



Memorandum from the Office of the Inspector General

January 31, 2008

Janet C. Herrin, WT 10D-K

FINAL REPORT – INSPECTION 2007-11023 – REVIEW OF TVA'S DAM SAFETY PROGRAM

Attached is the subject report for your review and action. As agreed to at the exit conference on December 19, 2007, we are issuing the report in final. Please advise us of your planned actions in response to our findings within 60 days of the date of this report.

Information contained in this report may be subject to public disclosure. Please advise us of any sensitive information in this report that you recommend be withheld.

If you have any questions, please contact Michael A. Driver, Project Manager, at (423) 751-8158 or Gregory C. Jaynes, Deputy Assistant Inspector General, Inspections, at (423) 751-7821. We appreciate the courtesy and cooperation received from your staff during this review.

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GCJ:HRK:BKA

Attachment

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OIG File No. 2007-11023



Tennessee Valley Authority
Office of the Inspector General

Inspection Report

REVIEW OF TVA'S DAM SAFETY PROGRAM

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2007-11023
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EXECUTIVE SUMMARY

Under the Tennessee Valley Authority (TVA) Act of 1933, as amended, TVA was authorized to construct, operate, and maintain dams in the Tennessee River basin. According to the National Inventory of Dams, TVA's dam inventory in 2007 included 49 main dams and 33 dikes and saddle dams. In keeping with its responsibility, TVA has maintained a dam safety program since its inception.

We reviewed the TVA dam safety inspection process to determine whether it met federal guidelines for dam safety, was being followed by Dam Safety inspection personnel, and was being adequately supported by an information database. Our review covered dam safety inspections at five dams in fiscal years 2006 and 2007. We last audited dam safety during 2001.

In summary, our review determined (1) the inspection process met the Federal Emergency Management Agency guidelines for periodic dam safety inspection programs; (2) Dam Safety inspection personnel appeared to adhere to the process for identifying, monitoring, and correcting inspection deficiencies based on the five dams we reviewed; and (3) information databases provided adequate support to manage the inspection process. However, our review found that (1) 57 out of 81 work orders/requests related to maintenance and repair (M&R) items identified by the dam safety inspections for the five dams we reviewed were not completed by the estimated due date stated on the inspection report and (2) there is a historical trend of not completing M&R items by the estimated due date.

Our review also determined management has implemented planned corrective actions in response to the recommendations in our 2001 audit.

We recommend the Senior Vice President of River Operations consider implementing a prioritization and scheduling procedure to enhance timely completion of M&R items.

BACKGROUND

Under the Tennessee Valley Authority (TVA) Act of 1933, as amended, TVA was authorized to construct, operate, and maintain dams in the Tennessee River basin. The Act authorized TVA to operate its dams and reservoirs for the unified development and regulation of hydroelectric power, flood control, river navigation, and public recreation. According to the National Inventory of Dams, TVA's dam inventory in 2007 included 49 main dams and 33 dikes and saddle dams.

In keeping with TVA's responsibility, a dam safety program has been maintained since its inception. The program was formalized in 1982 and has been funded solely by power revenues since fiscal year (FY) 2000. Typically, civil inspections assess the physical structure of the dams and associated embankments while mechanical and electrical inspections examine the dams' machinery and electrical circuitry. Maintenance and repair (M&R) items identified during inspections are monitored by Dam Safety managers and lead engineers. Dam Safety has an established, comprehensive inspection schedule to help ensure the safety and operation of TVA dams (see Figure 1).

TVA's Dams Safety Inspection Schedule

Interval	Inspection Type	Responsible Party
Monthly	Civil, Mechanical, & Electrical	Personnel at dam site ¹
15 Month	Civil Intermediate (High & Significant hazard dams)	Dam Safety Inspectors
30 Month	Civil Intermediate (Low hazard dams)	Dam Safety Inspectors
30 Month	Mechanical & Electrical Intermediate	Dam Safety Inspectors
60 Month	General (Civil, Mechanical & Electrical)	Dam Safety Inspectors
120 Month	Civil (focusing on specific areas such as spillways, gate guides, trash racks, penstocks, etc.)	Dam Safety Inspectors
As Needed	Special (Civil, Mechanical & Electrical)	Dam Safety Inspectors

Figure 1

Since 2000, the Enterprise Maintenance Planning and Control (EMPAC) system has been used as the consolidated database for M&R items and operating and maintenance (O&M) projects. However, EMPAC does not provide the capability to assign personnel, track individual inspection reports, or analyze instrumentation data. Accordingly, Dam Safety continued to use (1) its own

¹ Nonpower dams' monthly inspections are handled by Data Systems and Inspections personnel where one person has the responsibility for several dams. The dikes are handled by one of the Facilities Maintenance personnel assigned to the dam.

databases to supplement EMPAC and (2) Primavera² to assist with scheduling inspections.

