ROLL CALL

- Lieutenant Collins
- Supervisor Connelly
- Supervisor Conant
- Secretary Crowfoot
- Deputy Director Curry
- Supervisor Flores
- Supervisor Fuhrer
- Assemblyman Gallagher
- Supervisor Kimmelshue

- Deputy Licon
- Captain Million
- Director Nemeth
- Senator Nielsen
- Councilmember Pittman
- Mayor Reynolds
- Lieutenant Stokes
- Superintendent Teague
- Supervisor Vasquez
- Genoa Widener
ITEM 1: WELCOME AND INTRODUCTIONS
ITEM 2:
ACTION ITEMS & ROADMAPS
<table>
<thead>
<tr>
<th>Item</th>
<th>Meeting</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. Report out how instrumentation performed and was managed during winter operations</td>
<td>Mtg 2 11/2019</td>
<td>Ongoing.</td>
</tr>
</tbody>
</table>
## Commission Action Items Tracker

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Meeting</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>Follow-up on the status of Federal Emergency Management Agency (FEMA) reimbursement for spillway reconstruction</td>
<td>Mtg 3 02/2020</td>
<td>Ongoing.</td>
</tr>
<tr>
<td>7</td>
<td>Discussion to help state agencies and local partners address homelessness concern around Feather River</td>
<td>Mtg 3 02/2020</td>
<td>For future Commission consideration.</td>
</tr>
<tr>
<td>8</td>
<td>CalOES follow up with CalTrans on the status of their post-fire mitigation along County highways</td>
<td>Mtg 5 11/2020</td>
<td>Done. Work confirmed complete.</td>
</tr>
<tr>
<td>9</td>
<td>DWR updates on debris and storm inflows</td>
<td>Mtg 5 11/2020</td>
<td>DWR monitoring, will notify Commission as needed.</td>
</tr>
<tr>
<td>10</td>
<td>DWR follow-up re: Hyatt Power Plant</td>
<td>Mtg 5 11/2020</td>
<td>Done. Update provided at Q2 2021 meeting.</td>
</tr>
</tbody>
</table>
## Commission Action Items Tracker

<table>
<thead>
<tr>
<th>Item</th>
<th>Meeting</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>Mtg 6 2/19/21</td>
<td>On track.</td>
</tr>
<tr>
<td><strong>Offer new members, Kimmelshue, Fuhrer and Vasquez, a Commissioner orientation.</strong></td>
<td>Mtg 6 2/19/21</td>
<td>Done. Contact e-mail and phone # are available on Commission website.</td>
</tr>
<tr>
<td>12</td>
<td>Mtg 6 2/19/21</td>
<td><strong>Post additional contact information on OCAC website.</strong></td>
</tr>
</tbody>
</table>
# 2021 Public Meeting Agenda Roadmap

## Q3 (August 27, 2021) Infrastructure

### Topics
Planned Major Projects at Oroville Facilities
- Asset Management
- Annual Maintenance Plan

### Status Updates
Commission Report

## Q4 (December 3, 2021) Operations

### Topics
Oroville Dam Facility Operations
- Winter Operations Plan
- U.S. Army Corp of Engineers (water control manual update)

### Status Updates
Commission Report
Wildfire Season Update
### Q1 (2022) Partnerships

**Topics**
- Dam Facility Partnerships
  - FERC Relicensing
  - Recreation Partnerships
  - Public Safety Partnerships

**Status Updates**
Commission Report

### Q2 (2022) Joint Operations Center – Sacramento

**Topics**
- Joint Operations Center
  - Tour of Joint Operations Center *(Commissioner only portion)*
  - Overview of Joint Ops and Flood Ops
  - 2017 Lessons Learned and Current Procedures

**Status Updates**
Commission Report
Commission Report
Senate Bill 955 Requirements

SB 955 states the Commission will publish a report at least once every three years that provides the following:

- An overview of ongoing maintenance and improvements made at the Dam and Dam complex;
- A register of communications received from State Agencies and other parties to the Commission;
- Notice of upcoming plans made by State Agencies for the Dam and Dam Complex; and
- An overview of flood management projects on the Feather River affecting public safety and flood risk reduction.
Report Subcommittee Determined (August 2021)

Review tentative schedule (May 2021)

Subcommittee Presents High-Level Outline (December 2021)

Subcommittee Version 1 Draft Report (Q2 2022)

Subcommittee Presents Detailed Report Outline (Q1 2022)

Present Final Report (Q4 2022)

Full OCAC Review of Version 2 Draft Report (Q3 2022)
ITEM 3: DAM SAFETY PROGRAM: REGULATORY PERSPECTIVE
California’s Dam Safety Program

Sharon K. Tapia, P.E., PMP

May 28, 2021
Dam Safety Authorities

California Water Code
Division 3. Dams and Reservoirs
Part 1. Supervision of Dams and Reservoirs

California Code of Regulations
Title 23. Waters
Division 2. Department of Water Resources
Chapter 1. Dams and Reservoirs
Recent Dam Safety Initiatives & Legislation

**Dam Safety Initiatives:**
- Proposed Legislation for Emergency Action Plans
- Directed Expedited Reviews of Spillways
- Inspection Frequencies and Requirements
- Independent Review of DSOD's Dam Safety Protocols

**Governor's 4-Point Plan to Bolster Dam Safety and Flood Protection**
- Feb 24, 2017

**Senate Bill 92**
- Jun 27, 2017
- Hazard Potential Classification Update
- Inundation Maps*
- Emergency Action Plans
- Bolstered Enforcement*
- Amended Annual Dam Fees*

**Assembly Bill 1270**
- Feb 26, 2018

**Assembly Bill 2516**
- Sep 19, 2018
- Public Reporting of Information Related to Dams with Reservoir Restrictions

*Requires the promulgation of regulations.
DSOD & O&M within DWR

- Director DWR
- Director’s Safety Review Boards
- Deputy Director State Water Project
- Division of Operations and Maintenance (O&M) includes SWP Dam Safety Program
- Deputy Director Flood Mgmt. and Dam Safety
- Division of Safety of Dams (DSOD)
DSOD’s Staffing

OFFICE OF THE CHIEF

SECTION I

SECTION II

SECTION III

RE-EVAL SECTION I

RE-EVAL SECTION II

RE-EVAL SECTION II
Design Reviews & Re-evaluations

ELEV 507

- Core
- Claystone u/s
- Sandstone shell
Construction Oversight
Inspections & Surveillance Monitoring
Emergency Response

Source: CBS Local San Francisco
Follow Us On Social Media

CADWR

CA_DWR

calwater
cadepartmentofwaterresources
ITEM 4: DAM SAFETY PROGRAM: PUBLIC SAFETY PERSPECTIVE
Castaic Dam - High Outlet Tower and Access Bridge, Los Angeles County

