

Memorandum

To: CHAIR AND COMMISSIONERS

CTC Meeting: May 7, 2013

Reference No.: 3.7
Information



From: ANDRE BOUTROS
Executive Director

Subject: **San Francisco Bay Area Toll Bridge Seismic Retrofit 2013 First Quarter Project Progress and Financial Update**

Summary: Since the last Quarterly Report update, the following San Francisco Oakland Bay Bridge (SFOBB) Seismic Retrofit project construction and Toll Bridge Program Oversight Committee (TBPOC) activities occurred:

SFOBB East Span

Self Anchored Suspension (SAS) contract –

- On March 1, 2013, the contractor began stressing the anchor rods at the base of shear key S-1 and S-2 at the top of the E-2 pier. Shear keys are seismic elements designed to provide lateral restraint during an earthquake event. On the SAS, the lateral restraint is provided by a combination of four isolation bearings and four shear keys. This system is fastened to the top of the E-2 pier by 3 inch diameter anchor rods, for a total of 288 anchor rods. The first 98 anchor rods were manufactured in 2008 and the remaining 192 anchor rods were manufactured in 2010.
- Between March 8 and March 15, thirty two of the ninety eight 2008 anchor rods fractured. The contractor immediately de-tensioned the remaining 2008 rods and began working with the department on a parallel path of forensic analysis to determine why the 2008 rods failed and on an alternative attachment system for the two shear keys where the rods failed. The 2008 rods are permanently imbedded in the E-2 pier and cannot be removed and replaced.
- Forensic analysis indicates hydrogen entered the steel rods and caused what is known as hydrogen embrittlement. Hydrogen embrittlement is caused by hydrogen in combination with stress, either externally applied or internal residual stress. Hydrogen embrittlement can have two causes Internal Hydrogen Embrittlement (IHE) where residual hydrogen remains in the steel after processing (including pickling and electroplating) and Environmental Hydrogen Embrittlement (EHE) where hydrogen from an external source, e.g. hydrogen rich environment (standing water) is absorbed into the steel through Stress Corrosion Cracking (SCC) or through Cathodic Hydrogen Absorption (CHA). Either IHE or EHE alone or both in combination with each other can cause hydrogen embrittlement failure. We don't know if the hydrogen was introduced during rod fabrication (IHE) or after installation (EHE) or if it was externally applied stress (tensioning of the rods) or internal residual stress that caused the failure, but we do know it was hydrogen in the steel that caused the failure. More analysis is being done to determine the actual failure path.
- As stated above, the contractor, the department and the bridge design team is working on alternative attachment system design solutions for shear keys S-1 and S-2. As of April 17, 2013, the design alternatives have been narrowed down from about four or five to two. A steel collar

where a metal frame grillage would be added around the shear key base to hold it down that is at about a 45% design stage and a pre stressed collar made from post tensioning (PT) strands and concrete that is at about a 30% design stage. Once the designs are at about 65% design the TBPOC will decide which alternative will go to 100% design, fabrication and installation. The decision should be made before or in time for the May 7 CTC meeting.

- The 2010 rods are not imbedded in the E-2 pier and can be replaced if necessary. The TBPOC decided to test the 2010 rods in-site. All 192 rods were fully stressed and ten rods have been instrumented. The instrumented rods will be removed and will undergo destructive testing to determine their mechanical and physical properties. Two rods were removed for early destructive testing on April 20, 2013, an additional two rods will be removed for early destructive testing and the other six rods will be removed and tested after 30 days of stress. So far none of the 2010 rods have failed. After the destructive testing is completed the TBPOC will determine if the 2010 rods will remain in place or will be replaced.
- The TBPOC is fully engaged and in addition decided that all findings and decisions relative to the pier E-2 rods will be publically communicated at the Bay Area Toll Authority (BATA) regularly scheduled oversight committee and full board meetings and of course CTC meetings as they occur.

Background: In July 2005, Assembly Bill 144, (AB144) Hancock created the Toll Bridge Program Oversight Committee (TBPOC) to exercise project oversight and control over the Toll Bridge Seismic Retrofit Program. The TBPOC is comprised of the Director of the Department of Transportation (Caltrans), the Executive Director of the Bay Area Toll Authority (BATA), and the Executive Director of the California Transportation Commission (CTC). The TBPOC's program oversight and control activities include, review and approval of contract bid documents, contract change orders and resolution of major project issues.