To: TONY ANZIANO  
Program Manager  
Toll Bridge Program  

From: JON TAPPING  
SFOBB Project Risk Management Coordinator  

Subject: First Quarter 2010 Risk Management Report – Toll Bridge Seismic Retrofit Program

With the concurrence of the Toll Bridge Seismic Retrofit Program (TBSRP) Project Manager, I submit for your approval the First Quarter 2010 Quarterly Risk Management Report (QRMR) for the Toll Bridge Seismic Retrofit Program, reporting for the quarter ending March 31, 2010.

Recommend Approval:

JON TAPPING  
SFOBB Project Risk Management Coordinator  

KEN TERPSTRA  
Project Manager  
SFOBB East Span and West Approach  

Approved:

TONY ANZIANO  
Program Manager  
Toll Bridge Program  

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B. Rhinehart  CTC Executive Director  
A. Fremier  Project Management Team (BATA)  
S. Maller  Project Management Team (CTC)
# Table of Contents

1. INTRODUCTION ........................................................................................................................... 1
2. POTENTIAL DRAW ON PROGRAM CONTINGENCY ................................................................. 2
3. CORRIDOR SCHEDULE .................................................................................................................. 5
4. SAS – SELF ANCHORED SUSPENSION CONTRACT .............................................................. 15
5. YBI DETOUR CONTRACT ........................................................................................................ 20
6. OAKLAND TOUCHDOWN #1 (WESTBOUND) CONTRACT .................................................... 23
7. OAKLAND TOUCHDOWN #2 (EASTBOUND) CONTRACT ....................................................... 26
8. YBI TRANSITION STRUCTURES #1 CONTRACT ................................................................. 28
9. YBI TRANSITION STRUCTURES #2 CONTRACT ................................................................... 31
10. PROGRAM-LEVEL RISKS ........................................................................................................ 33
11. ANTIOCH BRIDGE RETROFIT CONTRACT ........................................................................ 35
12. DUMBARTON BRIDGE CONTRACT .................................................................................... 38
13. CAPITAL OUTLAY SUPPORT .............................................................................................. 41
APPENDIX "A"  RISK MANAGEMENT EXPLANATIONS ................................................................. 43
1 INTRODUCTION

Assembly Bill (AB) 144, signed into law on July 18, 2005, authorized the Department of Transportation (Department) to develop and implement an expanded comprehensive risk management plan for the Toll Bridge Seismic Retrofit Program (TBSRP) to augment the established risk management protocols and mitigation measures already in place.

The Antioch and Dumbarton bridge retrofit projects were incorporated into the TBSRP effective January 1, 2010 as per AB 1175. The two projects add their respective risks to the program as well as creating a step increase in the Program Contingency.

The Quarterly Risk Management Report (QRMR) summarizes risk management for each contract. It includes risk developments in the current quarter, risk management activities, risk management cost (RMC), RMC trend, and a look-ahead to next quarter. The Antioch and Dumbarton contracts were added this quarter.

The QRMR also includes sections for the potential draw on Program Contingency, the Corridor Schedule, program-level risks (not assigned to a particular contract) and Capital Outlay Support risks. This report is based on details in the related report: Risk Management Documentation.

The QRMR supports summary risk management information that is included in other TBSRP reports. Among these are the monthly report to the Toll Bridge Program Oversight Committee (TBPOC) and the quarterly TBPOC report to the California Legislature.

ABBREVIATIONS USED IN THIS REPORT

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>ABF</td>
<td>American Bridge Fluor Joint Venture</td>
</tr>
<tr>
<td>BATA</td>
<td>Bay Area Toll Authority</td>
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<tr>
<td>CCO</td>
<td>Contract Change Order</td>
</tr>
<tr>
<td>COS</td>
<td>Capital Outlay Support</td>
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<tr>
<td>CST</td>
<td>Corridor Schedule Team</td>
</tr>
<tr>
<td>ISD</td>
<td>Integrated Shop Drawings</td>
</tr>
<tr>
<td>NOPCs</td>
<td>Notices of Potential Claims</td>
</tr>
<tr>
<td>OBG</td>
<td>Orthotropic Box Girder</td>
</tr>
<tr>
<td>OTD 1</td>
<td>Oakland Touchdown #1 (Westbound) Contract</td>
</tr>
<tr>
<td>OTD 2</td>
<td>Oakland Touchdown #2 (Eastbound) Contract</td>
</tr>
<tr>
<td>PS&amp;E</td>
<td>Plans, Specifications and Estimate</td>
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<td>QRMR</td>
<td>Quarterly Risk Management Report</td>
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<td>RMC</td>
<td>Risk Management Cost</td>
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<td>Self Anchored Suspension Contract</td>
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<td>Toll Bridge Program Oversight Committee</td>
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<td>YBID</td>
<td>YBI Detour</td>
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<td>YBITS 1</td>
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</table>
2  POTENTIAL DRAW ON PROGRAM CONTINGENCY

2.1  TOTAL RISK MANAGEMENT COST AND TOTAL CONTINGENCY

The total contingency available to cover all risks of the program comprises the contingency available from all contracts, plus the current balance in the Program Contingency. Each contract in design has an assigned contingency allowance. A contract in construction has a remaining contingency that is the difference between its budget and the sum of Bid Items, State Furnished Materials, Contract Change Orders (CCOs) and Remaining Supplemental Work. COS has no contingency allowance. Contract contingencies are reported quarterly by Program Management to the Risk Management Team. The following table shows the changes in contingencies from the previous quarter.

<table>
<thead>
<tr>
<th></th>
<th>Q1 2010</th>
<th>Q4 2009</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Contingency Available from East Span Contracts ($M)</td>
<td>235.3</td>
<td>279.7</td>
<td>(44.4)</td>
</tr>
<tr>
<td>2. Contingency from Antioch &amp; Dumbarton Contracts ($M)</td>
<td>224.5</td>
<td>-</td>
<td>224.5</td>
</tr>
<tr>
<td>3. Program Contingency Balance ($M)</td>
<td>948.3</td>
<td>758.3</td>
<td>190.0</td>
</tr>
<tr>
<td>4. Total Contingency ($M)</td>
<td>1,408.1</td>
<td>1,038.0</td>
<td>370.1</td>
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</table>

Contingency available from East Span contracts decreased by $44.4 million due to $33.4 million in contract change orders and increases in the estimates for the YBITS 2 and OTD 2 contracts. Program Contingency increased by $190 million transferred from the Antioch and Dumbarton contracts. Total contingency increased by $370.1 million.

The 1st Quarter 2010 total Risk Management Cost (RMC) is virtually unchanged from the previous quarter even with the addition of the Antioch and Dumbarton contracts. The respective RMC curves are shown in Figure 1 with Total Contingency for reference.

FIGURE 1 – RISK MANAGEMENT COST AND TOTAL CONTINGENCY
The total contingency is currently sufficient to cover the costs of identified risks.

### 2.2 Potential Draw on Program Contingency

The risk management process calculates the potential draw on program contingency each quarter, and compares it to the current balance in the Program Contingency. The potential draw curve in Figure 2 is obtained by subtracting the total contingency available from contracts (items 1 in the above table) from the RMC curve in Figure 1.

![Potential Draw on Program Contingency](image.png)

**FIGURE 2 – POTENTIAL DRAW ON PROGRAM CONTINGENCY**

As of the end of the 1\textsuperscript{st} quarter 2010, the 50\% probable draw on Program Contingency is $526 million. The potential draw ranges from about $300 million to $700 million.

The $948.3 million Program Contingency balance can be used to cover the costs of identified risks.

Risk mitigation actions are continuously developed and implemented to reduce the potential draw on the Program Contingency.

**Out-of-Scope Program Risks:** Program risks do not include the approximately $50 – 80 million cost of risks that are outside the scope and budget of the program (i.e. Light Pipe, BASE System, and potential indirect impacts resulting from the City of San Francisco’s YBI Ramp project).

