Value Engineering

U.S. Army
Corps of Engineers
Washington, D.C. 20314

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ON THE COVER

Command & General Staff College, Ft. Leavenworth, Kansas.
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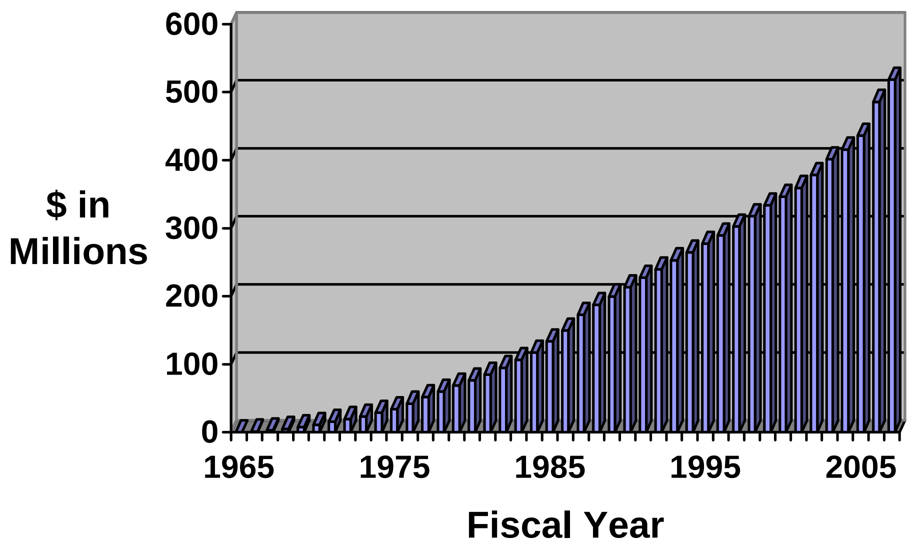
Cumulative Value Engineering Cost Avoidance and Savings



The USACE VM/VE Program has been a leader in applying the Value Engineering Methodology to construction projects since 1964, solidly demonstrating Corps cost effectiveness. The program has resulted in construction of over $5.3 billion in additional facilities, without additional funds requests. It has also assured added quality within available resources. Corps of Engineer sponsored workshops have documented cost savings and avoidance over recent years from $140 million to almost $500 million per year.

The Corps has recently used Value Management/Value Engineering: programmatically to create and implement transformation in how the Corps executes all Military Programs workload; to shorten schedules significantly, and provide quality projects with reduced budgets; to ensure full project coordination with all stakeholders; to assist in preparing project scopes, negotiating environmental contracts, planning optimization, and project review; to provide planning assistance to states/communities; and to assist in program reviews. The results shown above are simply documented, auditable byproducts, used to build and/or enhance authorized projects or reduce reprogramming actions.

History, Mission and Policy

History:

The concept of Value Engineering (VE) was first developed by Mr. Lawrence D. Miles, an engineer for General Electric Company. He created this technique in response to critical material shortages during World War II. Mr. Miles recognized that proper analysis of a product's function often led to improved performance and cost savings as alternative materials or manufacturing methods were discovered and employed. This formal, organized study of functions to satisfy the user's needs at the lowest life cycle costs through applied creativity has saved money and/or improved quality for companies and government ever since.

The U.S. Army Corps of Engineers (Corps) has been actively applying Value Engineering to its work since 1964. The Corps' program includes VE studies, construction contractor Value Engineering Change Proposals (VECP), and a formal training program. All Corps designs and construction have seen dramatic improvements in quality and cost effectiveness as a result of VE.

Mission:

The Corps is responsible for billions of dollars worth of annual design and construction, and has a deep commitment to assure that the public receives maximum value for these funds. VE documents the Corps' cost effectiveness and helps ensure optimum expenditure.

Policy:

Corps policy is to perform VE on all design and construction programs, and is based on the Federal Procurement Policy Act (41 U.S.C. 432), the Water Resources Development Act of 1986, the Office of Management and Budget Circular A-131 and Department of Defense strategic plans.

Training in Value

The Corps of Engineers makes a concentrated effort to provide its employees the knowledge and experience of VE methodology. To that end, the Corps developed a 40-hour construction-oriented VE workshop in 1968. Since that time over 7,000 Corps employees have received this VE training, along with many employees from other Federal agencies.

