In 1902, President Theodore Roosevelt signed the Reclamation Act, creating the U.S. Reclamation Service, now known as the Bureau of Reclamation. The goal of the act was to promote western settlement and growth through the development of a system of water storage and irrigation. On March 14, 1903, the Salt River Project (SRP) was authorized by the Secretary of the Interior. Roosevelt Dam, located at the confluence of the Salt River and Tonto Creek, was constructed between 1903 and 1911. With Roosevelt Dam and Reservoir as its cornerstone water conservation storage facility, SRP is arguably the nation’s oldest and most successful Reclamation project. Because the dam provided a much more reliable water supply, the early agricultural economy of the Valley of the Sun flourished and eventually matured into the bustling metropolis of the greater Phoenix area we know today.

The 1976 failure of Reclamation’s Teton Dam in Idaho prompted a thorough review of all federal dams. Because of improved hydrologic simulation techniques, Roosevelt Dam was deemed unsafe through overtopping when routing the Probable Maximum Flood (PMF), now estimated at 654,000 cubic feet per second (cfs), with volume exceeding 3 million acre-feet. Originally designed with an Inflow Design Flood of less than 250,000 cfs (Davis, 1903), the existing dam’s design was simply overwhelmed by the increased flow rate and volume of the new hydrology. Passage of the 1978 Reclamation Safety of Dams Act ensured remediation of suspected deficiencies. Thus in 1984, the Secretary of the Interior approved the modification to Roosevelt Dam to meet safety requirements and enhance flood control capabilities.

The 1968 Colorado Basin Project Act, which authorized the Central Arizona Project (CAP), also provided for extensive flood control protection to the Phoenix metropolitan area and downstream communities. To this end, construction of Orme Dam at the confluence of the Salt and Verde rivers was proposed, but subsequently rejected due to public opposition. Instead, Roosevelt Dam would be raised to provide greater flood control on the Salt River, a solution that would offer many of the benefits of Orme Dam and address Roosevelt’s deficiencies. As a result, in 1989, after nearly 80 years of service, modifications to Roosevelt Dam were initiated.

**Dam Improvements**

Major features of the dam modifications included raising the top of the existing dam from elevation 2,141 feet to 2,218 feet, constructing a top-seal radial gated spillway on each abutment, and upgrading an Aging Roosevelt Dam


Roosevelt Dam, prior to upgrades and showing original block construction (left; photo from SRP) and after upgrades (right; photo by Vitaly Shmatikov).

<table>
<thead>
<tr>
<th>Total Capacity</th>
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<tr>
<td>Safety of Dams</td>
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<tr>
<td>Flood Control</td>
<td>550,160 AF</td>
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<tr>
<td>New Conservation Space</td>
<td>304,729 AF</td>
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<tr>
<td>Salt River Project Conservation Storage</td>
<td>1,329,662 AF</td>
</tr>
<tr>
<td>Dead Storage Capacity</td>
<td>18,652 AF</td>
</tr>
</tbody>
</table>

Schematic cross-section of Roosevelt Dam, showing upgrades.


Roosevelt Dam, prior to upgrades and showing original block construction (left; photo from SRP) and after upgrades (right; photo by Vitaly Shmatikov).
constructing a lake-tap river outlet works/power penstock through the left abutment. The dam modification was designed as a single-curvature, uniform-thickness mass concrete arch dam. The upstream face of the modified dam is a vertical, aligned projection of the existing dam. Both dam designs feature a central arch with tangent sections on both sides leading to thrust blocks on the abutments. The existing spillway structures were removed from both abutments and replaced by the thrust blocks, which provide abutments above elevation 2,100 feet and contain the spillways.

The new spillways and expanded reservoir storage will help to regulate flood releases. The existing topography and conditions led to the design of the new spillway structures in the same general vicinity as the existing spillways. To dissipate the energy of the spillways, which flip the discharge into the downstream canyon, a plunge pool was constructed. The spillway alignments cause the discharge to impinge at or above the tailwater within the plunge pool, allowing some of the energy of the discharge jets to dissipate, and adding a downstream component to the discharge.

The new river outlet works were designed to be used for reservoir evacuation, flood releases, and normal releases. This feature was constructed under approximately 130 feet of water. It consists of a trashrack structure, a 16-foot diameter shaft, a 16-foot diameter steel-lined tunnel, and a 22-foot diameter wet-well gate shaft which houses a fixed-wheel gate used for emergency closure. The tunnel bifurcates into two 10-foot 9-inch steel-lined tunnels, with one serving the power plant and the other the river outlet works.

The top of the dam was raised 77 feet, more than doubling its storage capacity. However, only 15 feet (304,729 acre-feet, starting the old top of conservation storage at elevation 2,136 feet) will actually be used for long-term water conservation storage. This additional storage belongs to six valley cities who agreed to pay for the incremental cost of this feature of the dam: Phoenix, Mesa, Scottsdale, Tempe, Glendale, and Chandler. The remaining 67 feet is reserved for great flood events. The space between elevation 2,151 feet (the top of active conservation space) and 2,175 feet (the projected reservoir level for a 200-year flood event) is exclusively for flood control, with a capacity of roughly 556,000 acre-feet. The remaining 43 feet of capacity (more than 1.2 million acre-feet) is reserved for safely managing the PMF without exceeding a total release from the dam of 150,000 cfs. At the end of the PMF event, Roosevelt Dam would be brim full at elevation 2,218 feet.

**More Power for Less Water**

The modifications also necessitated work on the dam’s power plant. Higher operating heads meant that less water could generate the same amount of energy from the hydrogenerator. The effort focused on replacing the existing turbine with a more efficient one, such that the 36-megawatt plant can now produce the same amount of power as before with 2,200 cfs instead of 2,400 cfs. The plant was not expanded further because Roosevelt is operated as a run-of-river plant, with downstream water orders in the Valley determining how much power can be generated at the site.

The total cost of modifications to Roosevelt Dam was approximately $430 million. SRP is responsible for the congressionally mandated 15 percent of the Safety of Dams costs (roughly $22 million) as well as the upgrade to the generation unit. Besides the cities that paid for additional storage, other contributors include the Flood Control District of Maricopa County, the Central Arizona Water Conservation District (managing agency for deliveries of CAP water), the Arizona Department of Transportation, and the federal government.

**Shared Costs = Shared Benefits**

Several factors played into the decision to move Roosevelt’s modification ahead of other dams needing remediation. First, the work required was extensive and substantial. Clearly it would take a long time and be costly. Additionally, Arizona had been in a wet climate cycle for nearly two decades and many of Arizona’s local and national leaders were demanding attention to the state’s recurring flooding problems. At the same time, the CAP was being built, which gave Reclamation a strong presence in Arizona already, and the two projects had been intertwined by congressional mandates. Finally, and perhaps foremost, SRP, valley cities, the Flood Control District of Maricopa County, and the CAP were all willing to pay their share of the benefits of the project, and to do so upfront. Reclamation was able to expedite the work at Roosevelt by showing its leadership and Congress that local interests were vested in the timely completion of the Roosevelt Dam Project. The modifications to Roosevelt were deemed complete on April 12, 1996.

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**Reference**