EAST BAY
MUNICIPAL UTILITY DISTRICT

February 20, 2024

Ms. Niroop Srivatsa, City Manager
City of Lafayette
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Lafayette, CA 94549
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RE: City of Lafayette: Independent Structural Engineering and Architectural Commentary: Seismic Retrofit Study Update on Lafayette Reservoir Outlet Tower, February 6, 2024

Dear Ms. Srivatsa,

East Bay Municipal Utility District (EBMUD) received the City of Lafayette's Citizens Advisory Committee's (Committee) commentary on EBMUD's Lafayette Tower Seismic Upgrade Project (Project) and would like to take this opportunity to respond to the points raised in the document and present the facts.

Overall, the Committee's assertions in the commentary are incorrect. Much of the argument for their proposed alternative being viable relies on reduced factors of safety and on analysis methods that are not applicable to the design of retrofits to outlet tower structures and are not likely to be approved by the California Division of Safety of Dams (DSOD). As we mentioned when we met with you and the Committee on November 28, 2023, the proposed alternative of maintaining the full tower height by providing mild steel reinforcement in the upper half of the tower is not structurally viable. As stated in that meeting, EBMUD completed decades of studies, including a recent comprehensive evaluation of alternatives, that concluded that shortening of the tower was the safest, most appropriate approach for addressing the deficiencies of the tower. EBMUD has considered the City's input on aesthetics and incorporated a lightweight metal operating house into the design, with features reminiscent of the existing operating house. At the June 12, 2023 City Council meeting, EBMUD shared this design and committed to taking some time to consider a tall tower alternative to see if it might be structurally viable, while also meeting operational needs and budget constraints. EBMUD has performed this additional work and will summarize our findings in this letter.

Citizens Advisory Committee Commentary

The following responds to the points raised by the Committee:

1. **The analysis method relied upon for design evaluation does not represent the current state of practice for seismic analysis of a complex system of soil and structure such as the Tower.**

- While EBMUD and its consultant are familiar with the industry trends in using sophisticated nonlinear analysis methods to evaluate the seismic response, designing a retrofit is performed using more traditional analysis methods that include a degree of conservatism because of the uncertainty associated with the more advanced models and because DSOD requires using proven design methods with traditional analysis that can be replicated by multiple engineers.
- EBMUD's consultant, AECOM, performed two types of analysis to evaluate the tower:
  - A three-dimensional linear response spectrum analysis of the tower was performed using an industry-standard structural modeling software, SAP2000 with the following to account for nonlinear behavior and three-dimensional effects: secant stiffness for the tower walls to represent the cracking that would take place in the tower, soil springs at the bottom of the tower that are calibrated to the expected nonlinear soil-structure interaction effects, limits for demand-capacity ratios that represent acceptable ductile behavior in moment, and directional response combinations using the commonly used Square Root Sum of Squares method.
  - A three-dimensional nonlinear time history, soil-structure interaction (SSI) analysis was performed using an advanced geotechnical modeling software, FLAC with the tower walls and surrounding soil explicitly modeled to capture the "complex" nature of the system to evaluate any aspects in the seismic performance of the tower that are not captured in the SAP2000 analysis.
- Use of traditional analysis is in line with the DSOD design philosophy as represented in DSOD's comment on the basis of design in February 2020: *"We [DSOD] understand that the design is based in a nonlinear SSI analysis because the tower is embedded in soil, and soil has damping effects. However, for a significant repair we do not rely on models with this degree of nonlinearity because of the uncertainty associated with these types of analyses. In approving a significant repair, we [DSOD] review designs with a simplified analysis with less nonlinearity that can be replicated by multiple engineers".* Therefore, by using the response spectrum analysis, EBMUD's design evaluation represents the state of the practice for seismic analysis for retrofit design of dam outlet towers.

2. **The presentation appears to ignore the Committee's earlier observation that the only so-called "brittle failure mode" (in this case, the flexural mode) affecting the tower capacity can be resolved relatively simply by the addition of a modest amount of mild reinforcement in the upper portion of the tower height.**

- As noted during the November 28, 2023 presentation, EBMUD and its consultant had evaluated the retrofit proposed by the Committee. To cover possible moment deficiency in the tower, the retrofit must extend to elevation (EL) 410, which requires core drilling for 90 to 100 feet along the tower.
- Shear deficiency also exists below EL 410, and therefore a retrofit must be considered at the bottom of the tower. In evaluating the seismic performance of the existing tower, a higher strength can be used than that used in design codes. However, in performing the analysis for retrofit design, the lower strength required by the American Concrete

Institute design codes and the US Army Corps of Engineers Engineering Manuals must be used. Following these standards is a requirement for design and results in lower shear strengths. The outcome is that there are unacceptable demand-capacity ratios for shear in both the response spectrum analysis and the FLAC SSI analysis. The shear deficiency below elevation 410 feet must be addressed in the design. Therefore the retrofit cannot be resolved simply by the addition of a modest amount of mild reinforcement in the upper portion of the tower height.

