

Oroville Dam Safety Comprehensive Needs Assessment (CNA)

California Water Commission Briefing, September 18, 2019



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CALIFORNIA DEPARTMENT OF
WATER RESOURCES

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Purpose of the CNA

- **Identify and prioritize potential dam safety enhancement needs**
 - Document existing conditions
 - Identify current **dam safety** vulnerabilities using risk assessment tools
- **Identify risk reduction measures to improve dam safety and reliability**
 - Develop prioritized list of dam safety and operational reliability needs
 - Provide set of Alternative Plans to DWR management to consider in future investment



Initial Commitment for CNA

State of California
California Natural Resources Agency

Memorandum

Date: June 27, 2017

To: Sharon Tapia, Chief
Division of Safety of Dams

From: David R. Duval, Chief
Division of Operations and Maintenance
Department of Water Resources

Subject: Comprehensive Needs Assessment, Oroville Dam (State Dam No. 1-48), Butte County

Over the past decade, a number of efforts within the Division of Operations and Maintenance (O&M) have focused on improving the reliability of existing appurtenances and other dam safety measures that contribute to the safety and ongoing integrity of Oroville Dam and those appurtenant structures. Specifically, DWR has performed a number of studies to explore safe means of increasing the low level outlet (drawdown) capacity and access to cold water within the reservoir pool. The latter is a current Endangered Species Act mandate under DWR's P2100 FERC Hydroelectric License and these obligations to access cold water will increase with the anticipated new License. The Division of Operations and Maintenance plans to re-engage these various efforts and formally initiate a Comprehensive Needs Assessment to identify and prioritize dam safety enhancements for the future which would include enhanced instrumentation if deemed a necessary improvement.

As key internal and consultant resources from Spillway Recovery design phase become available, O&M plans to pursue this Assessment with the goal of identifying priorities and appropriate solutions to enhance dam safety and operational flexibility. Some solutions might also provide secondary benefits such as operational redundancy, improve compliance with downstream flow and temperature criteria, or possible power generation opportunities. O&M respectfully requests the Division of Safety of Dams' participation in this effort to assess the needs of the Oroville complex and to discuss priorities and preferred solutions with respect to dam safety. O&M will provide DSOD with a detailed plan, scope, and schedule for this effort by December 31, 2017.

If you have any questions, please contact me at (916) 653-8583 or your staff may contact David Panec, Chief of the Division of Operations and Maintenance's Dam Safety Branch, at (916) 653-0772.

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SURNAME
DWR 155 (Rev. 7/11)

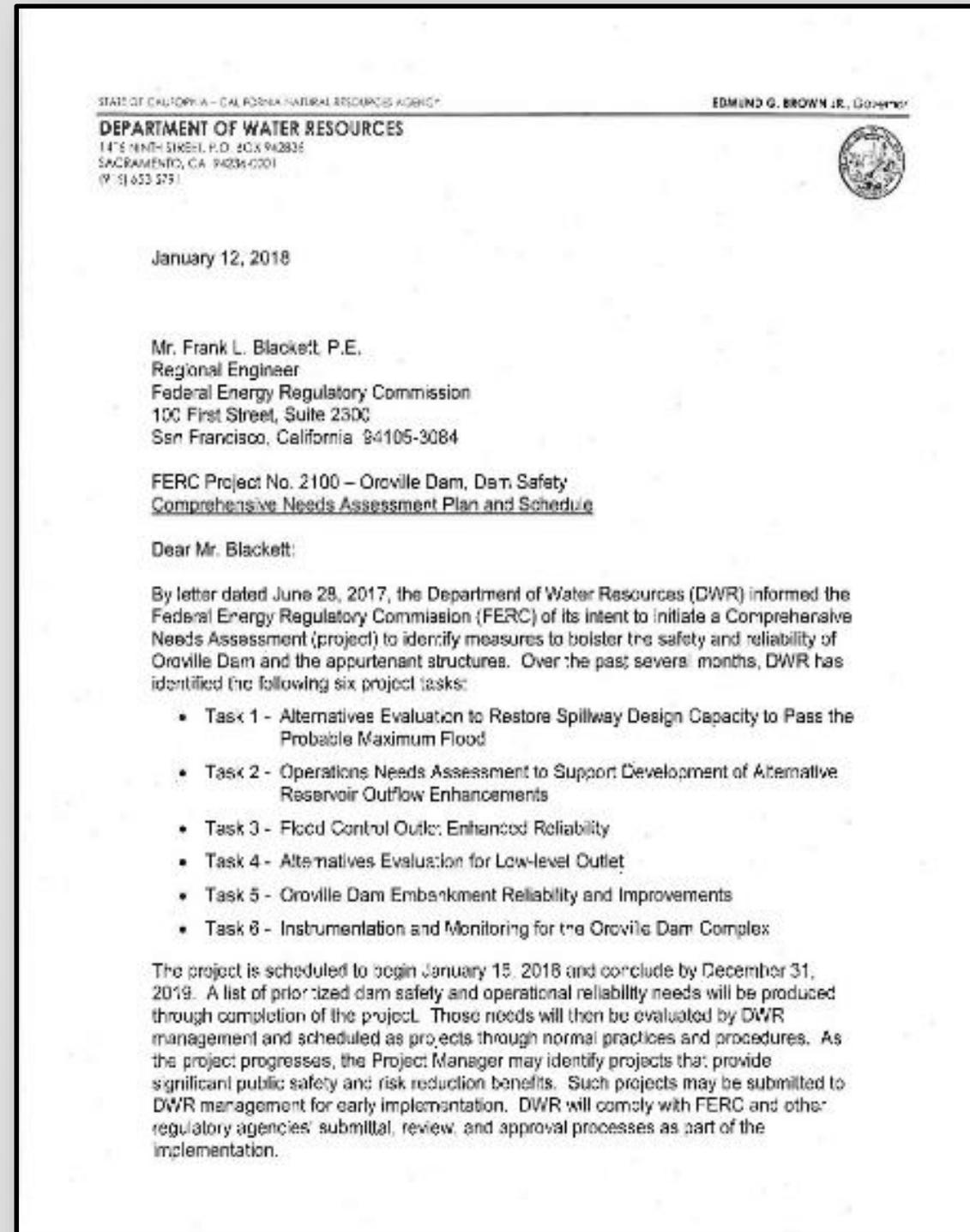
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The Division of Operations and Maintenance plans to re-engage these various efforts and formally initiate a Comprehensive Needs Assessment to identify and prioritize dam safety enhancements for the future

