

**JOINT REPORT OF THE TECHNICAL ADVISORS OF THE  
INTERNATIONAL BOUNDARY AND WATER COMMISSION REGARDING THE  
GEOTECHNICAL, ELECTRICAL, MECHANICAL & STRUCTURAL SAFETY OF  
RETAMAL DAM**

To the Honorable Commissioners  
International Boundary and Water Commission (IBWC)  
United States and Mexico  
El Paso, Texas and Ciudad Juarez, Chihuahua

Sirs:

The undersigned Technical Advisors to the Commission visited Retamal Dam on April 26, 2007, with the objective of physically inspecting the dam and reviewing the limited records available relative to the dam's geotechnical, electrical, mechanical, and structural features. We were briefed on actions taken to comply with recommendations of prior technical inspections. Our review did not cover hydrologic issues or hydraulic adequacy.

**Conclusions**

The project appears in good visual condition and appears on the surface to be generally well maintained. The electrical and mechanical equipment is capable of operating under normal conditions. However, until the identified center gate oscillation issue that occurs during flood events is resolved, the operation procedures should be modified as described below. The recommendations which are presented below should be implemented within a reasonable time frame.

Based on our observations, review of records, and in consideration of the project experiences, we conclude that the dam is conditionally unsafe as described below. Starting in the next funding request cycle, the recommendations below should be given high priority.

**General Recommendations**

1. Providing future technical advisors with briefing packages that include summaries and histories of such items as project experiences, repairs, as-built drawings, and instrumentation readings (tabular and graphical) should be continued. The briefing packages should be furnished at least three weeks in advance of scheduled inspection dates. In addition, a historical digest or document (including photographs) should be created that records history of incidents, problems and conditions that have been observed and dealt with at the project.
2. Continue with actions associated with recommendations from previous joint inspections that are applicable.

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**Electrical/Mechanical Recommendations**

1. In August 2005 the Retamal gates were used to regulate river flow of approximately 9,000 cfs. The quantity of flow released through the dam to the Rio Grand River downstream of Retamal was being regulated by operating the center gate. Upstream pool elevation was slightly above the top of the Mexico diversion weir. This gate began to oscillate and this apparently produced slack in the lifting cables connected to the walking beam. A cable jumped off the sheave in the float well and it was no longer possible to operate the center gate. The ability of the dam to regulate flow was compromised. Gate oscillation also had the potential to damage or fail gate and/or hoist components. There have been several unsuccessful gate and gate lifting system modifications in the past to eliminate gate oscillations.

Recommend that the gate lifting system be modified as follows: Eliminate the existing gate lifting system including the lifting link, walking beam, counterweight, and cable hoist. Construct a new hoist machinery bridge upstream of the center gate between the side gate interior piers. Install a new gate cable hoist supported by the machinery bridge. Connect the hoist to the gate by lifting cables on each gate side with hitches (pivotal cable connections) near the bottom of the gate. The resulting center gate hoist system will be similar to the existing one for the side gates.

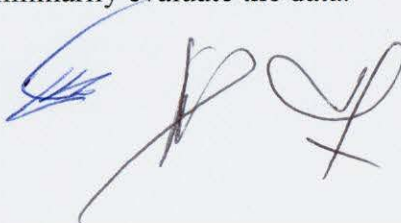
Until this modification is accomplished, recommend the following flood operating procedure: Leave the center gate fully closed as long as possible and use the two side gates to regulate the quantity of flow released downstream.

2. Continue the current electrical-mechanical maintenance program.
3. Repair transfer switch for emergency generator on Mexico side.
4. Continue plans for purchase of new emergency power generator, U.S. side, and construction of multipurpose building for generator, bathrooms, and air compressor.
5. Remove paint from sacrificial anodes on gates, where applicable.
6. Consider complete digital upgrade of Retamal Control Room, following similar upgrade of Anzalduas.

**Geotechnical/Structural Recommendations**

1. An annual Safety of Dams inspection and report should be prepared for Retamal Dam. This report would be similar in scope as the present Safety of Dams reports for Amistad Dam and Falcon Dam. Instrumentation of Retamal Dam should continue to be monitored and the data recorded. The data should be evaluated and presented in the annual Safety of Dams report.

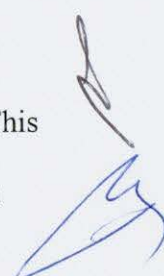
2. Train personnel from both sections in the use of instrumentation in order for them to be able to preliminarily evaluate the data.