3. **The shear capacity of the lower portion of the tower has been understated.**

- The Committee is referring to the core test results for the samples extracted from the lower portion of the tower. It should be noted that the concrete "design" strength noted on the original tower drawings is 2,000 psi.
- In determining the appropriate strength to use in analyses, the design team followed standard approaches by the American Concrete Institute. Note, there is no evidence from the construction records that the concrete in the lower portion was any different from other parts of the tower. Using a higher strength for the lower part of the tower cannot be justified by the core results at EL 444 only. Therefore, the shear capacity of the lower portion of the tower is not understated.

4. **The stated effect of the tower on the buried conduit assembly is questionable.**

- As mentioned during the November 28, 2023 presentation, EBMUD and its consultant were still evaluating the full-height tall tower alternative and had not shared the full analysis results with the Committee.
- The FLAC analysis shows high "negative" moments in the conduit just next to the tower. The "positive" moment away from the tower is influenced by this negative moment. The negative moments were truncated in the figure on page 23 of the presentation because they exist at the section of the conduit that is significantly stiffer and stronger than the rest of the conduit (due to the geometry of the conduits, being stacked vertically adjacent to the tower and side by side away from the tower). The apparent hump in the figure is the positive moment. The negative moments are driven by the rotation of the tower, which is higher for the full-height tall tower than that of the short tower. As a result, the positive moments are also higher and the stated effect of the tower on the buried conduit assembly is correct.

5. **The possibility of "added cost" of increased reinforcement of the buried conduit assembly due to a full-height tower has been exaggerated.**

- While it is true that safe access is a cost driver in retrofitting the conduits, transporting and installing reinforcement/steel strips in the conduit (confined space) is challenging, costly and carries increased risk.
- Note that the reinforcement will not be adequate to provide a composite section, and a steel strip retrofit is envisioned for the increased demand in the conduits at the vicinity of the tower. Therefore, the possibility of "added cost" of increased reinforcement of the buried conduit assembly due to a full-height tower has not been exaggerated.

6. **The "challenge" of installing reinforcement in the existing tower wall has been overstated.**

- EBMUD's consultant, AECOM, reached out to specialty contractors during the alternative selection process to evaluate center-core drilling in the tower walls.
- Although feasible, the risk and constructability considerations associated with installing reinforcement in the existing tower will involve higher construction costs and will likely require demolition of the control house at the top of the tower to allow for construction equipment to install the reinforcement. The challenge of installing reinforcement to the existing tower wall has not been overstated.

7. **The added seismic risk to the existing tower to allow time to analyze and obtain approval for a full-height retrofit would be insignificant relative to the 600-plus year return period envisioned for the criterion-level seismic event.**

- It is agreed that balancing seismic risk reduction with practical considerations is essential. While the risk may be small relative to the long return period, it is essential to assess the risk comprehensively. Therefore, the added risk during further analysis, and approval needs to be evaluated. This allowance should consider factors such as cost, availability of resources, urgency, and stakeholders direction. While long return periods reduce immediate urgency, a holistic view considers safety, risk to community, and construction cost. The timing of retrofit is decided through coordination between EBMUD and DSOD.

Tower Architecture and Community Significance

EBMUD completed a study of the tower's historical significance in 2018, which concluded that the tower would not qualify as a historical resource pursuant to California Environmental Quality Act Guidelines Section 15064.5(a), or a historic property under Section 106 of the National Historic Preservation Act. Because of this, EBMUD is limited in its ability to expend ratepayer funds on measures to maintain features, as this would constitute a gift of public funds. However, EBMUD is committed to fair and equitable measures for all the communities it serves, including many disadvantaged areas. As part of EBMUD's role in environmental stewardship and oversight of the significant public resource that is Lafayette Reservoir Recreation Area, EBMUD has a shared goal of appropriate aesthetics for the tower. As previously presented to the City Council, EBMUD will include a lightweight metal operating house, which is necessary for operations while providing a similar, yet modern look for the top of the tower. Also, as pointed out in the commentary, EBMUD has several publications that have documented the tower's construction and original appearance, which will be maintained so that future generations will understand the history of the tower, to which the new tower will be added as part of this legacy.

