Presentation

– Roller compacted concrete (RCC) dam concept and examples
– Concrete faced rockfill (CFR) dam concept and examples
– Construction schedules – concept level
– Conceptual level construction cost estimates
– Next steps
Purpose and Scope of Cost Estimate Report

– Develop conceptual-level cost estimates based on available information (prior to current phase of geotechnical investigation)
  • Dam types and dam axis alignments from Preliminary Geotechnical Investigation Phase II Report, Feb. 2016

– Compare relative costs; provide indication to NID of potential project costs
  • RCC dam and CFR dam at Axis 2 and Axis 6
Reservoir Plan & Dam Axis Locations
Conceptual RCC Dam Layout – Axes 2 & 6
Conceptual RCC Dam Sections
RCC Dam Conceptual Construction Site Layout
Toker Dam, Eritrea, E. Africa
Littlerock Dam, Palmdale, CA
Los Vaqueros Dam, Brentwood, CA
RCC Spillway Block
Los Vaqueros Dam, Brentwood, CA
RCC Spillway Block
CFR Dam Conceptual Layout – Axes 2 & 6
CFR Dam Conceptual Section
CFR Dam Conceptual Spillway Profile
CFR Dam Conceptual Construction Site Layout
Terror Lake CFR Dam, Kodiak Island, AK
Terror Lake CFR Dam, Kodiak Island, AK
Cirata Hydro Project CFR Dam, W. Java, Indonesia
Kárahnjúkar CFR Dam, Iceland
Conceptual Construction Schedule Considerations

– Variables considered in construction schedules
  • Productivity (depends on crew sizes, equipment spreads, access conditions, etc.)
  • Approaches to sequencing of activities
  • Number of shifts per day and days per work week

– Schedules focused on major activities most likely to influence total construction durations.
Conceptual Construction Schedule Considerations

– Durations of construction estimated for major work activities
  • Based on work quantities and typical productivity rates.
  • Productivity rates estimated based on experience
  • Other projects of similar type and magnitude.
  • Overall estimated durations consider logical sequence of work activities.
RCC Dam Conceptual Construction Schedule

2½ years
CFR Dam Conceptual Construction Schedule

4 years
Basis of Conceptual Estimates

– Conceptual level AACE Class 4 Estimate

– Approximate estimate range of accuracy at this level: 30% below to 30% above actual construction cost.

– Includes a 30% overall design contingency
  • Part of estimated construction cost - accounts for items that cannot be fully assessed due to conceptual level of current design alternatives.
  • Variable line item contingencies:
    o Excavation – 40%
    o Grouting – 40%
    o RCC – 30%
Basis of Conceptual Estimates

– An experienced cost estimator with construction and hard dollar contract bid experience prepared estimate.

– Estimate in 2016 dollars.

– Based on “design-bid-build” process.

– Estimates represent professional opinions of probable construction costs.
  • Actual construction costs could vary from these estimates based on many unknown and uncontrollable factors (geotechnical conditions, market conditions, etc.)
Exclusions from Estimate

– Design engineering: 5 to 8%

– Construction management and engineering services during construction: 8 to 10%

– Other potential project costs not directly related to dam construction are excluded:
  • NID’s project management & administration costs, reservoir clearing, land acquisition, legal, permitting, environmental review & documentation, and mitigation.

– Potential construction cost growth due to change orders is not included in estimate.
  • Can amount to 10% - 15% of total construction cost, particularly for projects that involve relatively large geotechnical uncertainty.
## Summary of Comparative Conceptual-level Construction Cost Estimates

<table>
<thead>
<tr>
<th>Dam/Axis</th>
<th>Est. Construction Cost</th>
<th>Relative Cost</th>
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<tbody>
<tr>
<td>RCC Dam (Axis 2)</td>
<td>$259M</td>
<td>1.00</td>
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<tr>
<td>RCC Dam (Axis 6)</td>
<td>$284M</td>
<td>1.10</td>
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<td>CFR Dam (Axis 2)</td>
<td>$339M</td>
<td>1.31</td>
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<td>CFR Dam (Axis 6)</td>
<td>$325M</td>
<td>1.25</td>
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## Conceptual-level Construction Cost Estimate Summary – RCC Dam

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
<th>Axis 2</th>
<th>Axis 6</th>
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<tbody>
<tr>
<td>A</td>
<td>Mobilization &amp; Site Development</td>
<td>$23,473,000</td>
<td>$25,368,000</td>
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<tr>
<td>B</td>
<td>Diversion &amp; Outlet</td>
<td>$3,607,000</td>
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<tr>
<td>C</td>
<td>Dam Foundation</td>
<td>$58,787,000</td>
<td>$53,379,000</td>
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<td>D</td>
<td>RCC &amp; Facing Concrete</td>
<td>$153,552,000</td>
<td>$182,234,000</td>
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<td>E</td>
<td>Spillway</td>
<td>$10,884,000</td>
<td>$10,723,000</td>
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<tr>
<td>F</td>
<td>Outlet &amp; Intake Structures</td>
<td>$7,775,000</td>
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<td>G</td>
<td>Instrumentation &amp; SCADA</td>
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<tr>
<td>Total</td>
<td></td>
<td>$259,203,000</td>
<td>$284,210,000</td>
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**Conceptual-level Construction Cost Estimate Summary - CFR Dam**

<table>
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<tr>
<th>Category</th>
<th>Description</th>
<th>Axis 2</th>
<th></th>
<th></th>
<th>Axis 6</th>
<th></th>
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<tbody>
<tr>
<td>A</td>
<td>Mobilization &amp; Site Development</td>
<td>$32,075,000</td>
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<tr>
<td>B</td>
<td>Diversion &amp; Outlet</td>
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<td>Dam Foundation</td>
<td>$51,579,000</td>
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<td>Embankment</td>
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<td>Concrete Face, Plinth &amp; Parapet</td>
<td>$46,331,000</td>
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<td>Spillway</td>
<td>$96,144,000</td>
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<td>Outlet &amp; Intake Structures</td>
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<td>$325,245,000</td>
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Next Steps – Current Work

– Complete Phase III Geotechnical Engineering Report
– Input to project description in support of the EIR
– Conceptual design stability and hydraulic analyses
– Cost estimate update based on Phase III geotechnical investigation and additional design work
– Conceptual Engineering Report
Thank You