



Memorandum from the Office of the Inspector General

October 13, 2010

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FINAL REPORT – INSPECTION 2009-12651 – REVIEW OF TVA'S DAM SAFETY PROGRAM

Attached is the subject final report for your review and action. Your written comments, which addressed your management decision and actions planned or taken, have been included in the report. Please notify us when final action is complete.

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 Heather R. Kulisek, Auditor, at (423) 785-4815 or Greg R. Stinson, Acting Director, Inspections, at (865) 633-7367. We appreciate the courtesy and cooperation received from your staff during the audit.

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OIG File No. 2009-12651



Tennessee Valley Authority
Office of the Inspector General

Inspection Report

REVIEW OF TVA'S DAM SAFETY PROGRAM

Inspection 2009-12651
October 13, 2010

ACRONYMS AND ABBREVIATIONS

DS&I	Data Systems and Instrumentation
EAPs	Environmental Protection Plans
FEMA	Federal Emergency Management Agency
FEMA 64 Owners	Emergency Action Planning for Dam Owners
FEMA 65 Dams	Earthquake Analyses and Design of Dams
FEMA 93	Federal Guidelines for Dam Safety
HBOC Hydro	Board of Consultants
Kingston Report	Inspection Report 2008-12283-02, Review of Kingston Fossil Plant Ash Spill Root Cause Study and Observations about Ash Management
MDE	Maximum Design Earthquake
NDSP	National Dam Safety Program
O&M	Operations and Maintenance
OIG	Office of the Inspector General
PFMA	Potential Failure Mode Analysis
PMF	Probable Maximum Flood
REs Respons	ible Engineers
RO River	Operations
TVA	Tennessee Valley Authority
USACE	U.S. Army Corps of Engineers

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- A. MARSHALL MILLER TEAM QUALIFICATIONS & EXPERIENCE SUMMARY
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Inspection 2009-12651 -- Review of TVA's Dam Safety Program

EXECUTIVE SUMMARY

Why the OIG Did This Review

This review was the result of broad interest surrounding the safety and condition of Tennessee Valley Authority (TVA) dams after the ash spill at Kingston Fossil Plant.

The objectives of this review were to determine if TVA's Dam Safety Program (1) identifies and adequately addresses significant risks, (2) is in compliance with TVA policies and procedures and applicable laws and regulations, and (3) encompasses all the aspects of a comprehensive dam safety program.

What the OIG Found

Our review found that TVA (1) is taking steps to identify and mitigate its risks, (2) is adhering to the Federal Guidelines for Dam Safety with a few exceptions, and (3) has a comprehensive dam safety program.

- **Identification and Mitigation of Risks** - TVA is currently taking strides to improve its risk management including moving from being reactive to proactive by mitigating and anticipating risks. According to TVA's Hydro Board of Consultants, it would be very difficult for something to happen that would not be detected in time to mitigate disaster with the monitoring TVA has in place. In addition, with the recommendations made by TVA's independent consultants, TVA is implementing new analysis that will assist with the identification and mitigation of risk. However, based on interviews with TVA plant personnel, clearer lines of responsibility, decreased lag time from inspection to report, rotation of inspectors, and Dam Safety personnel's presence during project work would enhance the identification and mitigation of Dam Safety risks.
- **Compliance With TVA Policies and Procedures and Applicable Laws and Regulations** - Our review found that TVA's policy is to follow the Federal Guidelines for dam safety, although not required to under federal law. TVA is adhering to the Federal Guidelines with the exception of certain aspects of the Operations and Maintenance (O&M) Manuals, Training and Awareness Program, and Emergency Action Plans (EAPs). Specifically, (1) O&M Manuals are not updated on a regular basis, (2) periodic evaluation is not being performed of

the site personnel conducting monthly inspections, and (3) the EAPs are lacking a process for terminating an emergency, a designated EAP Coordinator, and information related to unmanned dams. These deficiencies could hinder risk identification and mitigation activities.

- **Comprehensive Dam Safety Program** - The TVA Office of the Inspector General (OIG) contracted with Marshall Miller & Associates, Inc., to conduct a peer review of TVA's Dam Safety Program. Based on their review, it appears that while TVA has a comprehensive dam safety program in place, there are ways the program could be strengthened in the Inspection Program, Instrumentation Program, Dam Safety O&M Program, and Emergency Action Planning.
- **Systemic Issues Found in OIG Reviews** - There are several issues that were identified in Inspection Report 2008-12283-02 Review of Kingston Fossil Plant Ash Spill Root Cause Study and Observations about Ash Management that have also been noted during the course of this review. As noted in various places in this report, those issues relate to organization, accountability, and resources.

What the OIG and Marshall Miller Recommends

In conjunction with Marshall Miller, we recommend the Senior Vice President, River Operations, consider revisions to the:

- Inspection Program related to the (1) incorporation of the Instrumentation Group and the Emergency Preparedness function in the Dam Safety Group, (2) involvement of the hydro production support managers in site activities and inspection results, (3) scope of the Dam Safety Awareness Training, and (4) periodic evaluation and rotation of monthly inspectors.
- Instrumentation Program related to:
 - ❖ Increased staff for support of safety, workload management, and emergency response.
 - ❖ Increased funding in support of (a) instrumentation replacement and installation, (b) transition to automated data acquisition, and (c) communication improvements.
 - ❖ Strengthening of relationships between dam site personnel and the Data Systems and Instrumentation Group.
- O&M Program related to (1) increased staff and budget to facilitate the prompt handling of needed maintenance procedures, (2) increased security measures, and (3) update of O&M Manuals.

- Emergency Action Planning related to the (1) expansion of staff consistent with the increased scope of Dam Safety activities, (2) integration of EAPs in the overall Dam Safety Program, (3) tailoring of EAPs to individual sites and inclusion of additional information, (4) frequency of emergency exercises, (5) update of the decision-making chart included in the EAPs, and (6) periodic reconnaissance of downstream inundation areas.

In addition, the potential impact and risk of the parallel issues identified in this report should be thoroughly examined as part of TVA's effort to change the company's culture.

The Senior Vice President of River Operations, in conjunction with the Dam Safety Officer, provided comments on this report. Management agreed with our recommendations and plans to take corrective actions. We agree with management's planned actions to address our recommendations. Management's complete substantive comments are included in Appendix B of this report. TVA management also provided some administrative and clarifying comments for our consideration. These technical comments were reviewed and incorporated as appropriate.

BACKGROUND

Under the Tennessee Valley Authority Act of 1933, as amended, the Tennessee Valley Authority 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 2009 included 49 main dams and 35 dikes and saddle dams.¹

For 30 years, the federal government has been working to protect Americans from dam failure through the National Dam Safety Program (NDSP). The NDSP, which is lead by the Federal Emergency Management Agency (FEMA), is a partnership of the states, federal agencies, and other stakeholders to encourage individual and community responsibility for dam safety. The Federal Guidelines for Dam Safety encourage strict safety standards be applied (1) in the practices and procedures employed by federal agencies and (2) by dam owners regulated by the federal agencies. The Federal Guidelines address management practices and procedures, but do not attempt to establish technical standards. According to the Catalog of FEMA Dam Safety Resources, the Federal Guidelines provide the most complete and authoritative statement available of the desired management practices for promoting dam safety and the welfare of the public. They were issued in June 1979 and last reprinted in 2004.

