

ARKANSAS STATE HIGHWAY AND TRANSPORTATION DEPARTMENT

**VALUE ENGINEERING**  
**GUIDELINES AND PROCEDURES**



**October 2010**

**ARKANSAS STATE HIGHWAY AND TRANSPORTATION DEPARTMENT**

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**Approved:**

  
**Assistant Chief Engineer-Design**

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# **SECTION 1 INTRODUCTION**

Value Engineering (VE) is defined in the 23 CFR Part 627 as *“the systematic application of recognized techniques by a multi-disciplined team to identify the function of a product or service, establish a worth for that function, generate alternatives through the use of creative thinking, and provide the needed function to accomplish the original purpose of the project, reliably, and at the lowest life-cycle cost without sacrificing safety, necessary quality, and environmental attributes of the project.”*

## **1.1 PURPOSE**

The purpose of this document is to establish the Arkansas State Highway and Transportation Department’s (Department) policy and procedures for the VE program and to provide a consistent and uniform process for executing the VE program during the development of a project.

## **1.2 POLICIES**

Overseen by the FHWA, the Department will maintain a VE program to insure the effective use of the VE applications throughout the project development process. The Department is mandated by Title 23 United States Code (USC), Section 106 as amended by SAFETEA-LU to perform a VE study on all projects on the Federal-aid system with an estimated total cost of \$25 million or more and on bridge projects with an estimated total cost of \$20 million or more.

## **1.3 BACKGROUND**

In the 1970 Federal-aid Highway Act, the U.S. Congress authorized the U.S. Secretary of Transportation to require value engineering, or other cost-reduction analyses, on any proposed Federal-aid highway project on any Federal-aid system.

Congress extended the federal value engineering role in the National Highway Systems Act of 1995. This act included a provision requiring the U.S. Secretary to “establish a program to require States to carry out a value engineering analysis for all projects on the National Highway System with an estimated total cost of \$25,000,000 or more.”

The Federal Highway Administration (FHWA) published its regulation, Title 23 Part 627 of the Code of Federal Regulations to establish this program on February 14, 1997. The passage of the Safe, Accountable, Flexible, Efficient, Transportation Equity Act: A Legacy for Users” (SAFETEA-LU) of 2005 expanded the role of value engineering on the Federal-aid System and included a provision on bridge projects.

## 1.4 BENEFITS OF VALUE ENGINEERING

VE is an effective problem solving and quality assurance tool that has repeatedly demonstrated its ability to reduce project costs, improve quality and productivity, promote innovation, and eliminate unnecessary and costly design elements. Benefits of a VE program include:

- Constant review of design, construction, and maintenance standards.
- Structured, functional approach using a work plan that provides trained staff with a new method of approaching problems.
- Appreciation for concerns and issues of other functional areas or disciplines.
- Gained ability to apply VE principles in regular design process.
- Proven VE designs or techniques that provide savings and may be applied to future projects.

## 1.5 REFERENCES

American Association of State Highway and Transportation Officials (AASHTO)  
*Guidelines for Value Engineering*, March 2010.  
<http://bookstore.transportation.org>

Federal Highway Administration (FHWA) Value Engineering Website  
<http://www.fhwa.dot.gov/ve>

National Highway Institute (NHI)  
<http://www.nhi.fhwa.dot.gov/home.aspx>

SAVE International  
<http://www.value-eng.org/>

## **SECTION 2 PROGRAM ADMINISTRATION**

### **2.1 PROJECT SELECTION**

The selection of projects involves the identification of projects from the Arkansas Statewide Transportation Improvement Program (STIP).

#### ***2.1.1 Mandated Projects***

All projects on the Federal-aid system (defined by Section 103 of Title 23, USC, as the Interstate System and the National Highway System) with an estimated total cost of \$25 million or more that use Federal-aid highway program (FAHP) funding shall have a VE study performed during the development of the project.

Federal-aid bridge projects located on or off the Federal-aid system with an estimated total cost of \$20 million or more that use FAHP funding shall have a VE study performed.

