

**Before the Joint Committee on Transportation
183rd General Court
Commonwealth of Massachusetts**

For Release on Delivery
Expected at
10:30 a.m. EST
Thursday
December 2, 2004
CC-2005-005

Water Leaks Within the I-93 Tunnels of the Central Artery Project

**Statement of
Debra S. Ritt
Assistant Inspector General for Surface
and Maritime Programs
U.S. Department of Transportation**



Mr. Chairmen and Members of the Committee:

We appreciate the opportunity to testify today on water leaks in the I-93 section of the Central Artery Tunnel Project (Project). The Central Artery is the most expensive highway construction project in United States history, and one that is important to Massachusetts and all of New England.

Our office has a continuing role in reviewing the use of Federal funds on this Project. As Congress directed in 2001, the Secretary of Transportation must withhold obligations of Federal funds and all Project approvals until we determine that the annual Finance Plan update for the Central Artery reflects the total revenue requirements and financial resources needed to complete the Project.

It is well known that the Project has had a troubled history of significant schedule delays and cost increases. The Central Artery was originally estimated to be completed by December 1998—7 years earlier than the current estimate of September 2005. Costs have also steadily escalated from \$2.6 billion to \$14.625 billion, causing Congress to cap the Federal investment in the Project at \$8.549 billion. As of September 2004, all but \$81 million of Federal monies have been obligated.

In a previous audit, we reported that Project managers made misrepresentations by not fully disclosing \$1.4 billion of cost increases in the 1998 and 1999 Finance Plans.¹ The Securities and Exchange Commission found that the Massachusetts Turnpike Authority (Authority) and its former Chairman violated the Securities Act of 1933 on three municipal bond offerings. After making changes in its management, the Authority has been responsive to our recommendations on full cost and schedule disclosure in the annual Finance Plan updates and we have reported this to Secretary Mineta and the Congress.

As the Project is entering the final construction stages, the Authority has reported that 700 tunnel leaks remain in the Project's current inventory and that the earlier number of leaks it identified and tracked was considerably more. Authority officials have said some of the leaks are a normal part of the construction process, while others are construction deficiencies. It is already clear that the September 15th leak was not a normal occurrence.

There is much about this problem that we do not yet know, including how many leaks there are and their severity; how much it will cost to fix the leaks; and, how you can be assured that the responsible parties, not the taxpayers, are made to bear

¹ Report Number TR-2000-088, "Central Artery / Ted Williams Tunnel Project Highlights Need for Effective Federal Oversight," U.S. Department of Transportation, Office of Inspector General, June 7, 2000. OIG reports can be accessed on our website: www.oig.dot.gov.

the repair costs. Additionally, the problems surrounding the leaks involve multiple parties—the Authority itself, its project oversight manager (Bechtel/Parsons), and the construction contractors, each of whom have vested interests that will be affected by determining responsibility and, accordingly, their financial liability.

The imperative is how to identify the nature and extent of the leak problems, how and why they occurred, implementing an appropriate and lasting solution, and doing so in a manner that the responsible parties (not the taxpayers) bear the burden. In our opinion, the Authority itself, along with its internal and external experts, has the technical capacity to identify the extent of the leaks and take corrective action to make the appropriate repairs. But, we also believe that taxpayers and people who use the Artery must have confidence, from an independent party, that the Authority has taken these actions with all due diligence.

As for the questions of determining which entities may have responsibility, the costs they will assume, and ensuring that taxpayer interests are protected, we have reservations on how this can be done through existing arrangements and given the interests of the parties involved. For example, we do not yet know the extent to which errors or omissions in the design, construction, quality assurance, or oversight may have contributed to the leaks. Determining this responsibility has implications for the liabilities of the parties involved.

The Authority itself may ultimately bear some responsibility. Its oversight consultant, which handled certain design elements and quality assurance functions, cannot reasonably be considered completely objective. Then there are the contractors involved in all project phases. Finally, the cost recovery team is also associated with the Authority and has stated that it has had difficulty in obtaining relevant documentation and, perhaps as a result, its cost recoveries to date have been somewhat disappointing.

Therefore, as the Committee deliberates on how best to address this set of issues, one option for consideration is the creation of a small, independent, bipartisan commission, of limited duration, to report back its findings no later than June 30, 2005. The commission would be charged with determining the responsible parties and ensuring that they bear the costs of the leaks and not the taxpayers. In addition, the commission could oversee or help to ensure that the authority's efforts to identify and appropriately fix the leaks proceed with due diligence. In carrying out its duties, the commission could coordinate its actions, as appropriate, with the Commonwealth's Attorney General.