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1. The Program Contingency funds could be used for other beneficial purposes than to cover risks. The potential draw chart should not be construed as a forecast of the future balance of Program Contingency funds.
2. See A.3 Interpreting Risk Curves for an explanation of the curve and “range”.
### 2.3 PROGRAM CONTINGENCY TREND

The Quarterly Risk Management Report has reported the potential draw on the Program Contingency since the 1st quarter of 2007. Figure 3 shows the trend through the current quarter.

*FIGURE 3 – PROGRAM CONTINGENCY TREND*

The solid area depicts the range of potential draw that covers about 99% of all possible outcomes. There are possible outcomes beyond this range, but their probability is very small.

The 50% probable RMC did not change from the previous quarter and the total contingency increased by $370.1 million.
3  CORRIDOR SCHEDULE

3.1  INTRODUCTION

The Corridor Schedule Team (CST) developed an intermediate level schedule for the Corridor (East Span) to be used in evaluating schedule risk and recovery opportunities. The Corridor Schedule is a summarization of the contract schedules submitted by the various contractors and schedules developed by the Department for the contracts in design.

In the 1st quarter 2009 the CST and the Risk Management Team reported opportunities to mitigate potential delays in the SAS contract. The Teams update the opportunities each quarter upon receipt of the SAS Contractor's Schedule Update, and look for other opportunities to achieve seismic safety as soon as possible.

ABOUT SCHEDULE RISK

It is important to remember that the dates to achieve seismic safety are objectives, not certainties. A cost estimate is not a certainty and thus needs a contingency allowance to determine a budget that has an acceptable probability of being adequate. Similarly, a schedule is an estimate of time required and should have a time contingency to set a completion target date that has an acceptable probability of being realized. In each case, the contingency is intended to cover the risks.

Efforts are underway to accelerate the remaining work to achieve seismic safety as early as possible. Compressing or accelerating the schedule removes most, if not all, of the time contingency. If any critical activity (one on the longest path) requires additional time, the accelerated target dates will not be realized without taking additional mitigating actions. East End fabrication and erection, cable installation and load transfer are on the longest path. All of these activities are complex and challenging – to squeeze the time available also increases the probability of something not going according to plan.

Here's how the probabilities work: The basic rule is that to calculate the probability of A and B happening, one must multiply their probabilities.

For example, suppose that each of the four activities on the longest path has a 95% chance of completing within its estimated time. The probability that all four activities will complete within their respective estimated times is determined by multiplying 0.95 by itself four times, which equals 0.81. This means that there is an 81% chance of on-time completion, and a 19% chance of being late. Reduce the 95% chance per activity to 90% and the probability of on-time completion reduces to 66%; a 34% chance of being late. This does not calculate how late it might be; that is determined from the schedule risk analysis (Section 3.4), which considers the probability and potential impact of schedule risks inserted into the schedule logic.

SCHEDULE RISK ANALYSIS PROCESS

The schedule risk analysis process inserts risk activities into the schedule and adds uncertainty onto some schedule activity durations. When placing uncertainty onto the duration of an activity,

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1 See Appendix A.4 for a description of how risks are inserted into the Corridor Schedule.
the activity can possibly underrun its remaining duration (an opportunity) or possibly require more time.

The schedule risk analysis simulation is run after delay risks are inserted into the Corridor Schedule. The analysis produces a probability distribution for the milestones of each contract, and the milestones for westbound and eastbound opening. The schedule risk analysis results are used to update the potential delay costs in the contract and program-level risk registers.

### 3.2 Corridor Schedule Status

The ABF February 2010 Update Schedule for the SAS contract projects a contract completion date 11 months later than the current contract dates. This translates into up to 11 months potential delay in achieving seismic safety (eastbound open).

In previous quarters, the CST and the Risk Management Team jointly identified opportunities to mitigate the overall SAS contract schedule impacts due to delays in producing shop drawings and fabricating the East End\(^1\). Most of the opportunities are during field construction and include re-sequencing concurrent work and redefining SAS Phase completion requirements.

![SCHEDULE COMPARISON TABLE]

<table>
<thead>
<tr>
<th>2012</th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
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<tr>
<td>Q1</td>
<td>Q2</td>
<td>Q3</td>
<td>Q4</td>
</tr>
<tr>
<td>10-29-2012</td>
<td></td>
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<tr>
<td>11 mo</td>
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<tr>
<td>Q1</td>
<td>Q2</td>
<td>Q3</td>
<td>Q4</td>
</tr>
<tr>
<td>4-27-2013</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12 mo</td>
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<th>2012</th>
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<tr>
<td>Q1</td>
<td>Q2</td>
<td>Q3</td>
<td>Q4</td>
</tr>
<tr>
<td>10-24-2013</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11 mo</td>
<td></td>
<td></td>
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</tbody>
</table>

**Phase 1** – Load transfer complete and area west of W2 turned over to the YBITS 1 contractor.

**Phase 2** – SAS ready for westbound traffic

**Phase 3** – SAS ready for eastbound traffic.

**FIGURE 4 – ABF AND CORRIDOR SCHEDULE COMPARED**

The ABF February 2010 Update schedule shows Phase 1, 2 and 3 completions 10, 12 and 11 months later than the revised contract dates. The Corridor Schedule has slipped 2-3 months since the last quarter due to revised estimates for the completion of East End fabrication. Currently, the Corridor Schedule incorporates opportunities to recover approximately nine months of the delays reflected in the ABF February 2010 update.

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\(^1\) The term “East End” refers to Lifts 12-14 of the Orthotropic Box Girder (OBG).
Previously, the completion of East End fabrication was forecast for March 2011. The forecast was revised following discussions with ABF and the fabricator during recent visits to China. The current forecast for East End shipment is in late 2011, with possible acceleration to July 2011. The current Corridor Schedule assumes shipment in July 2011, with uncertainty extending to the end of 2011.

Recovery Opportunities Incorporated into the Corridor Schedule

During the development and update of the Corridor Schedule, the CST and Risk Team incorporated several opportunities and assumptions into the Corridor schedule. While some of the recovery opportunities are in the East End fabrication, most of the recovery opportunities are in the construction phase of the SAS contract. They include re-sequencing certain work activities to better reflect concurrent work and redefining SAS Phase completion requirements. These opportunities resulted in a Corridor Schedule with SAS milestone completion two to three months later than the current contract dates.

The major opportunities, assumptions and changes incorporated into the Corridor Schedule are listed below:

1. Accelerated completion of the OBG East End shop drawings
   - Co-location at Candraft
   - Implemented by incentive CCO 123 S1
2. Overlapping of the OBG East End shop drawings, translation and fabrication activities
   - Mobilized East End Team to China
   - Plate cutting started prior to translation completion
3. Assumed accelerated fabrication of the OBG Lifts 13 and 14
   - Procure additional shop space
   - Assemble a whole lift and paint it in the shop bay
   - Obtain and train additional welders
4. Additional shipments of permanent steel
   - Separate OBG Lift 11 from Lift 12 shipment
5. Early shipment of the tower template to San Francisco
   - Tower footing can be prepared before the Tower Lift 1 arrives
   - A second footing template has been fabricated and has been shipped to San Francisco in January 2010.
   - Footing template has been successfully fitted over the footing
6. Shorten cable installation work
   - Earlier start of the cable temporary works
   - Overlap cable temporary works with OBG erection
   - Use additional shift work to accelerate cable installation operations
   - Obtain additional equipment
7. Modify cable completion activities after load transfer
   - Overlap activities
   - Obtain additional equipment
8. Assumed revised sequence of MEP operations
9. Assumed re-defined scope of work for Phase completions
   - Phase 1 (turn over area to YBITS 1 contractor)
     - Leave temporary towers A, B and C in place until after bridge opening
     - Postpone cable shrouds and W2 dehumidification system
   - Phases 2 and 3 (ready for traffic)
     - Allow lane closures after traffic is on the westbound bridge
     - Postpone completion of some MEP work until after traffic opening
     - Could extend SAS contract completion to achieve earlier seismic safety.
10. Coordinate SAS and YBITS 1 schedules to allow both contractors to have access to the Hinge K area and facilitate completion of Hinge K
11. At westbound opening, allow a full bridge closure to facilitate demolition of existing structures by the OTD 2 contractor

Most of the opportunities have not yet been confirmed with, nor implemented by, the SAS contractor. Some of these adjustments required an increase in risk to scheduled activity durations.

