CALIFORNIA WATER FIX

RELIABLE. CLEAN. WATER.

PERFORMANCE STANDARDS

Exhibit A

PERFORMANCE STANDARDS AND DESIGN CONSIDERATIONS

These Performance Standards (Standards) have been written to provide a framework for the design of the many projects required by the California WaterFix. The purpose of these Standards is to assure uniformity in design concepts, formats, methodologies, procedures and quality of work products that are produced by the Design Consultants. These Standards will be continuously reviewed throughout the program as the design is advanced and modified if approved by the DCA.

The Performance Standards will be incorporated into the scope of work for the Design Consultants, and that the Design Consultants will prepare detailed design plans and specifications based on these standards. The Design Consultants may propose modifications to the Performance Standards; such modifications are subject to the requirements of the DCA Agreement.

FLOOD PROTECTION CONSIDERATIONS

The California WaterFix is configured to withstand flood water levels from the following potential sources listed below. These criteria will affect facility elevation, construction of levees, embankment design, and other flood protection measures.

- 200-year return flood event in the Sacramento, Mokelumne, San Joaquin Rivers, or adjacent sloughs.
- Inundation of floodplain from a 200-year return flood event with levee breach.
- Wind-induced wave run-up.
- Mean higher high water tides.
- Sea Level Rise (SLR) due to climate change over the next 100 years, estimated at 18 inches in the Delta.

Flood water levels resulting from these factors vary across the Delta, depending on location and source. The estimated flood levels on an island-by-island basis to be used in the design for each conveyance option facility will be developed in preliminary design. All flood protection levels must be confirmed and refined during subsequent study.

Preliminary flood level elevations were based upon six potential flooding scenarios

- River flooding assuming no levee failures.
- Floodplain flooding assuming multiple river levee failures or overflows.
- Island flooding limited by levee heights.
- Island flooding limited by river stage.
- Island flooding limited by flood volume.
- Tidal flooding due to SLR and assuming a levee breach without a storm flood event.

SLR values were based on the recommendation of the Delta Vision Blue Ribbon Task Force to set SLR planning standards for critical state investments.

The recommended preliminary flood protection criteria for California WaterFix are the 200-year flood event water surface elevation, including SLR, with an additional allowance of 3-feet for free board and wind-wave run-up. These criteria resulted in a range of preliminary flood level elevations from approximately 34 feet to 25 feet, which are consistent with DWR's 2009 *Proposed Interim Levee Design for Urban and Urbanizing Area State-Federal Project Levees*. These flood protection levels will be confirmed and refined for final design.

SEISMIC CRITERIA AND PERFORMANCE

The project is a new facility that transports water from north of the Delta to south of the Delta. The facilities within the California WaterFix are considered “critical facilities” as long delays in water delivery from the north to the south of the Delta could have a significant negative impact on human life and the California economy. Critical facilities comprise all public and private facilities deemed by a community to be essential for the delivery of vital services (FEMA 543). As a consequence of this classification, the facilities shall be designed as described as Essential Facilities as described in California Building Code (CBC) and American Society of Civil Engineers (ASCE) 7. Facilities that require extended time frames for repair/replacement (e.g. large pumps or tunnel structures) shall be designed with the highest seismic standard to prevent prolonged delays in water delivery after a large earthquake event.

DWR’s Water Resources Engineering Memorandum No. 70 (WREM-70) prescribes minimum Seismic Loading Criteria for the State Water Project, and provides different seismic loading criteria based on criticality of a facility. The WREM-70 allows flexibility so that the project engineer can judge which criteria to use. SWP facilities, located throughout California, vary in purpose and criticality. Designing all the facilities to the same seismic standard would not be feasible or cost effective. Therefore, the WREM-70 provides a wide range of seismic loading criteria for various types of facilities.

The selection of seismic loading criteria for the facilities was based on the consequences of failure, the criticality of the structure for water delivery, and the downtime and cost for the repair of the facility. Generally, higher seismic loading criteria are recommended for structures that have larger consequences of failure, greater importance for water delivery, or longer downtimes or greater costs for repair. Conversely, lower seismic loading criteria are recommended for structures that are not critical to water delivery and/or can be repaired in a reasonable time frame. For example, canals can be repaired faster/cheaper than compared to tunnels or large pumps in a pumping plant.

Project specific seismic criteria shall be developed that is consistent with WREM 70 and as shown in the table below.

Recommended Seismic Loading Criteria for California WaterFix Facilities (Modified from WREM-70)