We note that final completion of the project's I-93 tunnel segments is currently scheduled for September, 2005. Accordingly, we would also recommend that the Authority withhold final acceptance and not release funds held in retainage until these matters are resolved.

We also understand that the Administrator has directed FHWA to review the technical issues associated with the tunnels' design and construction and the resultant September wall panel breach as well as leaks where the roof girders connect to the panels. In addition, it will also perform a legal review of contract and financial documents to ensure taxpayers are adequately protected from any additional charges associated with identification and repair of the breach and leaks. We believe these steps will complement whatever proposals this Committee may choose to adopt.

The remainder of our testimony will focus on the information we know, based on our fact finding to date. Essentially, I will focus on four main questions:

- How many leaks have occurred and are they significant?
- Why are we just hearing about these problems?
- Who will pay to repair the leaks?
- What should the plan be for tackling this problem?

The Number and Significance of the I-93 Leaks

As early as 2000, the Authority, Bechtel/Parsons, and the Federal Highway Administration noted that leaks in the I-93 tunnels were occurring more frequently and at a higher rate than expected. We found that over the past 4 years, the Authority has cataloged a large number of leaks in the I-93 tunnels associated with the roof and wall interfaces and leaks in two of the slurry wall panels. Approximately 700 leaks were in the Project's current inventory as of last month. However, the Authority has not completed work to determine the likelihood of additional leaks or the recurrence of leaks that have been repaired.

The major leak reported on September 15th of this year involved a defective wall panel constructed by Modern Continental Construction Corporation (Modern Continental) that adjoins another wall panel constructed by Perini/Kiewit/Cashman (Perini). This leak occurred in the same wall panel where a leak had been reported in July 2001. Seven more defective wall panels have recently been found nearby.

The remaining known leaks are located where roof girders connect to wall panels. According to the Authority, these leaks may have been caused by ineffective

waterproofing or errors related to the design of the roof interface as well as the design of the panel walls. There are approximately 40,000 points in the I-93 tunnels that the Authority is inspecting to determine whether there are leaks of this nature.

Authority officials have said that many of the I-93 leaks are normal and that some leaks are to be expected when tunnels are constructed below the water table, as occurred on this Project. A 1996 article written by two Parsons Brinkerhoff employees working on the Project explained that leakage can occur at wall connections because the sides of the wall next to the soil cannot be waterproofed and imperfections in the concrete permit groundwater seepage.² We are not suggesting that the selection of the slurry wall method was a mistake. This method was selected, among other reasons, because it would allow vehicles to use the elevated highway while the tunnel construction proceeded directly below.

Because some water flow is expected, a tunnel owner will establish maximum permissible water flow criteria. The Project has established a permissible water flow criteria of 0.8 to 1 gallon per minute per 1,000 linear feet of tunnel³—a standard that is consistent with those of the San Francisco Bay Area Rapid Transit and Los Angeles County Metropolitan Transportation authorities. However, water flow can be expected to exceed this amount during construction as tunnels take in water through uncovered ramps, unfinished roofs, openings around beams that hold up the elevated highway, and unsealed utility conduits. According to the Authority, the most recent flow measured in the tunnels was 7 gallons per minute, which is below the maximum expected 16 gallons per minute (calculated using the Project's criteria for the entire tunnel) and considerably less than the 300 gallons per minute that was experienced in the September leak.

We believe the Authority's optimistic statements about the significance of the leaks may be premature because much is still unknown. In explaining the nature and severity of the leaks in the I-93 tunnels, we will discuss each type of leak in turn—those related to the wall panel and those that affect the roof.

Defects in the Wall Panel and Lack of Oversight Were Apparent Causes of the September Leak

On September 15, 2004, a leak breached the east wall of the I-93 northbound tunnel just south of Congress Street and about 70 feet below the surface of Atlantic Avenue. According to U.S. Department of Transportation leakage

² Should Slurry Walls Be Part of the Final Structure?, PB Network, Brian Brenner and Valery Gelfer, Fall 1996, Issue No. 36, Volume X, Number 3.

³ There are 16,000 linear feet of tunnel. As a result, the permissible water flow is 16 gallons per minute.

criteria, a severe leak has an active flow of 30 or more drips per minute. The September leak had a water flow of roughly 300 gallons per minute.