The workshop has been revised many times over the years to keep it current. Several different government agencies, including the Department of Energy, the Environmental Protection Agency, the Defense Nuclear Agency, the Coast Guard and the Navy have utilized the Corps' workshop to train their employees. Private contractors and designers have also attended.

The workshop format covers requirements, policies and procedures necessary to enable the participants to perform effectively as a VE study team member. Through lectures and practical application sessions, the course provides the history of VE and its development in the Corps. Team dynamics, human relations, and creative thinking are also presented. These topics help students become valuable assets to their organizations by teaching them to use VE techniques in their everyday job situations.

Approximately half of the training is devoted to workshop sessions in which all participants gain experience in performing a VE study on actual construction projects. Each student is assigned to a team at the beginning of the workshop based on experience and work history. The team is responsible for using the knowledge gained during the lectures to complete their VE study. Gathering information, brainstorming alternatives, analyzing ideas, developing proposals, and making an oral presentation of the recommendations are a part of a completed workshop experience. The concept of working with other people in a cooperative manner to develop solutions is a key aspect of the training.

The Corps' 40-hour workshops have been instrumental in accomplishing its goal of providing the highest quality product for the lowest life cycle cost. For more information about Corps VE training, contact Judy Armstrong at the USACE Learning Center 256-895-7419.

Value Engineering

The Corps of Engineers uses the Project Management Business Process (PMBP) as its delivery method for all projects. Each project has a project manager (PM) who leads the Project Delivery Team (PDT).

The Value Engineer is a member of the Project Delivery Team and as a team member provides advice to the team on how to best apply value management principals to the project. The value engineer then works with the team in the application of the selected technique.

VE Job Plan

Value Methodology is a systematic process that follows the Job Plan. The Job Plan consists of the following sequential phases:

Phase 1 - Information Phase

Project information is gathered and reviewed to ensure that all team members completely understand the current state of the project and constraints that influence project decisions. At this stage questions such as “What is it?”, “What does it do?” and “What does it cost?” are answered. It is critical that correct information be obtained at this time otherwise alternatives developed later will not suitably accomplish the required functions. A site visit should be performed in the information phase if at all possible.

Phase 2 **-** Function Analysis Phase

The team identifies the project functions using the two-word active verb/ measurable noun descriptors. This phase will help the team answer the question “What must it do?” During this phase the team may utilize the Function Analysis System Technique (FAST) Diagram method to determine relationships between the functions as well as the value and validity of the functions.

Phase 3 - Creative Phase

During this phase the value study team brainstorms alternative methods of achieving the project’s requirement functions. At this point, other ideas that could perform the basic function(s) are suggested for further consideration thus the team answers the question “What else can perform this function?” Because criticism can discourage participation, decrease the identification of alternatives, and inhibit the creative endeavor, all ideas are captured but are not evaluated at this time. The flow of idea generation is important at this time as one team member may spur the generation of an idea from another team member. Also, one team member may build upon the idea of another team member, a technique known as “piggybacking”.

Phase 4 - Evaluation Phase

In this phase the study team reduces the quantity of ideas generated in the creative phase to a short list of ideas with greatest potential to improve the function of the project. In some cases ideas are refined and/or new suggestions are developed. The retained alternatives are ranked in order of feasibility and cost while unsuitable ones are recorded but not further developed.

Phase 5 - Development Phase

At this point, the best alternatives are developed into formal written proposals. Alternatives are explored sufficiently to demonstrate technical viability, provide reasonably accurate cost estimates to answer the question, “What is the cost of the alternative?” determine advantages and disadvantages, and facilitate design documentation and construction. The work under consideration, before and after conditions, and advantages and disadvantages must be addressed in a clear, concise, and factual manner. Identifying follow up actions should address potential implementation problems.

Phase 6 - Presentation Phase

This phase consists of presenting the developed proposals in a formal presentation to decision makers. It is the value study team’s opportunity to “sell” the proposals to the decision makers, stakeholders, customers and design team.

Implementation: During implementation, approved value proposals obtained from the six-phase job plan are converted into actions. This is the most critical activity after the job plan is complete. If implementation is not successful then there is no value improvement and the study will have proven unproductive. The collection of proposals recommended during the value study must be developed into plans and specifications by project managers and designers in order to achieve value improvement. Delays must be minimized and misconceptions must be eliminated to ensure realization of the improvements brought about by the value process. Proper scheduling and follow-up discussions are critical to implementation success.