TVA's Dam Safety Program was formalized in 1982. TVA's Dam Safety Organization is responsible for ensuring that TVA's Dam Safety Program meets the Federal Guidelines. TVA's Dam Safety Program consists of modifications to ensure the structural integrity and safe operation of TVA's 49 dams and appurtenant structures, instrumentation to monitor dam performance, periodic inspections, maintenance and repairs, and emergency preparedness. Dam Safety is also responsible for saddle dams, dikes, and impoundments in the TVA system.²

In 2008, TVA experienced the Kingston Fossil Plant Ash Spill which had a significant operational and environmental impact. As a proactive measure, TVA's River Operations (RO) contracted with independent consultants to exercise "an abundance of caution" and to provide appropriate reassurance to all TVA's stakeholders regarding safety and stability. Specifically, TVA's purpose in commissioning this study was to obtain independent verification that TVA has a sound Dam Safety Inspection and Instrumentation Monitoring Program and that this program meets the intent of the Federal Guidelines. The consultants concluded that TVA's Dam Safety Program is thorough and generally comparable to other organizations of large dam owners and made

¹ A dike is an embankment for controlling or holding back the waters of the sea or a river. Saddle dams are typically earthen embankments located some distance upstream of the main dam and form part of a reservoir's rim or shoreline.

² Our review did not focus on saddle dams, dikes, or impoundments.

recommendations to improve the program. However, the consultants' report also states that TVA's Inspection and Instrumentation Program is on a par with those of other major dam owners and consistent with Federal Guidelines and practices if the recommendations made are implemented. TVA is taking action to address the concerns and recommendations identified in the consultants' report.

In 1998, 2001, and 2007, the Office of the Inspector General conducted reviews relating to Dam Safety's adherence to the FEMA Guidelines. This review was the result of broad interest surrounding TVA's program for assessing the safety and condition of TVA dams, taking into consideration the Kingston Fossil Plant ash impoundment failure.

OBJECTIVES, SCOPE, AND METHODOLOGY

The objectives of this review were to determine if TVA's Dam Safety Program (1) identifies and adequately addresses significant risks, (2) is in compliance with TVA policies and procedures and applicable laws and regulations, and (3) encompasses all the aspects of a comprehensive dam safety program. The scope of our review included key operational aspects of TVA's Dam Safety Program and the laws, regulations, processes, and procedures governing the program.

To determine if significant risks have been identified and are adequately being addressed, we:

- Interviewed members of the TVA Hydro Board of Consultants (HBOC)³ to determine the role they play in TVA's risk identification and mitigation and to obtain their assessment of TVA's Dam Safety Program.
- Reviewed reports from consultants used by TVA to assess their Dam Safety Program and determined if TVA had implemented or plans to implement corresponding recommendations.
- Interviewed RO personnel to determine what is being done to identify and address risks related to dam safety.
- Interviewed TVA management and performed walkdowns at selected dams to determine if risks are being adequately identified and mitigated by Dam Safety. Specifically, we selected 11 of TVA's 49 dams for site visits. The dams were selected based on TVA-identified risks, Dam Safety projects (in addition to their varying geographic locations), hazard classification, and use classifications. (See Figure 1 for the list of dams selected for site visit.)

³ The HBOC is a team of three internationally recognized experts in dam engineering used by TVA Dam Safety.

Figure 1: Listing of Dams Selected for On-Site Review

Dam Name	River	State	Type	Use	Hazard	
Bear Creek	Bear Creek	AL		Earth	Flood Control, Recreation	High
Little Bear Creek	Little Bear Creek	AL		Earth	Flood Control	High
Fort Loudoun	Tennessee River	TN		Concrete/Earth	Power	High
Great Falls	Caney Fork River	TN		Concrete	Power	Significant
Kentucky	Tennessee River	KY		Concrete/Earth	Power	High
Ocoee #1, 2, 3	Ocoee River	TN		Concrete	Power	High
Wilson	Tennessee River	AL		Concrete	Power	High
Wheeler	Tennessee River	AL		Concrete	Power	High
Blue Ridge	Toccoa River	GA		Earth	Power, Recreation	High

- Reviewed selected documentation pertaining to capital and operations and maintenance projects to determine if work is being prioritized and conducted.

To determine if TVA's Dam Safety Program is in compliance with TVA policies and procedures and laws and regulations, we:

- Reviewed (1) TVA policies and procedures, (2) applicable laws and regulations, and (3) Federal Guidelines to identify the requirements that TVA must adhere to.
- Interviewed Office of the General Counsel to determine what legislation TVA's Dam Safety Program is required to comply with.
- Reviewed reports from independent consultants hired by RO that compared TVA's Dam Safety Program with the Dam Safety Guidelines to identify any noted noncompliances.
- Reviewed documentation maintained by Dam Safety to verify that TVA's Dam Safety Program is adhering to the Federal Guidelines.
- Interviewed TVA's RO personnel to gain an understanding of TVA's Dam Safety Program.

To determine if TVA has a comprehensive dam safety program, we:

- Contracted Marshall Miller & Associates, Inc., to conduct a peer review of TVA's Dam Safety Program. To complete their peer review, Marshall Miller:
 - ❖ Visited Fort Loudoun Dam, Blue Ridge Dam, and Kentucky Dam and interviewed the Hydro Production support managers at each dam.
 - ❖ Reviewed documentation provided to the OIG team by RO.
 - ❖ Interviewed key Dam Safety personnel.

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

FINDINGS AND RECOMMENDATIONS

Our review found that TVA (1) is taking steps to identify and mitigate Dam Safety risks, (2) is adhering to the Federal Guidelines with a few exceptions, and (3) has a comprehensive dam safety program. TVA is currently taking strides to improve its risk management including moving from being reactive to proactive by mitigating and anticipating risks. However, based on interviews with TVA personnel, additional steps could be taken at the dam sites that could assist in identifying and mitigating Dam Safety risks. While TVA is adhering to the Federal Guidelines with some exceptions, and in Marshall Miller's opinion, has a fundamentally sound Dam Safety Program, there are opportunities for improvement in the Inspection Program, Instrumentation Program, Dam Safety Operation and Maintenance, and Emergency Action Planning. Additionally, there are several issues that were identified in Inspection Report 2008-12283-02, Review of Kingston Fossil Plant Ash Spill Root Cause Study and Observations about Ash Management (Kingston Report) that have also been noted during the course of this review. As noted in various places in this report, those issues relate to organization, accountability, and resources.

IDENTIFICATION AND MITIGATION OF RISKS

We found TVA is currently taking strides to improve risk management pertaining to dam safety. According to TVA's HBOC, the culture is being changed from one of "reactive to proactive" through the identification, anticipation, and mitigation of potential Dam Safety risks. TVA's HBOC also stated that it would be very difficult for something to happen that would not be detected in time to mitigate disaster with the monitoring TVA has in place. In addition, new analytical techniques are being implemented at the recommendation of TVA independent consultants that will enhance the identification and mitigation of risks. However, based on interviews with TVA plant personnel, clearer lines of responsibility, decreased lag time from inspection to report, rotation of inspectors, and Dam Safety personnel presence during project work would enhance identification and mitigation of Dam Safety risks.

Assessments of Dam Safety's Approach to Risk Management

TVA uses the HBOC as a sounding board for TVA's upcoming and ongoing Dam Safety projects. TVA selects the members of the HBOC based on the depth and breadth of their academic and/or professional involvement in the field of dam engineering and their experience related to current TVA Dam Safety projects and programs. The HBOC members work with other utilities worldwide bringing that knowledge and expertise to TVA. The HBOC provides insight into risks and issues that TVA may not be experienced with, in addition to recommending risk remediation, operational improvements, and cost-saving options. In discussions with the OIG team, the HBOC was complimentary of TVA's actions concerning risk assessment. They commented that TVA is moving from being "reactive to proactive" by mitigating and anticipating risks. Specifically, the HBOC stated that TVA has sent employees to observe projects at non-TVA dams to gain knowledge and ideas that may assist TVA in the future.

The HBOC's overall assessment of TVA's Dam Safety Program was that Dam Safety appears to be on the right track and has good institutional memory. In regard to the safety of TVA's dams, the HBOC stated that with the system TVA has in place, it would be very difficult for something to happen that would not be detected in time to mitigate disaster. The HBOC noted that TVA has been monitoring its dams for a very long time that allows them to benchmark and detect changes.

