Briefing Memorandum

Overview of the Folsom Dam Water Control Manual Update

Introduction

As directed by Congress, the U.S. Army Corps of Engineers (USACE), in collaboration with the U.S. Department of Interior Bureau of Reclamation (Reclamation), the State of California Central Valley Flood Protection Board (CVFPB), and the Sacramento Area Flood Control Agency (SAFCA) are taking steps to reduce flood risk to the Sacramento area through a variety of authorized facilities (including existing, those under construction and those yet to be constructed). These steps also include the revision of operation rules and criteria for Folsom Dam and Reservoir.

A key component to improved flood risk management for the Sacramento area is the Folsom Dam Joint Federal Project (JFP), currently under construction. The JFP will improve the ability of Folsom Dam to manage large flood events by allowing more water to be safely released earlier in a storm event, resulting in more storage capacity remaining in the reservoir to hold back the peak inflow when it arrives. The JFP has twin goals that simultaneously serve the specific missions of two Federal agencies. The flood risk management goal of USACE and their non-Federal partners, CVFPB and SAFCA, is to reduce flood risk in the Sacramento area in conjunction with other elements of the regional flood control system. The safety of dams goal of Reclamation is to pass the probable maximum flood (PMF) without causing failure of Folsom Dam. The PMF peak inflow is 906,000 cfs, of which, up to 314,000 cubic feet per second (cfs) will pass through the auxiliary spillway. These goals will be accomplished through construction of a gated auxiliary spillway, with a spillway crest elevation 50 feet lower in elevation than the current gated spillways on the main dam. In order to fully realize the benefits of the new auxiliary spillway, the existing water control manual (*Water Control Manual, Folsom Dam and Lake, American River, California;* USACE 1987) must be updated.

USACE is responsible for prescribing operations for flood risk management at Folsom Dam. The dam's water control manual, which includes the water control diagram and emergency spillway release diagram, is the document that stipulates the flood control operations of the dam. The water control diagram has been modified several times since Folsom Dam was constructed in 1956.

USACE, Reclamation, CVFPB, and SAFCA are seeking to minimize the risk that flood operations have been imposing on other authorized Folsom Dam project purposes since 1995, due to the 670,000 ac-ft variable operation. Congress has directed USACE to utilize a variable operation of up to 600,000 ac-ft for flood risk management purposes. An important goal of the Water Control Manual Update is to identify the use of that space in a way that conserves as much water as possible and maximizes all other project functions to the extent practicable, consistent with the flood risk management objectives of the Water Control Manual Update.

Background and Congressional Authorities

Folsom Dam and Reservoir form a multipurpose water project, constructed by USACE in 1956 and operated by Reclamation as an integrated part of the Central Valley Project (CVP). The dam and reservoir reduces flood risk for the Sacramento area while serving other project purposes including water supply (agricultural, domestic, municipal, and industrial), hydropower, fish and wildlife protection, water quality (including water temperature), recreation, and navigation.

As directed by Congress in the Flood Control Act of 1944, USACE is responsible for prescribing regulations for the use of storage allocated for flood control at Folsom Dam and Reservoir. USACE maintains a flood operations plan and Water Control Manual, last updated in 1986, that utilizes a flood control storage space of 400,000 acre-feet (ac-ft).

The 1986 flood raised concerns over the adequacy of the existing flood risk management system of the Sacramento area. These concerns led to a series of investigations and subsequent study authorizations (beginning with the 1991 American River Watershed Investigation Feasibility Report) to reduce the level of flood risk in the Sacramento area, and address the dam safety issues (safe passage of Probable Maximum Flood) at Folsom Dam. This report was followed by the American River Watershed Project, Supplemental Information Report in 1996. Although both reports recommended construction of a flood detention dam on the North Fork of the American River, Congress chose not to authorize the flood detention dam, but instead chose to rely on a series of modifications to the Folsom Dam and Reservoir along with levee improvements downstream of Folsom Dam to provide additional flood risk reduction for the Sacramento area, and to address the safety issues at Folsom Dam.