Contractor Participation

Value Engineering Change Proposals (VECP):

Through their experience, contractors often have ideas on how to construct a project component differently than required by the contract. For example, a particular idea may focus on other methods of construction, different materials, or alternative component arrangements. To gain the benefit of their experience, the Corps strongly encourages contractor participation in its VE program. The contractor increases its profit and the government reduces its cost.

The avenue provided for contracts is called the Value Engineering Change Proposal (VECP) clause. Mandated for use in all contracts exceeding $100,000 (and optional in contracts less than $100,000), the VECP clause specifies requirements for contractors to submit alternatives to required construction work. The VECP must satisfy the required function, at an equal or better quality, and at a reduced cost.

The VECP program is an incentive-based process. The contract cost reduction, called the Instant Contract Savings, on VECPs accepted and implemented by the Corps is shared with the contractor. This provides the contractor with a fair payment price for the work performed, plus a "bonus," of sorts, in the form of an additional payment for the savings associated with the VECP.

Contractor participation through VECPs remains a cornerstone of the Corps' VE program. It has proven to be an excellent means of partnering with a contractor and obtaining the highest value for the Federal construction dollar. To facilitate contractors in the development of VECPs, the Corps provides its VECP pamphlet, EP-11-4.

Value Engineering studies have added value to all types of military construction projects ensuring added quality within available resources. Value Engineering studies on design build request for proposals (RFP) identify overly prescriptive conditions and contracting wording which cause a contractor to bid unnecessarily higher.

For the traditional design-bid-build type of procurements value engineering studies on the design have resulted in cost avoidance used to increase quality or reduce unexpected cost overages.

Value Engineering provides many services during the design charrette

- Development of agenda
- Development of parametric and baseline cost estimate
- Facilitation and administration of the charrette
- Identification of funding shortfalls
- Creative Value Engineering Brainstorming Session
- Charrette Report Development
- Outbriefing

Examples are given in this section.

Value Engineering

Kansas City District
Lewis and Clark Center
Command & General Staff College, Ft. Leavenworth, KS

Project Description:
The hillside location will make the Command and General Staff College building the crown jewel and focal point of the CGSC campus. From its prestigious site on the southern hillside, it will be on prominent display, overlooking the Missouri River valley and welcoming visitors entering Fort Leavenworth through the Sherman Gate.

Featured Proposals

- The significant proposal was to relocate the building.

Estimated Project Cost:	**$150 million**
Total number of proposals approved:	**7**
Total VE Cost Avoidance:	**$19 million**

Value Engineering

Louisville District
Human Performance Wing
Wright Patterson AFB

Project Description:
Eight new Base Realignment and Closure (BRAC) projects will result in collocation of five existing Air Force and Navy organizations comprising education, research and clinical elements at WPAFB. The eight projects were bundled together for the VE study.

2008 Department of Defense
Special Award for Interagency Effort
Louisville District USACE, Air Force and Navy were awarded this honor for their work on this project.