While the independent review of Dam Safety's Inspection and Instrumentation Program conducted after the Kingston Ash Spill concluded that TVA's Dam Safety Program was comparable to other large dam owners, they found that TVA had no formal (1) Potential Failure Mode Analysis (PFMA) protocol⁴ and (2) Risk Analyses being conducted to help prioritize expenditures. However, TVA has taken steps to address these findings. One PFMA was completed in 2009, and three are planned for 2010. In addition, TVA has met with the U.S. Army Corps of Engineers (USACE) and plans to start using the USACE's risk management tool, which is a spreadsheet that applies defined consequences to defined risks to help prioritize expenditures.

Dam Safety's Risk Mitigation Activities

TVA has identified potential Dam Safety risks in areas such as leakage, flooding, and seismic stability and is taking steps to monitor and mitigate these risks.

- Any leakage at a dam is evaluated during periodic Dam Safety inspections, and when necessary, it is measured and recorded for trending purposes.

⁴ A PFMA is an exercise to identify all potential failure modes under various conditions and to assess those potential failure modes of enough significance to warrant continued awareness and attention to visual observation, monitoring, and remediation as appropriate.

- TVA is in the process of reevaluating the Probable Maximum Flood (PMF)⁵ for all dams and determining if modifications are required.
- Studies are being conducted to determine the Maximum Design Earthquake (MDE)⁶ for each of TVA's dams.

According to the 2004 RO study, some leakage, or unintended flow, is expected to occur at all dams either through structural joints, earthen embankments, reservoir rims, or foundation materials. Any leakage is evaluated during periodic dam inspections, and a determination is made as to whether the volume, rate of change, and sediment content (if any) of the leak pose structural concerns. When necessary, the leakage is periodically measured and recorded so that trends can be defined. Changes in these trends can indicate that a more detailed evaluation of the seepage is warranted. TVA has previously experienced issues with limestone karst⁷ foundations. Most recently, in 2009 and 2010, projects to remediate leakage were completed at Bear Creek and Little Bear Creek Dams, respectively.

Figure 2 shows the roller compacted concrete structure that was constructed at the downstream toe of Bear Creek Dam to block water passage under the dam that was completed in 2009. TVA is currently monitoring leakage at 17 dams. However, none of the dams being monitored for leakage require action to be taken at this time.

Figure 2: Recently Constructed Structure at Bear Creek Dam



⁵ The PMF is generally accepted as the standard for the safety design of dams where the incremental consequences of failure have been determined to be unacceptable. In essence, it is the maximum amount of flood control that is risk tolerable.

⁶ The MDE is the earthquake that produces the maximum level of ground motion for which a structure is to be designed or evaluated.

⁷ Karst is an area of limestone terrain characterized by sinks, ravines, and underground streams.

A recent update of TVA's river modeling program determined that the maximum floodwater elevations could be higher than previously calculated if a highly unlikely, worst-case winter rainfall were to occur in the upper part of the Tennessee Valley watershed. In 2009, temporary modifications were made to Cherokee, Fort Loudoun, Watts Bar, and Tellico Dams. There are plans for permanent modifications to be constructed in the future. To mitigate this potential risk, the PMFs for all TVA's dams are in the process of being reevaluated.

Figure 3 shows the interim measures that have been put in place at the Fort Loudoun Dam including staging of gravel, dirt, and trailers with the necessary equipment required to keep the floodwaters off the earth embankments in case of flood conditions.

Figure 3: Interim Measures in Place at Fort Loudoun Dam



In 2003, TVA contracted with an external consultant to conduct a seismic hazard assessment. This study was completed in 2007 and included both probabilistic and deterministic analyses as required by FEMA 65 Earthquake Analyses and Design of Dams (FEMA 65).⁸ Currently, TVA has contracted a consultant to gather information related to the population at risk and economies at risk. Based on this information, TVA will determine the MDE for each dam. Per FEMA 65, "Dams should be capable of withstanding the Maximum Design Earthquakes (MDE) without failure resulting in a catastrophic loss of the reservoir, or should

⁸ These guidelines provide the basic framework for the earthquake design and evaluation of dams.

present an acceptably low risk of failure if that is how the relevant agency approaches decision making."

A project is under way at Blue Ridge Dam to bring the dam up to the seismic requirements in addition to correcting a penstock bulge⁹ that occurred during construction. To make the dam seismically stable, TVA is repairing and stabilizing the upstream and downstream faces of the dam, as well as stabilizing the tower on the upstream side of the dam that manages the intake water. This project began in July 2010. Figure 4 shows the monitoring in place at Blue Ridge Dam in preparation for upcoming work.

Figure 4: Monitoring Instrumentation at Blue Ridge Dam



Opportunities for Improvement

The OIG team conducted interviews with the Hydro Production managers and TVA employees at each of the dams in our sample. The employees interviewed did not identify any additional risks that were not being addressed by Dam Safety. It was noted during the interviews that projects and issues deemed as significant receive the required funding. In addition, they generally considered themselves to have a positive relationship with Dam Safety and felt they could contact Dam Safety if there were any questions or concerns and they would be addressed.

⁹ The penstock partially collapsed in 1931 on initial filling. Recent inspections revealed the loss of additional rivets in the bulged area.

While we found nothing to indicate that TVA is not adequately mitigating Dam Safety risks, some concerns were expressed during interviews that should be considered as improvement opportunities. Specifically:

- The majority of dam personnel interviewed did state that more defined organizational roles and responsibilities are needed. Some areas of accountability and responsibility were unclear among Facilities Management, Dam Safety, and Hydro Production. The responsibilities of each organization should be clearly defined and communicated throughout the organization.
- While not a concern at all dams, at two sites the personnel would like to see a rotation of inspectors to have a "fresh set of eyes" look at the dams. A rotation schedule for dam inspectors should be implemented to ensure that all dams are being reviewed by multiple inspectors.
- Personnel at one site noted a concern that the plant level could not track the condition of the plant effectively due to the lag time before Dam Safety engineers see inspection notes in the work management system. However, this concern should be addressed because lag time is now being tracked by the RO performance metric tracking the Dam Safety Initial Inspection Report completion time. In addition, an e-mail is supposed to be sent to the appropriate managers citing deficiencies from the Dam Safety inspections.
- Personnel at one site mentioned they would like to have Dam Safety personnel on-site during the completion of projects at the site. The Manager of Dam Safety Inspection and Maintenance Engineering feels that since staffing has increased, they will be able to be more involved in on-site projects.

COMPLIANCE WITH TVA POLICIES AND PROCEDURES AND APPLICABLE LAWS AND REGULATIONS

Our review found that TVA's policy is to follow the Federal Guidelines for Dam Safety, although it is not required to under federal law. TVA is adhering to Federal Guidelines with the exception of certain aspects of the O&M Manuals, Training and Awareness Program, and Emergency Action Plans.

Public Law 104-303 helps to reduce the risks to life and property from dam failure in the United States through the establishment and maintenance of an effective national Dam Safety program to bring together the expertise and resources of the federal and nonfederal communities in achieving national Dam Safety hazard reduction. According to Public Law 104-303, "Nothing in this section (including the amendments made by this section) shall preempt or otherwise affect any dam safety program of a federal agency other than the FEMA, including any program that regulates, permits, or licenses any activity affecting a dam." Therefore, TVA is not required to adhere to the Federal Guidelines by law. However, TVA's RO Standard Department Procedure 10.8, Emergency

Response Plan,¹⁰ states that in an emergency, the Dam Safety Officer is "responsible for ensuring that the FEMA Federal Guidelines for Dam Safety are adhered to." In addition, TVA's RO Standard Department Procedure 6.0, Asset Maintenance and Modification,¹¹ states that the TVA Board has mandated that all Dam Safety-related work will comply with the Federal Guidelines.

We compared TVA's Dam Safety Program to the key management practices identified in the Federal Guidelines. The results of our review are provided in detail below.

