

California High-Speed Train System



TECHNICAL MEMORANDUM

Value Engineering Implementation Plan TM 100.07

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Note: Signatures apply for the latest technical memorandum revision as noted above.

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ABSTRACT

Value Engineering (VE) is a function-oriented, structured, multi-disciplinary team approach to solving problems or identifying improvements. The goal of the California High-Speed Train System (CHSTS) value engineering process is to improve resulting value from the project to the public by sustaining or improving performance attributes of the project while at the same time reducing overall cost including lifecycle operations and maintenance expenses.

The purpose of this memo is to establish a process of implementing accepted VE policies and procedures on CHSTS following a three-level approach including:

- Level 1 Program Wide – Review baseline performance, function
- Level 2 Project Wide – Review design guidelines, standardization of materials, structure types and components, assess alternate mitigations
- Level 3 Region Specific – Review alternative design solutions to major components that achieve functions and design criteria while maintaining quality and safety at lower cost



1.0 INTRODUCTION

1.1 GOALS AND OBJECTIVES

Value Engineering (VE) is a function-oriented, structured, multi-disciplinary team approach to solving problems or identifying improvements. The goal of the California High-Speed Train System (CHSTS) value engineering process is to improve resulting value from the project to the public by sustaining or improving performance attributes of the project while at the same time reducing overall cost including lifecycle operations and maintenance expenses.

The purpose of this memo is to establish a process of implementing accepted VE policies and procedures on CHSTS following a three-level approach including:

- Level 1 Program Wide – Review baseline performance, function
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- Level 3 Region Specific – Review alternative design solutions to major components that achieve functions and design criteria while maintaining quality and safety at lower cost.

VE is a management tool to be used in a systematic process designed to focus on the major and critical issues of a complex project or process, using a multi disciplinary team to develop recommendations for the important management decisions that must be made. Using this organized analytical process, with relevant information, the resulting management decisions will provide direction for the continued project development. The outcome of value engineering studies is often cost reduction, but the primary focus is "Value Improvement."

CHSTS will use the VE process to seek "value improvement" in various forms. For projects, this may result in improvements in defining the proper scope, functional design, constructability, coordination (both internal and external), and schedule for development. Other value improvements may include reduced environmental impact, reduced public inconvenience, or reduced project cost. In summary, the VE process will seek to evaluate and incorporate, to the extent possible, the values of the design engineer, construction engineer, maintenance personnel, contractor, public, approval agencies, local government, and other stakeholders. The important design decisions which must be made will be formulated from the recommendations developed and presented by the VE Team.

1.2 DEFINITIONS

The following technical terms and acronyms used in this document have specific connotations with regard to California High-Speed Train System.

<u>Function Analysis:</u>	The process of discerning the elemental functions comprising a project, product, or service.
<u>Function Analysis System Technique (FAST) diagram:</u>	A method of mapping the relationships between functions within a project. Functions are analyzed by aligning them in a "how" and "why" logic diagram.
<u>Job Plan:</u>	Defines the VE study procedure.
<u>Performance Attributes:</u>	Specific characteristics which are essential to achieve a project's objective. These variable characteristics can possess a range of values and can be measured either qualitatively or quantitatively.
<u>Performance Criteria:</u>	Performance is the capacity of a project, product or process to fulfill its intended function. Consensus on the primary performance expectations is critical.



<u>Performance Criteria Matrix:</u>	A technique using the paired comparison method of evaluating the importance of performance attributes in meeting the project's purpose and need.
<u>Performance Requirements:</u>	Characteristics of the project, product, or process necessary to comply with regulations and policies. Requirements are absolute and must be explicitly met.
<u>Return on Investment (ROI):</u>	The cost savings or performance benefit realized from the implementation of a VE study alternative.
<u>Value Engineering (VE):</u>	Systematic application of techniques by a multi-disciplinary team to improve the value of a project, product, or process by identifying and evaluating functions. The study objective is to provide the basic functions of the project, product or process at the lowest overall cost. The primary goal of a VE study is to improve value.
<u>Value:</u>	The relationship between performance of a project, product, or process and the cost of obtaining it. Optimum value is reached by maximizing performance while minimizing cost.
<u>Value Matrix:</u>	A technique for organizing cost and performance data in order to compare value alternatives to the project baseline.
<u>Value Metrics:</u>	A technique to define, evaluate and measure performance of a project, product or process.

