

Saluda Dam Remediation

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Updated Frequently-Asked Questions and Answers

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of the
Federal Energy Regulatory Commission**

- **What is the problem at Saluda Dam?**

It has been determined that a recurrence of the 1886 Charleston Earthquake (magnitude 7.3-7.5) would cause the Saluda dam to fail. Such an earthquake is expected once every 450 years.

- **Why is the dam remediation necessary?**

Lake Murray reservoir contains 2,200,000 acre-feet of water. Failure of the Saluda Dam would cause major flooding for many miles downstream, including the city of Columbia, flooding a population of over 100,000, with an expected significant loss of life. As an example of the extent of flooding estimated, the Gervais Street bridge would have about 58 feet of water going over it within about 6 to 7 hours of a failure of the Saluda Dam. This is about 106 feet above the Congaree River.

- **Why now?**

The Saluda Dam was completed in 1930 and over the years has been modified to satisfy current engineering criteria. In recent years, a better understanding of the Charleston Earthquake has been developed. The dam owner, South Carolina Electric & Gas Company (SCE&G) was directed to determine how this new information would affect its dam. Analyses completed by SCE&G and reviewed by FERC now reveal that the dam would fail under a repeat of the Charleston Earthquake.

- **Does the dam have to be fixed right away?**

SCE&G has been required to design and construct the fix on an expedited schedule. While the dam is safe under normal loading conditions, there is a very real danger to downstream life and property if an earthquake occurs.

By seismic design standards, the design earthquake at Saluda Dam has a very short recurrence interval (once every 450 years) and we are already 116 years into that short period. By comparison, the design earthquake used in most dam safety remediations on the west coast (California, Oregon, and Washington) have a recurrence interval of once every 2000-2500 years. Most importantly, while we have fairly dependable historical information on which to base the recurrence interval, there is no guarantee that an earthquake that would fail Saluda dam will not occur at anytime.

It is FERC's assessment that the seismic fix should proceed on an expedited basis without any delay. Further, the independent Board of Consultants (BOC) comprised of the most preeminent dam safety experts in the world, and expert consultants retained by FERC who are also among the leading seismic and geotechnical experts in the world, support that assessment.

- **With a recurrence interval at 450 years, and the 1886 event occurring some 116 years ago, are we safe for the next 334 years?**

No. This recurrence interval may seem to represent an improbable and distance event, but in reality represents a very active seismic environment on the same order as major earthquakes in California. For large structures such as dams, with great potential for destruction and loss of life, the recurrence of this earthquake must be viewed as an event that could occur in the near future. There is no guarantee that an earthquake that would fail Saluda dam will not occur at anytime. The science of seismic predictions has not advanced to the point of allowing exact determinations of when earthquakes will occur.

- **What is the solution?**

The remediation plan is to build a massive dam of rock with a roller-compacted concrete mid-section, immediately downstream of the existing dam. This would serve as a backup dam and retain the reservoir, if the existing dam ever failed.

- **How long will it take to construct the new dam?**

Construction is scheduled to begin in the Fall of 2002 and be completed in early 2006. Once the contract for construction has been awarded the schedule will be better established by the contractor. The completion of construction could be sooner.

- **Does South Carolina Electric & Gas Company have to do this?**

Yes. SCE&G holds a license to operate and maintain the Saluda Project. The license was issued by the Federal Energy Regulatory Commission, which has jurisdiction over this hydropower project. FERC has ordered that this project be remediated for the protection of life and property. SCE&G has been ordered to award the construction contract no later than August 12, 2002.

- **Are There Options?**

Yes, several options were considered. One option was to permanently return the Saluda River to its original state and remove the dam. Another option was to return the Saluda river to its original state while removing the existing dam and building a new dam. Another option was to permanently operate at much lower lake levels. Another option considered was a process called super jet grouting, in which cement-like support columns would be injected into the dam. Of all the options considered, the current remediation plan will cause the least disruptions to the area.

- **Will the lake level be impacted by the work?**

Yes, the lake level must be lowered. The BOC reviewing the project recommended that water levels be lowered during the early phases of construction of the new dam. The remediation will require excavation at the toe of the existing dam to depths of 60 feet (plus or minus). During this period of excavation and backfilling in the toe of the dam, it is necessary to relieve some of the forces in the dam to maintain adequate stability of the structure. The excavation into the downstream toe of the dam reduces the stability of the dam. Lowering the reservoir reduces these forces on the dam. The BOC found that the chance for any movement of the materials in the dam is significantly decreased as the lake water level is lowered. Based on those findings, FERC has directed SCE&G to lower water levels to an elevation of 345 feet - 13 feet lower than normal. To counterbalance the reduction of stability due to the excavation, the reservoir level needs to be reduced enough to maintain the stability of the dam at the level that currently exists at the full reservoir without the excavation. The reservoir level at 345 feet maintains the current level of stability. The water will remain at that level until the first phase of construction (excavation and backfilling of the toe of the existing dam) is complete. This period is expected to begin in the Fall of 2002 and last about 20 months. The 20 month period could potentially be shortened depending on how the dam reacts during construction. The dam will be monitored very closely during this critical phase of construction. The current schedule is based on conservative engineering assumptions. Real data obtained during construction may allow the excavation phase of the construction to be shortened. Once the excavation and backfilling is complete the lake can be raised while the remaining phases of construction are completed.