Management Practice--Establish a Dam Safety Officer and Appropriate Staff

TVA has established a Dam Safety Officer and a dedicated Dam Safety Group. The Dam Safety Officer is currently the General Manager, RO Engineering Support Services. The Dam Safety Group is responsible for ensuring that TVA's Dam Safety Program meets the Federal Guidelines.

Management Practice--Maintain an Updated Inventory of Dams

TVA maintains an updated inventory of its dams. It is updated every two years using a program employed by the USACE.

Management Practice--Document Design Criteria and Construction Activities

For all the dams constructed by TVA, detailed construction documentation is maintained. Dams that were purchased by TVA have detailed information about the dams, which has been maintained since their purchase.

Management Practice--Prepare O&M Instructions and Document Activities

Dam-specific O&M Manuals are maintained for each of TVA's 49 dams. However, FEMA 93 Federal Guidelines for Dam Safety (FEMA 93)¹² states, "All operation and maintenance manuals should be kept current, and records should be maintained of instructions, inspections, and equipment testing, with copies to those responsible for design and dam safety inspections." We found that while TVA does maintain an O&M Manual and information related to each dam in a Project Performance Report,¹³ TVA O&M Manuals are not updated on a regular basis. The manuals the OIG team observed had not been updated for 15 years. A procedure should be implemented to regularly review and update the O&M Manuals.

¹⁰ RO Standard Department Procedure 10.8, Emergency Response Plan, describes the procedures to be used to ensure systematic and coordinated Valley-wide response to different types of emergencies that require actions within RO.

¹¹ RO Standard Department Procedure 6.0 Asset Maintenance and Modification, establishes governing rules for a standardized program for maintenance activities associated with the physical assets within the responsibility of RO.

¹² These guidelines apply to management practices for Dam Safety of all federal agencies responsible for the planning, design, construction, operation, or regulation of dams.

¹³ A Project Performance Report is an in-depth summary of the health of the dam.

Management Practice--Maintain a Training and Awareness Program

TVA is in the process of implementing a standard department procedure to establish training and qualification requirements for inspection personnel who perform inspections of civil features and inspection and test operation of Dam Safety equipment. The general and intermediate inspections are conducted by Dam Safety inspectors. Dam Safety inspectors are trained through using Training Aids for Dam Safety and attending conferences. The monthly inspections are completed by personnel at the dams. They are trained through the Dam Safety Awareness Training course, which explains the Dam Safety Program and the types of deficiencies to look for when inspecting a dam. According to FEMA 93, the personnel conducting informal reviews "must be evaluated periodically to assure that they understand the requirements and are capable of performing them." According to Dam Safety personnel, no periodic evaluations are performed.

In addition FEMA 93 maintains that the inspection team "should comprise individuals having appropriate specialized knowledge in structural, mechanical, electrical, hydraulic, and embankment design; geology; concrete materials; and construction procedures." According to Dam Safety management, TVA's inspection teams possess all this knowledge with the exception of a geotechnical expert. Efforts are ongoing within TVA to acquire an expert in this field.

Management Practice--Prepare and Maintain EAPs for Each Dam

TVA has developed and maintains an EAP for each of the 49 dams in the TVA system. These plans consist of initial notification procedures, contact information, emergency classification, and site-specific flooded area information. TVA updates the EAPs annually, and they are distributed to all internal and external organizations that would be involved in a TVA Dam Safety event. We observed that the copies of EAPs in the River Operations Emergency Operations Center had a revision date of 2005. However, at the dam sites, the hydro production support managers had the most recent 2009 updated EAPs.

We compared FEMA 64 Emergency Action Planning for Dam Owners (FEMA 64)¹⁴ to TVA's EAPs. The following improvements could be made to TVA's EAPs. According to FEMA 64:

- An EAP should state "when and how a declared emergency will be terminated." Our review of the EAPs in our sample found nothing stating when and how a declared emergency will be terminated. The EAPs should be revised to include the conditions for terminating an emergency.
- "The dam owner should specify in the EAP the designated EAP coordinator who will be responsible for EAP-related activities." We noted that the EAPs sampled did not identify the designated EAP coordinator. The EAPs should clearly designate the EAP coordinator.

¹⁴ The purpose of these guidelines is to encourage thorough and consistent emergency action planning for dams to help save lives and reduce property damage. The guidelines cover basic considerations for preparing an EAP, the basic elements of an EAP, and the suggested format for an EAP.

- The "EAP should describe any instrumentation for monitoring the behavior of unattended dams, and explain how warning systems should be activated." Our review of sampled EAPs and discussion with Dam Safety personnel found that this information is not being kept in the EAPs. The EAPs should be revised to include information related to the instrumentation and warning systems for unmanned dams.

Management Practice--Establish a Program of Periodic Inspections and Evaluation of Dams

The general and intermediate inspections are being completed in the time frame outlined in the Federal Guidelines. TVA completes their general inspections on a 5-year rotation and their intermediate inspections on a 15-month rotation to account for the change of seasons. The civil inspections were completed based on checklists outlined in the Federal Guidelines. However, the mechanical/electrical checklists have not been implemented at this time.

Management Practice--Monitor and Evaluate the Performance of Each Dam and Appurtenant Structure and Provide Remedial Construction as Necessary

TVA Dam Safety was monitoring and evaluating the performance of each dam through the assignment of Responsible Engineers (REs) and the completion of Project Performance Reports. TVA Dam Safety is in the process of re-designating a RE for each of the dams. REs have been used before by Dam Safety, however, the program lost momentum with staff reductions in recent years. The RE is to serve as the point of contact on all dam-related issues. The intent is to have someone familiar with all aspects of the dam, including past, present, and future information. The RE is responsible for information including the historical information on the dam, instrumentation data, and inspection reports. The RE would also be responsible for monitoring trends in the instrumentation data to identify potential issues and reviewing Project Performance Reports. Project Performance Reports are completed every five years for all high hazard dams and dams with issues. A Project Performance Report is an in-depth summary of the health of the dam. The report includes the history, foundation issues, instrumentation history, current evaluation, and any other pertinent information that relates to the dam. The Project Performance Reports were initially completed by contractors.

COMPREHENSIVE DAM SAFETY PROGRAM

The TVA OIG contracted with Marshall Miller to conduct a peer review of TVA's Dam Safety Program. Based on their review, it appears that, while TVA has a comprehensive dam safety program in place, there are ways the program could be strengthened. During its engagement, Marshall Miller conducted interviews with various representatives of the OIG and TVA, among others, and was provided access to various documents including EAPs, engineering design drawings, technical specifications, copies of expert reports prepared by third

parties retained by the TVA, and other pertinent documentation that was examined during the peer review.

In summary, Marshall Miller identified TVA's program as being thorough, fundamentally sound, and comparable to similar organizations that own and maintain and, with the proposed reorganization of the Dam Safety Group, anticipates that this action will further enhance program operations. If not already planned as part of the current reorganization, the peer review team believes the program would be further strengthened by the Instrumentation Group and the Emergency Preparedness function being incorporated into the Dam Safety Group.

In addition, Marshall Miller endorses the Dam Safety Group's implementation of the RE concept. The REs will be responsible for three to four dams and should be familiar with everything that goes on at these dams. The peer review team understands they will (1) be advocates for addressing any needs or shortcomings associated with these facilities, (2) be accountable for Dam Safety O&M issues, and (3) facilitate needed funding for such issues for the dams for which they are responsible. While, in Marshall Miller's opinion, the Dam Safety Program is fundamentally sound, there are areas where improvements could be made including the Inspection Program, Instrumentation Program, Dam Safety O&M, and Emergency Action Planning.