Acronyms

AA	Alternative Analysis
CHSTS	California High-Speed Train System
CVS	Certified Value Specialist
DOT	Department of Transportation
EIR/S	Environmental Impact Report/Statement
FAST	Functional Analysis Systems Technique
FFGA	Full Funding Grant Agreement
FHWA	Federal Highway Administration
FRA	Federal Railroad Administration
FTA	Federal Transit Administration
LCC	Life Cycle Cost
O&M	Operations and Maintenance
PE	Preliminary Engineering
PMO	Program Management Oversight
PMT	Program Management Team
RC	Regional Consultant
USC	United States Code
VE	Value Engineering



2.0 REGULATORY BACKGROUND

Presently, there are no FRA regulations requiring railroad projects to undertake VE studies. However, there are federal regulations issued by FHWA and FTA that establish definitive set of requirements for application of VE practices on high expenditure transportation projects such as CHSTS.

Federal Transit Administration (FTA) has implemented specific requirements for applications of VE studies as part of its Full Funding Grant Agreement (FFGA) process. In accordance with FTA Circular 5010.1C, "Grant Management Guidelines," a transit agency must apply value engineering techniques to new starts projects and all other FTA-funded major capital projects. Thus, FTA expects an applicant for an FFGA to identify cost savings during planning, preliminary engineering, and final design of a new starts project, and to achieve those cost savings during construction of the project, as the result of value engineering.

In addition, Title 23 United States Code (USC), Section 106 requires State DOTs to establish a program to improve project quality, reduce project costs, foster innovation, eliminate unnecessary and costly design elements, and ensure efficient investments by requiring that value engineering studies are performed during the concept and design phase, by a multidisciplinary team of persons not involved in the project. The State DOTs must ensure that a VE study has been performed on all applicable projects and that all resulting, approved recommendations are incorporated into the plans, specifications and estimate.



3.0 VALUE ENGINEERING APPROACH

This is a value engineering approach to review scope and project design criteria in a top down process challenging all aspects of the project against agreed functions to meet objectives and whether those functions can be satisfied by adopting less expensive solutions while maintaining value. VE workshops are typically held in the early stages to ensure design is not progressed to such a level that any savings generated become costly and time consuming to implement. The Figure 1 illustrates the classical relationship between diminishing savings, resistance to change and cost to change.

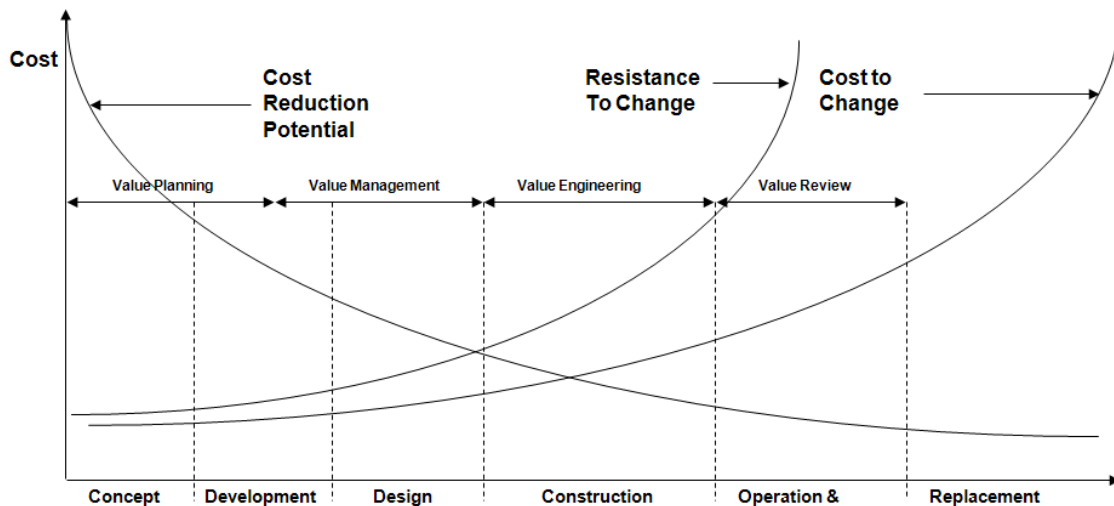


Figure 1 Time and Life Costs

This supports the strategy of 'right first time', adopting the Pareto 80/20 rule in maximizing return on time and cost of investment in Value Engineering and maximum cost reduction potential.

