistic" and "flawless". However, deploying strategy requires translation into specific requirements for each planning deliverable and those are generally missing. E.g., how can cost and schedule be "holistic" if Resource Planning is not done or integrated cost and schedule risk analysis is not done?

Cost Strategy

- Ambiguous Strategy: In various planning documents, the following statements were found "balance between absolute cost and cost predictability", "Least Cost" (not lowest), and "Cost Effectiveness". However, nowhere are these statements articulated into an estimating requirement or guideline as to what the "base" estimate should represent. In practice, each estimator was making their own judgments based on their experience. Based on my experience, most estimators try to predict the average bid including a risk premium (i.e., no contingency should be needed at the time bids are incorporated into the control budget).
- Predictability is the Implicit Strategy: lacking any statement about targets or similar, cost basis is mediocre, historical performance (i.e., predictable; we don't want to be embarrassed by our "base" estimate being below the bid.) So, how do we know what premium are we paying?
- Ad-hoc Pricing Basis: decisions are being made to use higher quotes rather than average or least-technically acceptable quotes without any articulated strategy or requirement for this.
- Fuzzy Comparison Basis: Estimators are implicitly trying to predict a "reasonable" bid (i.e., the highest bid after discarding the absurd ones).
- RESULT: Lost Pricing Intelligence: The project will not know what premium they may be paying for less than optimal performance and risk.
    - i.e., when you get a "low" bid, is it ridiculous or is it reasonably achievable and we should give them a chance. Team will not know with the conservative base.

Cost/Schedule Integration and Tradeoff Strategy

- Ambiguous: The statement that cost and schedule will be managed "holistically" is repeated in several documents, however, nowhere is the interface of estimating and schedule discussed other than in the context of final loading of cost into the schedule to get resource curves and a cash flow.
- Estimating and Scheduling Marginally Integrated: There is no discussion of resource planning or resource loading in estimating or planning and scheduling plans and documents. There is a focus on "Constructability-is that a proxy for schedule integration (if so, say so).
- Cost and Schedule Risk Quantification are not integrated: There is no explicit connection of cost and schedule risk analysis and quantification. Resource planning is aided by understanding how the plan can be made "risk-tolerant".
- RESULT: Implied strategy Is expensive (including having NO schedule contingency): my reading is that that the first power date is involute; but does this mean "at all costs"? I found places that estimators were adding allowances for schedule issues. Cost contingency will be high if every risk response must recover schedule at all costs.

Risk Management Strategy

- Disconnects Between the Risk Policy/Philosophy and Estimating. Some examples are below;
  - Philosophy says risk is "improved when "achievable objectives" are first established; so what is the cost objective? (see above).
  - Philosophy says decisions are facilitated "through a comprehensive understanding of risks"; so what is comprehensive about estimating contingency with methods that do not tie to identified risks? Why is escalation estimated deterministically? Why are cost and schedule risks analyzed separately?
  - Policy says "Improve decision-making by thoroughly understanding project risks and uncertainties". So why was there no funding of strategic risks (many with 100% probability of occurring); Why is no probabilistic information generated for consideration in economics? In actuality, absolutely no uncertainty information is being communicated in the Gate 2 estimate outcome (i.e., contingency is a control account that is expected to be spent and does not communicate uncertainty).
- Weak Logic in Treatment of Risk Costs: What message is sent when no reserves are included for 100% probable risks (e.g., shortages of labor)? If they are "balanced by opportunities", then include that in the method; what are those opportunities?
- Ambiguous or Confusing Terminology: "Tactical" and "Strategic" are mistakenly defined as synonymous with contingency and reserves respectively. Yet, most of the strategic risks are not negotiable and have 100% probability of occurring (e.g., shortage of labor); there is only uncertainty in scale of impact.
- Obfuscation: Trademarked, black box methods (and non-industry standard terminology) obscure the fact that the risk quantification methods used were not well aligned with industry risk analysis principles (e.g., did not explicitly quantify the risks identified).
- Other artifacts of risk policy/philosophy vs. practices disconnect:
  - No clear discussion of how contingency and reserves will be funded and managed in Change Management or Project Control plans.
  - No mention of risk "quantification" in the PEP.
  - No mention of schedule contingency or buffers in the Planning & Schedule Plans.
  - Misinterpretation of IPA cost growth metrics (there contingency p50 value is the starting point and does not cover project-specific risks; only systemic risks).