Inspection Program

To assess TVA's Dam Safety Inspection Program, Marshall Miller visited three dams (Fort Loudoun, Blue Ridge, and Kentucky) and interviewed site personnel and the Manager of Dam Safety Inspection and Maintenance Engineering. Their review noted the following aspects of TVA's Dam Safety Inspection Program:

- The Manager of Dam Safety Inspection and Maintenance Engineering is knowledgeable of his functions and responsibilities.
- The Dam Safety Group is currently undergoing a general reorganization and will perform an independent governance role. The reorganized group will be part of RO. Having a strong, independent Dam Safety Organization within TVA is a very positive development and should improve TVA safety practices.
- Serious deficiencies identified during inspections typically get a prompt response.

Marshall Miller presented the following observations and recommended actions related to TVA's Dam Safety Inspection Program:

- The Manager of Dam Safety Inspection and Maintenance Engineering currently has nine staff members. Marshall Miller determined this to be insufficient staff for performing the current schedule of inspections for TVA's 49 dams. It is the peer review team's understanding that reorganization is currently under way and that this reorganization will expand the Dam Safety Group staff. The peer review team endorses such a reorganization.
- Plant personnel at some of the facilities visited appeared to have a limited knowledge of Dam Safety's inspection procedures, and none of these personnel appeared thoroughly familiar with these procedures or with the scope and findings of Dam Safety's inspection activities.
- The scope of Dam Safety Awareness training should be expanded to include a description of Dam Safety Group activities, instrumentation monitoring and data review, and other Dam Safety issues. Site personnel should be made aware of the importance of inspections and instrumentation monitoring. Marshall Miller recommends the preparation of a comprehensive PowerPoint presentation including actual examples to be used as part of the Dam Safety Awareness training. The training should also provide an outline of the new organization and the way site personnel interact with Dam Safety personnel.
- The peer review team endorses the implementation of the RE concept for groups of dams, and it encourages interaction by the REs with the reorganized Dam Safety Group.

Instrumentation Program

To assess TVA's Dam Safety Inspection Program, Marshall Miller visited three dams and interviewed site personnel and the Manager of RO Data Systems and Instrumentation. Marshall Miller's review noted the following aspects of TVA's Dam Safety Instrumentation Program:

- The Manager of RO Data Systems and Instrumentation (DS&I) is knowledgeable of her functions and responsibilities.
- Technologically outmoded equipment is being replaced.
- DS&I is planning to automate more instrumentation.

Marshall Miller presented the following observations and recommended actions related to TVA's Instrumentation Program:

- Hydro production support managers are not very familiar with the scope, performance, or measurements of instrumentation at their sites and referred the peer review team to the DS&I Group. Marshall Miller's discussions with hydro production support managers and the Manager of RO DS&I indicated that increased interaction and cooperation between plant/site personnel and the DS&I Group would benefit both parties.

- Currently DS&I has six technicians to man six field offices but would prefer two technicians in each field office for personnel safety and workload management reasons, given the remoteness and/or ruggedness of some of the sites and the travel distances between the sites overseen by each field office. The mobile communications from some sites is poor to nonexistent with typical equipment, which presents added impetus for a teaming approach to oversight responsibilities at more remote facilities that are not staffed daily. Marshall Miller assumes that the DS&I Group will be part of the reorganized Dam Safety Group and that DS&I will gain additional staff as needed. The peer review team endorses such reorganization, especially with regard to staffing each field office with at least two technicians for personnel safety, workload management, and emergency response reasons.
- It appears that the DS&I Group is underfunded. Failed instrumentation replacement and the upgrading of equipment are currently completed when funds are available. The peer review team recommends that their budget be increased sufficiently to, for example, (1) support more prompt replacement of failed instruments and installation of additional instrumentation where necessary, (2) transition to automated data acquisition where reasonably justified and where Dam Safety issues warrant closer monitoring, and (3) enhance mobile communications for field technicians.

O&M Procedures

To assess TVA's Dam Safety O&M procedures, Marshall Miller visited three dams and interviewed site personnel. Marshall Miller's review noted the following aspects of TVA's O&M procedures:

- All the dams visited have auxiliary power systems in the event of electrical power failure.
- Marshall Miller was informed during visits to the three sites that each spillway gate is raised under normal and auxiliary power on an annual basis or concurrent with Dam Safety 15-month inspections. Marshall Miller was informed that this practice has recently been instated.
- All the dams visited had warning signs immediately downstream of the dam, as well as audible warning systems.
- Special instructions for inspections and/or checking equipment are issued when severe natural phenomena occur. Such instructions had been issued to the Fort Loudoun Dam hydro production support manager on the day that the peer review team visited due to a magnitude 3.3 earthquake that occurred in the region the night before.
- Some facilities have materials prestaged so that they can be deployed in the event of an emergency. Sandbags were staged at Fort Loudoun Dam.

Marshall Miller presented the following observations and recommended actions related to TVA's O&M procedures:

- Based on interviews with site personnel, maintenance activities appear to be limited somewhat by the availability of personnel. The Dam Safety O&M function of TVA should be staffed and funded such that individual facility maintenance issues are handled promptly.
- Security problems have generally been minor, mostly involving petty vandalism. One instance was noted where copper wire was stolen. Blue Ridge Dam is typically unmanned. It is visited by a maintenance crew for a few hours twice a week. Marshall Miller recommends that TVA consider installation of remote video systems for facilities that are unmanned for long periods of time and for other critical dam features that could be disabled by sabotage. For mostly unmanned dams such as Blue Ridge Dam, such a system could potentially provide an early warning of serious site problems.

EAPs

To assess TVA's Dam Safety emergency action planning, Marshall Miller visited three dams, interviewed site personnel and the Emergency Preparedness Specialist, and reviewed documentation such as the EAPs for selected dams. The peer review team made the following observations concerning the development/content and the integration of the EAPs:

EAP Development/Content

- TVA EAPs comprise a generic front portion plus some site-specific appendices, including inundation maps. EAPs should be less generic and more tailored to individual sites.
- The flow chart provided in the EAP indicates the decision-making process for determining if an emergency exists, but does not define fully the notification chain. The decision process is relatively complex with many TVA groups interacting. The TVA Dam Safety Manager, who is responsible for directing emergency activities, is not involved in the initial decision as to whether an emergency is occurring. In addition, the indicated role of site hydro production support managers/personnel is only to notify TVA senior staff that a potential emergency situation exists. The decision-making chart in the generic portion of the EAP should be updated to include the Dam Safety Manager in the decision-making process and should better define the response of the hydro production support manager relative to implementing emergency response activities.
- A generic telephone list of EAP contacts is provided in the EAP. Emergency response individuals to be contacted for a specific site are not clearly indicated. A separate, facility-specific notification chart should be provided in the EAP for each dam.
- Reconnaissance of downstream inundation areas should be performed at least every five years to determine if there are substantive changes that could

affect the inundation analyses or warrant changes in the emergency response procedures (e.g., notification or evacuation of additional places or persons).

- The dam break simulation and inundation analyses for each dam should be reviewed periodically to determine that the basic inputs and data on which the analyses are based are still current and that the analytical methodologies are consistent with current practice.
- The EAPs provide no information relative to traffic control points, evacuation routes, or emergency reception and treatment centers. These functions are left to local authorities. TVA handles emergency response related to TVA property and supports the response actions of local authorities as requested. TVA should consider adding information such as traffic control points, evacuation routes, and emergency reception and treatment areas to inundation maps, or should verify that local emergency responders and agencies are prepared to handle these responsibilities in the event of EAP implementation.

EAP Integration

- The new Dam Safety Organization should strongly encourage all involved parties to become knowledgeable relative to EAP content and individual responsibilities in an emergency. It was observed by the peer review team that the familiarity of site personnel with EAP contents varied considerably.
- EAP tabletop and functional exercises are conducted at times for some facilities when deemed warranted by TVA, but the protocol for scheduling such exercises is not clearly defined. Marshall Miller understands that it is TVA's intent to conduct tabletop exercises for all high hazard dams, but some site hydro production support managers have not participated in EAP exercises, possibly due to reorganizations. Functional exercises are conducted for the most critical facilities in special circumstances but apparently are not scheduled regularly for all facilities at the present time. Tabletop exercises should be conducted concurrent with intermediate inspections (approximately every 15 months), and functional exercises should be conducted every five years for each high hazard dam in accordance with FEMA 64.
- There is insufficient staff support to prepare and annually maintain EAPs for 49 dams. Staff should be expanded consistent with the increased scope of activities and responsibilities. The emergency preparedness function should be more fully integrated into the overall TVA Dam Safety Program.