The breached wall is made of concrete panels that were built using the slurry wall trench excavation technique. As the trench was excavated, it was filled with a special clay mix, called slurry, to support the earth around the trench. Deep structural steel piles were placed vertically in the trench, 4 to 6 feet apart. Once the excavation was complete, concrete was pumped into the trench from the bottom up with flexible pipes called “tremies” and the slurry was gradually displaced.

Two experts retained by the Authority—Mueser Rutledge Consulting Engineers (Mueser Rutledge) and Lemley & Associates (Lemley)—are reviewing the leaks in the I-93 tunnels. In a November 3, 2004, report, Mueser Rutledge concluded that the breach was caused by a series of construction deficiencies documented during the fabrication of the panel that leaked. According to Mueser Rutledge, the investigation for more defective panels is still on-going and a list of all suspect panels is expected by next month. According to the Authority, Lemley has not issued any reports.

We found that Bechtel/Parsons reported that a leak in the same wall panel had occurred on July 20, 2001. Construction progress records from that period revealed that Modern Continental, according to Bechtel/Parsons and Mueser Rutledge, made a string of errors during the construction of the concrete panel where the leak occurred. Specifically, the Mueser Rutledge review of Bechtel/Parsons’ construction records found:

- Before excavation, the contractor failed to remove the temporary steel endplate placed at the adjoining concrete panel built by another contractor, as well as the residual concrete around the endplate.
- The trench was not properly cleaned of debris at the completion of the excavation for the panel, or debris fell into the panel just before or during placement of the concrete. The inclusion of debris diminished the structural integrity of the panel.
- Because of an obstruction, the contractor could not install a steel reinforcing cage that according to specifications had to span the length of the panel within the concrete. The contractor reduced the size of the cage rather than remove the obstruction.

- The obstruction prevented the contractor from using two tremie pipes to lay the concrete as required by the contract. Using only one pipe caused an uneven distribution of the concrete in the trench.
- The bottom of the cage shifted out of position during concrete placement.
- Finally, during the tunnel excavation, a leak and debris inclusion were discovered in the slurry wall, but workers patched the defect, rather than remove the inclusion and permanently repair it.

Whether the September breach is a one-of-a-kind event or a harbinger of systemic problems in the tunnel walls remains an open question. The engineering surveys of the tunnel walls by Mueser Rutledge and Lemley are ongoing, and results are due soon.

In addition, according to an engineer with a section designer, engineers found two slurry wall panels with inclusions (including the one that breached on September 15th). As of November 30, they had checked 22 more panels and found 7 with defects. Engineers will continue this process until they have inspected all 10,000 wall panels in all contract sections of the I-93 tunnels. Separately, Bechtel/Parsons is now conducting an investigation of the other concrete wall panels in the tunnel section where the leak occurred to determine whether they comply with contract specifications.

Systemic I-93 Roof Leaks Are Due to Unfinished Construction, Lack of Oversight, Waterproofing Deficiencies, or Possible Design Errors

As stated previously, the majority of the leaks have occurred where the roof girders connect to the slurry wall panels throughout the I-93 tunnels. According to the Authority, these leaks, if not corrected in a timely manner, could corrode steel beams and electrical wiring. Currently, the Authority is monitoring approximately 40,000 connection points in the tunnels where the roof girders interface with the tunnel walls. The Authority has also hired a third engineering consultant, Ben C. Gerwick, Inc., to concentrate specifically on the roof leaks.

We found evidence to suggest that the roof leaks may be associated with the selection and installation of waterproofing systems. Construction documents indicated that the Project was experiencing waterproofing problems in the latter part of the 1990s. In a positive step, the Project established a Waterproofing Task Force in March 1997 to address problems being experienced with several of the Project construction contracts.

In its July 31, 1997, report, the task force attributed 95 percent of the Project's waterproofing problems to unsatisfactory quality control practices of the construction contractors. The report did not, however, address the adequacy of quality assurance, which is the responsibility of Bechtel/Parsons. The task force also found that waterproofing systems had not been adequately prepared and installed, and reported that the Project would continue to have problems unless contractors changed their surface preparation and installation practices. Finally, the task force recommended eliminating future use of two waterproofing systems,⁴ which had already been installed on segments of the I-93 tunnels, but were not working.