Featured Proposals

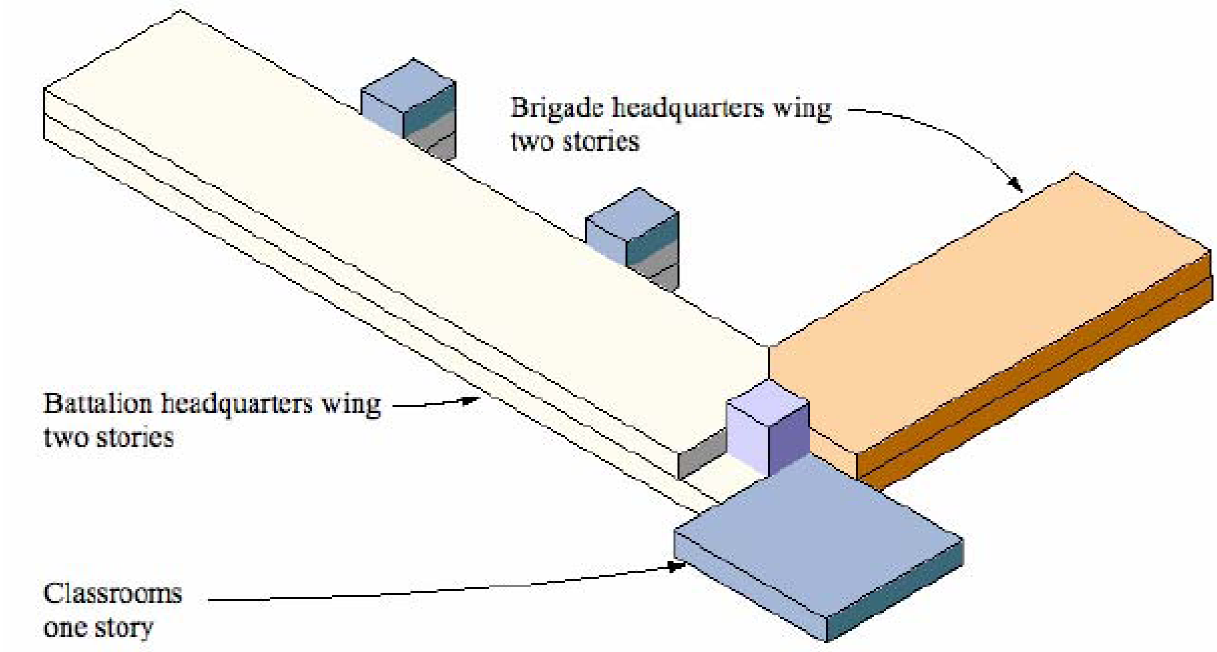
- Establish a Construction "Free Zone", a contractors work site outside the base security area
- Extended construction duration to allow the contractor greater flexibility in scheduling the work

Estimated Project Cost:	**$208.7 million**
Total number of proposals approved:	**30**
Total VE Cost Avoidance:	**$56 million**

Value Engineering

Savannah / Mobile
Battalion / Brigade Headquarters

Conceptual Isometric from VE Study



Project Description:
Standard “statement of work” for Battalion/Brigade Headquarters facilities to be constructed CONUS wide.

Featured Proposals

- Open office area relocated to exterior resulting in more natural light
- Single story classrooms

Estimated Project Cost:	**Not project specific – based on a standard design**
Total number of proposals approved:	**25**
Total VE Cost Avoidance:	**$1.5 million**

Value Engineering

Sacramento District
Groundwater Treatment Plant
Hawthorne Army Depot, Nevada

Project Description:
Build a groundwater treatment plant capable of treating arsenic and fluoride. Project is to include distribution and storage systems connecting to the potable water system, a water storage tank, water cooling tower, and building information systems.

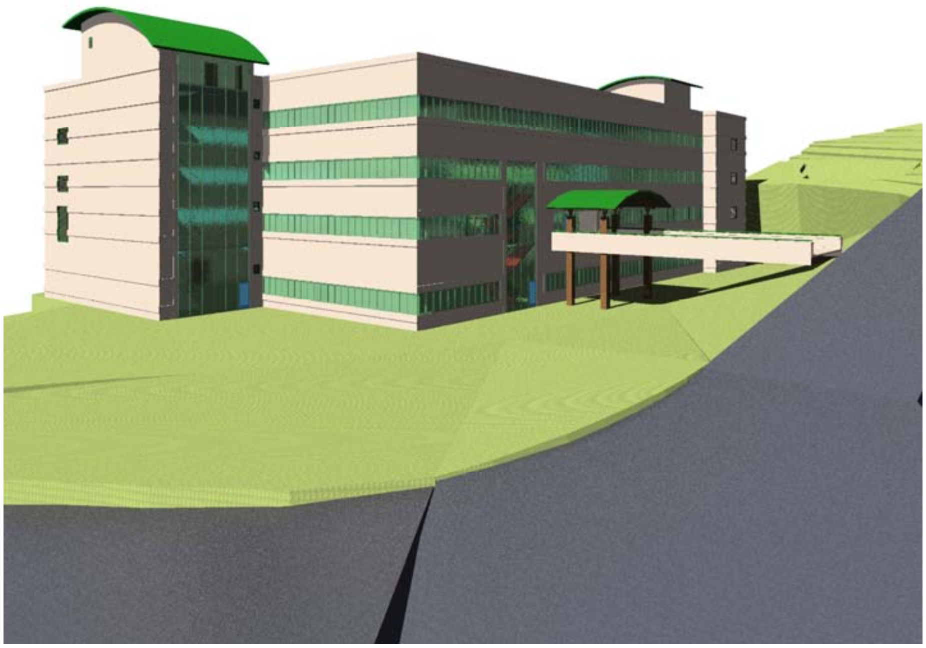
Featured Proposals

- Use filter presses in lieu of evaporative lagoons
- Use existing surface water treatment plant auxiliary equipment

Estimated Project Cost:	**$11 million**
Total number of proposals approved:	**6**
Total VE Cost Avoidance:	**$0.9 million**

Value Engineering

Sacramento District
General Instructional Building VI
Presidio of Monterey, California



Project Description:
Construct standard criteria General Instruction Building (GIB). The facility includes classrooms, staff and faculty offices, conference room, multi-purpose training area, cultural rooms, curriculum resource areas and other academic support areas.