### 3.3 Corridor Schedule Critical Paths

A primary critical path has no float – it is the longest path. Any delay to an activity on a critical path will delay the completion milestones. Secondary and tertiary paths, while not on the longest path, are close enough that they could move onto the primary path as the project progresses.

Over time different paths will progress at different paces and the current absolute critical path may change. This is especially true for large projects with long schedules. It is imperative that management and the project team focus not only on the current critical path but also on the near-critical paths. Maintaining focus on the near-critical paths allows the management team to identify potential delays and take the appropriate mitigation actions.

**Paths to Load Transfer**

Completion of the SAS load transfer is a key milestone to completing the SAS and YBITS 1 leading to opening the bridge to traffic. There are three critical paths to load transfer as shown in Figure 5.
For the SAS contract, the most critical path to load transfer includes the OBG Lift 13 and 14 shop drawings, fabrication, and erection followed by the cable temporary works, PWS (cable) installation, and suspender installation.

The secondary and tertiary paths include the erection of Tower Lifts 3, 4 and 5, which are constrained by the fabrication and delivery of the respective lifts. Tower Lift 3 is planned to be on a voyage with OBG Lift 11 and Tower Lifts 4 and 5 are planned to be on a voyage with OBG Lift 12.

Departure from China of both of these voyages is controlled by the respective OBG lift fabrication. In secondary and tertiary paths, the tower lifts are ready for shipment several months ahead of the OBG. There is a possibility to resequence the voyage cargo to accelerate the tower lift deliveries. This would reduce the risk of the tower erection controlling the cable erection. However, with the uncertainty in the fabrication schedule, progress should be closely monitored before any decision is made to re-sequence deliveries.

All tower erection must be completed before starting the cable system temporary works. The OBG sections through Lift 6E must be erected before setting Tower Lift 1.

**PATHS FROM LOAD TRANSFER TO WESTBOUND OPENING**

SAS load transfer leads to opening the bridge in the westbound direction. The critical paths from load transfer to westbound opening are shown in Figure 6.
On the primary path, once load transfer is completed the SAS contractor removes the temporary works at W2 and clears the area for the YBI Transition Structures (YBITS 1) contractor to complete the westbound frame 2 and the Hinge K closure.

On the secondary path, the SAS contractor has to complete the cable wrapping and painting, and the electrical and mechanical systems must be completed on the westbound bridge.

The Westbound Opening milestone is driven by the YBITS 1 contract, with the SAS contract work finishing about one month prior. This difference is so small that either contract could be the driver and decisions to adjust the SAS contract schedule should also consider the effects on the YBITS 1 contract schedule.

**Paths from Westbound Opening to Eastbound Opening**

Since a portion of the existing westbound bridge and roadway is in conflict with the new eastbound structure and roadway, traffic must be transferred to the new westbound structure prior to completion of the eastbound bridge and approach. Once traffic is switched to the new westbound bridge, the critical paths to opening eastbound traffic are shown in Figure 7. They have not changed from the previous quarter.
On the primary path, partial demolition of the existing bridge upper deck is followed by completion of the Oakland Touchdown Eastbound (OTD 2) Frame 2 and roadway excavation, lightweight fill and paving for the eastbound roadway. Completion of the YBITS eastbound Frame 2 and Hinge KE and SAS eastbound mechanical and electrical systems are secondary paths to opening the eastbound bridge to traffic.

The eastbound opening milestone is driven by the OTD 2 contract, with the YBITS 1 and SAS contracts finishing 2-3 months prior. Decisions to adjust the SAS contract schedule should consider the effects on the YBITS 1 and OTD 2 contracts. Any decision should not focus solely on the SAS contract even though it is the one that is currently behind schedule. Lessons learned from the Oakland Touchdown Westbound (OTD 1) and YBI Detour (YBID) contracts will be used to reassess OTD 2 contract risks, and may change the risks in the OTD 2 schedule and the driver of eastbound opening.

3.4 Schedule Risk Analysis Results

The schedule risk analysis results outlined below are expressed as potential additional duration from the current approved milestones for the SAS contract and opening westbound and eastbound to traffic. It is important to understand that the risks in the recovered Corridor Schedule are as yet unmitigated. The unmitigated risks are those that the project team believes could impact the recovered Corridor Schedule. Various teams are working diligently to reduce the probability of these risks occurring, and preparing response plans to minimize their impact should they occur.
SAS CONTRACT

The results for the SAS schedule milestones are shown in Figure 8. The potential additional duration is measured from the current SAS contract dates, and assumes that the nine months of recovery opportunity from the contractor’s schedule update is fully realized. Otherwise, the potential additional duration will increase by the number of months not recovered.

![Unmitigated Risks to Recovered SAS Schedule](image)

Phase 1 – Load transfer complete and area west of W2 turned over to the YBITS 1 contractor.
Phase 2 – SAS ready for westbound traffic
Phase 3 – SAS ready for eastbound traffic.

FIGURE 8 – UNMITIGATED RISKS TO RECOVERED SAS SCHEDULE

The schedule risks to Phase 1 govern the additional duration in the SAS and bridge opening schedule. They include the fabrication of the East End (Lifts 13 and 14), erection of the OBG East End lifts, suspension cable system installation and load transfer.

Teams are actively engaged in each of these areas to mitigate these risks to the greatest extent possible. East End schedule risk mitigation measures include:

- Forming a team of key personnel to resolve shop drawing issues promptly,
- Providing additional training to welders on critical welds in the East End, and,
- Building models to identify challenging areas and work procedures in the East End fabrication.

With respect to the cable installation and load transfer, the Cable Erection Risk Management (CERM) team has been meeting regularly for the past three years to resolve potential cable issues and many of their recommendations have already been implemented. Additional measures under consideration include:
The results of their efforts will be used to update the schedule risks in future reports.

**WESTBOUND AND EASTBOUND OPENING**

The westbound and eastbound milestones are when the bridge opens to traffic in the respective directions. Seismic safety will be achieved at the eastbound opening milestone.

The risk analysis results for the two milestones are shown in Figure 9. The potential additional duration is measured from the current approved dates, and assumes that the 9 months of SAS recovery opportunity is fully realized.

The westbound opening milestone is impacted by risks in Phase 1 of SAS, risks to the completion of Hinge K by the YBITS contractor, and risks to the completion of MEP systems for the westbound direction.

The eastbound opening milestone is impacted by risks to the westbound milestone, risks in the OTD 2 contract, risks in the YBITS 1 contract and risks to the completion of MEP systems for the eastbound direction.

Teams are investigating ways to mitigate the Hinge K completion risk. Lessons learned from the construction of the hinges of the Skyway contract are being incorporated into the SAS contract. The project management team is investigating ways to shorten the OTD Eastbound schedule and...
mitigating risks associated with the demolition of the existing structures by scheduling the work during a potential weekend bridge closure. The MEP team, formed over a year and a half ago, continues to mitigate MEP system risks and remove the system’s construction from the critical path through bridge opening. An MEP team is resolving issues with the traveler system to keep it off the critical path and mitigate risk.

**Cost of Schedule Recovery and Mitigating Schedule Risks**

It is likely that the project teams will be able to mitigate a good portion of the potential schedule delays by implementing the mitigation measures outlined above. Implementing these measures will have direct cost impacts. The Risk Management Team has included items in the SAS contract and program-level risk registers to cover the potential costs of risk mitigation and recovering the SAS schedule.
4 SAS – SELF ANCHORED SUSPENSION CONTRACT

4.1 STATUS

The SAS contract is estimated to be 49 percent complete. The probable cost of SAS risks decreased by 12 percent this quarter. This reflects a decrease or retirement of several risks, offset by increased potential delay due to the shift in expected completion of East End fabrication from March 2011 to July 2011.