In 1995, SAFCA entered into an agreement with Reclamation to provide additional flood risk reduction for the Sacramento area. In accordance with the 1995 agreement, Reclamation operates Folsom Dam and Reservoir to provide additional flood storage space in the reservoir on an as-needed basis. This operations plan, commonly referred to as a 400,000 - 670,000 ac-ft creditable space plan, states that beyond the 400,000 ac-ft (regulated by the USACE) up to an additional 270,000 ac-ft, for a total storage of 670,000 ac-ft, may be used for flood control in Folsom Reservoir based on creditable storage from upstream reservoirs. According to the 1995 agreement, SAFCA would purchase water to replace any water storage shortage caused by the creditable storage operation. SAFCA also agreed to fund several physical improvements to Folsom Dam and the downstream river channel to offset the risk of reduced reservoir storage levels. These included modifications to the temperature control shutters on the intakes to Folsom Dam's power penstocks; boat ramp extensions; and shallow floodplain habitat improvements in the lower portion of the American River.

In the Water Resources Development Act of 1996 (WRDA 1996) Congress directed Reclamation to continue the creditable 400,000 - 670,000 ac-ft operation and to extend the 1995 agreement with SAFCA until such time as a comprehensive flood damage reduction plan for the American River watershed has been implemented. WRDA 1996 and the Energy and Water Development Appropriations Act of 2002 established a new cost-sharing formula for the creditable flood control option; SAFCA shall be responsible for 25 percent of any costs incurred and Reclamation is responsible for the remaining 75 percent.

The Water Resources Development Act of 1999 (WRDA 99), Section 101, states that, upon completion of what is now the JFP, the variable space allocated to flood control within the reservoir shall be reduced

from the current operating range of 400,000-670,000 ac-ft to 400,000-600,000 ac-ft. Additionally, WRDA 99 states that USACE, in cooperation with Reclamation, shall update the flood management plan for Folsom Dam to reflect the operational capabilities created by authorized improvements and improved weather forecasts based on the Advanced Hydrologic Prediction System of the National Weather Service. In addition, WRDA 99, Section 556 states that USACE, in consultation with the State of California and local water resources agencies, shall undertake a study of increasing surcharge flood control storage and there is to be no increase in conservation storage at the Folsom Dam Reservoir. This section also authorized the American River Watershed, Long Term Study 2002, which recommended the Folsom Dam raise.

The Energy and Water Development Appropriations Act of 2004 authorized raising Folsom Dam by seven feet for flood risk management purposes (Dam Raise) as well as construction of a permanent bridge to replace Folsom Dam Road, which was closed to public access in 2001.

Shortly thereafter, the Energy and Water Development Appropriations Act of 2006 (2006 EWDAA) directed USACE and Reclamation to collaborate to maximize flood damage reduction and address dam safety at Folsom Dam. The 2006 EWDAA directed the USACE and Reclamation to consider reasonable modifications to the existing authorized activities, including an auxiliary spillway. This collaboration resulted in the JFP at Folsom Dam.

In March of 2007, the Folsom Dam Modification and Dam Raise, Post Authorization Change Report (2007 PACR) was completed and recommended the JFP (which addressed both USACE flood damage reduction project and Reclamation's dam safety issues) and the 3.5-foot Dam Raise (which addresses USACE's flood damage reduction only). The JFP includes a six submerged tainter gate structure and an auxiliary spillway. The 3.5-foot Dam Raise includes upgrades to the three emergency spillway tainter gates at the dam, and various dam safety features at and around Folsom Dam. The results of the 2007 PACR are anticipated to reduce flood risk downstream generally equivalent to the flood risk reduction intended to be provided by the Folsom Modification Project and the 7 foot Dam Raise. The new auxiliary spillway is now effectively the plan referred to in WRDA 99 subsection (A). Authorization to construct the auxiliary spillway and dam safety features were included in the Water Resources Development Act of 2007 (WRDA 2007).

Water Control Manual Update Purpose

The purpose of the analysis is to develop the technical information required to update the existing WCM, namely, *Water Control Manual, Folsom Dam and Lake, American River, California* (USACE 1987).

SPK will use the findings from the analysis to:

- Revise operation rules for Folsom Dam to reduce flood risk, and
- Integrate NWS forecasts into flood operation rules.

The new operation rules will be developed to, at a minimum, meet the following three (3) primary dam safety and flood risk management objectives of the Manual Update partners:

1. Pass the Probable Maximum Flood (PMF) while maintaining 3 feet of freeboard below the top of dam to stay within the Dam Safety constraints of Reclamation.