PROCESS (AND PLANNING)

Positives:

- Striving for best practices and discipline in practice at working level.
- There is a willingness to be disciplined in defining processes and plans.
- Basis is adequate to support AACE Class 3 designation

General Critique:

- Industry Failing; the allied project control professions are not good at planning their own work (they are great for expecting that of others). This project appears to have tried to "fight the tide" of EPCM competency weakness, but has fallen short as have so many others.

Requirements

- No requirements: These should flow from strategy (requirements=how to deploy strategy), but strategy has not been articulated so tough to develop requirements. In reviews, what is a "good" estimate in Nalcor's eyes? What number is the right number? I don't know what LCP wants, so my report says what I think they should be.

Estimate Process

- No Process: the Project Management Plan has a "Cost Estimate Process" wherein estimating has a single box labeled "Prepare Estimate". I suspect the EPCM has processes elsewhere but it has not been built into the project documents.

Estimate Plan

- No Plan: This flows from process which is not there either. The owner team has a mental picture of a plan, but little on paper except some major tasks, milestones, staffing, and punch lists. At this point, the plan is to a) get to funding, and b) establish a basis for control and bid packaging.
    - In August 2011 there was a plan and kickoff, but mostly a high level task and staff list
- Mixing Estimating and Budgeting: "Packaging" is taking place before the estimate is completely QC'd or Resource Planning is done. Arguably, packaging can be seen as a form of QC to get engineering and area input. In any case, it impeding getting an integrated estimate deliverable that can be reviewed as a whole and aligned with the schedule. Will the packaging have to be done over after the gate review changes (we know the estimate will be recast somewhat, but now we have to recast the packaging). There is no right or wrong here-just tradeoffs.
- Need to develop a "Transition Plan" for getting the estimate into the control tool (packaging is usually a part of that) accommodating Resource Planning and Risk Analysis outcomes, addressing late changes, and responding to inevitable post-Gate 3 second-guessing. The team should be ready to respond to changes.
- Ad-hoc review: There is review taking place, but it's not clear what the plan is. Also, again, what requirements should the review assure have been achieved?

Basis of Estimate

- Lagging; see above regarding planning

ORGANIZATION/COMPETENCIES

Positives:

- Fairly robust team including experienced lead owner estimator working with enlightened senior management.
- Discipline or scope specialists on team or on call (e.g., hydro, transmission, etc.).
- Owner has ability to do in-house check estimates for much of the scope.
- Willing to call in consultants as needed.

Planning
- By SNC estimating; not a strong competency

Quantification
- By SNC engineering disciplines; reasonable staffing and competency

Costing/Pricing
- By SNC estimating and procurement; reasonable staffing and competency
- Competency may have been more "hard money" subcontract point of view

Risk Quantification
- No in-house staffing or competency

Budgeting (including Packaging)
- By team contracting, controls and estimating; reasonable staffing and competency

Review
- Using consultants

METHODS AND TOOLS (GENERAL)

Positives:
- Striving for best practices and integration between systems
- Trying to leverage the participant's existing strengths
- For software, generally using recognized tools, but willing to develop or use specially designed ones if they are better

General Critique:
- The estimating system may not have been optimal from a blank slate perspective
- Reference unit hour data (or production rates for mass earthwork and concrete) is coming from everywhere without stated strategy, source, documentation of criteria of selection, etc. (see Strategy and Planning above)
- Hard money, construction estimating being applied; value added?

WBS
- Complete, logical structure with physical and cost account breakout.
- Construction packaging is well advanced and the Gate 3 estimate will be by package

Quantification
- Directs: Traditional. Quantity take-off by engineers, excavation from 3D CAD, some structural and other by sketches and preliminary drawings
- Indirects; Traditional. Staffing and expenses by responsible persons

Estimating (Costing/Pricing)
- Field: Highly detailed (hard money type), take-off based, few factors, estimator judgment
- Mass Earthwork/Concrete/Transmission: production rate based; judgment of owner and SNC experts, but no criteria of chosen rates (for example, production costs are highly dependent on haul distances which drives the number of vehicles; was the production cycle analyzed for hauling logistics given the assumed pits, dumps, batch plant locations, etc.?)
- Balance of Plant; various reference based unit hours times location factor
- Office: Staffing with durations and rates, plus expenses
- Materials: Major items quoted (long lead nearing commitment)

Software
- Construction Directs/Indirects: HCSS used, but typically the work is done in Excel worksheets by discipline estimators and transferred into HCSS where final tweeks are made
- Indirects: Spreadsheets