Featured Proposals

- Reassess threat analysis to allow more flexibility in material
- Reduce floor-to-floor height while maintaining all needed functions and quality
- Use return air plenums for perimeter spaces

Estimated Project Cost:	**$28 million**
Total number of proposals approved:	**11**
Total VE Cost Avoidance:	**$3.8 million**

For civil works projects value engineering studies are conducted on plans and specifications. In this section are examples of various types of projects for which value engineering studies have improved the projects.

Value Engineering

Huntington District
Marmet Lock Replacement Project
Belle, West Virginia

Marmet Lock Replacement Project
Marmet was the busiest lock in the nation in 2005 and 2006 according to both hardware operations and lockages utilizing twin lock chambers measuring 56'x360' which were opened for operation in 1934. The project includes construction of an additional 110'x 800' lock landward of the existing locks which will be left in place and used as auxiliary lock chambers. The Corps and the Contractor maximized the use of Value Engineering (VE) and the Value Engineering Change Proposal Program (VECP) to achieve $3.9 million of cost avoidance and $2.0 million in VECP savings for a combined total of $5.9 million in savings. The project earned the 2006 DoD VE Achievement Award in the special category.

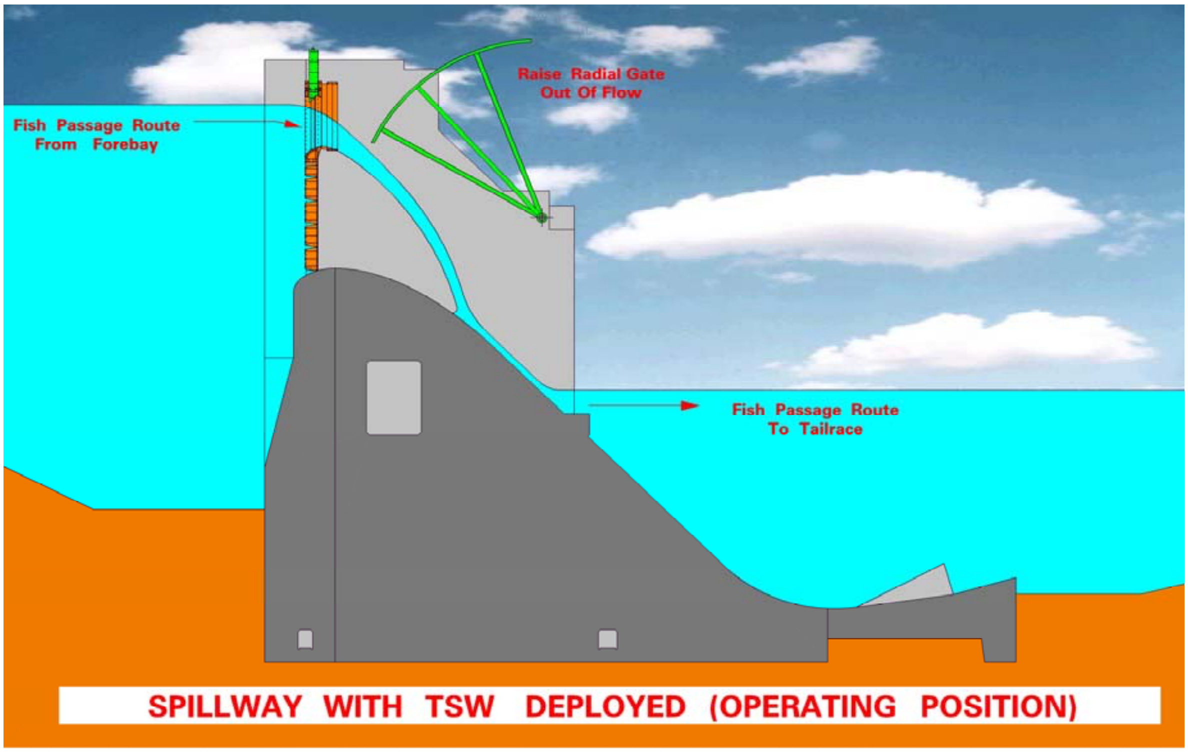
Featured Proposals

- Use rock from existing dike and excavation to build new dike – $1,752,000
- Construct deflector dike with stone from existing dike or rock excavation. Core of new dike can be constructed from excavated rock and capped with stone from existing deflector dike (which is to be removed under this contract).