A three level structure for a CHSTS Value Engineering analysis is proposed and the objectives, participants, outcome and timescale are summarized for each of the following Levels:

- Level 1 Program Wide – Review the basis of design, (i.e., confirm the basic functionality for Phase 1 and beyond, headways, number of tracks, operating speed, design criteria, performance criteria, passenger comfort, organization of program team, schedule/scope, procurement, etc.) against an agreed set of high level functions.
- Level 2 Project Wide – Generate 'high level' ideas to realize economies of scales in everything from component selection, structural type, procurement framework agreements which may be tied to long term O&M agreements. Review soft costs - project management staffing strategies, project office locations, printing contracts, data storage and retrieval, implementation of IT systems, etc.
- Level 3 Region Specific – Generate 'high level' ideas to realize significant cost savings resulting from horizontal/vertical alignment changes, optimization of lengths and widths of major aerial structures and tunnels, real property acquisition vs. more structures or alignment adjustments. Adopt Pareto 80/20 rule in these evaluations.



4.0 VE BENEFITS

Value Engineering is an effective problem solving and quality assurance tool that can validate project scope, need and purpose, baseline design, and facilitate achieving overall safety and performance goals while minimizing capital and operating costs.

VE studies provide an opportunity for a structured and thorough review by functional experts. VE studies often reveal new information that fosters project's advancement in a timely manner.

The earlier a VE study is undertaken, the more beneficial it will be. Conducting studies in the later phases of a project, after a significant amount of time and money has been committed to a chosen design, diminishes the opportunity for identifying viable improvements without compromising the delivery schedule. The "Benefit Matrix" below depicts the benefits that can be derived during the following four primary phases of CHSTS project development:

Potential VE Benefits \ Project Phase	Alternative Analysis	15% Design/PE	Final Design	Construction
Supports sound decision-making	H	H	H	H
Develop solutions to difficult engineering challenges	H	H	H	H
Reduce Project Development Support Cost – Expedite Delivery	H	H	H	H
Extend expected service life	H	H	H	M
Reduce Capital Cost to Construct	M	H	H	M
Reduce Cost to Operate/Maintain	M	H	H	L
Clarify Need and Purpose	H	M	L	L
Ensure Land Use compatibility	H	M	L	L
Identify best alternatives to meet the Authority's safety and performance standards	M	H	M	L
Early discovery of opportunities and constraints	H	H	M	L
Build stakeholder consensus	H	H	M	L
Obtain input from community representation	H	H	M	L
Avoid/Minimize Environmental Impacts	H	H	M	L
Avoid/Minimize ROW Impacts	H	H	H	L
Improve modal choices and connectivity	H	H	M	L
Identify optimum phasing/staging opportunities	M	H	H	L
Validate project scope	M	H	H	L
Validate/Refine current project design	L	M	H	L
Reduce the need for Construction Change Orders	L	M	H	L

H – High, M – Medium, L - Low

It is recommended that formal Level 3 VE studies led by a Certified Value Specialist (CVS) in accordance with the methodologies outlined in this memo are implemented on CHSTS projects following completion of 15% In-Progress design. Informal VE studies can be performed by the project staff as early as at the Alternative Analysis stage to support definition of the alignment alternatives recommended for inclusion in the environmental review process.



5.0 PROCESS AND PROCEDURES

Each Value Engineering study can be defined in the following steps, which are grouped in three phases (adopted from Caltrans Value Analysis Team Guide, 2003):

Phase 1 – Preparation

- Initiate Study – Identify study project, roles and responsibilities; define study goals.
- Organize Study – Conduct preparation meeting; select team members; identify stakeholders and decision makers, identify required data.
- Prepare Data – Collect and distribute data; prepare construction cost models; develop life cycle cost model (LCC).

Phase 2 – Value Engineering Analysis

- Inform Team – Receive designer presentation; develop performance criteria; visit project site.
- Analyze Functions – Identify basic functions and cost drivers; prepare functional analysis systems technique (FAST) diagram.
- Create Ideas – List a large quantity of alternative ideas; use group/individual brainstorming.
- Evaluate Ideas – Evaluate all ideas against performance criteria (Value = Performance/Cost); rank all ideas.
- Develop Alternatives – Develop high-ranked ideas into VE alternatives; measure performance.
- Critique Alternatives – Review of alternatives by VE team and Technical Reviewers to develop and ensure team consensus and technical viability. Develop and rate recommended VE alternative set(s).
- Present Alternatives – Give interim presentation of alternatives; prepare preliminary report.
- Assess Alternatives – Review alternatives with stakeholders and decision makers; prepare draft implementation decisions.
- Resolve Alternatives – Resolve dispositions; edit and revise alternatives; summarize results.
- Present Results – Give formal presentation of accepted alternatives.