In a December 2001 draft report⁵ on Project cost overruns, Project officials had determined the original design of the waterproofing above the roof girders in one section of the I-93 tunnels provided insufficient protection against leaks. To address this issue, the original design specifications were later amended to require the application of waterproofing spray over an area greater than originally specified and the installation of a protective board.

In 2000 the Project established a Leak Task Force composed of representatives from Bechtel/Parsons, FHWA, and the Authority to develop a response plan for the leaks in the I-93 tunnels. The task force identified leaks in seven segments of the tunnels. It found that the leaks seemed to be directly proportional to rainfall, suggesting that it was not the ground water that was penetrating the tunnels, but water originating in the area above the tunnel roof. Because construction of I-93 was not finished, the tunnels remained partially open to the weather, taking in water through uncovered ramps, unfinished roofs, openings around beams that held up the elevated highway, and unsealed utility conduits.

Why Are We Just Hearing About These Problems?

Although the leaks were known several years earlier, the catalyst for the current focus was the September 15th leak which, according to press accounts, created a 10-mile traffic back-up. The Authority is now bringing in experts to review the construction of the wall panels and examine the roof-wall interfaces. However, we found that problems with the breached wall panel had been noted several years earlier by Bechtel/Parsons. For example:

- Multiple deficiencies were noted in Modern Continental's excavation of the trench and construction of the slurry wall by Bechtel/Parsons during its

⁴ The Bentonite and Cold-Applied Polyurethane waterproofing systems—two of five waterproofing systems used on the Project.

⁵ Central Artery/Tunnel Project Review and Assessment of C15A2 Global Contract Modification, Deloitte & Touche, December 2001.

quality assurance reviews. However, Mueser Rutledge did not find any documentation that showed Bechtel/Parsons addressed these deficiencies, for example, ensuring that Modern Continental rebuilt the wall according to specifications.

- As early as June 1998, construction records documented running water and seepage in both the Modern Continental segment and an adjoining wall of the I-93 tunnels constructed by Perini. However, Modern Continental patched the leaks and continued construction without evaluating the full extent of the problem.
- In December 2001, Modern Continental sent a report to Bechtel/Parsons advising that a leak in the same slurry wall panel had been discovered. Bechtel/Parsons responded to the contractor's report by instructing Modern Continental to undertake testing and to draft a plan to repair the leak. But the paper trail ends there—neither the Authority nor Bechtel/Parsons could provide documentation to indicate that testing was done, a repair plan was drafted, or that the repair was completed and approved.

As noted earlier, construction documents indicated that the Project was also experiencing waterproofing failures in the 1990s on other tunnels, and these issues continued as the I-93 tunnels were being constructed. The Waterproofing Task Force's July 1997 report identified a number of actions that were needed to prevent recurrences. However, it is not clear whether the task force's recommendations were implemented.

It is apparent that the Project had problems with waterproofing in the tunnel being constructed by Perini/Kiewit/Cashman up through 2002. According to a Bechtel/Parsons field engineer who oversaw contractors' work on several sections of the tunnel, when they succeeded in plugging wall leaks, proceeding from the bottom of the tunnel towards the roof, the water was pushed upward and out of the roof joints instead. They then attempted to waterproof the wall from the roof down, but a good seal where the wall and roof met could not be achieved. Grout was later injected into the leak areas. When that did not work, a sealant was placed on the surface, but the water leaks went around the seal. Another engineering firm suggested using a different compound. This compound was tried for a while, but leaks reappeared. Bechtel/Parsons also found that the corrosion protection on the steel beams was degrading from contact with water and had to be reapplied. Project workers took about 30 months, from December 1999 to the summer of 2002, to find a sealant that appeared to plug the leaks.

FHWA has been involved in the I-93 tunnel leaks and waterproofing issues since the mid-1990s. For example, in May 1997, it presented an "inspection-in-depth"

report on the waterproofing activities of the Perini/Kewit/Cashman contract. The purpose of FHWA's report was to evaluate the contractor's waterproofing submittals, contract drawing details, and the waterproofing systems already in place. In addition, FHWA participated in both the Waterproofing and Leak Task Forces, and assisted the Authority in its analysis of the September 15th leak.

Steps Must Be Taken to Protect Taxpayers

Sufficient steps must be taken to prevent the taxpayers from being saddled with the cost of the leaks. Bechtel/Parsons has said that many leak repairs were anticipated and pose no threat to the Project's budget. However, final costs will depend on how many leaks there are, their severity, the cost to repair, and whether leak-related costs—such as damage to electrical components—exist beyond the repair work. Key to protecting the taxpayer will be resolving the uncertainty about who is ultimately responsible for the leaks.