- Owner's Costs: Custom Access database tool, spreadsheets

Databases and References

- Unit Hours; for balance of plant, various sources (in-house, Richardson's, estimator's personal data, etc.)
- Production rates: for mass earthwork and concrete based on construction estimating expertise
- Construction equipment rates from market manuals
- Materials; major items based on quotation, minor items from various in-house sources
- No empirical risk data

Benchmarking and Reconciliation

- Reconciled to Gate 2
- Two independent check estimates of mass excavation and concrete
- IPA for high level review
- This review (validation pending having an estimate fully tabulated)

Contingency

- Westney "Risk Resolution" ® approach
- "Tactical Risk"; Not clear what this quantifies-no risks were identified in Gate 2
- Line-Item Ranging with Monte Carlo Simulation (MCS)
- L/H ranges obtained from team in traditional brainstorming
- Outcome is equivalent to selection of a single high-end biased distribution applied to total L/ML/H with 100% dependency. Purpose of high bias distribution is presumably to override team bias towards too low of a high range (and presumably closer to empirical reality)
- Purpose of 100% dependence is to override "iatrogenic" risks of independent items balancing out lows and highs in the simulation.
- Approach makes the best of "line-item" ranging, but still leaves the fact that it has no documented basis in Risk Identification

Reserve

- Westney "Risk Resolution" ® approach
- "Strategic Risk"; Risk-driven approach
    - Strategic Risks are "failure of the general execution plan" which are defined as outside the control of the team
    - This categorization is meaningful for who is responsible to be the risk owner and risk actionee, but it is irrelevant to contingency quantification; most of these risks have 100% probability of occurring and some money is expected to be spent (which is the definition of contingency). If there are uncertain balancing opportunities, explicitly include them in the analysis.
- Expected Value method with Monte Carlo Simulation (MCS), except probability of occurrence is not evaluated (it is assumed to be 100% for all risks)
- L/H ranges obtained from team in traditional brainstorming
- Outcome is equivalent to a high-end biased distribution applied to total L/Avg/H with no dependency
- Purpose of high bias distribution is to override team bias towards too low of a high range
- Purpose of zero dependence is that most are independent (but question should be asked)
- Approach is an over-simplification of the Expected Value method; removes the questions of probability of occurrence, most likely values, and dependence.

Schedule Risk

- Traditional CPM with Monte-Carlo simulation
- Applied to a summary level schedule

- Irrelevant to cost estimate as there was no attempt to integrate cost and schedule risk analysis

Escalation Risk

- Market-adjusted economist indices by time period and by cost/commodity (bins)
- Best indices sought for each bin
- Market adjusted arguably covers some of the "Strategic" risks that were otherwise ignored
- Not probabilistic
- Not sure if indices are based on same economic scenarios as the business case model

Exchange Risk

- Not reviewed

Review

- Lead owner estimator spot checks (presumably same on EPC M side)
- 3rd party high level review
- Package leader review of quantities and estimate (area managers expected to take ownership of both scope and budget)

DELIVERABLE REVIEW

Summary/Metrics

- None available at this time
- Snap-shot summaries combine EPCM into one. CM needs its own cost focus as it is entirely different than Engineering. Actually PM, E&P, and CM is preferred.

Directs Quantification

- Review discipline reports that are now being compiled into manuals by "package"
- Generally well documented

Labor Rates

- Special study based on Labor Agreement strategy (Labor stability is stated objective which is the only part of estimate with a clearly articulated cost strategy).
- Highly detailed covers all "burdened rates" including base, union, provincial markups
- Excludes "northern allowance", living allowance, travel to camp allowance (these are risks)

Productivity (Balance of Plant)

- USGC or Richardson factors noted in BoE but hap-hazard buried in narratives
- No documentation of how those factors were derived (is there a productivity study?

Production Rates (Mass Earthwork, Concrete, Transmission)

- Consensus of various experts, but no good documentation of basis or summarizing them

Material and Equipment Pricing

- Quotations are being compiled into backup books including tabulation sheets as appropriate
- Generally well documented

Construction Indirects

- Detailed estimates are included in each HCSS section
- Better documented than norm (reflecting a more hard money approach)

Project Indirects

- Each cost category had a responsible person develop an estimate of varying detail. Some costs such as air travel have extensive analysis evident. Others such as camp operations are mostly hand written or email backup notes using gross unit costs x approximate quantities. Not in great detail. These costs are in continuous review.