The SAS contractor’s February 2010 schedule update indicates that the project completion milestone for seismic safety (eastbound open) may be up to 11 months later than the revised contract date. The revised contract dates include 197 days that were granted to resolve previous fabrication issues.

An important aspect of the SAS schedule – and of all schedules for large projects – is that there may be multiple critical paths to milestones.

Focusing on the path that is the most critical, while important, may divert attention from other near-critical paths. The most critical path to load transfer contains the OBG East End shop drawings, fabrication and erection of Lifts 13 and 14. A secondary critical path runs through the erection of Tower Lifts 3, 4 and 5, which are dependent on the fabrication and delivery of these lifts – the tertiary critical path.

4.2 RISK MANAGEMENT ACTIVITIES

SAS SCHEDULE RECOVERY

SAS schedule recovery opportunities are detailed in Section 3.2 above.

EAST END SHOP DRAWINGS

As discussed in previous Quarterly Risk Management Reports, efforts to generate shop drawings for the East End have been time-consuming. Three-dimensional models of the East End identified many conflicts that were resolved or could be resolved prior to developing shop drawings. However, this was only a preliminary step in the development of shop drawings for these elements.

Shop drawings for the East End are progressing well but remain a critical operation for the project. Shop drawing production was incentivized. The incentives and the placement of key personnel by the Department onto this item of work have facilitated getting this challenging issue under control. The Department marked the majority of shop drawings as “Approved” or “Approved as Noted” by the March 1, 2010 target date.
Department representatives meet regularly with the Contractor to identify opportunities to improve the review and approval process and to get the shop drawings ready for fabrication by ZPMC, the contractor’s fabricator. Teams were formed to streamline the time and effort required by ZPMC to “translate” the drawings for fabrication. This effort is expected to take 2 months for each lift. Key personnel from the Department, its design consultant and the contractor’s shop drawing developer have been relocated to China to assist in streamlining this process.

**Fabrication of OBG and Tower**

The TBPOC approved incentive and disincentive provisions associated with the first and third permanent steel shipments. These provisions resulted in the first shipment of permanent works departing the Chinese fabrication facility in late December 2009, and arrived in mid-January 2010. The second OBG Shipment departed March 29, 2010 and is expected to arrive 3 to 4 weeks later.

At this time, it appears that the incentive offered to the Contractor/Fabricator for the first tower shipment was insufficient to motivate them to accelerate operations so as to earn the incentive.

Team China continues to develop strategies to reduce risk and to accelerate fabrication while maintaining the specified quality. The contractor and Team China remain diligent in their Quality Control and Quality Assurance efforts to assure only elements that meet contractual quality standards will be shipped from China.

**SAS Cable Installation**

While the SAS appears to have two cables, there is actually only one continuous main cable that is anchored within the decks at the eastern end, where it ties into the Skyway orthotropic box girder sections. This cable is carried over the tower and wrapped around W2 bent cap at the western end. The Cable Focus Team is developing strategies and solutions to mitigate potential risks associated with the cable.

Initial trial testing of the main cable strands, an important risk mitigation measure, was performed in September 2009. The first half of the cable shipment has arrived and the second is expected this summer.

The Cable Focus Team meets weekly to address issues and refine cable erection plans. It has retained international experts in cable installation and has made recommendations to the Department.
4.3 **RISK MANAGEMENT COST**

The chart below shows the probability distribution of Risk Management Cost (RMC). This information is provided to the Project Manager and Program Manager for their consideration in budget analysis and quarterly forecasting.

The current quarter RMC probability distribution is the aggregate of risks, Notices of Potential Claims (NOPCs) and future CCOs as of March 31, 2010. The remaining contingency on this contract is $86 million.

The following table shows three RMC values from the current curve, each with its associated probability of being exceeded.

<table>
<thead>
<tr>
<th>Probability of Greater Risk Management Cost</th>
</tr>
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<tbody>
<tr>
<td>Probability</td>
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<tr>
<td>Risk Management Cost</td>
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</table>

**RISK MANAGEMENT TREND**

The chart shows the total of Bid Items, State Furnished Materials, remaining Supplemental Work and CCOs from the 1st quarter 2007 to date. The range of Capital Outlay risks is on top (in red)

The width of the RMC range embraces over 99 percent of the possible outcomes. The budget line is the approved TBPOC budget for the quarter.

1 Capital Outlay Support risks are reported in Section 13.
4.4 **LOOK AHEAD**

**SHIPMENT DATES**

Forecasting shipment dates continues to be challenging. Although the first two OBG shipments have departed the fabrication facility, subsequent shipment dates still have considerable uncertainty. The uncertainty should reduce with each shipment as the teams apply lessons learned to managing the fabrication processes.

The SAS contractor is contemplating rearranging OBG and Tower lifts among shipments, and possibly adding two shipments, to deliver the bridge components to the jobsite as soon as possible.

**ENGAGE SCHEDULE PARTNERSHIP**

The Joint Opportunity Schedule development began in the 1st quarter 2009 as a joint effort between the Department and the contractor. It has been tabled as efforts were redirected to resolving the East End shop drawing issues. Now that many of the issues have been resolved, project management is expected to engage the Contractor to jointly develop a schedule for the remaining portion of the project.

The Risk Management Team views a joint schedule as an essential planning tool that should be used to identify and call attention to risks and their potential impacts on bridge opening. While incentives/disincentives on completion milestones may be considered, the joint schedule ought to include specific actions to facilitate schedule recovery – actions that are tangible, measureable and achievable.

The Department and the Contractor have begun discussing ways to move forward on the construction of the bridge to meet the TBPOC’s goal of opening the bridge in 2013. Discussions have concentrated on three key areas: streamlining East End fabrication, accelerating cable erection through load transfer, and redefining requirements for placing traffic on the bridge.
RESOLUTION OF FABRICATION ISSUES

A Contract Change Order was issued to resolve the fabrication issues for the OBG Lifts 1 to 11 and the Tower. While this change order resolved many issues to date, there is still a year left in fabrication and issues are expected to arise and require resolution; of particular concern, are change orders written for deferred time and cost.

Some issues have been resolved using incentives and down payments for extra work on East End shop drawing development. Change orders are contemplated for the resolution of East End fabrication issues and for accelerating construction activities in the Bay Area.

Meetings held in mid-March identified specific means that could be implemented in the East End fabrication process to mitigate the fabrication schedule. These meetings succeeded in developing several concepts that are being implemented with others expected to follow.
5 YBI DETOUR CONTRACT

5.1 STATUS

This contract is in construction with approximately 92 percent of the revised scope of the contract now completed. The probable cost of risks decreased about 30 percent this quarter. This was primarily due to the successful progression of the demolition work and a transfer of some risk associated with the S-Curve safety enhancements into CCOs. Two risks were retired from the risk register this quarter.

5.2 RISK MANAGEMENT ACTIVITIES

S-CURVE SAFETY ENHANCEMENTS

The project team had previously assessed cost risks to cover various safety enhancements to the Detour. These measures are now incorporated into the work, the costs are transferring to the CCO Log, and these risks are retired.

The Risk Management team assessed the risks associated with various night closure configurations that might be implemented on the S-Curve until project completion. Potential lane closure costs after project completion are carried in the YBITS 1 contract risk register.

DEMOLITION

With approximately 75% of the demolition work now complete, the risk cost is reduced by 50% and will likely be retired next quarter.

5.3 RISK MANAGEMENT COST

The chart below shows the probability distribution of RMC. This information is provided to the Project Manager and Program Manager for their consideration in budget analysis and quarterly forecasting.

The current quarter RMC probability distribution is the aggregate of risks, NOPCs and future CCOs as of March 31, 2010. The remaining contingency on this contract is $18.5 million.
The following table shows three RMC values from the current curve, each with its associated probability of being exceeded.