Facility Type		Seismic Loading[1]	Selection Basis	Analysis Method[2]
Dams and Reservoirs		Greater of 84th Percentile (DSHA) and 975-year Return Period (RP) (PSHA)	Modified DSOD Method	Envelope of DSHA and PSHA
Conveyance Facilities	Canal	975-yr RP (PSHA)	Damage consequence and ease of repair	PSHA
Conveyance Facilities	Pipelines	Greater of 84th percentile (DSHA) and 2475-yr RP (PSHA)	Modified FEMA Function Class IV and difficult to repair	Envelope of DSHA and PSHA
Conveyance Facilities	Pipelines	Operational Basis Seismic Check Based on 144-yr RP (PSHA)	Performance based approach to target elastic behavior and avoid outages and subterranean repairs.	PSHA
Conveyance Facilities	Tunnels (Include inlets and outlets)	Greater of 84th percentile (DSHA) and 2475-yr RP (PSHA)	Consideration of criticality and difficulty and cost of repair	Envelope of DSHA and PSHA
Conveyance Facilities	Tunnels (Include inlets and outlets)	Operational Basis Seismic Check Based on 144-yr RP (PSHA)	Performance based approach to target elastic behavior and avoid outages and subterranean repairs.	PSHA
Bridges		CalTrans Seismic Design Spectrum	CalTrans Seismic Design Criteria (SDC ver. 1.6 Appendix B)	Envelope of DSHA, PSHA
Building and Hydraulic Structures, Utility Overcrossings, and Mechanical and Electrical Equipments		Seismic Response Based on ASCE 7 MCE	Modified ASCE 7 Design Spectral Response to Approx. 975-yr RP – Collapse Prevention Performance Level	PSHA with DSHA Cap
Building and Hydraulic Structures, Utility Overcrossings, and Mechanical and Electrical Equipments		Operational Basis Seismic Check Based on 144-yr RP (PSHA)	Pseudo Performance Based Approach to target Operational Performance Level	PSHA

[1] Seismic load shall be greater or equal to a deterministic spectrum from a 6.5 moment magnitude strike slip fault earthquake at a distance of 12 Km.

[2] PSHA – Probabilistic Seismic Hazard Analysis, DSHA – Deterministic Seismic Hazard Analysis.

STRUCTURAL DESIGN CRITERIA

This section summarizes the codes and standards that will be generally used in structural design to promote consistency and compatibility between projects. More specific project information will be developed during execution of the project to support detailed design, engineering, and construction specifications.

All structures and parts thereof shall be designed and detailed in accordance with the design procedures as permitted in the governing codes and standards for the specific type of structure.

DESIGN LIFESPAN

For the Performance Standards pertaining to the California WaterFix, the design lifespan is set at a minimum of 100 years for all facilities. All facilities shall be designed to meet or exceed all specified seismic, and flood conditions while also ensure a measure of design robustness that will protect the structures from normal wear and tear and potential effects of corrosion over the expected lifecycle.

The design life of a structure is generally associated with the robustness of the feature to withstand a variety of environmental conditions during the anticipated operational life of the facility. Typically, longer durations of design lifespan are specified based on the critical or lifeline nature of a structure or facility. The longer design life (100-year) provides a higher level of performance and durability in order to maintain continuous system operation with minimum disruption of service. Typically, a structure is required to withstand a variety of deterministic and probabilistic loads (wind, seismic, operation, corrosion, fatigue, etc.) that might be anticipated to occur over the life of the structure. Consequently, a structure with a design life of 100 years will have the ability to withstand higher design loads than a structure with a design life of 50 years. A design lifespan is a factor that is taken into account during the design phase of a project component or facility. A design lifespan is not a guarantee of ultimate longevity. Consequently, it is recognized that a structure with a 100-year design lifespan won't necessarily imply a system that lasts for 100 years. One established service life design methodology that is built on a broad base of experience and that resides in the public domain is the International Federation for Structural Concrete (fib) Model Code for Service Life Design (fib Bulletin 34, 2006). This methodology has recently been implemented in ISO 16204:2012 Service Life Design of Concrete Structures. The methodology was developed through the publicly funded DuraCrete research project and was validated by a consortium of universities and consulting firms to offer a reliability-based approach similar in principle to modern limit states design-based structural design codes.

The fib methodology provides a rational probability-based approach to service life design of concrete structures subject to corrosion, a major deterioration mechanism for bridges, tunnels and marine structures. The approach is analogous to structural design for which durability-related loads and resistances are assessed and quantified probabilistically, considering element specific exposures and material properties. For example, durability loads include surface chloride concentrations and ambient temperature, and durability resistances include concrete cover and permeability. Based on the fib methodology, durability requirements can be quantified and measured to verify that the required materials and properties are achieved.

STANDARDS AND CODES

The following list of standards and codes is not meant to be all inclusive; rather it is a representative list of codes and standards to be utilized in the design of the California WaterFix facilities. Due to the current proposed timeline for design and construction of the project, the "next (or upcoming) cycle" of model codes shall be used as the design basis for structures, including but not limited to:

- United States Army Corps of Engineers (USACE) Engineering Manuals
- 2013 California Building Code (2013 CBC) [based on 2012 International Building Code (IBC) and all referenced standards including: American Society of Civil Engineers (ASCE) 7-10 Minimum Design Loads for Buildings and Other Structures, American Concrete Institute (ACI) 318-11, & 530/530.1-13, American Institute of Steel Construction (AISC) Steel Construction Manual 14th Edition and 2010 documents (341, 358 & 360), American Welding Society (AWS) D1.1/D1.1M:2010 Structural Welding Code-Steel, 22nd Ed.]
- American Association of State Highway and Transportation Officials LRFD Bridge Design Specifications 6th Edition along with any published California Amendments by the California Department of Transportation (AASHTO BDS2012). Seismic design of bridges and highways shall conform to the latest Caltrans Seismic Design Criteria (SDC).
- Standard Specifications and Standard Plans published by the California Department of Transportation (Caltrans), latest edition, where applicable
- American Water Works Association (AWWA) Manual M9 Concrete Pressure Pipe 3rd Edition 2008 and AWWA Manual M11 Steel Pipe-A Guide for Design and Installation 4th Edition 2004.

The codes and standards listed above shall be used, unless subsequent engineering phases designate another edition to be used. During the design process, local jurisdictional codes shall be reviewed for special requirements.