2. Control a 1/100 annual chance flow (i.e. "the 100-year flood") to a maximum release of 115,000 cubic feet per second (cfs) to support Federal Emergency Management Agency (FEMA) levee accreditation along the American River, by SAFCA.
3. Control a 1/200 annual chance flow (i.e. "the 200-year flood"), as defined by criteria set by the State of California Department of Water Resources (DWR), to a maximum release of 160,000 cfs, when taking into account all the authorized modifications within the American River Watershed.

Key considerations in the development of the water control plan include dam safety requirements; Endangered Species Act (ESA) requirements; other fish and wildlife needs; water quality requirements; and water supply, water rights permit terms and conditions, power generation, and recreational needs. In its development, the Manual Update will conform as equitably as possible with other authorized Folsom Dam Project purposes and operational criteria, including seasonal downstream flow and temperature requirements specified by National Marine Fisheries Service (NMFS) Biological Opinion. The Manual Update will also consider fishery requirements for ramping rates for releases from Folsom Dam.

The findings of the Water Control Manual Update will be used to define the dam's new operational rules. USACE will then update the existing water control manual, namely, *Water Control Manual, Folsom Dam and Lake, American River, California* (USACE 1987). This update will include a new water control diagram and emergency spillway release diagram. The Water Control Manual Update will be completed prior to completion of the auxiliary spillway, and will be accompanied by appropriate environmental documentation that will describe the decision-making process that was followed to arrive at the recommended changes to flood control operations.

Future updates to the water control manual are expected as additional modifications are completed. Future modifications would include the authorized 3.5-foot dam raise which will provide additional space for flood operations, and future downstream levee improvements (erosion protection) allowing for increased releases.

Partner Roles and Responsibilities

There are four partnering agencies on this Water Control Manual Update:

- U.S. Army Corps of Engineers: USACE is the lead Federal agency for the Water Control Manual Update, as well as the National Environmental Policy Act (NEPA) lead agency. USACE will prepare all necessary documents and update the water control manual in collaboration with the other partners.

- U.S. Department of Interior Bureau of Reclamation: Reclamation is the Federal partner responsible for operation and maintenance of Folsom Dam and Reservoir. Reclamation is also a cosignatory of the interim agreement with SAFCA and provides technical and policy support to the Manual Update. As operator of Folsom Dam, Reclamation will also be the cosignatory on the updated water control manual.

- Central Valley Flood Protection Board: The State legal entity for the JFP is the Central Valley Flood Protection Board (CVFPB). CVFPB is a non-Federal cost sharing partner with USACE for the JFP and the Water Control Manual Update. The project operational portion of the CVFPB for the JFP is represented by the State of California Department of Water Resources (DWR). CVFPB is

also the lead agency responsible for the California Environmental Quality Act (CEQA) and signatory of the decision document for the State. DWR provides policy and technical expertise and staff to support the CVFPB's activities associated with the Manual Update.

For JFP, DWR collaborates State's interest in Oversight Management Group, Change Management Board, Project Management Group, Integration Team and Project Delivery Team (PDT). For the Water Control Manual Update, DWR collaborates the State's interest in Project Alternative Solutions Study (PASS), Mid-level Management Group and PDT. Other roles and responsibilities for the State (CVFPB/DWR) are described in the Project Cooperation Agreement and the subsequent amendments between USACE, the State of California and SAFCA for Construction of the American River Watershed, California (Folsom Dam Modifications)

- Sacramento Area Flood Control Agency: SAFCA is the local cost sharing partner with CVFPB for the JFP and the Water Control Manual Update, a CEQA responsible agency, and cosignatory of the interim agreement with Reclamation.

Overview of the Engineering Modeling Process

The USACE engineering modeling process has three primary goals:

- To produce an updated water control manual for Folsom Dam that includes an updated Water Control Diagram and Emergency Spillway Release Diagram.

- To produce data that supports the decision making process for identifying the recommended plan.

- To produce data that supports fulfillment of the Water Control Manual Update partners' policy and legal requirements, such as compliance with NEPA, CEQA, and other laws and regulations.

Operators must be able to rely on the updated water control manual in flood situations. Each point of the manual must be studied and developed in detail, to ensure successful operation of the Dam for flood risk management and dam safety purposes.