At this time, work is still on-going and the ultimate cost is not known. Some of the construction contractors are repairing the leaks at their own expense, including Modern Continental who has been repairing the faulty wall panel. According to the Authority, it has spent approximately \$7 million over the last 3 years for leak repairs, all of which was paid to McCourt/Obiyashi, the tunnel finishing contractor. Recently, the Authority stated it has identified costs related to leak repairs of almost \$17 million. However, it stated it has yet to charge the responsible construction or oversight contractors for these costs.

We also identified a modification where a contractor who was responsible for repairing leaks at his own expense had submitted a \$2 million claim for leak repairs. We are still determining whether the Authority accepted this claim. Whether this should be part of the amount that the Authority will seek to recover needs to be explored further, but it does indicate that there very well could be more costs than the \$17 million the Authority quoted.

In addition to the cost of fixing the leaks, other related costs should not be passed on to the taxpayer. These include the cost of the three consultants recently hired to assess the leak damage as well as the replacement of damaged wall panels, electrical components, and insulation; reapplication of waterproofing systems; and constant monitoring and patching of the leak sites. To date, the Authority has not identified or quantified all of these costs.

In 1994, the cost recovery program came into existence and since that time has been managed by two different teams. After 8 years of cost recovery efforts the first team recovered only \$30,000. However, the second team has made greater progress by recovering \$3.5 million out of \$744 million worth of items identified.

These results are anemic considering that the team has closed approximately 70 percent of the 735 items identified for cost recovery. Included in the closed items are 13 leak-related change orders, for which the team determined there was no contractor liability. Given the current focus on the leaks, the team is reevaluating its earlier decisions.

The tunnel contracts contain financial safeguards to ensure contractors satisfactorily complete all outstanding construction issues before final acceptance is granted. To date, the Authority states it has withheld 5 percent of each contractor invoice and is supposed to release these funds after final acceptance approval. None of the construction contractors involved in the leaking tunnel sections have been granted final approval, although we still have not determined whether any of these funds have been released.

Users of the Artery and Taxpayers Must Have Confidence in Any Solution

The Commonwealth must move expeditiously in identifying a solution. If the leak problems are not resolved before the Project's scheduled completion in September 2005, the Commonwealth may be saddled with significant maintenance and repair costs. Should leaks occur after the Authority has accepted the contractors' work and their respective warranty periods have lapsed, then it will become a continuing expense for the taxpayers.

However, as we have outlined in our testimony, much is still unknown. We have differing counts of how many leaks there are, and have heard ranges from 700 to something significantly more. Have some been double-counted or even counted at all? This needs to be determined, and that should be the first order of business by the Authority. We have also heard conflicting statements, even within the Authority, of whether the majority of the leaks are construction deficiencies or design issues.

The Authority is on the right track to identify the extent of the leaks and the necessary corrective action. However, the problems surrounding the leaks involve multiple parties. As stated earlier, each party involved may have different interests at stake in how these issues are ultimately resolved.

As the Committee deliberates on how best to address this set of issues, one option for consideration is the creation of a small, independent, bipartisan commission, of limited duration, to report back its findings no later than June 30, 2005. The commission would be charged with determining the responsible parties and ensuring that they bear the costs of the leaks and not the taxpayers. In addition, the commission could oversee or help to ensure that the authority's efforts to

identify and appropriately fix the leaks proceeds with due diligence. In carrying out its duties, the commission could coordinate its actions, as appropriate, with the Commonwealth's Attorney General.

At a minimum, the following questions should be addressed:

- What are the precise number and severity of the leaks and are more likely to occur or re-occur?
- What are the causes of the leaks and who is responsible? Why was construction allowed to continue when deficiencies were noted in the slurry wall panel?
- What is the total amount that has been spent on leak repairs, waterproofing and other related costs and how much has been charged back to responsible parties?
- What will be the continuing maintenance cost to manage future leaks and are these costs in excess of what was expected?
- Has the Cost Recovery Team sufficiently identified the leak-related costs that should be recovered?

We note that final completion of the project's I-93 tunnel segments is currently scheduled for September, 2005. Accordingly, we would also recommend that the Authority withhold final acceptance and not release funds held in retainage until these matters are resolved.

Mr. Chairman, this concludes my prepared statement. I would be pleased to address any questions you or members of the Committee may have.