Any other Federal-aid projects that the U.S. Secretary of Transportation determines to be appropriate shall have a VE study performed.

A VE study is required if the established scope and estimated project costs in the preliminary design report or environmental document meets the criteria noted above. After the required VE study is complete, if the project is subsequently split into smaller projects in final design or is programmed to be completed by the letting of multiple construction contracts, an additional VE study is not required.

#### ***2.1.2 Additional Projects***

VE studies are encouraged on additional projects that have the highest potential for value improvements. All projects shown in the STIP may be considered potential VE candidates. Individual screening will be required to determine those projects. The screening criteria should include, but not be limited to, the following:

- More than one alternative solution
- Relative complexity in design
- Accelerated time schedule in planning and design phases
- Opportunity for implementation of state of the art practices
- Complicated maintenance of traffic requirements

Additional VE studies may be required when a substantial change to the project's scope or design requires re-evaluation of the environmental document.

## 2.2 SCHEDULING

The VE study should be conducted during one of the following phases of the project development:

- Planning Phase
- Environmental Phase
- Up to 30% Design Phase
- 30-60% Design Phase
- 60% Design Phase or later

For Design-Build Projects, the VE study shall be conducted prior to the release of the Request for Proposal (RFP).

Generally, the greatest potential for improvement in a project is during the early phases of the project development.

VE studies usually require three to five days meeting time for an average project. However, the actual length of time required is determined by the complexity of the project and the team composition. The study results should be finalized within 4-8 weeks of the start of the study.

## 2.3 TEAM SELECTION

23 CFR Part 627.5(2) states:

*“Studies must be performed using multi-disciplined teams of individuals not personally involved in the design of the project. Study teams should consist of a team leader and individuals from different specialty areas, such as design, construction, environment, planning, maintenance, right-of-way, and other areas depending upon the type of project being reviewed. Individuals from the public and other agencies may also be included on the team when their inclusion is found to be in the public interest.”*

VE teams typically consist of five to eight members, including the team leader. Members of the VE teams should be from different specialty areas and should be recommended by their respective supervisors. The team leader is responsible for conducting the project review in accordance with the policies and procedures described in this document. In addition, he or she must have completed the formal VE training and preferably have served as a team member on at least one VE study.

Qualified VE consultants may be employed to conduct VE studies. A consulting firm should not conduct a VE study on projects where they have an interest in the project. It is strongly recommended that consultants be qualified VE practitioners, experienced in performing and leading VE studies (have participated in several VE studies as a team and as a team leader), and have sufficient VE training, education, and experience to be recognized by SAVE International as meeting the requirements for certification.

For Federal-aid projects, anyone directly involved in the design of the project should not be a team member, but is expected to participate as a consultation source. If a project has Federal Oversight, the FHWA will be notified of the study and the opportunity will be provided for their participation.

## **2.4 VE TRAINING**

VE training is scheduled on an as needed basis. It is usually through a week-long VE Workshop. Additional training may be considered in areas such as introduction of new materials, innovation in design or construction, life-cycle cost analysis, etc. to enhance the VE program.

Employees from design, planning, environmental, right-of-way, and operations are the primary VE trainees. Trainees should be recommended by their respective Division Heads.

## **2.5 VALUE ENGINEERING CHANGE PROPOSAL (VECP)**

The Department has established a VE incentive clause in its construction contracts. For all projects with estimated construction costs over \$2 million, a special provision (SP) is included in the construction documents that encourages the Contractor to submit a Value Engineering Change Proposal (VECP) at any time after execution of the construction contract. A copy of the SP is included in Appendix A. As outlined in the SP, the Contractor will be paid by the Department 50% of the actual savings as reflected by the difference between the cost of the revised work and the cost of the related construction required by the original contract computed at contract bid prices if the VECP is accepted.