<table>
<thead>
<tr>
<th>Probability of Greater Risk Management Cost</th>
<th>Probability</th>
<th>90%</th>
<th>50%</th>
<th>10%</th>
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</thead>
<tbody>
<tr>
<td>Risk Management Cost</td>
<td></td>
<td>$9 M</td>
<td>$12 M</td>
<td>$15 M</td>
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</table>

**RMC Trend**

The chart shows the total of Bid Items, State Furnished Materials, remaining Supplemental Work and CCOs from the 1st quarter 2007 to date. The range of CO risks is on top (in red). The width of the range embraces over 99 percent of the possible outcomes. The budget line is the approved TBPOC budget for the quarter.
5.4 **LOOK AHEAD**

**DEMOLITION AND CONSTRUCTION OF BENT 5**

The demolition of the old bridge from the East Tie-In to the West Tie-In and the construction of Bent 5 will be completed over the next several months. Risks will be reduced and retired as the work progresses.
6 OAKLAND TOUCHDOWN #1 (WESTBOUND) CONTRACT

6.1 STATUS

This contract is in construction, nearing 93% percent completion. Three risks were retired due to the progress of the work, resulting in a 3 percent decrease in the probable cost of risks. The remaining risk allowances will cover job close-out costs and any upcoming CCOs or claims from the contractor or his subcontractors.

6.2 RISK MANAGEMENT ACTIVITIES

RETIRED RISKS

Three residual risks were retired due to the progress of the work:

- Conflicts with unknown utilities,
- Contractor’s work impacts known utilities,
- Conflicts or differing opinions over welding.

Minor changes that may result from these risks will be covered by the miscellaneous CCOs risk allowance.

6.3 RISK MANAGEMENT COST

The chart below shows the probability distribution of RMC. This information is provided to the Project Manager and Program Manager for their consideration in budget analysis and quarterly forecasting.

The current quarter RMC probability distribution is the aggregate of risks, NOPCs and future CCOs as of March 31, 2010. The remaining contingency on this contract is $5.4 million.
The following table shows three RMC values from the current curve, each with its associated probability of being exceeded.

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<tr>
<th>Probability of Greater Risk Management Cost</th>
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<tr>
<td>Probability</td>
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<tr>
<td>Risk Management Cost</td>
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</table>
**RMC Trend**

The chart shows the total of Bid Items, State Furnished Materials, remaining Supplemental Work and CCOs from the 1st quarter 2007 to date. The range of Capital Outlay risks is on top (in red). The width of the range embraces over 99 percent of the possible outcomes. The budget line is the approved TBPOC budget for the quarter.

The chart is for all OTD contracts combined because the TBPOC has not established a budget for each contract.

**6.4 Look Ahead**

**Project Completion**

The project is scheduled to complete by the contractual date, or possibly earlier. Remaining activities include: completing the bike path, electrical service platforms, Mole Substation building, Maintenance Road Detour, Eastbound Detour, and punch list.
7      OAKLAND TOUCHDOWN #2 (EASTBOUND) CONTRACT

7.1      STATUS

This contract is in design, at the 95 percent phase. The probable cost of risks increased by 10 percent this quarter due to increases in the risk that the estimate is not consistent with the current proposed schedule and in the risk of impacts to public traffic due to a potential full bridge closure. The risks of design conflicts and incomplete contract documents at RTL were reduced.

7.2      RISK MANAGEMENT ACTIVITIES

CURRENT ESTIMATE NOT CONSISTENT WITH PROPOSED ACCELERATION OF EASTBOUND OPENING

The proposed OTD 2 schedule compresses the time between westbound and eastbound openings from one year to 7 months. The current estimate does not account for the necessary acceleration, which may call for double shifts and 7-day work weeks. If the schedule is accepted, the estimate will increase. The risk probability increased this quarter to reflect the current plan to compress the eastbound opening schedule.

POTENTIAL IMPACTS ON PUBLIC TRAFFIC

A full bridge closure before westbound opening is being considered. The closure will ensure that the grinding, paving work, and pavement delineation on the westbound can be completed without potentially impacting safety. A closure will also allow safe demolition of the existing westbound structure where it crosses over eastbound traffic. The probability of the risk was increased to reflect that the decision is leaning toward a full bridge closure.

PS&E DATE CHANGES

The OTD 2 PS&E dates were changed without affecting the advertisement dates to allow the Department to finalize work items such as the seismic joints, the existing bridge demolition, and the bike path temporary parking lot. The date change reduced the risk that contract documents will not be complete by Ready to List (RTL) date.

DEVELOPMENT OF INTEGRATED SHOP DRAWINGS (ISDS) DURING DESIGN

A decision was made to develop ISDs for the project during the design phase to solve electrical-mechanical-structural conflicts and to revise the contract plans accordingly. Lessons learned from the OTD 1 and YBITS 1 contracts were incorporated. Work on ISDs began during the quarter and is expected to be completed shortly. The risk allowance was reduced to reflect the progress of this mitigation action.

7.3      RISK MANAGEMENT COST

The chart below shows the probability distribution of RMC. This information is provided to the Project Manager and Program Manager for their consideration in budget analysis and quarterly forecasting.
The current quarter RMC probability distribution is the aggregate of risks, NOPCs and future CCOs as of March 31, 2010. The remaining contingency on this contract is $9.5 million.

The following table shows three RMC values from the current curve, each with its associated probability of being exceeded.

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<th>Probability of Greater Risk Management Cost</th>
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<td>Probability</td>
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**RMC Trend**

The TBPOC has not established a budget for each OTD contract. The chart for all OTD contracts combined is on page 25.

**7.4 Look Ahead**

**Bridge Opening Planning**

The OTD 2 contract will put traffic on the westbound lanes and later on the eastbound. Detailed plans for the traffic switches are to be prepared, including an evaluation of whether a single full bridge closure will be required.
8 YBI Transition Structures #1 Contract

8.1 Status

The YBITS 1 contract was awarded to the lowest bidder, MCM Construction, Inc. The first contract working day was March 10, 2010, with field work commencing in September 2010. The probable cost of risks of this contract decreased by 7 percent this quarter, due a revised quantification of delay costs. One risk was added, one risk increased, and one replaced by a CCO allowance.

8.2 Risk Management Activities

Revised Quantification of Delay Costs

A schedule risk assessment is conducted quarterly, resulting in the expected number of delay days on the project, for which the contractor will be compensated at a daily rate. A detailed estimate of the rate was performed this quarter, based on the bid results, and a lower daily rate was computed. The use of the new rate resulted in a net reduction in the delay risk cost.

Perceived Ambiguity between Contract Specifications and Plans May Affect Staging

The YBITS 1 contractor submitted a preliminary schedule indicating a plan to complete westbound Frame 2 prior to availability of the required area at W2. The contractor assumed that this would be possible due to perceived ambiguity between the plans and specifications. The contractor indicated a plan to reuse WB frame 2 falsework for the eastbound, which may not be possible if Frame 2 cannot be completed as the contractor has assumed.

The Department is in discussions with the YBITS 1 and SAS contractors to determine if early access to the area can be allowed. However, the schedules for both contracts are still too fluid to make a determination. Additionally, the design team is investigating possible options to facilitate partial stressing of the frame and falsework release. If the area cannot be made available to the YBITS 1 contractor and redesign is not possible, a CCO may be required to purchase a second set of falsework for eastbound Frame 2. A risk allowance for the potential costs was added.

Potential Changes to The Expansion Joints Design

The in-house design for the SAS joints may be revised or replaced by commercial, proprietary joints. Four of the 6 YBITS 1 joints may need to be changed to the type selected. The joints are complex, long lead-time items, and their design requires consensus among many parties. Changes would require a CCO, and the risk has increased this quarter to reflect cost estimates for the commercial joints.

Future CCOs

The allowance for addenda items not incorporated before award was replaced with a CCO allowance for upcoming CCOs.
8.3 **Risk Management Cost**

The chart below shows the probability distribution of RMC. This information is provided to the Project Manager and Program Manager for their consideration in budget analysis and quarterly forecasting.

The current quarter RMC probability distribution is the aggregate of risks, NOPCs and future CCOs as of March 31, 2010. The remaining contingency on this contract is $29.0 million.

The following table shows three RMC values from the current curve, each with its associated probability of being exceeded.