- **How long has lowering the lake level been under consideration?**

The need to lower the lake level was just discovered in February 2002. SCE&G has said that it would avoid lowering the lake if at all possible. However, as the results of more studies became available, it was determined that normal water levels are not an option. The risk to downstream life and property is significantly reduced if the reservoir is lowered to Elevation 345 during construction. While lower water levels will create disruption for lake dwellers, businesses and users alike, the safety of the public cannot and must not be compromised.

- **Is it possible the lake will be lowered to less than 345 feet?**

Based on current information, the lake will not have to be lowered below 345 feet. However, if any unanticipated facts or events arise during construction to indicate otherwise, the lake will be lowered to a level that allows for the safe completion of the work. We will not compromise safety. We will keep the public apprised if such an action becomes necessary.

- **Is 345 a lot lower than normal operating levels?**

The elevation typically fluctuates between 350 and 358 feet over the course of a year. The project license allows SCE&G to operate between 345 and 360 feet.

- **Why was 345 feet selected as the appropriate level?**

Once it was determined that the water level needed to be lowered for safety reasons, SCE&G was asked to study the impacts of lowering water levels to 330, 335, 340 and 345 feet. Although the 330 lake level provides the most increase in stability, the FERC determined that elevation 345 was the maximum lake level compatible with safe construction. This lake level, along with extensive dewatering at the dam toe, maintains the overall stability at the same level that currently exists in the dam. This design philosophy reduces concern over the possible generation of large pore pressures in the dam due to increased shear strains during excavation, a process that would weaken the dam.

The 345 lake level reduces the 2.2 million acre-feet lake volume by approximately 30%. Should serious problems arise during construction, and further drawdown is required on an emergency basis, the lowered reservoir at elevation 345 will reduce the time required to achieve a safe and stable condition.

The lowered lake level will reduce the water pressure exerted on the dam and the resulting pore pressures felt in the soil at the toe excavation. This lessens the likelihood of a piping failure, a process of soil removal by seeping water that bypasses the dewatering system through rock fractures or other unforeseen defects in the dam and foundation.

The 345 level has the least impact on lake residents, users and businesses of the options considered, allows SCE&G to operate within its current license limits, and maintains overall stability of the dam. It also has the least impact on municipal water systems serving Newberry, West Columbia and Columbia

- **How will the lake level be lowered?**

The lake will be lowered by passing the water through the hydropower project. A plan to monitor the dam during the lowering of the reservoir will be developed and implemented. In addition, the reservoir will be lowered no faster than ½ foot per day.

- **When will the lake be lowered?**

The anticipated schedule is that the lake will be lowered in the fall of 2002 and will be at the targeted 345-foot elevation by the time construction begins, which should be in late October or early November.

- **How long will the lake remain at the lower level?**

The project will have several key phases. One phase involves excavating and backfilling in areas adjacent to the downstream toe of the dam, to depths of 60 feet (plus or minus) to reach the bedrock. This phase will be done over 20 to 24 months in sections approximately 250 feet long, or slightly less than the length of a football field. The lake will remain lowered during this entire period. This decision will be reviewed if the initial phases of dewatering achieve greater than expected results, and if the instrumentation during excavation shows no undesirable movement or material response. The review, based on actual dam behavior during construction, may allow the drawdown criteria to be relaxed and the reservoir levels increased. Regardless, once the excavation and backfilling phase is complete, the plan is to return the reservoir to its normal operating level. It is expected that the reservoir can remain at normal levels during the other phases of the new dam construction.

- **What are the other phases? How will this massive structure be built?**

The first phase will be an extensive "dewatering" program to remove water from within the dam -- which is common in earthen dams -- to a safe working level. This is the most critical requirement to complete before safely beginning construction. The next phase will be the excavation work in the existing dam toe and in the areas downstream of the toe of the dam. Next, the excavations will be backfilled and reinforced with conventional concrete, roller-compacted concrete or soil and rock, depending on the location. Finally, once the areas adjacent to the toe of the dam are fully reinforced, the final construction phase of the new dam, the new rockfill berm and RCC section, will begin. Again, once the excavation and backfilling phase is completed, the reservoir can be raised to normal levels during the remaining phases of construction.