## **2.6 REPORTING**

The Department prepares an annual VE program evaluation report which demonstrates the overall program performance over the Federal fiscal year (ending September 30) and submits the report to the FHWA. The report may include the following:

- Number of VE studies
- Cost of the VE studies
- Number of proposed and approved recommendations
- Value of proposed and approved recommendations
- Total cost of projects being studied
- Number of construction VECPs submitted and approved
- Value of VECPs submitted and approved
- Number of individuals trained in VE
- Functional benefits of VE studies and VECPs
- Return on investment
- Percent of project costs saved
- Recommendation acceptance rate
- Average cost savings per recommendation

- VECP acceptance rate

## **2.7 VE PROGRAM COORDINATOR**

The Department has a designated VE Program Coordinator who is responsible for promoting and administering the Department's VE Program. The primary duties of the VE Coordinator consist of, but are not limited to, the following:

- Review the STIP to identify VE project candidates and make recommendations to the Assistant Chief Engineer for Design.
- Schedule and facilitate VE studies.
- Coordinate VE training.
- Maintain VE training records.
- Monitor the progress of VE studies and proposals.
- Prepare annual program evaluation reports.

## **2.8 VE IMPLEMENTATION**

The acceptance or rejection of the VE study report recommendations shall be made by the VE Implementation Committee (Implementation Committee). The Department's Implementation Committee consists of the Assistant Chief Engineers for Planning, Design and Operations. Final approval of the recommended VE report shall be given by the Deputy Director and Chief Engineer.

## **2.9 LOCAL PUBLIC AGENCY VE PROGRAM**

The Department shall notify the Local Public Agency (LPA) of the VE requirement when a VE study is required. The LPA is responsible for assuring that a VE study has been performed on a LPA project. In its construction contracts, the LPA is encouraged to include a VE incentive clause for all projects that use FAHP funding. The LPA, in compliance with the federal mandates, must follow the VE requirements defined in this document.

## **SECTION 3 VE WORK PLAN**

The VE work plan is an organized plan of action for VE studies which should generally follow the outline of the Value Engineering Study – Workbook (see Appendix B). The key features of a VE study should consist of the following steps:

- Preparation/Information
- Investigation/ Function Analysis
- Speculation
- Evaluation
- Development
- Presentation
- Implementation

### **3.1 PEPARATION/INFORMATION**

The objective of this step is to acquire knowledge of the project from the purpose and need to detailed design elements. A checklist similar to the following should be developed for each study.

- Planning Studies
- Environmental Document
- Project Planning Committee Recommendation (PPC)
- Traffic Data
- Design Criteria
- Hydraulic Report
- Geotechnical Report
- Pavement Design
- Title Sheet
- Typical Sections
- Plan & Profile
- Cross Sections
- Bridge Layouts
- Maintenance of Traffic
- Cost estimates
- Other

In order to conduct the VE study in the most efficient manner, the team should gather all pertinent project information prior to the first VE meeting.

## **3.2 INVESTIGATION/FUNCTION ANALYSIS**

During this phase, the team should use a two-word active verb measurable noun context to define the project functions. By analyzing the functions, the team will be able to determine which function needs improvement, elimination or combination. Activities that may be used for this phase consist of:

- Identify major elements of the project.
- Develop a cost model for all the major elements.
- Identify key functions and performance criteria.
- Prepare Function Analysts System Technique (FAST) diagram.
- Determine worth of each function.
- Determine high-cost functions.

## **3.3 SPECULATION**

During this phase, the team should direct creative effort toward the development of alternatives to accomplish the identified functions. By using creative techniques such as brainstorming with active participation from all members, the greatest number, best quality and least costly alternative ideas can be discovered. Activities that may be used for this phase consist of:

- Concentrate on creating as many ideas as possible on how the function can be performed.
- Write down all of the ideas, consider all possible combinations and determine the best method of performing the function.
- Challenge the present method of performing the function and take advantage of new products, processes and materials.

## **3.4 EVALUATION**

The objective of the evaluation phase is to analyze the results of the speculation phase, review the various alternatives and select the best ideas for further development. The team should take the following steps to reduce the ideas to a manageable number.