Estimated Project Cost:	**$280 million**
Total number of proposals approved:	**5**
Total VE Cost Avoidance:	**$5.9 million (includes $2 million in VECP's)**

Value Engineering

Walla Walla District
Little Goose Temporary Spillway Weir (TSW)



Project Description:
The Little Goose Lock and Dam are located on the Lower Snake River in Washington State. TSW are installed in a spillway bay as a surface bypass, an innovation designed to attract and safely pass downstream migrating juvenile salmon and steelhead (smolts) upstream to below the dams. The TSW are test structures used to verify attraction and fish condition performance as surrogate systems prior to installation of permanent structures.

Featured Proposals
- Re-use existing stoplogs instead of constructing new stoplogs
- Relocate the prototype test from bay 2 to bay 1
- Combine with another contract to decrease contract preparation and contractor mobilization costs

Estimated Project Cost:	**$6.3 million**
Total number of proposals approved:	**1**
Total VE Cost Avoidance:	**$2.1M**

Value Engineering

Portland District
The Dalles Spillway Extension
The Dalles, Oregon

Project Description:
The Spillway Extension project goals are to increase the overall juvenile salmon survival by reducing the current predation impacts and in addition repairing an uplifted area of the spillway apron.

Featured Proposals

- Reduce height of the spill wall
- Use chord segment instead of arcs
- Use tendons in lieu of rock bolts
- Reduce concrete strength in localized areas
- Use grouting instead of secant piles
- Cast anchor ducts in precast cells
- Improve concrete quality by reducing amount of tremie concrete

Estimated Project Cost:	**$38.5 Million**
Total number of proposals approved:	**8 (7-Qualitative Improvement)**
Total VE Cost Avoidance:	**$3.7 million**

US Army Corps of Engineers®

Value Engineering

Portland District
Elk Creek Lake Fish Passage Corridor
Oregon

Project Description:
This project provides passive passage for anadromous fish including Endangered Species Coho salmon and winter and summer steelhead.

Featured Proposals

- Minimize upstream channel work
- Protect existing roller compacted concrete on the right bank, through the cut at the blast line
- Replace rip-rap with softer bio-engineering approaches
- Revisit the hydraulic model to minimize cut and fill

Estimated Project Cost:	**$15.0 million**
Total number of proposals approved:	**5 (1-Qualitative Improvement)**
Total VE Cost Avoidance:	**$3.2 million**

Value Engineering

Los Angeles District City District
Los Angeles County Drainage Area (LACDA)
Los Angeles, CA

Project Description:
This project upgrades 26 miles of channels within the Los Angeles County Drainage Area.

Featured Proposals

- Modify bridge nose piers instead of raising bridges
- Redesign conflux of Los Angeles and Rio Hondo rivers
- Increase height of earth berms
- The major proposal was a suggestion to use physical modeling to determine if the nose piers on the bridges could be modified instead of raising the bridges. Modeling demonstrated this alternative solution would work. Return on investment was 70 to 1.

Estimated Project Cost:	**$216 million**
Total number of proposals approved:	**1**
Total VE Cost Avoidance:	**$61 million**

Value Engineering

Albuquerque District
Santa Ana Pueblo Riparian / Wetland Restoration Project
Bernalillo, New Mexico

Before

After

Project Description:
The purpose of the Santa Ana Pueblo Riparian/Wetland Restoration Project is to develop a five mile greenway corridor along the Rio Grande River near Bernalillo, New Mexico.

