

Markland Gate Failure

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Operations Managers

LRL / LRP

11 February 2010

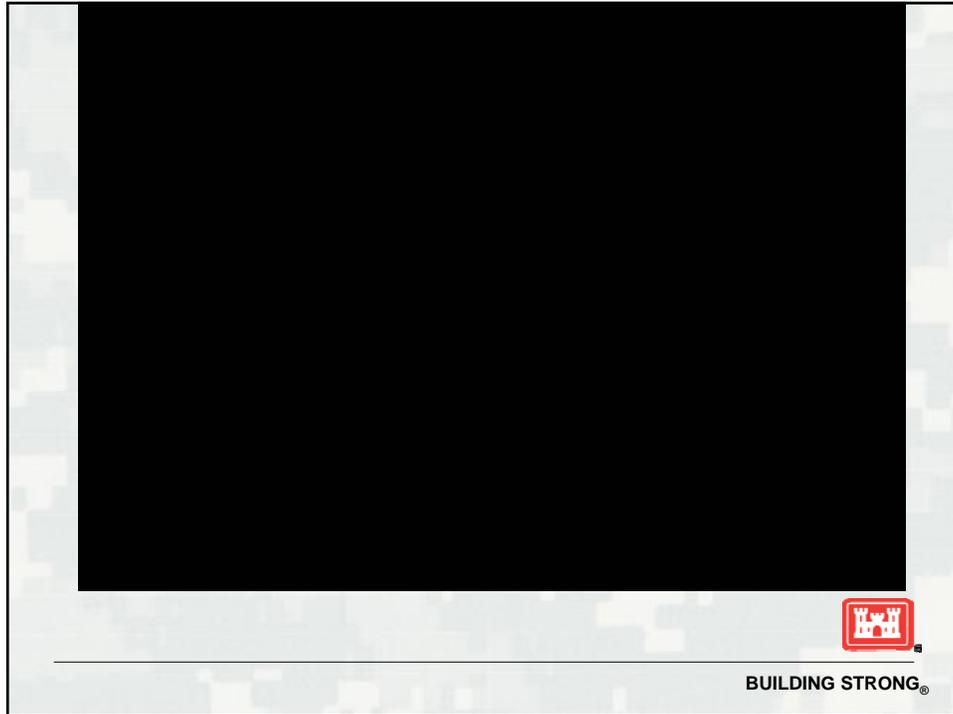


Markland Gate Failure General

- 2008 tonnage = 53.2M
- Averages 10 – 15 tows per day
- 1,200' main, 600' auxiliary chambers



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Markland Gate Failure Chain of Events

- At 0744 on 27 September 2009 the M/V Stephen L. Colby completed downbound lockage through the main chamber.
- M/V CQ Princess enters the main chamber to lock upbound.



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Markland Gate Failure Chain of Events

- Operators prepare to lock the M/V CQ Princess by closing the emptying valves, making sure the CQ Princess is secure, and closing lower miter gate.
- Flow entering chamber through the open filling valve overpowers the hydraulics and slams gate leaves together.



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Markland Gate Failure Chain of Events

- Leaves are not properly mitered as chamber continues to fill. Operators try to close filling valve but failed solenoid is holding pilot valve in the open position.
- Mitering device buckles under the load and the gate leaves move over the sill, the strut arms break away, and three of four anchor arms fail.



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Markland Gate Failure Chain of Events

- The river wall (rw) leaf breaks away and falls into the chamber.
- The middle wall (mw) leaf is pointing downstream with one anchor arm holding it in place.
- 0800 – lockmaster and operations managers notified of the incident.
- Ohio River closed at Markland L/D.



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Chain of Events



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Chain of Events



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Response

- Solenoid valve is disassembled and pilot valve closed by hand. Filling valve closes.
- Louisville Repair Station fleet is moved out of the auxiliary chamber and moored on the lower approach wall.
- Transit is set up to monitor movement of the mw leaf.



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Response

- At 2030 on 27 September 2009 Colonel Landry approves opening the auxiliary chamber to traffic.
- Ohio River reopens to traffic at Markland L/D.



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Recovery and Repair

- Developed plan with Engineering Division to stabilize mw gate leaf.
- Survey crew dispatched to locate the rw gate leaf.
- Towing industry is engaged to coordinate lockages through auxiliary chamber.