- Compare various features of all alternatives under consideration.
- Record all the advantages and disadvantages for each alternative.
- Rank the alternatives using a numerical rating system.

Further evaluation of the alternative ideas may be needed by using additional criteria such as:

- Probability of successful implementation.
- Relative cost-reduction potential.

### **3.5 DEVELOPMENT**

During this phase, the alternatives that are developed from the evaluation phase are further developed into detailed alternative design ideas. The intent is to obtain adequate information to determine the implementation potentials.

The best ideas are completed and developed with the assistance of experts. Document all recommended design changes, materials, procedures, compliances to standards and policies, life cycle cost analysis, and implementation requirements.

A VE study report shall be drafted and distributed to the appropriate Divisions for review.

### **3.6 PRESENTATION**

After all the review comments have been incorporated into the study report, the VE team will present the study results to the Implementation Committee. The presentation of the recommendations must be concise, factual and accurate. All the data required in order for the Committee to reach a decision shall be provided.

### **3.7 IMPLEMENTATION**

The Committee will review the study report and evaluate the recommendations based on, but not limited to the following performance measures:

- Reduced overall cost
- Minimized environmental impact
- Improved safety
- Enhanced operational performance
- Improved constructability

After the Committee determines which VE recommendations are acceptable for implementation and provides justifications for rejecting those that are not acceptable, a summary of the recommendations will be send to the Deputy Director and Chief Engineer for approval.

Once the Deputy Director and Chief Engineer approves the implementation of the VE recommendations, the final VE study report and the approved VE recommendation memo will be distributed to the appropriate Divisions. If the project has Federal Oversight, a copy of the final report and the approved VE recommendation memo will be forwarded to the FHWA.

**APPENDIX A    SPECIAL PROVISION FOR VECP**

10-24-94  
09-10-96 Rev.  
03-04-03 Rev.  
04-15-03 Rev.  
06-03-10 Rev.

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**SPECIAL PROVISION**  
**JOB #**  
**VALUE ENGINEERING**

Section 104 of the Standard Specifications for Highway Construction, Edition of 2003, is hereby amended as follows:

The following is added as a new subsection:

**104.08 Value Engineering Change Proposals (VECP). (a) General.** The Contractor may submit a Value Engineering Change Proposal at any time after execution of the Contract by the Department. Any VECP submitted before this date shall be deemed to have been submitted on the date the Contract was executed by the Department and the time allowed for consideration of the VECP shall begin on that date. Any cost savings generated to the Contract as a result of a VECP submitted by the Contractor and approved by the Department shall be shared equally between the Contractor and the Department.

The Contractor may submit a VECP for an approved subcontractor. Subcontractors may not submit a VECP except through the Contractor.

Bid prices shall not be based on the anticipated approval of a VECP. If a VECP is rejected, the Contract shall be completed at the Contract bid prices.

If the Department determines that the time for response indicated in the submittal is insufficient for review, the Contractor will be promptly notified. Based on the additional time needed by the Department for review and the effect on the Contractor's schedule occasioned by the added time, the Department will evaluate the need for a time extension.

The Contractor shall have no claim against the Department for any delay to the Contract based on the failure to respond within the time indicated in the submittal if additional information is needed to complete the review.

VECPs contemplated are those that could produce a savings to the Department without impairing essential functions and characteristics of the facility; including but not limited to, service life, economy of operation, ease of maintenance, desired appearance, and safety.

The Contractor may submit for review a "VECP Concept" provided that it contains enough information to clearly define the work involved and the benefits to be realized. Written notification by the Department that the review has been completed and that the "VECP Concept" appears to be favorable merely indicates that the engineering and plan development may continue for submittal of the VE Change Proposal and is not authorization for any construction work to begin. Should the final design not reflect the

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expected benefits, the Department may reject the “VECP Concept” and the VE Change Proposal without recourse by the Contractor.