Featured Proposals

- Replace over bank armor rock with a downstream sheet pile wall
- Use vinyl sheet pile in lieu of steel sheet pile

Estimated Project Cost:	**$3.5 million**
Total number of proposals approved:	**5**
Total VE Cost Avoidance:	**$0.9 million**

Value Engineering

Jacksonville District
Portuguese Dam / Portuguese & Bucana Rivers Project
Ponce, Puerto Rico

Renderings of Curved RCC Dam Before and After Filling

Project Description:
The project is located in south central Puerto Rico as one of two multi-purpose reservoirs with improvements providing flood protection, water supply and recreations for Ponce and surrounding areas. The rock founded dam features a 1,317 foot crest length and 220 foot height for 12,325 acre-feet of reservoir storage. Flood damage reduction was estimated at $1.9 billion with the project in place. The design was changed from a double curvature thin concrete arched dam to a gravity Roller Compacted Concrete (RCC) arch dam.

Featured Proposals

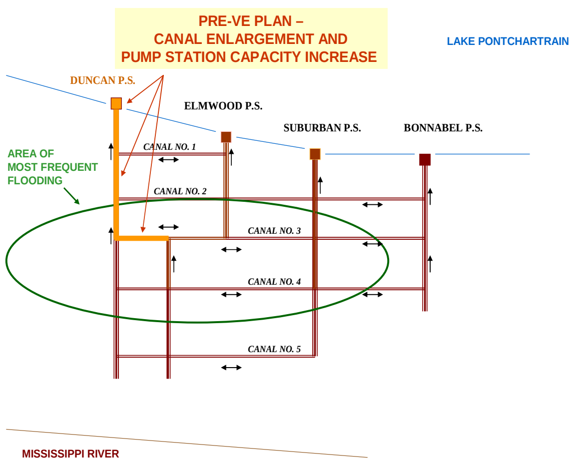
- The significant proposal was to develop a gravity Roller Compacted Concrete (RCC) arch dam to replace the double-curvature concrete arch section dam
- The new dam section minimizes stress concentrations due to seismic loading
- The RCC plan eliminated embedded cooling, joint work and instrumentation required for the arch dam, and eliminated the trestle system
- On-site quarry plant was replaced with aggregates from off-site supplier
- Accommodate future 50 foot raise in height for future water supply. The new dam tracked as nearly as possible original alignment, minimizing foundation and grout curtain modifications

Estimated Project Cost:	**$180.1 million**
(Dam only awarded for construction March 2008)	
Total number of proposals approved:	**1**
Total VE Savings:	**$22 million**

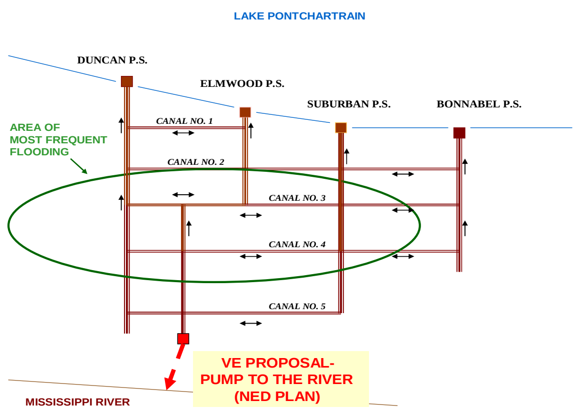
Value Engineering

New Orleans District
Southeast Louisiana Flood Control (SELA)
Pump to the River
Harahan, LA

SELA – Pump to the River
(Pre VE Plan)
The original project base plan consisted of 'traditional' downstream canal enlargements and pump station capacity increase. Cost of this plan proved to be in excess of flood control benefits produced.



VE Plan
This ***Planning Phase*** VE Workshop proposed a new upstream pump station and force main conveyance to divert flow 'uphill' (non-traditional practice), to the Mississippi River in lieu of downstream canal and pump station improvements. This configuration proved to be cost-effective and produced significant net project benefits and was selected as the National Economic Development (NED) Plan.



Estimated Project Cost:	**$68 million**
Total Estimated Present Worth of Project Benefits Generated from VE Plan:	**$105 million**
Net Present Worth of Cost Avoidance (Project Benefits less Cost):	**$37 million**

Value Engineering

Kansas City District
Tuttle Creek Dam
Manhattan, Kansas

Project Description:
Stabilize the soil beneath the dam. Given that the earthquake causes the sands beneath the dam to liquefy, one method to address this situation was to prevent the sands from liquefying.

