ACEC Arizona & Maricopa County Liaison
Cave Buttes Dam Modification Project

Steve Brown, P.E.
Sr. Geotechnical Engineer/Project Manager
Dam Safety Branch, FCDMC

Marc McIntosh, P.E.
Project Manager
AECOM
Outline

- Basic structure information
- Why was Cave Buttes Dam built?
- Why is the dam being modified?
- Modification Project Design – Auxiliary Outlet
- Construction Manager at Risk: Pre-Construction
- Agency Coordination
Cave Buttes Dam Structure Info

- Constructed by US Army Corps of Engineers (Corps) in 1980
- District maintains and operates
- Main dam 2,275 ft. long and 110 ft. high
- Three dikes
- Flood storage capacity is 86,000 ac-ft.

X 12 miles high!
Why was Cave Buttes Dam built?
Cave Creek Dam Impoundment – Insufficient Capacity
Cave Buttes Dam Impoundment - 2010
Why are we modifying the dam?

- Existing outlet is a single 45” diameter conduit (relatively low outlet capacity)
- There are seepage concerns at the dam
- In 1993, seepage was observed at the left abutment
- The dam has never experienced a full reservoir (untested)
- To reduce drawdown time from ~55 days to <30 days → **RISK REDUCTION**
Potential Consequences are HIGH!

Over 1 MILLION people in the dam failure inundation area
The District plans for a future “Phase 2” project to add internal erosion mitigation measures to the dam.
1993 Seepage

Approximate 1993 Seep Location

Seep was clear, but unexpected after such a short loading duration.
Cave Buttes Dam Modification Project
Design Elements

- New 60-inch diameter steel-lined auxiliary tunnel outlet
  - Auxiliary outlet operated to stay within current 100-yr floodplain

Ancillary Features

- Intake tower with hydraulic gate
- Outlet structure
- Gate House
- Inlet/Outlet Channels
- New stream flow gauge downstream
Project Site

Cave Creek Dam

Cave Buttes Dam

Dike 1

Dike 2
Tunnel Boring Machine

Actual machine that will be used on the Cave Buttes Project
Construction Manager at Risk: Pre-Construction

- Why CMAR?
- Procurement
- Pre-Construction Activities
- Lessons Learned

Original Graphic: CDM Smith
Why CMAR?

- Complicated or Unique Project Scope
- Quality is #1 Priority
- Construction Budget Management & Control
- United Project Team/Improved Working Relationships
- Regulatory Agency Complexities
Why CMAR for Cave Buttes?

• Is the project unique or specialized?
  - Dams have much more scrutiny than many other heavy civil jobs.
  - Tunneling is a specialized field.

• How many local contractors have the appropriate experience?
  - Few qualified tunneling companies locally.
  - Qualifications-based procurement is advantageous

• United Project Team/Improved Working Relationships
  - Owner/EOR/CMAR working together; non-adversarial.
CMAR Procurement

- Qualifications Based
- When to Bring the CMAR Onboard
  - General scope of work must be well defined
  - Ideally at 30% design; Recommend NLT 60%
- Include Major Sub-Contractors on Pre-Construction Contract
- Include Range of Estimated Construction Cost and Construction Cost Model in the RFQ
CMAR Pre-Construction Activities

- Design Document Review
- Constructability Review
- Work Plan Preparation
- Technical Submittals
- Additional Investigation/Testing
- Guaranteed Maximum Price (GMP)
- Construction Risk Meetings
Guaranteed Maximum Price (GMP)

- Adopt a Cost Model for Application of “Below the Line” Items
- GMP Fully “Open Book”
- Detailed, Independent GMP Review
- Quality EOR Estimate Required for Effective Negotiations
- Reconcile Quantities and Bid Items Early On
- Recognize Ability to Balance Cost and Risk
- Use Allowance Items to Minimize Potential Change Orders
- Iterative Process Allows for Effective Budget Planning (30%, 60%, 90%, Final)

The GMP Summary should follow a similar format as shown below:

<table>
<thead>
<tr>
<th>Project Name:</th>
<th>Project Location</th>
<th>DATE</th>
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**Cost Description:**

- **A. Direct Costs:**
  - A1 Prime Contractors Direct Cost of Construction $100,000
  - A2 Sub Contractors Cost $50,000
  - A3 Construction Management $20,000
  - A4 Total of Direct Costs $170,000

- **B. Indirect Costs:**
  - B1 Administrative & Supervision of Subcontractors (See Note D) $10,000

- **C. Profit Excluding Subcontractors:**
  - C1 Profit Excluding Subcontractors: Profit if Subtotal 1 > Subtotal 2 $5,000

- **D. Total Direct Costs:**
  - D1 Total Direct Cost $175,000

- **E. Bonds and Insurance:**
  - E1 Bonds (calculated at 1% of total contract) $2,500

- **F. Subtotal 3:**

- **G. GMP Design Phase Cost Model:**

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*Note D: The costs for administrative and supervision of subcontractors are based on a percentage of total subcontractor costs.*
Construction Risk Meetings

• Identify risks to cost and schedule (e.g. a tunnel collapse)
• Determine if risk items can be mitigated through design/construction
• Assign who owns remaining risk items: Owner, CMAR, or Shared Risk
• Choose to accept risk or include allowances to address risk
  - Accepting a Risk: The “risk owner” bears the cost/schedule risk
  - Allowances: Must be requested and approved to be utilized, but the amount is included in the GMP total; therefore no change order is required.
• Complete a Risk Register documenting all decisions and agreements
Cave Buttes Dam is licensed by the Arizona Department of Water Resources (ADWR)

Both agencies require permits to modify Cave Buttes Dam

Agency coordination on dam projects is extensive
ADWR Dam Safety

- Short-staffed; ADWR review times are often on the critical path for project schedules
  - District has an IGA with ADWR for Pre-Application Reviews
  - ADWR reviews preliminary submittals to minimize potential schedule delays during later stages of design
- The District provides ADWR with its desired review priorities when multiple projects are under review
- Monthly conference call to review statuses and discuss schedule
USACE

• USACE 408 Permit Program is insufficiently funded. Lack of budget often keeps reviewers from working on your permit.
  ➢ District has an IGA with USACE to expedite 408 Reviews.
  ➢ IGA funding ensures that consistent progress will be made, but it is still a lengthy process for large projects.

• Significant modifications to Corps structures trigger additional requirements such as a Safety Assurance Review (SAR).
  ➢ The SAR team is an independent team contracted by the District to fulfill the USACE SAR requirement.

• Monthly conference calls to discuss progress and schedule
Cave Buttes Modification Project
Key Points & Lessons Learned

- CMAR is a valuable tool for unique and complex projects
- Bring CMAR onboard early in order to take full advantage of the CMAR delivery method
- Detailed work upfront leads to smoother sailing later on
- The CMAR’s Work Plan becomes an important supplement to the plans and specifications
- Quality EOR estimates and detailed GMP reviews are necessary to ensure effective price negotiations
- Pro-active approach to agency coordination can be used to minimize schedule impacts