Oroville Citizens Advisory Commission
May 28, 2021

Presented by:
David Sarkisian, PE, CEG
Chief of Dam Safety Services
SWP Chief Dam Safety Engineer
<table>
<thead>
<tr>
<th>Field Division</th>
<th>Dam</th>
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<tbody>
<tr>
<td>Oroville</td>
<td>Oroville Dam</td>
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<tr>
<td>Oroville</td>
<td>Parish Camp Saddle Dam</td>
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<tr>
<td>Oroville</td>
<td>Bidwell Bar Canyon Saddle Dam</td>
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<tr>
<td>Oroville</td>
<td>Thermalito Diversion Dam</td>
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<td>Oroville</td>
<td>Thermalito Forebay Dam</td>
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<td>Oroville</td>
<td>Thermalito Afterbay Dam</td>
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<td>Oroville</td>
<td>Feather River Fish Barrier Dam</td>
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<td>Oroville</td>
<td>Antelope Dam</td>
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<td>Oroville</td>
<td>Frenchman Dam</td>
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<td>Oroville</td>
<td>Grizzly Valley Dam</td>
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<tr>
<td>Delta</td>
<td>Bethany Dams</td>
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<td>Delta</td>
<td>Clifton Court Forebay Dam</td>
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<td>Delta</td>
<td>Del Valle Dam</td>
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<tr>
<td>Delta</td>
<td>Patterson Dam</td>
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<tr>
<td>Delta</td>
<td>Dyer Dam</td>
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<tr>
<td>San Luis</td>
<td>O’Neill Forebay Dam</td>
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<tr>
<td>San Luis</td>
<td>Sisk Dam (San Luis Reservoir)</td>
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<tr>
<td>San Luis</td>
<td>Little Panoche Detention Dam</td>
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<tr>
<td>San Luis</td>
<td>Los Banos Dam</td>
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<tr>
<td>Southern</td>
<td>Pyramid Dam</td>
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<td>Southern</td>
<td>Quail Dam</td>
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<td>Southern</td>
<td>Castaic Dam</td>
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<td>Southern</td>
<td>Devils Canyon Second Afterbay Dam</td>
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<tr>
<td>Southern</td>
<td>Cedar Springs Dam</td>
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<td>Southern</td>
<td>Crafton Hills Dam</td>
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<tr>
<td>Southern</td>
<td>Perris Dam</td>
</tr>
</tbody>
</table>

C A L I F O R N I A  D E P A R T M E N T  O F  W A T E R  R E S O U R C E S
Focus for Typical Industry Dam Safety Program – Pre-2000

- Surveillance & Inspections
- Dam Safety Assessments
- Reservoir Operations
- Maintenance
- Design and Construction
- Emergency Action Plans
- Independent Reviews

B. F. Sisk Dam (San Luis Reservoir) Glory Hole Spillway and Gianelli Pumping-Generating Plant Intake Structure
2017-2018 SWP Dam Safety Program Reviews

- Independent Forensic Team Report
- Owner’s Dam Safety Program Audit
- ISO 55000/ASDSO Peer Review
- Management Reviews/Visits with Peers
- Dam Safety Program Maturity Matrices
Common Areas Identified for Improvement

• Update the SWP Dam Safety Policy
• Define the Top-down structure
• Increase training and interaction with dam safety organizations
• Implement Cross-Divisional Dam Safety Teams
• Link the SWP Dam Safety Program to the O&M Asset Management Program
• Improve Culture of Continuous Improvement
Road-mapping of Multi-year Dam Safety Program Initiatives

- 30 initiatives or “tasks” identified → Consolidated to 16 Initiatives
Initiative No. 1 – Solidify Guiding Documents, Including the SWP Dam Safety Program Document

- Updated Policy Signed by Director on November 2, 2018
- Public safety is the highest priority for the Department and the SWP
- Assigns responsibilities and accountability to key positions
- Formally Established Program Elements
SWP Dam Safety Program Elements

- Surveillance
- Dam Safety Assessments
- Reservoir Operations
- Maintenance
- Design and Construction
- Risk Management

- Emergency Preparedness
- Independent Reviews
- Project Delivery
- Communication
- Documentation
- Technical Expertise
- Program Reviews
Initiative No. 2 – Complete SWP Dam Safety Program Functional Design Implementation
Initiative No. 4 – Enhance DWR’s Approach to Dam Safety-related Risk Management

Oroville Dam Comprehensive Needs Assessment: Risk Assessment plus Risk Reduction Measures
Initiative No. 7 – Enhance Emergency Preparedness

- Dam Breach Inundation Map Web Publisher (ca.gov)
- Emergency Action Plans (EAPs)
- Virtual Annual EAP Seminars
- Tabletop and Functional EAP Exercises
- Internal Rapid Response and Recovery Plans