Phase 3 - Reporting

- Following the VE study, the Team Leader assembles all study documentation into the final report:
- Publish Results – Prepare final VE Study Report; distribute printed and electronic copies.
- Close out VE study – Resolve open conditionally accepted VE alternatives and update the Executive Summary.



6.0 ROLES AND RESPONSIBILITIES

Participants of VE studies can be described using two main groups:

- Sponsors and Key-Decision Makers
- VE Study Team

6.1 SPONSORS AND KEY- DECISION MAKERS

Program /Project Managers are the primary sponsors for VE studies and help to ensure a successful study. Their responsibilities include:

- Identifying projects to be subjected to value engineering.
- Providing adequate resources for the required and/or desired VE study into the project work plan budget and schedule.
- Develop the VE study charter to outline the study's scope, objectives, participants and schedule.
- Recruit the most qualified VE team members; this may include sub-consultant experts, who can work directly with other multi-discipline team members on various project issues.
- Resolving the implementation dispositions of VE alternatives (accept, accept with modification(s), conditionally accept, or reject).
- Ensuring compliance by implementing all accepted alternatives into the project.

Executive Managers/Decision Makers should be involved in VE studies particularly for study preparation, the initial study kick-off meeting, team VE presentation and post study review activities resulting in viable and beneficial VE recommendations. Their responsibilities include the following:

- Support the Study Coordinators and Project Managers to recruit the best team members and study participants.
- Review the study charter and attend the study kick-off meeting to make sure all important issues and study objectives are adequately addressed.
- Provide the "Implementation Disposition" and decision rationale for each VE team recommendation.
- Attend Implementation meeting and approve each recommendation with an Accept, Conditionally Accept or Reject decision.
- Provide input on "Conditionally Accepted" alternatives to the Team Leader. Identify responsibilities and time schedules needed to resolve "Conditions".

Stakeholders/Community Representatives are also encouraged to participate in VE studies. The Kick-off and implementation meetings are specifically designed to include these part-time study members so their thoughts and concerns can be met in the Study objectives and outcomes.

6.2 VALUE ENGINEERING STUDY TEAM

The Team Leader generally is responsible for the following:

- Meeting with Project Stakeholders, decision makers and team members in preparation of a VE study.
- Leading the VE team through the VE methodology.
- Documenting the VE alternatives to ensure clear, thorough communication of the VE team's concepts.
- Preparing the VE report, following the requirements outlined in the VE Report Guide, in a timely fashion to the program manager.
- Providing electronic and/or hard copies to all interested parties.
- Ensuring the VE Study is in compliance with CHSTS guidance.
- Performing a follow-up on the implementation plan.

The experience and knowledge of the VE team members must match the complexity of the project being studied. VE team members must be capable of working within a team environment, be willing to express themselves and be willing to listen to the ideas of others. Specifically, the VE



team includes specialists who can develop and determine the technical, economic, political, and environmental feasibility of alternatives included in the project scope.

VE teams will typically consist of five to ten members, including the team leader. Teams within this range are effective, as they are large enough to represent the project's key technical areas of expertise, while small enough to achieve the desired cohesiveness and synergy. VE team members are expected to have the following qualifications:

- Competency in their field of expertise.
- Time to devote to the entire duration of the VE study.
- Preparation time to review the project prior to the study.
- Skills and the mindset to complete all necessary VE study tasks, including writing VE proposals and estimating costs.
- An open mind, a belief that there is always room for improvement and willingness to share and debate the pros and cons of VE alternatives.
- Post study workshop time to review and comment on the Preliminary VE study report and participate on the VE study implementation meeting.

It is recommended that the following participants are included in the VE study teams:

- Authority CEO, Authority Board members, Authority Staff, PMT
- Financial sponsors (FRA, State), Regulatory Compliance (FRA)
- Independent subject matter experts



7.0 VALUE ENGINEERING STUDY REPORT

The objective of a VE study is to develop a proposal to maximize performance while minimizing cost. The VE report will contain all of the documentation needed to communicate the findings of the VE study and facilitate implementation of the VE alternatives. The Team Leader is primarily responsible for gathering the documentation generated by the study team and compiling it systematically into a report.

Two reports, a preliminary and final, will be generated for every study. The purpose of the preliminary report is to provide documentation of the VE alternatives to the reviewers and team members in order to get their response to the viability and acceptability of the alternatives. The preliminary report will be prepared and distributed within two or three weeks after the VE Study. The final report will be prepared after the implementation meeting to document the decision maker's comments, implementation plans, and decisions. The final report will serve as the final documentation of the VE study.