June 27 and 28, 2017 DWR Letters to FERC and DSOD



Initial Outline of Comprehensive Needs Assessment



January 12, 2018 DWR Letter to FERC

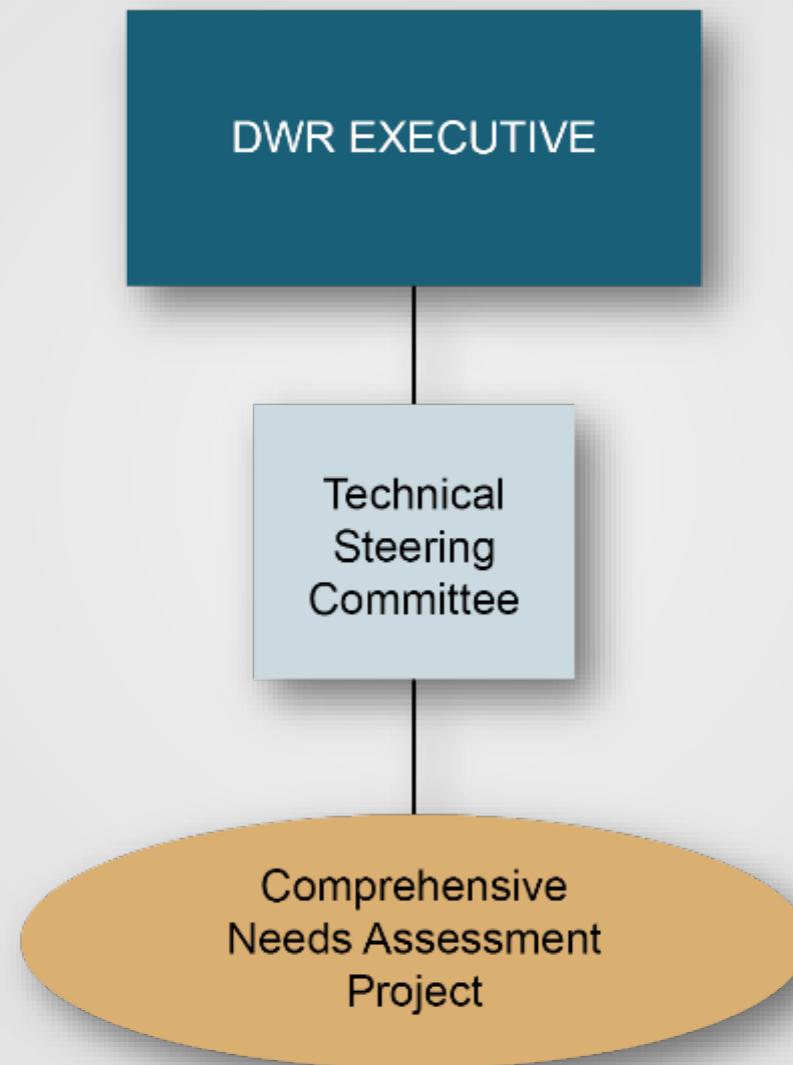


Final Product of CNA

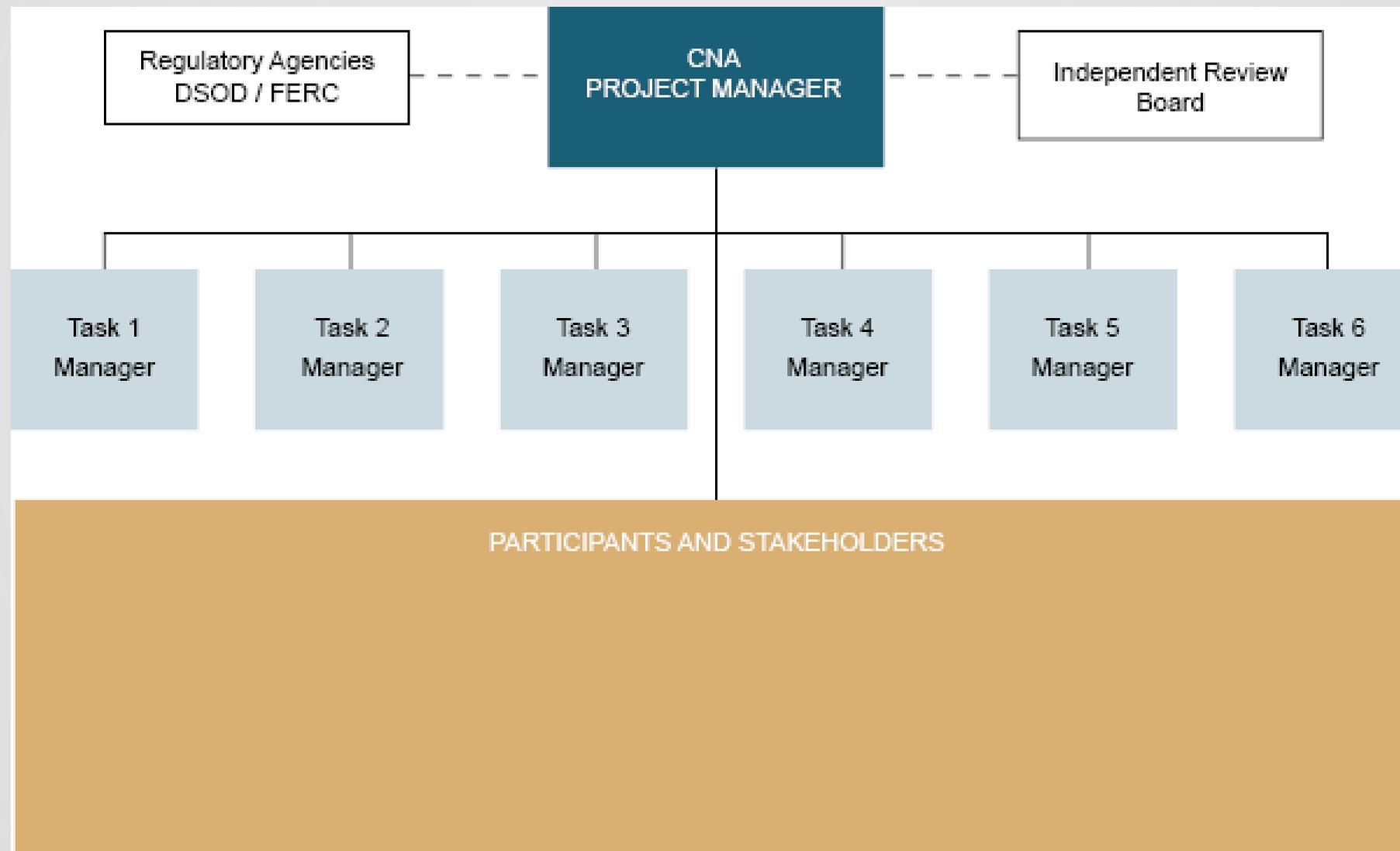
A report documenting an Existing Conditions Assessment that identifies current Dam Safety risks at the Oroville Dam complex, opportunities to reduce risk, and a set of Alternative Plans that DWR could consider for future implementation for risk reduction.



Executive Level Structure



Project Management and Task Level Structure



CNA Tasks

- Task 1 - Spillway Capacity Restoration
- Task 2 - Operations Needs Assessment
- Task 3 - Flood Control Outlet (FCO) Enhanced Reliability
- Task 4 - Low-level Outlet Enhancement
- Task 5 - Embankment Reliability and Improvements
- Task 6 - Instrumentation and Monitoring



CNA will employ Risk-Informed Decision Making (RIDM) Processes

The RIDM approach is the process of making safety decisions by evaluating if existing risks are tolerable and present risk measures are adequate, and if not, whether alternative risk reduction measures are justified.