**(b) Submittal of Proposal.** The following materials and information shall be submitted with each proposal:

1. A statement that the proposal is submitted as a VECP.
2. A description of the difference between the existing Contract and the proposed change, and the cooperative advantages and disadvantages of each, including effects on service life, economy of operations, ease of maintenance, desired appearance, and safety.
3. A complete set of plans and specifications showing the proposed revisions relative to the original Contract features and requirements.
4. A complete analysis indicating the final estimate costs and quantities to be replaced by the Proposal compared to the new costs and quantities generated by the Proposal.
5. A statement specifying the date by which a Change Order adopting the Proposal must be executed to obtain the maximum cost reduction during the remainder of the Contract. This is the review time.
6. A statement detailing the effect the Proposal will have on the Contract time for completing the Contract.
7. A description of any previous use or testing of the Proposal and the conditions and results. If the Proposal was previously submitted on another Department project, indicate the date, Contract number, and the action taken by the Department.

**(c) Conditions.** VECPs will be considered only when all the following conditions are met:

1. VECPs, approved or not approved by the Department, apply only to the ongoing Contract(s) referenced in the Proposal and become the property of the Department. The Proposal(s) shall contain no restrictions imposed by the Contractor on their use or disclosure. The Department has the right to use, duplicate, and disclose in whole or in part any data necessary for the utilization of the Proposal. The Department retains the right to utilize any accepted Proposal or part thereof on other projects without obligation to the Contractor.

10-24-94  
09-10-96 Rev.  
03-04-03 Rev.  
04-15-03 Rev.  
06-03-10 Rev.

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This provision is not intended to deny rights provided by law with respect to patented materials or processes.

2. If the Department is already considering certain revisions to the Contract or has approved certain changes in the Contract for general use that are subsequently incorporated in a VECP, the Department will reject the Proposal and may proceed without obligation to the Contractor.
3. The Contractor shall have no claim against the Department for additional costs or delays resulting from the rejection of a VECP, including but not limited to, "VECP Concept" acceptance, engineering and development costs, loss of anticipated profits, increased material or labor costs.
4. The Department will determine if a Proposal qualifies for consideration and evaluation. It may reject any Proposal that requires excessive time or costs for review, evaluation, and/or investigations, or that is not consistent with the Department's design policies and criteria for the project.
5. The Engineer will reject all or any portion of work performed under an approved VECP if unsatisfactory results are obtained. The Engineer will direct the removal of such rejected work and require construction to proceed under the original Contract requirements without reimbursement for work performed under the proposal, or for its removal. Where modifications to the VECP, other than changes to the estimated quantities, are approved to adjust to field or other conditions, reimbursement will be limited to the total amount payable for the work at the Contract bid prices as if it were constructed under the original contract requirements. The rejection or limitation of reimbursement shall not constitute the basis of any claim against the Department for delay or for other costs.
6. The proposed work shall not contain experimental features but shall be proven features that have been used under similar or acceptable conditions on other projects or locations acceptable to the Department.
7. Proposals will not be considered if equivalent options are already provided in the Contract.
8. The savings generated by the Proposal must be sufficient to warrant a review and processing.

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9. A Proposal changing the type and/or thickness of the pavement structure or revising quantities simply by adjusting grades will not be considered.
10. Additional information needed to evaluate Proposals, shall be provided in a timely manner. Untimely submittals of additional information will result in rejection of the Proposal. Where design changes are proposed, the additional information could include results of field investigations and surveys, design computations, and field change sheets. The review time shall be extended by the number of days between the request by the Department for additional information and the delivery of such additional information.