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<th>Probability of Greater Risk Management Cost</th>
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<td>Probability</td>
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<td>Risk Management Cost</td>
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</table>

**RMC Trend**

The chart shows the total of Bid Items, State Furnished Materials, remaining Supplemental Work and CCOs from the 1st quarter 2007 to date. The range of Capital Outlay risks is on top (in red). The width of the range embraces over 99 percent of the possible outcomes. The budget line is the approved TBPOC budget for the quarter.
The chart is for all YBI contracts combined because the TBPOC has not established a budget for each contract.

### 8.4 LOOK AHEAD

**Hinge “K” Availability**

Delays to the YBITS 1 contract may occur if the SAS contractor is not ready to vacate the Hinge “K” area by the required time. Based on the status of the YBID and SAS contracts, the YBITS 1 contract duration was extended to coordinate with the current SAS contract dates. However, the YBITS 1 contract may be impacted if additional delays are encountered on the SAS contract. The risk management team recommends a meeting with the YBITS 1 and the SAS contractors to discuss possible solutions.

**Issue Early Contract Change Orders**

Early issue of the planned CCOs will mitigate potential delays to submittals and construction.
9 YBI TRANSITION STRUCTURES #2 CONTRACT

9.1 STATUS

This contract is in design with completion of Plans, Specifications and Estimate (PS&E) expected in March 2011. The probable cost of risk decreased by 5 percent this quarter due to the selection of a design solution to resolve a structural conflict.

9.2 RISK MANAGEMENT ACTIVITIES

DESIGN RESOLUTION – WTI PHASE 3 AND THE EASTBOUND OFF-RAMP

Providing a safe routing of the final eastbound off-ramp requires a modification to the WTI Phase 3 south side structural design. Two solutions were under consideration: (1) design a structure fix, or, (2) get a design exception for a non-standard off-ramp alignment. The structure fix solution was selected and the proposed design has been reviewed and approved by the Seismic Safety Peer Review Panel with minor comments, resulting in a decrease in the risk cost estimate this quarter.

The structure fix involves a complex design solution that may necessitate further design adjustments, thus a mock-up by YBITS 1 contract is planned. Additional lane closures during construction may impact traffic more than previously planned. Additional costs (and possibly time) will be needed to retrofit the WTI structure and construct the off-ramp. Staging coordination with the City of San Francisco Ramps project is under way.

SLIGHT INCREASE IN THE RISK THAT DESIGN MAY NOT BE COMPLETE AT RTL DATE

The current Ready to List (RTL) date is in early 2011. The probability of the risk that the design may not be complete by the RTL date has increased from “very low” to “low” this quarter, due to the work required on the WTI Phase 3 structural fix. The RTL date may be changed in the future to match the SAS project status.

COORDINATION WITH CITY OF SAN FRANCISCO RAMPS PROJECT

The YBITS 2 contract may be combined with the City of San Francisco Ramps project (SFR). Coordination of staging plans and schedule is underway. A combined risk management effort by SFR and YBITS 2 staff began this quarter to bolster risk mitigation planning. The SFR risk management results will remain separate from this report, as the project is funded by the City of San Francisco.

9.3 RISK MANAGEMENT COST

The chart below shows the probability distribution of RMC. This information is provided to the Project Manager and Program Manager for their consideration in budget analysis and quarterly forecasting.
The current quarter RMC probability distribution is the aggregate of risks, NOPCs and future CCOs as of March 31, 2010. The remaining contingency on this contract is $7.0 million.

The following table shows three RMC values from the current curve, each with its associated probability of being exceeded.

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<th>Probability of Greater Risk Management Cost</th>
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<td>Risk Management Cost</td>
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**RMC TREND**

The TBPOC has not established a budget for each YBI contract. The chart for all YBI contracts combined is on page 29.

**9.4 LOOK AHEAD**

**DEVELOPMENT OF INTEGRATED SHOP DRAWINGS (ISDs) DURING DESIGN**

A decision was made to develop ISDs for the project during the design phase to solve electrical-mechanical-structural conflicts and then revise the contract plans accordingly. Work on ISDs is planned to begin in the next quarter.

**PROPOSED SCHEDULE EVALUATION**

The YBITS 2 contract first order of work is to demolish the Yerba Buena Island Detour starting after eastbound opening. Thus contract award is planned to coincide with the westbound opening, about 6 months before eastbound opening. The current advertise and award schedule should be adjusted in the future to match the progress of the SAS and YBITS 1 contracts.
10 PROGRAM-LEVEL RISKS

The Program Risk Register contains risks that are not specific to a particular contract and risks that may affect several contracts. The 50% probable RMC of program-level risks increased by about $14 million quarter because the 2-3 month slippage caused by the East End fabrication schedule resulted in an increase to the escalation of unawarded contracts.

The delay cost risks in the SAS and YBITS 1 risk registers are calculated on the assumption that the SAS contract will be recovered by about 9 months. Accordingly, the program-level risk register captures the potential extra costs of delay if the 9-month recovery is not realized. This risk impacts the SAS and YBITS 1 contracts, as well as the Capital Outlay Support, and adds escalation to the unawarded contracts.

The delay cost risks in the contract risk registers may be considered a reserve to offset the direct costs of mitigating schedule delay risks. In the program-level risk register, the risk of extra delay costs if the SAS schedule is not recovered may be viewed as a reserve against the direct costs of schedule recovery.

10.1 RISK MANAGEMENT COST

The chart below shows the probability distribution of Program-Level RMC as of March 31, 2010.

The following table shows three RMC values from the current curve, each with its associated probability of being exceeded.

<table>
<thead>
<tr>
<th>Probability of Greater Risk Management Cost</th>
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<td>Probability</td>
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<td>Risk Management Cost</td>
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The Program Risk Register does not include: Light Pipe, BASE system, and residual risk to the Department for including the YBI ramp for the City of San Francisco.
11 **ANTIOCH BRIDGE RETROFIT CONTRACT**

11.1 **STATUS**

This project was added to the Toll Bridge Program on 1st January 2010 under AB1175. Bids were opened on this contract on March 3, 2010 and contract award is expected shortly. The Risk Management Team has quantified risks of the Antioch project since it was at 35% design completion over 2 years ago. Sixteen risks totaling $17 million in probable cost were retired this quarter when the project transitioned from Design to Construction.

11.2 **RISK MANAGEMENT ACTIVITIES**

**BATA PROTOTYPE BEARING DEVELOPMENT PROJECT**

The seismic retrofit strategy requires the use of friction pendulum isolation (FPI) bearings. There was only one bearing manufacturer prequalified by Caltrans to supply FPI bearings. Due to the size and specific bearing properties, such as friction, there were risks that the bearing testing would require lead times that could vary and delay the project. Early risk management meetings identified this risk as one of the three primary risks that this project needed to address. It was decided that the bearing procurement would be carried out in two phases, prototype bearing development and production bearing procurement, to mitigate delay risk.

The design team completed plans and special provisions for the prototype bearings and testing during the first few months of 2009. Prototype design, manufacturing and testing was expected to take 9 to 12 months. It was the team’s desire to have the bearing types approved and ready for production at or shortly after award of the construction contracts in April, 2010.

On April 8, 2009 an agreement was executed between BATA and Earthquake Protection Systems (EPS) to design, manufacture, and test FPI prototype bearings. Bearing testing was to be carried out at EPS facilities and quality assurance tests would be conducted at the University of California, San Diego.

The general contractor will no longer be responsible for the prototype bearings and risks associated with the prototype program have been reduced by eliminating the prototype program from the construction contract. In doing so, the project team significantly reduced potential delay.
risk during construction and reduced overall construction time to seismically retrofit these structures.

**Isolation Opportunity: Keeping out of the water**

The initial retrofit strategy for the project had envisioned significant marine work associated with the installation of large diameter piles around the deep water foundations. Early risk management meetings identified this risk as one of the three primary risks that this project faced and it was agreed that the team would invest significant resources in trying to limit the amount of marine work that would be necessary to retrofit the bridge.