In 1998 and 2001, the Office of the Inspector General (OIG) conducted reviews relating to Dam Safety's adherence to the Federal Emergency Management Agency (FEMA) guidelines, specifically FEMA 93 *Federal Guidelines for Dam Safety*. The 1998 audit (OIG Audit 98-050F-01) reviewed the reliability of data sources and information systems used in measuring TVA's Dam Safety Performance Indicator. The 2001 review (OIG Audit 2001-076F) evaluated compliance with FEMA guidelines.

The current review was included in the 2007 Annual Inspection Plan and conducted as a periodic follow-up to the review conducted in 2001.

OBJECTIVE, SCOPE, AND METHODOLOGY

The objectives of this review were to determine whether River Operations':

- Inspection process met FEMA guidance for periodic inspection programs;
- Personnel adhered to the inspection process for identifying, monitoring, and correcting inspection deficiencies; and
- Information system databases adequately supported the inspection process.

The scope of our review covered dam safety inspections conducted in FYs 2006 and 2007. Our review utilized policies and procedures in place during FYs 2006 and 2007.³ To achieve our objectives, we:

- Walked down the procedures for conducting inspections with a Dam Safety lead engineer to gain an understanding of the inspection process.
- Reviewed FEMA's *Federal Guidelines for Dam Safety* and compared River Operations' inspection procedures to the FEMA guidance for periodic inspection programs.
- Obtained and reviewed copies of corrective actions reports to ensure compliance with FEMA guidelines.
- Reviewed training materials, conducted interviews, and reviewed training records for a Dam Safety engineer who performs dam safety inspections to determine compliance with FEMA guidelines.
- Judgmentally selected five dams for review based on previous reviews, current issues, and location as shown in Figure 2. The FEMA hazard classification for four of the dams is "High," indicating either significant

² Primavera is software used by Dam Safety primarily for scheduling purposes.

³ Beginning in FY 2008, a restructuring of the Dam Safety organization will take place that will affect dam safety inspections and may require updated policies and procedures.

economic impact or loss of life in the event of dam failure. The classification of one dam as a "Significant" hazard indicates that failure or improper operation would result in no probable loss of human life but could cause economic loss, environmental damage, disruption of lifeline facilities, or could affect other concerns.

Dam Name	River	State	Type	Use	Hazard
Wilson	Tennessee River	AL	Concrete	Power	High
Hiwassee	Hiwassee River	NC	Concrete	Power	High
Chickamauga	Tennessee River	TN	Concrete	Power	High
Fontana	Little Tennessee	NC	Concrete	Power	High
Bear Creek	Bear Creek River	AL	Embankment	Flood Control	Significant

Figure 2

For each of the five dams, we:

- Obtained and reviewed the inspection reports issued during the review period for the dams in order to ensure compliance with FEMA guidelines and obtain a listing of M&R items.
- Searched EMPAC for M&R items identified in the inspection reports to determine whether the items (1) had been included in the database and (2) were completed by the estimated due date.
- Compared M&R items for the selected dams with previous audit information to assess the effectiveness of M&R completion.
- Examined Dam Safety's permanent history files to determine whether they included inspection reports for the dams selected for review.

This inspection was conducted in accordance with the "Quality Standards for Inspections."

FINDINGS

In summary, our review determined River Operations' (1) inspection process met FEMA guidelines for periodic dam safety inspection programs; (2) inspection personnel appeared to adhere to the process for identifying, monitoring, and correcting inspection deficiencies based on the five dams we reviewed; and (3) information databases provided adequate support for the inspection process. However, our review found that (1) 57 out of 81 work orders/requests related to M&R items identified by the dam safety inspections for the five dams we reviewed were not completed by the estimated due date stated on the inspection report and (2) there is a historical trend of not completing M&R items by the

estimated due date. Our review also determined management has implemented planned corrective actions in response to the recommendations in our 2001 audit.