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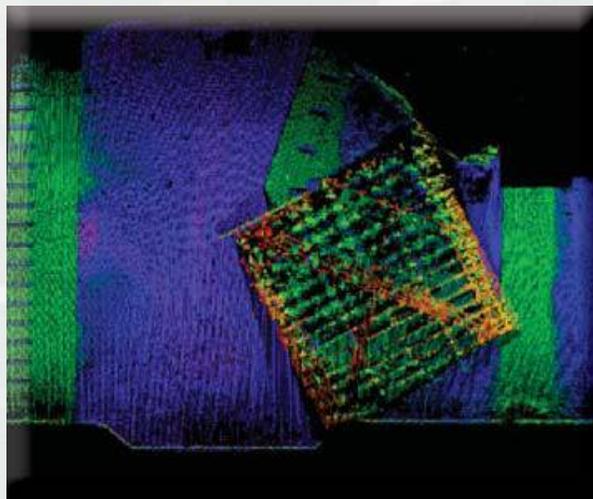
Recovery and Repair

- Survey crew finds rw leaf partially blocking the bulkhead sill. Leaf must be moved to set bulkheads.
- Corps determines hiring a contractor is most efficient method to move rw leaf.
- Towing industry requests a helper boat be supplied by the Corps.



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Recovery and Repair



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Recovery and Repair

- New miter gate leaf contract is accelerated to a mid-March 2010 delivery.
- Helper boat contract is awarded.
- Corps contracts salvor to move rw miter gate leaf.
- Lifted mw leaf on 19 October and placed on the DeLong barge.



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Recovery and Repair



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Recovery and Repair



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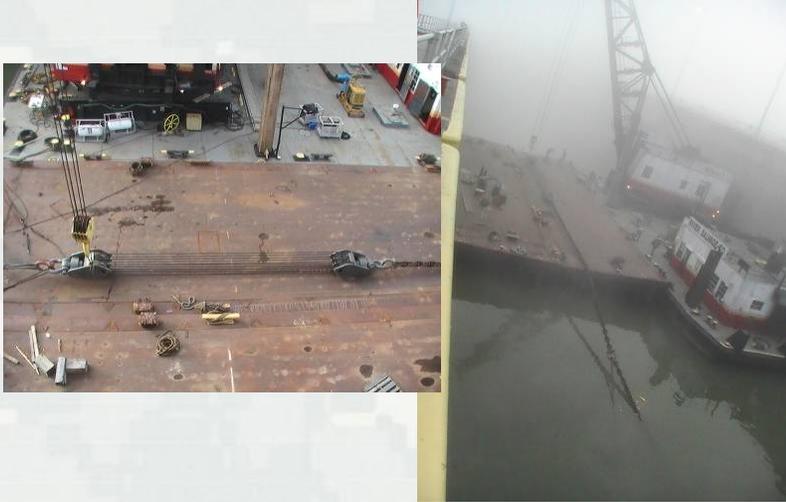
Recovery and Repair

- Salvage contractor moved rw leaf off the bulkhead sill on 25 October.
- Corps set bulkheads, dewatered chamber and installed eight point lifting system.
- Lifted rw leaf out of chamber and placed it on the DeLong barge on 10 November.



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Recovery and Repair



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Recovery and Repair



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Recovery and Repair

- Fleet returns to Louisville to repair gate leaves on 13 November.
- Completed gate leaf repair 12 January 2010.
- Installation of repaired leaves is river dependent. Chamber must be dewatered.



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Actions

- Solenoids at all projects have been checked. Older units will be replaced.
- Operation of interlock systems checked. Plans are being developed to enhance the interlocks.
- Reviewed lockage procedures with all lock operators.



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Standing Gate Recovery



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Horizontal Leaf Recovery



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Damage to Gate



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Damage to Gate



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Other Damage



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Repairs



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Markland Gate Failure

OP ORD 2009-4 Tasks

- Continue FEM implementation
- Maintenance interval and inspection procedure for solenoids and indicators
- Add “valve to gate” interlock
- Inspect/Improve control ergonomics
- Standardize lock operating procedures, training and certification



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Markland Gate Failure

OP ORD 2009-4

- Increase public/customer awareness to report any unusual conditions during lockages
- Develop a system wide Failure Mode Effects Analysis (FMEA)
- Develop a written checklist for each lock operation



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Questions?



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