This approach would not only decrease the initial capital cost of the work but would also significantly reduce future risks that are prevalent with marine foundation work. The project design team worked diligently with state of the art isolation bearing systems to develop a retrofit strategy that avoided the need for deep water retrofits of the bridge's foundations. The Seismic Peer Review Committee agreed with the revised retrofit strategy which immediately resulted in a 25% reduction in estimated project costs.

**Vanguard Focus Teams Addressed Environmental Risks**

Early risk management meetings identified environmental delay risk as one of the three primary risks that this project faces. The project team immediately put several teams in place to make sure that all environmental permit issues were addressed in a timely manner, so as not to delay the bridge's retrofit. Permitting agencies were engaged early in the design process and the priority given to the project by Caltrans management ensured that the various agencies remained engaged throughout the process. The project team managed to PS&E the project on schedule and thus significant risk costs were retired with the on-time delivery.

11.3 **Risk Management Cost**

The chart below shows the probability distribution of RMC. This information is provided to the Project Manager and Program Manager for their consideration in budget analysis and quarterly forecasting.

The current quarter RMC probability distribution is the aggregate of risks, NOPCs and future CCOs as of March 31, 2010. The remaining contingency on this contract is $110.8 million.
The following table shows three RMC values from the current curve, each with its associated probability of being exceeded.

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<thead>
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<th>Probability of Greater Risk Management Cost</th>
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<td>Risk Management Cost</td>
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11.4 **LOOK AHEAD**

**CRITICAL WORK IN ENVIRONMENTAL WORK WINDOW**

The Department will work closely with the Contractor and the permitting agencies to try to get all site access in-place prior to the close of the environmental work window. This will help to achieve seismic safety at the earliest possible date.

**SUCCESSFULLY COMPLETE PROCUREMENT OF ISOLATION BEARINGS**

The Antioch Retrofit has 82 bearings to be installed. Production bearings delivery to the general contractor will need to be scheduled and delivered as planned to avoid delay claims. The PS&E contract documents sole-sourced the production bearings through the general contractor. QC testing on the production bearings will be conducted at EPS and 10% of the bearings will be QA tested at UCSD. The project will work closely with EPS and the Contractor to ensure that the sole-source agreement delivers seismic safety at the earliest possible date.
12  DUMBARTON BRIDGE CONTRACT

12.1  STATUS

This project was added to the Toll Bridge Program on 1st January 2010 under AB1175. Bids are scheduled to be opened on May 27, 2010 and contract award is expected shortly thereafter. The Risk Management Team has quantified risks of the Dumbarton Bridge Retrofit project since it was at 35% design completion over 2 years ago. Thirteen risks totaling $15 million in probable cost were retired this quarter with the pending transition of the project from Design to Construction.

12.2  RISK MANAGEMENT ACTIVITIES

**ISOLATION OPPORTUNITY: KEEPING OUT OF THE WATER**

The initial retrofit strategy for the project had envisioned significant marine work associated with the installation of large diameter piles around the deep water foundations. Early risk management meetings identified this risk as one of the three primary risks that this project faced and it was agreed that the team would invest significant resources in trying to limit the amount of marine work that would be necessary to retrofit the bridge.

This approach would not only decrease the initial capital cost of the work but would also significantly reduce future risks that are prevalent with marine foundation work. The project design team worked diligently with state of the art isolation bearing systems to develop a retrofit strategy that avoided the need for deep water retrofits of the bridge’s foundations. The Seismic Peer Review Committee agreed with the revised retrofit strategy which immediately resulted in a 35% reduction in estimated project costs.

**BATA PROTOTYPE BEARING DEVELOPMENT PROJECT**

The seismic retrofit strategy requires the use of friction pendulum isolation (FPI) bearings. There was only one bearing manufacturer prequalified by Caltrans to supply FPI bearings. Due to the size and specific bearing properties, such as friction, there were risks that the bearing testing would require lead times that could vary and delay the project. Early risk management meetings identified this risk as one of the three primary risks that this project needed to address. It was decided that the bearing procurement would be carried out in two phases, prototype bearing development and production bearing procurement.

The design team completed plans and special provisions for the prototype bearings and testing during the first few months of 2009. Prototype design, manufacturing and testing was expected to take 9 to 12 months. It was the team’s desire to have the bearing types approved and ready for
production at or shortly after award of the construction contracts in April, 2010. On April 8th, 2009 an agreement was executed between BATA and Earthquake Protection Systems (EPS) to design, manufacture, and test FPI prototype bearings. Bearing testing was to be carried out at EPS facilities and quality assurance tests would be conducted at the University of California, San Diego.

The general contractor will no longer be responsible for the prototype bearings and risks associated with the prototype program have been reduced by eliminating the prototype program from the construction contract. In doing so, the project team significantly reduced potential delay risk during construction and reduced overall construction time to seismically retrofit these structures.

**FOCUS TEAMS ADDRESSED ENVIRONMENTAL RISKS**

Early risk management meetings identified Environmental delay risk as one of the three primary risks that this project faced. The project team immediately put several teams in place to make sure that all environmental permit issues were addressed in a timely manner, so as not to delay the bridge’s retrofit.

Permitting agencies were engaged early in the design process and the priority given to the project by Caltrans management insured that the different agencies remained engaged throughout the process. The project team managed to PS&E the project on schedule and thus significant risk costs were retired.

**12.3 RISK MANAGEMENT COST**

The chart below shows the probability distribution of RMC. This information is provided to the Project Manager and Program Manager for their consideration in budget analysis and quarterly forecasting.

The current quarter RMC probability distribution is the aggregate of risks, NOPCs and future CCOs as of March 31, 2010. The remaining contingency on this contract is $113.7 million.
The following table shows three RMC values from the current curve, each with its associated probability of being exceeded.

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12.4 LOOK AHEAD

FURTHER ISOLATION OPPORTUNITY

Based upon the revised bearing size, and preliminary test results on the UCSD test model, the structural team is reporting that some retrofit measures may not be necessary. A consultant of has been engaged to perform state-of-the-art seismic analysis to evaluate the retrofit measure that may be eliminated, including:

- Prestressing Cast-in-place Concrete ($0.9M)
- Str. Concrete Bent Cap ($40.5M)
- Str. Concrete Column, Drill & Bond Dowel, Conc. Coring ($32M)

The project team is working diligently to enhance these opportunities to the greatest extent possible and reap the full benefit of the cost savings by deleting the work prior to contract bid opening. Once the work is deleted, the Engineers Estimate will be reduced substantially. The large opportunity in the risk register will be retired and there will be a commensurate increase in the probable cost of risk.
13 CAPITAL OUTLAY SUPPORT

The Capital Outlay Support cost includes support cost risks that affect all contracts and risks from contracts that have an impact on COS. The COS risks are measured from the current approved COS budget. Any COS cost risk in excess of the current approved COS budget would be a draw on the Program Contingency.

Figure 10 shows the current COS cost differential probability distribution, with the previous quarter result in blue.

![COS Risk Graph]

**FIGURE 10 – CAPITAL OUTLAY SUPPORT RISK**

The 50% probable COS cost risk increased by about $6 million mainly due to the slippage in the East End fabrication schedule. The TBPOC is expected to approve a $204 million increase in the COS budget next quarter. The increase will allow about an equal amount of COS risk to be retired because they have occurred and no longer need to be carried in the COS register.

13.1 COS RISK TREND

Figure 11 shows the COS risk from the 1st quarter 2007 to date. The range of COS risks is on top. The width of the range is such that it embraces over 99 percent of the possible outcomes.
FIGURE 11 – COS RISK TREND
Appendix "A"  

**RISK MANAGEMENT EXPLANATIONS**

**A.1 WHAT RISK MANAGEMENT DOES AND DOES NOT INCLUDE**

Risk management of a project addresses risks that may affect its defined objectives of cost, time, scope and quality. Given a project plan, risk management generally looks at ways in which the project may not go according to plan. Risk management focuses on the defined project scope and objectives, and therefore does not include:

1. Risks or possible decisions that may kill the project. If the project ceases to exist, there are no risks to manage.

   For example, risk management does not include risks such as the loss of funding, natural disaster that destroys all or part of the construction, acts of governments, etc.