(FEMA, 2015)

Risk = product of the likelihood of an adverse event and the consequences of that event

(U.S. Bureau of Reclamation, 2003)



CNA – Extension of DWR AM Risk Matrix

Likelihood Annual Probability		Comprehensive Needs Assessment – Extension of DWR Division of Operations & Maintenance Risk Matrix										
		1 Insignificant	2 Minor	3 Moderate	4 High	5 Major	6 Extreme	7 Catastrophic	8	9	10	11
1	10	10	20	30	40	50	60	70	80	90	100	110
1	9	9	18	27	36	45	54	63	72	81	90	99
$3 \times 10^{-1} - 1$	8.5	8.5	17	25.5	34	42.5	51	59.5	68	76.5	85	93.5
$10^{-1} - 3 \times 10^{-1}$	8	8	16	24	32	40	48	56	64	72	80	88
$3 \times 10^{-2} - 10^{-1}$	7.5	7.5	15	22.5	30	37.5	45	52.5	60	67.5	75	82.5
$10^{-2} - 3 \times 10^{-2}$	7	7	14	21	28	35	42	49	56	63	70	77
$10^{-3} - 10^{-2}$	6	6	12	18	24	30	36	42	48	54	60	66
$10^{-4} - 10^{-3}$	5	5	10	15	20	25	30	35	40	45	50	55
$10^{-5} - 10^{-4}$	4	4	8	12	16	20	24	28	32	36	40	44
$10^{-6} - 10^{-5}$	3	3	6	9	12	15	18	21	24	27	30	33
$10^{-7} - 10^{-6}$	2	2	4	6	8	10	12	14	16	18	20	22
$< 10^{-7}$	1	1	2	3	4	5	6	7	8	9	10	11
Consequence Category	Consequence											
	1 Insignificant	2 Minor	3 Moderate	4 High	5 Major	6 Extreme	7 Catastrophic	8	9	10	11	
Public Safety (including Personnel Safety)	No injury	Near miss, minor injuries	Minor injuries	Single injury	Multiple injuries, permanent disability	Fatality 0 – 1 fatalities	Multiple Fatalities 1 -10 fatalities	10 – 100 fatalities	100 – 1,000 fatalities	1,000 – 10,000 fatalities	> 10,000 fatalities	
Financial Impacts (Direct and Indirect)	< \$100k	\$100k - \$1M	\$1M - \$10M	\$10M- \$100M	\$100M - \$1B	\$1B - \$10B	\$10B - \$100B	\$100B - \$250B	\$250B - \$500B	\$500B - \$1T	> \$1T	



CNA Existing Conditions Assessment Status

- Over 372 Potential Failure Modes (PFMs) Considered
- ~127 PFMs fully developed (~245 Considered but not developed)
- Generally 3 to 4 Scenarios developed per PFM
 - ➔ ~407 PFM Scenarios fully developed
- 5 Consequence Conditions Assessed per PFM Scenario
 - ➔ ~2056 PFM Consequences fully evaluated



Common view of PFM

Definition of a PFM

- A specific **chain of events** leading to a dam failure.
- The FERC defines a failure as an **uncontrolled release** of water. Therefore, a failure does not need to be a complete and catastrophic failure of the dam.
- The PFM should be **developed with no regard** of likelihood or possibility.

Slide from Mr. Blackett's presentation
*Identifying, Describing, and Classifying
Potential Failure Modes* on FERC website



Independent Review Board

➤ Role

- Provide independent review, comments, and recommendations to DWR on the approach, content, and execution of CNA project tasks, and draft and final reports.

➤ Diversity of experience

- Composed of a group of technical experts of varied but complementary backgrounds, education, and professional experience.

➤ Tasks

- Background review
- IRB meetings
- Community member meetings



Independent Review Board Members

- Independent dam safety expert
- Independent water system operations expert
- Independent water resources project expert
- Oroville Emergency Recovery – Spillways, Board of Consultants
- Oroville 2019 Part 12D Review Consulting Board Representative



Ad Hoc Group

Who are the Community Members?

Roles

- Communicate accurate information and context about elements of the CNA under consideration to the stakeholders and interest groups that they represent.
- Provide informed community and stakeholder perspectives to the IRB as the Oroville Dam CNA progresses.
- Receive questions about the CNA from the community and interested parties and communicate relevant questions or concerns to the IRB.



Ad Hoc Group (Continue)

Responsibilities

- Be informed about the elements of the Oroville Dam and appurtenant structures that will be addressed in the CNA.
- Avoid making assumptions about a planning direction or decision. Confirm information with questions and discussion, and by reviewing meeting summaries.
- Participate in the ad hoc group through the end of the project to ensure continuity and consistency.
- Adhere to the rules of engagement.



Thank You



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