- **Will the highway remain open during construction?**

Yes. SCE&G is working closely with the Department of Transportation. The highway will remain open, and an additional two-lane segment will be built adjacent to the existing highway, during construction of the new dam.

- **What precautions will be taken during construction should an emergency develop?**

An emergency action plan is in effect now, and will be in effect during construction. This plan has been tested and improved by input from emergency management agencies. There will be another test of the emergency action plan in August 2002. SCE&G works closely with state and county emergency preparedness officials on a regular basis and continues to collaborate on improvements to the communication system. Should an emergency develop during construction, the 30% reduction of reservoir volume (reservoir level reduced to 345 feet) will give the emergency management personnel additional time to react to an emergency.

- **How will the lower lake levels impact marina owners, businesses, recreational areas, boat docks, and fishermen?**

Lower lake levels will impact all of these to some extent. FERC staff will prepare an environmental assessment (EA) to identify and analyze impacts associated with the dam remediation project, including the temporary drawdown, and to identify measures that can be implemented to minimize these impacts.

- **How will boaters know of any new underwater hazards created at the lowered lake levels?**

The South Carolina Department of Natural Resources will re-locate buoys to warn boaters of underwater hazards at the lowered lake levels.

- **Will affected parties have any input in the Environmental Assessment process?**

Yes. FERC staff will hold public scoping meetings to help identify impacts and potential mitigation measures. A draft Environmental Assessment (EA) will be sent out for public and agency comment and those comments will be considered in the preparation of the final EA.

- **Will the lower level impact people who live around the lake and use wells?**

The lake has been lowered to elevation 345 several times in the past decade, with the most recent occasion taking place in 1996 when the lake level was lowered for treatment of hydrilla an invasive plant species. There was no reported impact to wells during that event. This issue will be considered in the Environmental Assessment.

- **When will the refilling of the reservoir begin?**

When the excavation and backfilling at the toe of the dam is completed, the reservoir will begin to be refilled. The backfilled excavation will form the foundation for the new dam. SCE&G will be directed by the FERC to develop and follow a plan to refill the reservoir. Once the last segment of the foundation is excavated and backfilled with rock, the reservoir will be allowed to begin refilling to its normal reservoir level. This will occur as the dam above the backfilled foundation begins to be constructed.

- **How long will the refilling take?**

The refilling period will depend on inflow to the reservoir and rainfall. For example, based on a normal inflow of 2,900 cfs and assuming no outflow, it would take approximately 4 months to refill the reservoir.

- **What happens if there is a severe storm event during the excavation stage of construction? Will that raise the lake to a dangerous level?**

No. SCE&G is developing a plan to operate the powerhouse and spillway gates so that in any weather event during the excavation & backfilling stage, the water level will not exceed 345 feet.

- **How will the public be involved?**

Public input is important to FERC. There will be several opportunities for the public to comment on this activity, and to become involved in the environmental assessment process. There will be mailings to affected residents, public notices in local newspapers, periodic informational meetings with local officials, and public meetings to keep the general public well informed.

- **Do we need a "second opinion" on the need for the seismic fix and the selected alternative?**

The planning, design and future construction of the Saluda seismic fix has been and will continue to be accomplished under the oversight and guidance of a number of independent expert engineering and seismic consultants. The independent Board of Consultants (BOC), which is required by FERC, is comprised of engineering consultants who are among the most preeminent dams safety experts in the world. The BOC is made up of Dr. Ralph B. Peck, who is one of the most respected and renowned geotechnical engineers in practice today, Mr. Eric B. Kollgaard, a world renowned concrete dams expert, Mr. Joseph L. Ehaz, who has 36 years of experience in the design and construction of dams, and Mr. Randall P. Bass, who led Georgia Safe dams program and is currently one of the world's leading consultants in Roller compacted concrete (RCC) technology. In addition, FERC has retained expert consultants, Dr. Alfred J. Hendron, Jr., Dr. I. M. Idriss, Dr. Ralph Archuletta and Mr. Kenneth Hanson, who are also among the most preeminent geotechnical, seismic and RCC experts, respectively, in the world, to advise FERC staff in overseeing this project. Numerous internal FERC staff have had involvement with various aspects of the project, including project engineer Dr. Steve Collins, with final decision authority by Mr. Constantine Tjoumas, Director of FERC's Division of Dam Safety and Inspections, each with over thirty years of experience in dam safety evaluation and remediation. Every phase of the project, including consideration of alternatives, selection of alternatives, design criteria, project design, plans and specifications, construction, and construction quality control has been and will continue to be under the review and guidance of the BOC and FERC's expert consultants as well as FERC staff.