SYSTEMIC ISSUES FOUND IN OIG REVIEWS

While TVA's Dam Safety Program is taking strides to move from a reactive to a proactive culture, there are several issues that were identified in the Kingston Report that have also been noted during the course of this review. As noted in various places in this report, those issues relate to organization, accountability, and resources.

In the Kingston Report, it was noted that fragmented organizational responsibilities created silos that contributed to inadequate communication and that without policies and procedures it is unclear who is responsible for specific tasks. Similarly, in this review, there are areas of accountability and responsibility that are unclear. Maintenance was also noted as a "big problem" during the Kingston root cause analysis. Likewise, during this review, observations were made that staffing and funding should be increased in this area to promptly handle issues that arise at the plants and that the O&M Manuals for the plant are not updated regularly. Since these are all issues that negatively impacted TVA's management of the ash impoundments, the potential impact and risk of the parallel issues identified in this review of the Dam Safety Program should be thoroughly examined as part of TVA's effort to change the company's culture.

SUMMARY OF OIG AND MARSHALL MILLER RECOMMENDATIONS

In summary, the Senior Vice President, RO, should implement the following recommendations regarding the Inspection Program, Instrumentation Program, O&M Program, and EAPs.

Inspection Program

- If not already planned as part of the current reorganization, incorporate the Instrumentation Group and the Emergency Preparedness function into the Dam Safety Group.
- Implement a process whereby hydro production support managers are informed of Dam Safety Group activities that pertain to their facility and the results of inspections.
- Expand the scope of Dam Safety Awareness training to include a description of Dam Safety Group activities, instrumentation monitoring and data review, and other Dam Safety issues. Site personnel should also be made aware of the importance of inspections and instrumentation monitoring.
- Implement a procedure that requires periodic evaluation of site personnel conducting monthly inspections.
- Implement a dam inspector rotation schedule to make certain all dams are being reviewed by multiple inspectors.

Instrumentation Program

- Determine and document the appropriate staffing level for DS&I, taking into consideration needed support of personal safety, workload management, and emergency response.
- Increase the DS&I budget sufficiently to support (1) more prompt replacement of failed instruments and installation of additional instrumentation where necessary, (2) transition to automated data acquisition where reasonably justified and where Dam Safety issues warrant closer monitoring, and (3) enhanced mobile communications for field technicians.
- Implement actions to strengthen the interaction and cooperation between plant/site personnel and the DS&I Group.

O&M Program

- Provide the necessary staffing and funding so that individual facility maintenance issues can be handled promptly.
- Consider installation of remote video systems for facilities that are unmanned for long periods of time and for other critical dam features that could be disabled by sabotage.
- Implement a procedure requiring regular review and perform updates as necessary of the O&M Manuals.

EAP

- Expand the staff of the Emergency Preparedness function consistent with its recommended increased scope of activities and responsibilities.
- Integrate Emergency Preparedness more fully into the overall TVA Dam Safety Program.
 - ❖ Revise EAPs to be less generic and more tailored to individual sites. Specifically, each EAP should indicate what specific individuals/agencies necessary in emergency response are to be contacted in the event of an emergency and in what order. A facility-specific flow chart would be helpful in this regard.
 - ❖ Better define the role of the hydro production support manager/site personnel in emergency response.
- Require (1) tabletop exercises be conducted concurrent with intermediate inspections (approximately every 15 months) and (2) functional exercises be conducted every five years for each high-hazard dam in accordance with FEMA 64.
- Update the decision-making chart in the generic portion of the EAP and include the Dam Safety Manager in the decision-making process relative to implementing emergency response activities.
- Periodically review the dam break simulation and inundation analyses for each dam to determine that the basic inputs and data on which the analyses are based are still current and that the analytical methodologies are consistent with current practice.
- Add information such as traffic control points, evacuation routes, and emergency reception and treatment areas to inundation maps, and verify that local emergency responders and agencies are prepared to handle these responsibilities in the event of an EAP implementation.
- Perform reconnaissance of downstream inundation areas at least every five years to determine if there are any substantive changes that could affect the inundation analyses or warrant changes in the emergency response procedures (e.g., notification or evacuation of additional places or persons).
- Provide benchmark levels and conditions for defining the initiation or termination of an emergency situation in EAPs.
- Revise EAPs to include (1) the conditions for terminating an emergency, (2) the designated EAP Coordinator, and (3) information related to the instrumentation and warning systems for unmanned dams.

Systemic Issues

- The potential impact and risk of the parallel issues identified in this report should be thoroughly examined as part of TVA's effort to change the company's culture.

Management's Response – The Senior Vice President of River Operations in conjunction with the Dam Safety Officer provided comments on a draft of this report and agreed with our recommendations and plan to take corrective actions. Management's complete substantive comments are included in Appendix B of this report. TVA management also provided some administrative and clarifying comments for our consideration. These technical comments were reviewed and incorporated as appropriate.

Auditor's Response – We concur with TVA management's planned and completed actions to address our recommendations.



Energy/Environmental/Engineering/Carbon

TEAM QUALIFICATIONS & EXPERIENCE SUMMARY

Marshall Miller & Associates, Inc. (Marshall Miller), an employee-owned and Engineering News-Record (ENR) Magazine top 500 company, began offering geologic services to the mining industry in 1975. Marshall Miller is founded on a wealth of geo-environmental engineering experience and provides a range of services to the mining, utility, financial, governmental, and legal industries. Marshall Miller employs nearly 200 engineers, geologists, scientists and other professionals who work from regional offices in nine states. Marshall Miller retained D'Appolonia, Engineering Division of Ground Technology, Inc., of Monroeville, Pennsylvania, for its expertise with dams, levees, earthen embankments, tailings dams and impoundments, problem ground conditions, and forensic investigations. Although D'Appolonia has formally served as a contracted technical resource for the Marshall Miller team since March 2009, key personnel from Marshall Miller and D'Appolonia have had a working relationship since the 1970's. Since 1956, D'Appolonia has completed more than 200 dam related projects for water supply, hydroelectric power generation, flood control, irrigation, recreation, and tailings disposal.

In addition to designs for new construction, our work often involves rehabilitation and stabilization of nonperforming civil works, life extension and expansion of existing facilities. The following list describes the dam safety related capabilities and services for our project team:

- Siting / Design / Permitting and Feasibility
- Remedial Design / Value Engineering
- Flood Routing Analyses and Hydrology / Hydraulic Design
- Dam Break Analyses
- Public Hearings and Public Relations Activities
- Inspections and Incident Investigation
- Seismic Response Analyses
- Emergency Action Plans
- Subsurface Exploration Including Geologic and Hydrogeologic Studies
- Preparation of Permit Documents for Regulatory Approval
- Slope Stability Analyses
- Seismic and Liquefaction Studies
- Embankment Layout and Design
- 3-D Computerized Modeling and Color Renderings
- Construction Quality Assurance / Quality Control
- Potential Failure Mode Analysis

The Marshall Miller and D'Appolonia project team employs professionals specializing in civil and geotechnical engineering, geology and geophysics, water resources, hydrology and hydraulic engineering and construction management. Combined, Marshall Miller and D'Appolonia's team of qualified professionals has extensive experience with these facilities throughout many regions of the United States. Our project team has current knowledge of the permitting process and interfaces routinely with the federal and state agencies and individuals responsible for the review and issuance of permits in several states.