The VE Study Report includes the following sections:

- Table of Contents (P, F)
- Distribution List (P, F)
- Executive Summary (P, F)
- VE Study Summary Report (F)
- VE Alternatives (P, F)
- Project Analysis (F)
- Project Description (P, F)
- Idea Evaluations (P, F)
- VE Process (P, F)

(P – Preliminary, F – Final)

For detailed instructions and guidelines on preparation of VE Study Reports can be found on the Caltrans Value Analysis website at <http://www.dot.ca.gov/hq/oppd/value/guides.htm> .



8.0 VALUE ENGINEERING PLAN

CHSTS is a major transportation infrastructure investment, and although no federal or state imposed requirements to implement VE on passenger rail projects exist at this time, it is recommended that a formal VE process is applied in CHSTS development as described below. Refer to Appendix A, VE Implementation Timeline for timing information.

8.1 LEVEL 1 VALUE ENGINEERING STUDY (PROGRAM-WIDE)

8.1.1 Objectives

Review and reconfirm the basis of design including basic functionality for Phase 1 and beyond, headways, number of tracks, operating speed, design criteria, performance criteria, passenger comfort, organization of program team, schedule/scope, procurement, etc., against an agreed set of high level functions.

8.1.2 Value Engineering

The VE team will be led by a CVS and will consist of up to 15 people involved with the program and from outside including the following:

- Authority CEO
- Authority Board members
- Authority Staff
- PMT Senior Management
- PMO Manager
- Financial sponsors (FRA, State)
- Regulatory Compliance (FRA)

8.1.3 Outcome

At the conclusion of the Level 1 VE study, the following outcome can be anticipated:

- Confirmation of project design baseline.
- Identification of design criteria topics which could be evaluated further with a goal of achieving significant capital and / or operating cost savings.
- VE Study Report providing an indication of what savings in delivery cost and schedule might be achievable given adjustments to specific design criteria, recommendations and the way forward and how this might impact project progression.

8.1.4 Timing

It is in the interest of the project that the Level 1 VE Study is conducted as soon as possible. The greatest potential savings are likely to be found in separating need from wants (that is what is necessary versus what is desirable) in the scope and design criteria.

Any unjustified scope should be removed and any excessive design criteria redefined prior to the design proceeding further as subsequent changes to contain cost escalations will be time consuming and expensive to re-work.

8.2 LEVEL 2 VALUE ENGINEERING STUDY (PROGRAM-WIDE)

8.2.1 Objectives

The Level 2 VE study will review potential program-wide benefits resulting from economies of scale in component election and structures types to procurement strategies and third party agreements. At this level, VE effort will also review soft costs allocations, project management staffing strategies, project office locations, implementation of IT systems, etc.



8.2.2 Value Engineering Team

The VE Team will be led by a CVS and will consist of up to 15 people involved with the program and from outside including the following:

- Authority Chief Program Manager
- Authority Director of Engineering
- PMT Director/ Deputy Director
- PMT discipline leads
- PMO Representative
- Financial sponsors (FRA, State)
- Regulatory Compliance (FRA)
- Independent subject matter experts

8.2.3 Outcome

At the conclusion of the Level 2 VE study, the following outcomes can be anticipated:

- Recommendations on standardization of components, designs, materials used, contractual long term agreements that may generate significant cost savings within the existing design criteria without compromising safety or quality and meeting the functional objectives of the project
- VE Study Report, indicating what savings in delivery cost and schedule might be achievable arising from the suggested 'ideas'

8.2.4 Timing

It is in the interest of the project that the Level 2 VE Study is conducted as soon as possible after Level 1 (preferably not later than 2 months after Level 1) as it will establish commonality in design solutions. The greatest potential savings are likely to be found in standardization of designs between sections (procurement contracts), use of common detailing, agreement of a 'theme' related to budget for aesthetics, agreement of common standard for such elements as noise barriers, etc.

8.3 LEVEL 3 VALUE ENGINEERING STUDY (PROJECT SPECIFIC)

8.3.1 Objectives

The Level 3 VE Study will be a series of project-specific studies looking for opportunities to realize significant cost savings in major structures, alignment horizontal/vertical alignment changes, width of structures, lengths of tunnels, and specific property takes versus alignment adjustments. The focus of this level is on main and critical structures. The Pareto 80/20 rule shall be adopted.