**(d) Payment.** If the VECP is accepted, the changes and payment will be authorized by Change Order. Reimbursement will be made as follows:

1. The changes will be incorporated into the Contract by changes in quantities or unit prices of existing pay items, by the addition of new pay items, or any combination of these methods, as appropriate. Existing pay items are the original Contract pay items and any pay items that have been added to the Contract by Supplemental Agreement on or before the date the VECP is submitted.
2. The cost of the revised work as determined from the changes will be paid as specified in the Change Order. In addition, the Department will pay the Contractor 50 percent of the actual savings to the Department as reflected by the difference between the cost of the revised work and the cost of the related construction required by the original Contract computed at Contract bid prices. This payment will be made upon satisfactory completion of all work under the VECP.
3. Costs for "VECP Concept" acceptance, engineering and development, design, and implementation associated with the VECP are not eligible for reimbursement.
4. Payments as designated above will be made to the Contractor. If the VECP was originated by a subcontractor, the Contractor shall be responsible for any and all payments to the subcontractor arising from the approval of the VECP.

**APPENDIX B    NHI VALUE ENGINEERING STUDY – WORKBOOK**

NHI COURSE No. 13405  
VALUE ENGINEERING  
FOR HIGHWAYS



U.S. Department  
of Transportation

**Federal Highway  
Administration**

*VALUE  
ENGINEERING  
STUDY - WORKBOOK*

Project Name: \_\_\_\_\_

Location: \_\_\_\_\_

Team No. \_\_\_\_\_ Date: \_\_\_\_\_

## Value Engineering - Study Identification

Project:	Team:
Location:	Date:

### VE TEAM MEMBERS

Name:	Title:	Organization:	Telephone:

### PROJECT DESCRIPTION

Length:	Cost:
Design Speed:	Projected Traffic:
Projected Award Date:	Type of Funds:
Major Project Elements:	

### ROUTE CONDITION / GEOMETRY

Adjacent Segments:	Overall Route:

## Investigation Phase - Sources

Project:	Team:
Location:	Date:

### APPROVING / AUTHORIZING PERSONS

Name:	Position:	Telephone:

### PERSONAL CONTACTS

Name:	Telephone:	Notes:

### DOCUMENTS / ABSTRACTS

Reference:	Notes:

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## Investigation Phase - Cost Model

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Project:

Team:

Date:

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# Investigation Phase - FAST Diagram

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Project:

Team:

Date:

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# **SPECULATION PHASE - BRAINSTORMING**

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Project:

Team:

Date:

---

Item:

Function:

Function:

Item:





## Development Phase - Recommendations

Creative Idea No.

Team:

Recommendation:

Date:

**Original Design** (Sketch attached Y N)

**Proposed Change** (Sketch attached Y N)

**Justification** (Describe advantages/disadvantages, reasoning, and compliance with standards and requirements)

Life Cycle Cost Summary (Present Worth Method)			
	Initial Cost	Future Cost	Total Cost
Original Design			
Proposed Change			
Savings			

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## Development Phase - Sketches

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Creative Idea No.

Team:

Recommendation:

Date:

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**Original Design**

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**Recommended Design**

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## **Development Phase - Calculations**

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Creative Idea No.

Team:

Recommendation:

Date:

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# Life Cycle Cost Analysis - Present Worth Method

Creative Idea No. \_\_\_\_\_

Team: \_\_\_\_\_

Recommendation: \_\_\_\_\_

Date: \_\_\_\_\_

Discount Rate: \_\_\_\_\_

Economic Life: \_\_\_\_\_ Years

	Original	Design	Alt. No.1	
	Cost	PW	Cost	PW
<b>1. Initial Cost:</b>				

<b>Single Expenditures:</b> (i.e., stage Construction, Major Maintenance) a. Year ____ PWF _____ b. Year ____ PWF _____ c. Year ____ PWF _____ d. Salvage / Unused Service Life Year ____ PWF _____				
<b>2. Future Single Costs:</b>				

<b>Annual Costs:</b> a. General Maintenance PWF _____ b. Other Annual Costs PWF _____				
<b>3. Future Annual Costs</b>				

<b>4. Total Future Costs: (2 + 3)</b>				
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<b>5. Total Life Cycle Costs: (1 + 4)</b>				
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# **Development Phase - Executive Summary**

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Project:

Team:

Date:

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