Owner's Costs

- MS Access estimating tool which is staffing based

- Did not review in any detail, but appears to be generally well documented; some elements similar to Project Indirects

EPCM

- Excluded from review scope-estimate in negotiation

Contingency (Gate 2 proxy)

- Reviewed Gate 2 "Project Risk Analysis"
- Dependence on Consultant's documentation; no industry practice referenced, method somewhat obfuscated but nothing unique upon inspection
- Tactical vs. Strategic risks equated to contingency and reserve
- No cost and schedule risk integration in methods

Escalation (Gate 2 proxy)

- Reviewed Gate 2 "Estimate Escalation Report"
- Method described per AACE recommended practice

Exchange rates

- Not in review scope

GENERAL QUALITY

Error and Omissions

- Very limited checks, but no significant errors or omissions noted

Traceability

- Review limited to verifying links of Dec 15 HCSS estimate report to quantity take-off and material pricing backup.
- Randomly selected a few items in the Dec 15 HCSS estimate, and both were traceable
  - For one, the "packaging" work had resulted in updates to quantities which were going through the design change documentation process and had not made its way to final estimate. But process was working.
  - For another, the unit pricing varied between the estimator's input and the Dec 15 report; however, the unit price entered in HCSS matched the material quotes (someone edited the data appropriately in midstream, but original estimators backup not edited)

Document control

- An intern is on staff helping
- Estimate reports get coded in SLI project codes
- Backup is in books, or being compiled for Gate 3, and readily retrievable
- Estimate backup is not coded using SLI codes
- Not certain if HCSS has a field populated with backup book number (don't think so because one backup book was created while I was doing the review). A little bit of scouting to find a number source.

Change Control

- Between Gate 2 and 3 focused on scope control
- After Dec 15, changes to take-off recorded in General Change Sheet document

Review

- No formal estimate review documents identified or reviewed (i.e., meeting minutes, action items, etc.)

METRICS/VALIDATION

Pending: If this is to take place, should document the expectations for cost metrics.

OTHER OBSERVATIONS

Project Control

- Project Control progressing and performance measurement approach is ambiguous.
  - If EVMS (ANSI 748) is to be applied, then the current Change Management, Control and Estimating practices are not adequate. Be clear in exactly what measures are going to be produced and monitored.
  - For SPI = (Earned Value (EV) or Budgeted Cost of Work Performed (BCWP)) / Planned Value (PV) or Budgeted Cost of Work Scheduled (BCWS). BCWS means the schedule must be fully resource loaded in real-time, and every change must be time scaled by progressing period. On mega projects, this is too onerous, so resources are just entered as uniform spending which defeats the purpose and worse, produces false measures
  - EVMS is an "iatrogenic" risk; it contains ZERO causal intelligence (see below) and robs limited resources of time to be proactive. The risk is that it diminishes control by diverting energy to systems and reports and can yield false data per previous bullet. There is no impartial empirical evidence that it improves performance (my IPA research shows there is little "space" for improvement beyond traditional EV).
  - EVMS is impossible to report less than monthly and research shows that monthly reporting is ineffective.
- Project Control plan has nothing about gathering "Causal Intelligence".
  - LCP should state philosophy that "Reporting is not Control" and that senior control staff should spend more time on gathering causal information and analyzing corrective action than on accounting measures.
  - Then, follow through on those philosophies which include specific sections in plan on how "intelligence gathering" will take place specifically.
  - Consider time-honored causal measurement practices like "Work Sampling" (see AACE Recommended Practice and used by TVA hydropower).
- Resource Planning (iterative balancing, etc.) is never mentioned anywhere
- No link between Project Control/Change Management and Risk Management. Be explicit that during execution (from a cost/schedule perspective), risk is a sub-element of or directly linked with Change Management; i.e., all changes and trends are run by Risk team, and all risks are run by Controls team.

Change Management

- Change Control Board: can be dangerous source of delay if given excess authority. Be VERY clear in the charter what its role is. In practice, at LCP, NO authority resides in in the CC Board (despite what plans say) because the Project Director picks who has to sign. So it is really just an "advisory" board of key stakeholders selected for their awareness of their area's interests, to "facilitate" the Project Director's obtaining of input and assurance. The Project Director has *complete authority* because they decide who signs. The Board can challenge the Director, but not override them (and this is generally effective).
- See above about linking Risk Mgmt. and Change Mgmt. after Gate 3
- Change form is inadequate to support EVMS SPI measure (see previous)