8.3.2 Value Engineering Team

The VE Team will be led by a CVS and will consist of up to 15 people not directly involved with design development subject to VE study and may include the following:

- Authority Director of Engineering
- PMT discipline leads
- PMO Representative
- Regional Consultant staff
- Stakeholders
- Independent subject matter experts

8.3.3 Outcome

At the conclusion of a Level 3 VE study, the following outcomes can be anticipated:

- Specific list of ideas that will reduce capital cost of construction of major structures and alignment features in each section under study
- VE Study Report indicating what savings in delivery cost and schedule might be achievable arising from the suggested 'ideas'



8.3.4 Timing

It is in the interest of the project that the Level 3 VE Studies are conducted in the mid stages of Alternative Analysis (AA) and Preliminary Engineering to provide meaningful input in to selection of alternatives for environmental studies and before the maximum benefit is lost and a resistance to change takes place.

Regional Consultant(s) will conduct an informal VE Study involving staff already engaged with the project and to be scheduled following development of a preliminary AA so that the alignments may be assessed for cost prior to preparation of supplemental AA document.

Once 15% Design In-Progress Submittal has been made, Regional Consultant(s) will conduct a formal Level 3 VE Study in accordance with the processes documented in this memo, and provide input for the 15% Draft Submittal that supports development of the Draft EIR/S.



June 12, 2013

PMT-CHSRA-03421

Frank Vacca
Chief Program Manager
California High-Speed Rail Authority
770 L Street, Suite 800
Sacramento, CA 95814

RE: Request for Authority review and concurrence of
TM 100.07 Value Engineering Implementation Plan, R0

Mr. Vacca,

TM 100.07 Value Engineering Implementation Plan is attached for your review and concurrence. Value Engineering (VE) is a function-oriented, structured, multi-disciplinary team approach to solving problems or identifying improvements. The goal of the California High-Speed Train System (CHSTS) value engineering process is to improve resulting value from the project to the public by sustaining or improving performance attributes of the project while at the same time reducing overall cost including lifecycle operations and maintenance expenses.

The purpose of this memo is to establish a process of implementing accepted VE policies and procedures on CHSTS following a three-level approach including:

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- Level 3 Region Specific – Review alternative design solutions to major components that achieve functions and design criteria while maintaining quality and safety at lower cost

It is understood that this is a living document and will be updated as required. If this meets with your requirements, please sign below acknowledging your concurrence for adoption and use on the program.

Regards,


Brent Felker, P.E.
Program Director

California High-Speed Rail Authority
Concurrence


Frank Vacca, Chief Program Manager

Date: 6-19-2013

Enclosure: TM 100.07 Value Engineering Implementation Plan, R0



SIGNATURE/APPROVAL ROUTING SHEET

DOCUMENT(S) INFORMATION	
To: Geny Baldini-Koutchis	
From: Kris Livingston <i>- via Louis - Escalle</i>	
Subject: TM 100.07 Value Engineering Implementation Plan, Revision 0	
Description of Enclosed Document(s): The purpose of the memo listed above is to establish a process of implementing accepted VE policies and procedures on CHSTS following a three-level approach including: Level 1 Program Wide – Review baseline performance, function. Level 2 Project Wide – Review design guidelines, standardization of materials, structure types and components, assess alternate mitigations. Level 3 Region Specific – Review alternative design solutions to major components that achieve functions and design criteria while maintaining quality and safety at lower cost.	
<input type="checkbox"/> Expedite	Due Date:

REVIEWER INFORMATION		
Reviewer #1 Name (Print): Brent Felker	Reviewer's Initial/Date: <i>BPF 6-14-13</i>	Comments:
Reviewer #2 Name (Print): Frank Vacca	Reviewer's Initial/Date: <i>FV 6-19-13</i>	Comments:
Reviewer #3 Name (Print):	Reviewer's Initial/Date:	Comments:
Reviewer #4 Name (Print):	Reviewer's Initial/Date:	Comments:
Reviewer #5 Name (Print):	Reviewer's Initial/Date:	Comments:

- | | |
|--|--|
| <input type="checkbox"/> Approval/Signoff (initials) | <input type="checkbox"/> Information |
| <input checked="" type="checkbox"/> Signature | <input type="checkbox"/> Do Not Release – Call When Signed |
| <input checked="" type="checkbox"/> Hand Carry or Call for Pick up
Name: Kris Livingston Ext.: 9515 | <input type="checkbox"/> Release When Signed |

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