The Marshall Miller and D'Appolonia project team is comprised of the following professionals:

- Mr. William S. Almes, P.E., Director of Geotechnical Services and Project Manager for TVA OIG;
- Mr. Edmundo J. Laporte, P.E., Senior Engineer;
- Mr. William M. Lupi, P.E., Project Engineer;
- Mr. Richard G. Almes, P.E., Principal Geotechnical Consultant
- Mr. Christopher J. Lewis, P. E., Principal Geotechnical Engineer ;
- Mr. J. Timothy Onstott, P.E., Principal Geotechnical Engineer; and
- Mr. Aaron J. Antell, P.E., Project Engineer

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Associates
Ranked a Top
Engineering &
Design Firm by
ENR Magazine

Marshall Miller & Associates - Where Experience Matters

September 23, 2010

Robert E. Martin, ET 3C-K

REQUEST FOR COMMENTS - DRAFT INSPECTION 2009-12651 - REVIEW OF TVA'S DAM SAFETY PROGRAM

River Operations (RO) and TVA's Dam Safety Governance Organization (DSG) have reviewed Draft Inspection 2009-12651 and jointly submit the attached coordinated response.

As requested, RO and DSG have addressed each recommendation identified in the draft report and have indicated agreement/disagreement, actions taken or planned, and date actions were completed or are planned to be completed.

In light of when this inspection was initiated by the Office of the Inspector General, it is River Operations' understanding that this inspection was performed on River Operations' Dam Safety Program.


In March 2010, DSG was established by TVA as part of the Organizational Effectiveness Initiative. This organization is in the process of formalizing its structure and functions, as well as drafting a Governance document. To ensure that DSG develops a robust, comprehensive Governance document, it has been coordinating with the various TVA organizations that operate and maintain dam safety assets.

To that end, DSG provided responses to some of the recommendations of Draft Inspection 2009-12651.

We appreciate the opportunity to work with Heath Kulisek and Gregory Jaynes of your staff. Please contact us if you have questions or wish to discuss further.



John J. McCormick, Jr.
Senior Vice President
River Operations
LP 3D-C



Michael T. Scott
TVA Dam Safety Officer
LP 3D-C

MTS:HWL
Attachment
cc: See page 2

Robert E. Martin
Page 2
September 23, 2010

cc (Attachment):

Peyton T. Hairston, Jr., WT 7B-K
William R. McCollum, Jr., LP 6A-C
Joyce L. Shaffer, WT 9B-K
John M. Thomas III, MR 3A-C
Robert B. Wells, WT 9B-K
Wendy Williams, WT 9B-K
OIG File No. 2009-12651

Note of Clarification

River Operations' (RO) Non-Power Asset Program manages the dam safety assets that are operated and maintained by River Operations. These assets consist of 49 dams, 14 locks, and the appurtenant structures. This program was formerly named River Operations' Dam Safety Program.

The newly established TVA Dam Safety Governance program (DSG), which was created as part of TVA's Organizational Effectiveness Initiative, is responsible for developing a comprehensive dam safety program that will provide the framework by which all TVA-owned and operated dam safety structures will be assessed to determine compliance with the Federal Guidelines for Dam Safety.

INSPECTION PROGRAM		
#	Recommendation	Plan of Action
1	If not already planned as part of the current reorganization, incorporate the Instrumentation Group and the Emergency Preparedness function into the Dam Safety Group.	<p>RO Response: As part of TVA's Organizational Effectiveness Initiative, RO established the Non-Power Asset Program, which is responsible for managing RO's dam safety assets. Instrumentation and Emergency Preparedness are part of the Non-Power Asset Program. RO's Non-Power Asset program will incorporate into its existing program TVA's Dam Safety Governance procedures related to Instrumentation and Emergency Preparedness following the implementation of the Governance procedures.</p> <p>Target Date: 3/31/2012</p> <p>DSG Response: The TVA Dam Safety Governance (DSG) organization was established by TVA as part of the Organizational Effectiveness Initiative and directed to establish a comprehensive dam safety program. The TVA DSG is in the process of developing procedures that will provide guidance to TVA organizations that operate dam safety structures on the necessary instrumentation and emergency preparedness functions that must be performed. The TVA DSG procedures will also include guidance on the following dam safety functions: (1) Design; (2) Construction; (3) Operations, Maintenance & Repair; and (4) Inspections. The Governance organization, Governance procedures, and training on Governance procedures are scheduled to be fully implemented by the end of FY11.</p> <p>Target date: 9/30/2011</p>
2	Implement a process whereby plant managers are informed of Dam Safety Group activities that pertain to their facility and the results of inspections.	<p>RO Response: RO does not have plant managers. Currently RO has Regional Managers who are responsible for Hydro Production (HP) plant groups and Support Managers who are responsible for a specific plant or plants.</p> <p>RO's Non-Power Asset Program (RO NPA) inspection program currently notifies HP Regional and Support managers of any significant inspection findings within five days by e-mail and provides copies of the inspection report within 30 days of the inspection. RO NPA will provide dam safety inspection training to the HP Management staff on October 26, 2010. The training will contain information to interpret the reports and the recommendations. The training can then be cascaded by HP management throughout the HP organization. The training will request HP management staff to cascade inspection reports and/or a summary of findings through the organization. RO NPA inspectors will also provide advanced</p>

		<p>notifications to the HP Regional and Support managers of upcoming inspections.</p> <p>Target date: 12/31/2010</p>
3	<p>Expand the scope of Dam Safety Awareness training to include a description of Dam Safety Group activities, instrumentation monitoring and data review, and other Dam Safety issues. Site personnel should also be made aware of the importance of inspections and instrumentation monitoring.</p>	<p>RO Response: RO will expand the Dam Safety Awareness training to include descriptions of dam safety activities not already identified during training or in training material. RO will also provide an electronic copy of the training to HP management staff that can be distributed throughout the organization.</p> <p>Target date: 9/30/2011</p> <p>DSG Response: The TVA DSG will develop appropriate dam safety training materials and conduct training sessions as part of the implementation of the Dam Safety Governance procedures. The TVA DSG training program will incorporate the recommendations of the Inspector General. The Governance organization, Governance procedures, and training on Governance procedures are scheduled to be fully implemented by the end of FY11.</p> <p>Target date: 9/30/2011</p>
4	<p>Implement a procedure that requires periodic evaluation of site personnel conducting monthly inspections.</p>	<p>RO Response: RO NPA will implement TVA Dam Safety Governance requirements to perform periodic evaluations of staff performing monthly inspections.</p> <p>Target date: 3/31/2012</p> <p>DSG Response: As part of the TVA DSG procedures, there will be a specific procedure on Inspections that will require dam safety asset owners to perform periodic evaluations of people performing inspections. The Governance organization, Governance procedures, and training on Governance procedures are scheduled to be fully implemented by the end of FY11.</p> <p>Target Date: 9/30/2011</p>
5	<p>Implement a dam inspector rotation schedule to make certain all dams are being reviewed by multiple inspectors.</p>	<p>RO Response: RO NPA current practice is to rotate inspectors. RO NPA will proceduralize this practice in accordance with TVA Dam Safety Governance inspection requirements.</p> <p>Target date: 3/31/2012</p> <p>DSG Response: As part of the TVA DSG procedures, there will be a specific procedure on Inspections that will require dam safety asset owners to use only qualified dam safety inspectors and periodically rotate the inspectors. The Governance organization, Governance procedures, and training on Governance procedures are scheduled to be fully implemented by the end of FY11.</p> <p>Target Date: 9/30/2011</p>
INSTRUMENTATION PROGRAM		
6	<p>Determine and document the appropriate staffing</p>	<p>RO Response: RO's Non-Power Asset Program will review the</p>