2. Risks or possible decisions that may materially change the project. If the project objectives are changed substantially, risk management will start afresh on the “new” project.

   For example, the YBID Implementation Strategy Memorandum materially changed the YBI Detour contract. The risk of such a decision was not in the risk register of the original contract.

In a nutshell, risk management is confined to quantifying risks that are intended to be covered by project and program contingency.

**A.2 ABOUT “RISK” AND “OPPORTUNITY”**

The concept of risk can include both upside as well as downside impacts. This means that the word “risk” can be used to describe uncertainties that, if they occurred, would have a negative or harmful effect, and the same word can also describe uncertainties that, if they occurred, would be helpful. In short, there are two sides to risk: threats and opportunities.

A risk that has no threat is a “pure opportunity”. It is simply an unplanned good thing that might happen. For example, a new design method might be released which we can apply to benefit our project.

Opportunity is the inverse of threat if a risk has both threat and opportunity. Where a risk variable exists on a continuous scale and there is uncertainty over the eventual outcome, instead of just defining the risk as the downside it might also be possible to consider upside potential. For example, if we have included escalation at 5% in our budget for future contracts and this rate could range from say 3% to 7% depending on economic conditions at the time of advertisement, we have an opportunity in the 3%-5% range and a threat in the 5%-7% range. Opportunity and threat exist in the one risk. If the budget were based on 7% escalation we would have only opportunity. If based on 3% we would have only threat.

Threat and opportunity can also depend on how we define the risk. For example, if the risk is that an external agency may relax its requirements and this saves us money relative to what we have budgeted currently in our plan, this is an opportunity. If the risk is defined as the agency may tighten its requirements and this adds to our costs, this is a threat. We can only separate the
opportunity and threat if we are certain that the agency may act only one way and not the other. If the risk is that the agency may change its requirements, we could have impacts that range from positive to negative. We would have both opportunity and threat in the same risk, and the degree of each would depend on what we have budgeted in our plan.

Uncertainty in the cost of major CCOs is another example of opportunity. If we enter an estimate into the CCO log and the final outcome could range from less than the estimate to more than the estimate, we have both an opportunity and a threat. The degree of opportunity and threat depends on where the estimate lies within the range.

**Projects in Design**

Projects in design have the greatest potential for opportunities because the project is still open to changes. Risk reduction and avoidance are opportunities, as are value analysis, constructability reviews and innovations in design, construction methods and materials.

**Projects in Construction**

Once a project enters construction, the project objectives (scope, time and cost) are fixed contractually. Any changes are made using a contract change order (CCO). The only opportunity to save money or time is from a negative CCO such as resulting from a Cost Reduction Incentive Proposal (CRIP) by a contractor. Otherwise, CCOs add cost and/or time to the project. So, the prime opportunity during construction is to reduce or eliminate risks.

**A.3 Interpreting Risk Curves**

Combining all risks of a contract using Monte Carlo simulation methods produces a risk cost curve such as in Figure 12. It is the familiar "bell curve" shape that covers all possible combinations of the risks, and can be thought of as a "smoothed out" version of a histogram that depicts the relative frequencies of small output cost ranges. It extends from zero cost at one end (none of the risks occur) to a very large cost number at the other end (all risks occur). The area under the density curve equals one, that is, it covers 100% of the possible outcomes.
FIGURE 12 – PROBABILITY DENSITY CURVE

The probability density curve is not very convenient for determining the probability of a cost exceeding a specific value. For example, the probability of exceeding $120M in Figure 12 is determined by calculating the area under the curve to the right of $120M. Instead of performing such calculations from the probability density curve, it is transformed into the probability curve in Figure 13 by performing the area-under-the-curve calculations for all costs on the horizontal axis.

FIGURE 13 – CUMULATIVE DESCENDING PROBABILITY CURVE

The curve in Figure 13 can be used to directly read off the probability of exceeding any value of cost. For example, there is a 15% chance of exceeding $120M. Note that although the curve appears to reach a zero probability of overrun at about $150M, there is still less than a 1% chance of some cost greater than $150M. None of the probabilities above $150M are zero; they are just very small, much less than 1%.

Note that the curve does not include risks or possible decisions that may kill or materially change the project.

WHAT DO WE MEAN BY “Range”?

In our reports, we often refer to a “range” of risk management cost or draw on Program Contingency. Although the risk curve extends to very small values of probability, for practical purposes, we define “range” to cover about 99% of all possible outcomes. In other words, the “range” extends from where the risk curve appears to reach 100% probability to where it appears to reach 0% probability. For example, the “range” of risk cost in Figure 13 is from about $50M to $150M.
A.4 **How Risks are Inserted into the Corridor Schedule**

The Corridor Schedule Team developed an intermediate level schedule for the Corridor to be used in evaluating schedule risk and recovery opportunities. This Corridor Schedule is a summarization of the contract schedules submitted by the various contractors and schedules developed by the Department for the contracts in design.

The Corridor Schedule Team has inserted into the schedule “risk” activities representative of the risks identified in each of the quarterly contract risk meetings. A single risk from the risk register can occur in several places in the schedule and therefore “risk” activities are created and evaluated for each occurrence.

To describe the process, consider the three sequential activities in Figure 14, adapted from a section of the Corridor Schedule. The data is fictitious, for illustrative purposes only.

<table>
<thead>
<tr>
<th>ID</th>
<th>Description</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Erect Cable System Temporary Works</td>
<td>120</td>
</tr>
<tr>
<td>2</td>
<td>Install Cable System</td>
<td>157</td>
</tr>
<tr>
<td>3</td>
<td>Transfer load to cable</td>
<td>36</td>
</tr>
</tbody>
</table>

**FIGURE 14 THREE ACTIVITIES FROM CORRIDOR SCHEDULE**

Each activity has a scheduled duration, but the duration may not be certain. A range of uncertainty is estimated for each activity, expressed as a minimum, most likely and maximum duration in the rightmost columns of Figure 15. The duration uncertainty distribution is represented by the blue triangle.

<table>
<thead>
<tr>
<th>ID</th>
<th>Description</th>
<th>Duration</th>
<th>Min</th>
<th>Ml</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Erect Cable System Temporary Works</td>
<td>120</td>
<td>100</td>
<td>120</td>
<td>150</td>
</tr>
<tr>
<td>2</td>
<td>Install Cable System</td>
<td>157</td>
<td>140</td>
<td>157</td>
<td>196</td>
</tr>
<tr>
<td>3</td>
<td>Transfer load to cable</td>
<td>36</td>
<td>36</td>
<td>45</td>
<td>75</td>
</tr>
</tbody>
</table>

**FIGURE 15 UNCERTAINTIES IN SCHEDULED DURATIONS**

If an activity has a risk associated with it in the risk register, the risk is inserted after the activity in the form of a “risk activity”.

The example schedule in Figure 16 has the risk activities inserted.
The risk activities (the red rows) appear as zero-duration activities so as not to change the schedule dates. Each risk activity has a probability of the risk occurring (“Prob %”) and a duration range defined by the values in the minimum (“Min”), most likely (“ML”) and maximum (“Max”) columns.

Since schedule risks can be concurrent and are not necessarily additive, the schedule is analyzed using Monte Carlo simulation to develop probabilistic schedule results. Each Monte Carlo iteration creates a version of the schedule by selecting at random which risk activities are included, and, for the included risk activities, a duration drawn at random for their respective duration ranges. For 1000 Monte Carlo iterations, analyzing the 1000 schedules produces the probability distributions of path durations through the schedule, probability distributions for key milestones, and the probability of an activity or risk activity being on a critical path (its “criticality”).

The probable critical paths are determined by tracing backward through the schedule. Starting from a finish milestone, the first activity on the path is the milestone’s predecessor having the highest criticality. The next activity is the highest-criticality predecessor of the first activity, and so on to the beginning of the schedule. There may be a juncture where there are two predecessors of approximately equal criticality. At this point the probable critical path splits into two, and each of these is traced back to the beginning. This is how primary, secondary and tertiary probable critical paths are determined.