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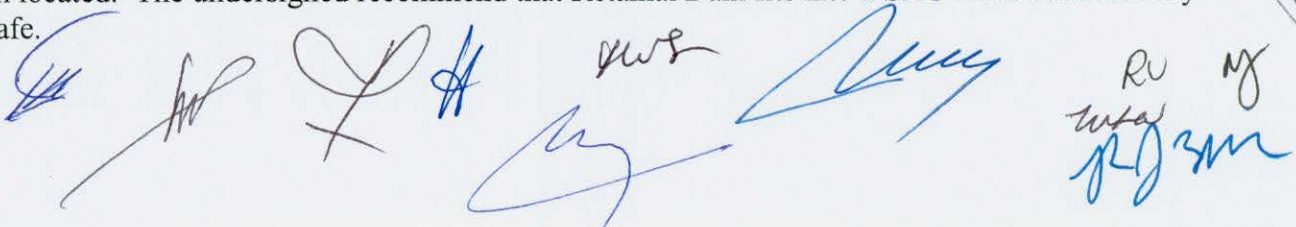
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3. Replace the damaged joint monitors and install the appropriate protection on new monitors.
4. Horizontal alignment surveys should be established to monitor the gate abutment piers and gate interior piers for upstream or downstream movements. This would require two survey monuments to be installed on each gate abutment pier and on each gate interior pier, one upstream and one downstream. Monitoring of the overall horizontal alignment and review of the as-built foundation drawings are needed to evaluate the continuing differential settlement. Readings should be performed annually, evaluated and presented in the annual Safety of Dams report.
5. Remove the sedimentation/sand bar with trees located downstream of the structure on the left side of the discharge channel to re-establish the original cross-section. The U.S. Section has applied for and obtained the necessary environments permits to perform this work. However, joint funding was reportedly not currently available. Since the permits are valid only through 2009, priority should be given to jointly funding and accomplishing this work prior to then.
6. The project Emergency Action Plan (EAP) should continue to be updated on an annual basis to maintain current emergency phone numbers, supply lists, and contractors. The effort should be continued to create a joint plan usable by both countries. The IBWC should continue to encourage the development and testing of evacuation plans by the responsible local authorities. Joint emergency exercises by both countries should be conducted to test the EAP.
7. Drains should be installed in both upstream and downstream in the retaining walls in each abutment. The location and number of drains in each wall should be designed by a qualified geotechnical/structural engineer.
8. The inspection team recommends that a risk based action classification that is being developed by the Corps of Engineers is appropriate for application to the IBWC dams. The Corps is assessing its dams and will place each dam into Dam Safety Action Classes (DSAC) based on their individual dam safety risk considered as probability of failure and potential failure consequences. This allows the Corps to focus on the correct dam safety issues and not the 'next on the list' or 'one size fits all' in a time of constrained resources. There are five Dam Safety Action Classes as follows:

DSAC I – URGENT AND COMPELLING (Unsafe)  
DSAC II – URGENT (Potentially Unsafe)  
DSAC III – HIGH PRIORITY (Conditionally Unsafe)  
DSAC IV – PRIORITY (Marginally Safe)  
DSAC V – NORMAL (Safe)

Assignment of a DSAC to Retamal Dam at this point has to be based on engineering judgment because the level of risk is not known; i.e., the project has a high population and high infrastructure at risk in both the U.S. and Mexico, and the probability of unsatisfactory performance (failure) is unknown. As-built foundation drawings and design documents have not been located. The undersigned recommend that Retamal Dam fits into DSAC-III as conditionally unsafe.



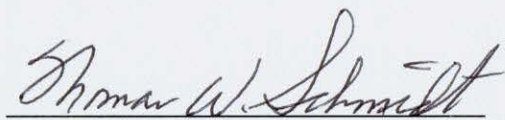
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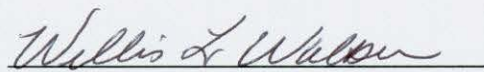
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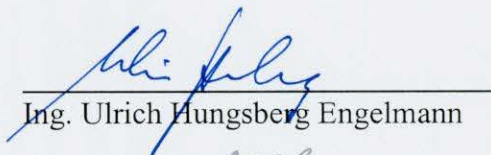
  
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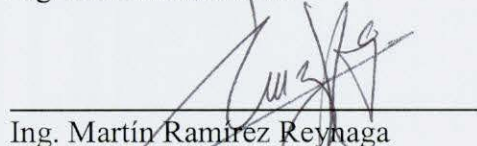
  
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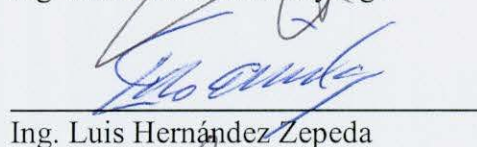
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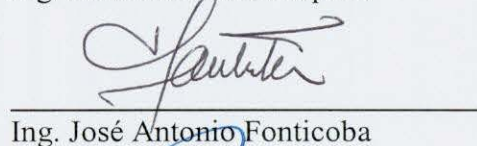
  
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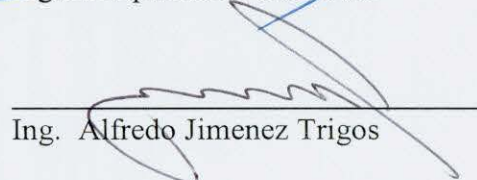
  
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