	level for DS&I, taking into consideration needed support of personal safety, workload management, and emergency response.	budget, current staffing levels, and workload of the DS&I Group and appropriately document existing or potential resource gaps. Identified gaps will be appropriately addressed as part of the FY12 Business Planning Cycle. Target date: 7/30/2011
7	Increase the DS&I budget sufficiently to support (1) more prompt replacement of failed instruments and installation of additional instrumentation where necessary, (2) transition to automated data acquisition where reasonably justified and where Dam Safety issues warrant closer monitoring, and (3) enhanced mobile communications for field technicians.	RO Response: RO will review the DS&I budget, and incorporate, where appropriate, increases for instrumentation, automated data acquisition, and mobile communications as part of the FY12 Business Planning Cycle. Target date: 7/30/2011
8	Implement actions to strengthen the interaction and cooperation between plant/site personnel and the DS&I Group.	RO Response: RO will work with the appropriate plant/site personnel to strengthen the interaction between the plants and DS&I. RO NPA will provide dam safety instrumentation training to the Hydro Production (HP) Management staff on October 26, 2010. The training will be cascaded by HP management throughout the HP organization. DS&I personnel will also provide advanced notifications to the HP Regional and Support managers of upcoming instrumentation readings. Target date: 12/31/2010
O&M PROGRAM		
9	Provide the necessary staffing and funding so that individual facility maintenance issues can be handled promptly.	RO Response: RO's existing Non-Power Asset Dam Safety Program identifies Maintenance and Repair (M&R) items during an inspection and assigns responsibility for completing the M&R items, as well as a due date for each M&R item. RO coordinates resources with TVA's Facilities Management and Power Service Shops to address many of the M&R items identified during an inspection. As part of the FY12 Business Planning cycle, RO will review existing resources assigned to manage M&R items and determine where improvements or efficiencies can be made. Target date: 7/30/2011
10	Consider installation of remote video systems for facilities that are unmanned for long periods of time and for other critical dam features that could be disabled by sabotage.	RO Response: All of RO's dams are inspected on a routine basis in order to ensure instrumentation is functioning correctly. These inspections provide adequate opportunity to identify possible sabotage of equipment/instrumentation located at the dam. As part of the FY12 Business Planning cycle, RO will re-evaluate the need to install remote video systems at its dams. Target date: 7/30/2011
11	Implement a procedure requiring regular review and perform updates as necessary for the O&M Manuals.	RO Response: RO NPA will implement an O&M Manual procedure in accordance with Dam Safety Governance requirements. Target Date: 3/31/2012 DSG Response: As part of the TVA DSG procedures, asset owners will be required to maintain Operation & Maintenance Manuals

		<p>throughout the life of the structure. The asset owners will be responsible for updating the manual as required to remain current. The Governance organization, Governance procedures, and training on Governance procedures are scheduled to be fully implemented by the end of FY11.</p> <p>Target Date: 9/30/2011</p>
	EAP	
12	<p>Expand the staff of the Emergency Preparedness function consistent with its recommended increased scope of activities and responsibilities.</p>	<p>RO Response: RO has a workforce plan and succession plan that it updates regularly and which is used to identify workforce needs. RO recently hired an employee to support Emergency Preparedness activities.</p> <p>Target Date: Complete</p>
13	<p>Integrate Emergency Preparedness more fully into the overall TVA Dam Safety Program.</p> <p>*Revise the EAPs to be less generic and more tailored to individual sites. Specifically, each EAP should indicate what specific individuals/agencies necessary in emergency response are to be contacted in the event of an emergency and in what order. A facility-specific flow chart would be helpful in this regard.</p> <p>*Better define the role of the plant manager/site personnel in emergency response.</p>	<p>RO Response: There is no TVA Dam Safety Program. Please reference the Note of Clarification at the beginning of the recommendations.</p> <p>RO maintains an Emergency Action Plan (EAP) for each dam, which includes a contact list of individuals and emergency management agencies that need to be contacted. RO will incorporate into its existing EAPs better definitions of the roles and responsibilities of site personnel. In addition, RO will incorporate additional procedures or requirements as part of the TVA Dam Safety Governance procedures.</p> <p>Target Date: 3/31/2012</p> <p>DSG Response: As part of the TVA DSG procedures, there will be an Emergency Preparedness procedure that defines specific requirements that the asset owners must implement. The Governance organization, Governance procedures, and training on Governance procedures are scheduled to be fully implemented by the end of FY11.</p> <p>Target Date: 9/30/2011</p>
14	<p>Require (1) tabletop exercises be conducted concurrent with intermediate inspections (approximately every 15 months) and (2) functional exercises be conducted every five years for each high-hazard dam in accordance with FEMA 64.</p>	<p>RO Response: RO will adhere to the TVA Dam Safety Governance procedures pertaining to tabletop and functional exercises.</p> <p>Target Date: 3/31/2012</p> <p>DSG Response: As part of the TVA DSG procedures, there will be requirements concerning tabletop and functional exercises in accordance with FEMA 64. The Governance organization, Governance procedures, and training on Governance procedures are scheduled to be fully implemented by the end of FY11.</p> <p>Target Date: 9/30/2011</p>

15	Update the decision-making chart in the generic portion of the EAP and include the Dam Safety Manager in the decision-making process relative to implementing emergency response activities.	RO Response: The current RO organization does not include the role of Dam Safety Manager. RO will revise the decision making charts in the existing EAPs. Target Date: 3/31/2011
16	Periodically review the dam break simulation and inundation analyses for each dam to determine that the basic inputs and data on which the analyses are based are still current and that the analytical methodologies are consistent with current practice.	RO Response: RO performs periodic evaluations of the dam break and inundation analyses and updates as necessary. Target Date: Complete
17	Add information such as traffic control points, evacuation routes, and emergency reception and treatment areas to inundation maps, and verify that local emergency responders and agencies are prepared to handle these responsibilities in the event of an EAP implementation.	RO Response: The State and local emergency management agencies (EMAs) are responsible for establishing and managing the communication of traffic control points, evacuation routes, and emergency reception and treatment areas. RO provides State and local EMA's with inundation maps in order to aid them in establishing appropriate evacuation routes. An addition, RO performs interagency tabletop and functional exercises with the State and local EMA's to ensure coordination and share knowledge. Target Date: Complete
18	Perform reconnaissance of downstream inundation areas at least every five years to determine if there are any substantive changes that could affect the inundation analyses or warrant changes in the emergency response procedures (e.g., notification or evacuation of additional places or persons).	RO Response: RO meets with State and local emergency management agencies (EMAs) on an <u>annual</u> basis to review and update Emergency Action Plans. One of the items reviewed at the annual meeting is the inundation maps and the State and local EMAs adjust their emergency plans to reflect any changes to the inundation maps identified at the annual meeting. TVA is not responsible for analysis within the inundation area, maintaining EMA emergency response procedures, ensuring appropriate evacuation routes, or notifying residents of emergencies. This is the responsibility of the State and local EMA's. Target Date: Complete
19	Provide benchmark levels and conditions for defining the initiation or termination of an emergency situation in EAPs.	RO Response: RO will develop benchmark levels and conditions for defining the initiation or termination of an emergency situation in RO's EAPs. Target Date: 9/30/2011
20	Revise EAPs to include (1) the conditions for terminating an emergency, (2) the designated EAP Coordinator, and (3) information related to the instrumentation and warning systems for unmanned dams.	RO Response: RO will revise EAPs to include the conditions for terminating an emergency, the designated EAP Coordinator, and information related to the instrumentation and warning systems for unmanned dams Target Date: 9/30/2011
SYSTEMATIC ISSUES		

21	The potential impact and risk of the parallel issues identified in this report should be thoroughly examined as part of TVA's effort to change the company's culture.	<p>RO Response: RO will incorporate and adhere to the TVA Dam Safety Governance procedures.</p> <p>Target Date: 3/31/2012</p> <p>DSG Response: The TVA Dam Safety Governance (DSG) organization was established by TVA as part of the Organizational Effectiveness Initiative and directed to establish a comprehensive dam safety program. The Governance organization, Governance procedures, and training on Governance procedures are scheduled to be fully implemented by the end of FY11.</p> <p>Target Date: 9/30/2011</p>
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