Considerations in this modeling effort include the non-federal sponsors' flood management goals of successful operation of the dam and reservoir, to route both a one percent chance event (1/100 inflow design event) sustaining a release of 115,000 cubic feet per second (cfs), and a 0.5% chance event (1/200 inflow design event), sustaining releases at 160,000 cfs. The engineering models are being used to simulate hydrologic and hydraulic conditions on the American River as they relate to the Dam and Reservoir only. The analysis of risk and uncertainty, as related to inflow hydrology, operational variation, and geotechnical issues are not considered in these models, but will be addressed elsewhere.

The emergency spillway release diagram's purpose is operational consideration of dam safety. Reclamation is assisting USACE with an operations plan that will pass a Probable Maximum Flood (PMF) within 3' of freeboard of the top of dam.

USACE uses HEC-ResSim, developed by USACE's Hydraulic Engineering Center, for reservoir routing applications and development of the Reservoir Operation Sets (ROSs) to be evaluated as part of the Water Control Manual Update. HEC-RAS and FLO-2D will be used to perform floodplain analyses.

Reclamation and the DWR use CalSim II to evaluate CVP and SWP contract deliveries. Comparisons of period of record (1921 – 2002) model output from HEC-ResSim and CalSim II will be used to determine how a particular ROS could be modified to better meet CVP/SWP beneficial use criteria. These comparisons are referred to as Tier 1 analyses.

Fundamental engineering questions for USACE and partners to answer include:

- How will the JFP be operated in a flood event?
- What does the guide curve look like, including both the fall drawdown and spring refill components?
- How will the operation plan incorporate the use of forecasts from National Weather Service?
- How will the new plan include creditable storage considerations and the upstream reservoirs' capability for capturing inflow?
- How will accumulated precipitation in the basin and other basin wetness indices be incorporated into the updated plan?

Environmental Analyses Summary

The evaluation of environmental effects will be focused on changes that flood management operation alternatives would have on other authorized Folsom Dam Project purposes, including water supply, hydropower, water quality, fish and wildlife protection, recreation, and navigation.

USACE has prepared a Water Resources Modeling Work Plan describing the modeling strategy for integrating output data between HEC-ResSim and CalSim II. The Water Resources Modeling Work Plan identifies the approach for evaluating the potential project impacts to power generation, temperature, and other environmental considerations. As outlined within that plan, the following evaluations, in addition to the Tier 1 analyses noted above, will be conducted:

- Tier 2 Analysis – An assessment of metrics related to SWP/CVP beneficial water uses as reflected in output from CalSim II. The Tier 2 analysis will only be completed on selected operational alternatives that have been screened and brought forward as potential with-project conditions.

- Tier 3 – Analysis of temperature, water quality, fish mortality, sediment transport, power generation, and recreation. As with the Tier 2 assessment, the Tier 3 analysis will only be completed on selected operational alternatives that have been screened and brought forward as potential with-project conditions.

The environmental effects analyses will be based on comparisons between computer model simulations of the alternatives, including the No Action/Future Without-Project Condition (FWOP), and baseline/existing conditions. The existing condition baseline flood management operation will reflect the current 400,000 – 670,000 ac-ft water control plan without the auxiliary spillway in place. The No Action/FWOP will reflect a 400,000 – 670,000 ac-ft operation similar to the current plan, but with the auxiliary spillway in place.

There is interest from certain stakeholders to compare project alternatives to a historic reference condition that reflects flood management operations prior to the implementation of creditable space storage operations. This reference condition would reflect operations utilizing the USACE 1986 WCD with a maximum flood storage capacity of 400,000 ac-ft at Folsom Dam. The need for carrying out full

environmental effects analyses against this reference condition will be determined during the scoping process.

Effects, both adverse and beneficial, will be identified and quantified to the appropriate extent. Adverse effects will be avoided, minimized, or mitigated to the extent practicable.

Depending on results of the environmental effects analyses, formal consultation with U.S. Fish and Wildlife Service (USFWS) and/or National Marine Fisheries Service (NMFS) under Section 7 of the Endangered Species Act (ESA) may be necessary if adverse effects to federally protected species could occur as a result of implementation of the selected flood management operations alternative. Likewise, consultation with California Department of Fish and Game (CDFG) would be necessary if the selected alternative could have adverse effects on state-protected species. Along with NEPA, CEQA, ESA, and the California Endangered Species Act, all other applicable Federal, state, and local laws will be complied with.

NEPA and CEQA public involvement efforts will include hosting public scoping meetings, providing study information and status updates on a study website and through periodic workshops, and soliciting comments on the Draft and Final NEPA and CEQA documents through public meetings, mailings, and email.