MEETING FEMA GUIDELINES FOR DAM SAFETY

Our review determined Dam Safety's inspection process met FEMA guidelines for periodic inspection programs. FEMA guidelines state dam safety inspections should be scheduled on a regular basis, performed by qualified personnel, described in writing, and monitored by appropriate officials. The guidelines also indicate deficiencies identified during the inspections should be corrected in a timely manner and documented in permanent files.

In comparing Dam Safety's inspection process to FEMA's guidance for periodic dam safety inspection programs, our review determined:

- A folder containing a checklist of tasks to be performed during each inspection, prior inspection reports, open and closed M&R items for the dam to be inspected, and details from monthly inspections conducted since the previous inspection was provided for the inspectors' review prior to inspection.
- At the beginning of each month, EMPAC generated written work orders or work requests. These orders and requests included items noted in previous inspections that warranted additional attention.

For each of the five dams reviewed, we determined:

- Dam Safety scheduled regular inspections that were augmented by special, as-needed inspections if an item warranted further observation.
- Monthly inspections were conducted by trained personnel at the dams. Intermediate, general, and special inspections were conducted by civil, electrical, or mechanical engineers from Dam Safety. Both a licensed professional engineer and the manager of Dam Safety reviewed work conducted and the reports before they were issued. The issued report was signed by both the manager of Dam Safety and the licensed professional engineer and was maintained in the hardcopy history files.
- Dam Safety maintained hardcopy history files on each dam. These files contained the original construction drawings and diagrams on each dam, inspection reports (often with diagrams and photo exhibits), and instrumentation data and analyses.

ADHERING TO THE DAM SAFETY INSPECTION PROCESS

Based on the five dams we reviewed, it appears River Operations' personnel adhered to the process for identifying, monitoring, and correcting inspection deficiencies. In evaluating whether the dam safety inspection process was being followed, our review determined:

- Regular inspections were generally conducted when scheduled. The average length of time between the scheduled inspection date and the date the inspection was actually completed was 65 days.
- M&R items identified in previous reports were included in the file reviewed by the inspector prior to conducting a dam safety inspection. This allowed the inspector to determine if the M&R items have been corrected.
- Dam Safety lead engineers closely monitored the results of the monthly inspections, conducted periodic and special inspections, and authorized and coordinated repair activities. Status reports on open maintenance and repair items were routinely generated and distributed to managers and lead engineers.
- All finalized FYs 2006 and 2007 inspection reports pertaining to the dams we selected were stored in permanent files (often with detailed drawings, photo exhibits, and instrumentation data from measuring devices at the dams).

SUPPORTING THE DAM SAFETY INSPECTION PROCESS

Our review found that information databases provided adequate support for the inspection process. Since 2000, EMPAC has been used as the consolidated database for M&R and O&M projects. Currently, the Dam Safety Inspection Program is supported by EMPAC, Primavera, multiple databases, and spreadsheets that are used to schedule inspections, assign personnel to inspections, track individual inspection reports, and analyze instrumentation data.

To review the reliability of the databases used for maintaining dam safety inspections, we searched EMPAC for the 81 FYs 2006-2007 M&R items associated with the five dams in our sample. We found that all the work requests/orders were in EMPAC and being tracked.

Completion of M&R Items by Their Estimated Completion Date

We found that as of October 1, 2007, 57 of the 81 (70 percent) work orders/requests associated with the M&R items found in the reports on the five dams we reviewed were either still open or completed after their estimated completion date. In the inspection reports issued, the M&R items' work orders/requests were given an estimated completion date. These dates were compared to the completed dates in EMPAC. Dam Safety personnel indicated that the delay in completing the M&R items could be due to the fact that when tasks are assigned to the roving crew the items may be delayed until there are multiple items that need to be completed at that location, thus avoiding multiple trips to the dams. Additionally, the due date for many items in EMPAC was different from the estimated due date found in the inspection reports. According to Dam Safety personnel, the dates may be extended if they are contacted by the organization responsible for completing the item with a suitable explanation for the delay.