Evaluation of Tall Tower Alternative

As promised during the June 12, 2023 City Council meeting and our meeting on November 28, 2023, EBMUD performed an evaluation to see if there might be a structurally viable alternative for maintaining the current height of the tower. In order to make such an alternative viable, the following design elements are needed:

- Reinforcement is needed throughout the full height of tower and cannot be drilled inside the walls as proposed by the City.
- Structural analysis shows bending forces on the conduits would be approximately 50 percent higher than for the shortened tower and would therefore require installation of additional steel strip reinforcement to both conduits to distance of 150 feet downstream of the tower to mitigate cracking in the conduits.
- Construction of this alternative would require removing and replacing the existing operating house, likely with a similar metal structure as for the shortened tower alternative.

Based on EBMUD's evaluation, such an alternative would require additional design time of approximately six to nine months. Because of the nature of the retrofit, such an alternative would increase the cost of the construction contract by approximately $6 million dollars, and require approximately $2 million dollars in additional design and construction management costs, bringing the cost of this alternative to approximately $8 million dollars over the shortened tower alternative, as shown in the table below:

Factor	**Tower Shortening with Metal Operating House**	**Tall Tower with Full-Length Steel Strips and Metal Operating House**	
Cost		TOTAL COST	INCREASED COST
- Remaining Design Consultant	$1.0 M	$1.9 M	$0.9 M
- Remaining In-House Design Support	$0.2 M	$0.3 M	$0.1 M
- Construction Management	$2.0 M	$2.9 M	$0.9 M
- Construction Contract	**$13.5 M**	**$19.2 M**	**$5.7 M**
- **TOTAL PROJECT COST**	**$16.7 M**	**$24.3 M**	**$7.6 M**
Schedule			
- Design	Through 2024	Through Early- to Mid-2025	
- Construction	2025 Construction Season	2026 Construction Season	
DSOD Approval	Approved	Uncertain to unlikely approval with potential for other unforeseen scope increases	

It is also important to note that this alternative may not be acceptable to DSOD. As stated in their September 15, 2023 letter to the City:

"The tower system is a critical appurtenance to the dam that serves as both the emergency outlet and spillway for the dam and reservoir. Because of this dual purpose, there are critical risks associated with the potential failure of the system that would impact all means of evacuating the reservoir in the event of an emergency or result in an uncontrolled release of the reservoir, which is not acceptable for public safety."

For this reason, the safety, reliability, and robustness of the selected alternative is of paramount importance. The shortened tower alternative has been selected as the safest, most resilient way to address the seismic risk. We have found that a fully reinforced tall tower with a substantial conduit retrofit may be structurally feasible, but it is more complex, costly, higher risk and would still require replacement of the control house at the top of the tower. It is imperative that EBMUD refrains from burdening its ratepayers, especially those in our customer assistance program, with such exorbitant costs. As responsible financial stewards, our fiduciary obligation to the public cannot condone the allocation of $8 million in ratepayer funds towards an endeavor that has proven to be unsatisfactory. Failure to recognize this would not only reflect poorly on our collective stewardship of public funds but also undermine the trust placed in us by the community and stakeholders.

In conclusion, we trust that you now grasp the gravity of the situation and thoroughness of our analyses and recognize the District's unwavering commitment to safeguarding the facility and the communities downstream. This encompasses not only Lafayette but also neighboring areas such as Walnut Creek, Pleasant Hill, Concord, Martinez, and other unincorporated regions within Contra Costa County. Our dedication to ensuring the safety and well-being of all residents remains steadfast.

We want to caution the City regarding its Committee's findings and want to guard against pursuit of an irresponsible project approach that is not supported by the appropriate analyses and relies on relaxed standards. EBMUD, its engineers, and its consultants are ultimately accountable for the design and are unwilling to take an action that reduces safety. The City and EBMUD have a shared responsibility for safety of the community. We would like to believe that the City would not want to be in the position of advocating for an alternative that presents a higher risk to public safety.

As I mentioned in my email to you, EBMUD is available to present the tall tower alternative and address any technical questions you may have and will reach out to you with potential dates.

Sincerely,

Olufemi O. Yoloye
Director of Engineering and Construction

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