Featured Proposals

- The revised design replaced the cutoff wall and the upstream stabilization with a series of transverse self-hardening cement/bentonite slurry walls
- Seepage conditions are improved by burying the relief well collector ditch and possibly adding large diameter pumped wells downstream

Estimated Project Cost:	**$245 million**
Total number of proposals approved:	**16**
Total VE Cost Avoidance:	**$50 million**

Value Engineering is offered as a service to our customers. In this section are examples of how other agencies have benefited from value engineering.

Work for Others

Value Engineering

Louisville District
USDA Forest Products Laboratory
Madison, Wisconsin

US Army Corps of Engineers

Project Description:
The Forest Products Laboratory is undertaking a program to improve the functionality of five of its research laboratories and also improve the HVAC system within the main administrative building.

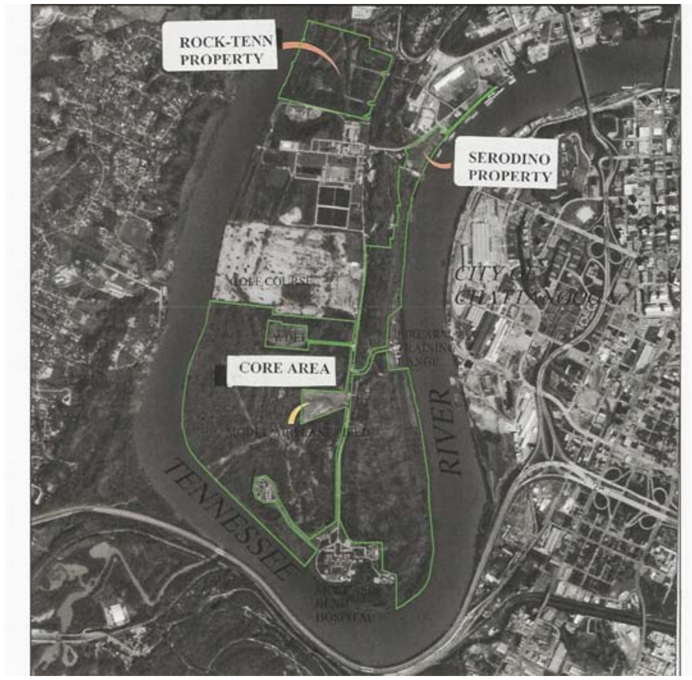
Featured Proposals

- Combine EML, composites, wood preservation, and durability into one building on the site to the east of building 1 ($2,192,000)
- Replace and expand the existing HVAC systems with a new centralized fan coil system ($1,000,000)

U.S. Department of Agriculture project	
Estimated Project Cost:	**$35.8 million**
Total number of proposals approved:	**7**
Total VE Cost Avoidance:	**$3.2 million**

Value Engineering

Nashville District
Riverbank Stabilization at Moccasin Bend
Chattanooga, Tennessee



Project Description:
Stabilization of the right descending riverbank of Moccasin Bend on the Tennessee River in order to protect the cultural resources and prevention of additional losses of these assets to the river via erosion and slope failure.

Featured Proposals

- The selected preferred alternative is separated into four treatments based on the priority rankings of the archeological assets along the various reaches of the banks of the Moccasin Bend of the Tennessee River. Each treatment is distinguished by the level of protection they provide to the archeological asset below the treatment.

National Park Service project

Estimated Project Cost:	**$36.9 million**
Total number of proposals approved:	**4**
Total VE Cost Avoidance:	**$23.4 million**

Contractor Participation

US Army Corps of Engineers®

Value Engineering

Jacksonville District
Rio de Grande Arecibo Flood Damage Reduction Project
Puerto Rico

Project Description:
The project provides coastal floodplain protection with a by-pass diversion channel from Rio de Arecibo. Original Porto Rico Department of Transportation approval precluded excavation, requiring jet grouting of poor soils, steel sheetpile wingwalls, and micro-tunneling of culverts.

Features of VECP Proposals

- The VECP solution places six -72" (1,456 LF) culverts crossing Hwy PR-10 by open cut. A temporary 4-lane highway by-pass plan was accepted by PR DOT. The simpler open-cut construction method also provided better quality control with geo-grid foundation reinforcing, visible joint inspection and testing, and select back-fill of the original roadbed.
- Care of traffic met emergency evacuation level of service
- Original completion schedule maintained
- Quantitative savings were realized

Estimated Project Cost:	**$12.8 million (Contract Amount)**
Total number of proposals approved:	**1**
Total VE Savings:	**$1.5 million**

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