We also compared the number of items not resolved by their expected completion dates in EMPAC in our 1998 and 2001 review samples to our 2007 sample to determine if completion rates have improved. To effectively compare the analysis and apply methodology consistent with previous OIG reviews, M&R items considered open and not overdue, cancelled, or converted to O&M projects were excluded from the comparison. Our review determined the percentage of sampled items that missed their expected completion dates increased from 55 percent in 2001 to 60 percent in 2007. Further analysis of our samples found:

- Our 1998 sample showed only 18 percent of the M&R items had been completed by their due dates, 38 percent had been completed after their due dates, and 44 percent missed their due dates and remained open as of the 1998 OIG review analysis date.
- Our 2001 sample showed 45 percent of the M&R items in our sample had been completed by their due dates, 32 percent had been completed after their due dates with an average of 13 months late, and 23 percent missed their due dates and remained open as of the 2001 OIG review analysis date with an average of 11 months overdue.
- Our 2007 sample showed 40 percent of the M&R items in our sample had been completed by their due dates, 34 percent had been completed after their due dates with an average of 7 months late, and 26 percent missed their due dates and remained open as of September 19, 2007, with an average of 18 months overdue.

See Figure 3 for a comparison of the results of our 1998, 2001, and 2007 samples.

Comparison of FYs 2006-2007 M&R Items to Previous Audits

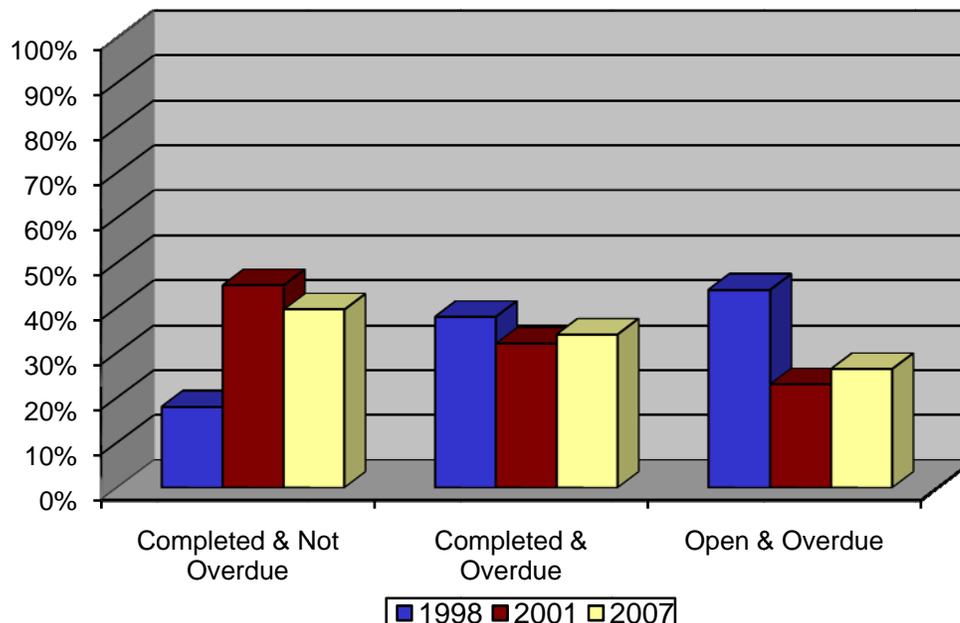


Figure 3

Currently, the priority of M&R items is based on the assigned due dates. If there is an emergency, Dam Safety coordinates directly with Facilities Management to have the task completed. In the previous review conducted by the OIG in 2001, it was noted that M&R items were assigned a priority code. These priority codes are no longer used by Dam Safety. According to Dam Safety personnel, typically the work done by Facilities Management has to be done at certain times of the year so the due date was a better way of ensuring the work was completed at that time. Facilities Management indicators that are used to track M&R items go by how many items were not completed on time, so this is watched closely by Facilities Management. However, once the assigned due date has passed, it becomes an ineffective measure of the priority of the M&R item.

FOLLOW-UP ON PREVIOUS AUDIT

We found that management has implemented planned corrective actions in response to our 2001 review of dam safety. Specifically, River Operations has implemented measures to (1) regularly update inspection checklists, (2) appropriately route inspection reports, and (3) appropriately evaluate long, overdue M&R items.

RECOMMENDATION

The Senior Vice President of River Operations should consider implementing a prioritization and scheduling procedure that ensures timely completion of M&R items.