Fair Weather Failure Inundation Map for Bidwell Bar Canyon Saddle Dam, Butte County
Initiative No. 8 – Identify DSP-related Core Competencies

- Identified the knowledge, skills, and abilities required for successful execution of job duties within O&M Dam Safety Services.
- Utilized the US Dept. of Labor Engineering Competency model
- Multiple Tiers of competencies
- Challenges of Tier 5 competencies
Initiative No. 12 – Formalize and Expand Dam Safety Program Training

✓ Established Training Plans to require development of **dam safety core competencies**
✓ Training Contracts
✓ Developed SWP Dam Safety Awareness Modules 1A and 1B
✓ Developing Field Division-specific Dam Safety Training Modules
Initiative No. 13 – Enhance Industry Outreach

• Increased collaboration with the U.S. Army Corps of Engineers and Bureau of Reclamation

• Increased dam safety conference and workshop attendance.

• Participation in CEATI – Dam Safety Interest Group.
Initiative No. 14 – Develop DSP Management of Change Program and Communication Plan

- Early Implementation Projects
- Future Dam Safety Projects
- Emergency Action Plan-related Activities
- Inspection & Surveillance Activities (multiple responsible parties)
- Maintenance Activities
- Operational Activities
- Seasonal Forecasting
- Dam Safety Program Enhancements
Initiative No. 16 – Develop More Formal Dam Safety Program Management Review

• Bi-weekly SWP Dam Safety Program Steering Committee Meetings
• Quarterly meetings with FERC and DSOD
• Independent Verification & Validation
• Annual Program Reporting
• 5-year Program Review/Audit
Thank you
ITEM 5: RISK ASSESSMENT
Risk Management in Socio-Technical Systems
Comments from Oroville Dam CNA Process

Dr. R. Storesund, PE., GE, Consulting Engineer, Storesund Consulting
American Society of Civil Engineers, Region 9 Governor – San Francisco Section
Executive Director, UC Berkeley’s Center for Catastrophic Risk Management
President & CEO, NextGen Mapping, Inc. (Software Development)
President & CEO, Storesund Construction, Inc. (Class A, B, C-57)
President & Director, SafeR³ (Non-Profit)

May 28, 2021
About Rune

• Dual Degree Program UC Santa Cruz/UC Berkeley
  – BA Anthropology (UC Santa Cruz)
  – BS Civil Engineering (UC Berkeley)
• Masters in Geotechnical Engineering (UC Berkeley)
• Doctorate in Civil Systems (UC Berkeley)
• Executive Director, UC Berkeley’s Center for Catastrophic Risk Management
• Consulting Engineer, Storesund Consulting
• President & CEO, NextGen Mapping, Inc. (Software Development)
• President & CEO, Storesund Construction, Inc. (Class A, B, C-57)
• President & Director, SafeR³ (Non-Profit)
My Disaster Research

- 1986 NASA Challenger
- 2003 NASA Columbia
- 2005 Hurricane Katrina
- 2010 San Bruno PGE Explosion
- 2010 Deepwater Horizon
- 2014 Oso Landslide (WA State)
- 2015 Aliso Canyon Gas Leak
- 2017 Oroville Dam Spillway Failure
- 2017 US Navy Ship Collisions
- 2018 California Wildfires (Butte County)
- 2019 Brumadinho Landslide
- 2019 Boeing 737 MAX
- 2020 Michigan Dam Failures
Oroville Dam CNA Ad Hoc

- Served at the invitation of Senator Nielsen and Assemblyman Gallagher
- Risk Management Perspective
- Ad Hoc: July 2018 to December 2020
- May 10, 2021 Report with Reflections and Recommendations

http://safer3.world/
What I’d like to Talk About Today

- What is risk & crisis
- Socio-Technical Systems (people and organizations too!)
- Understanding utility of “uncertainty” as a management variable
- Setting performance expectations (“Expected” performance)
- Use of “Leading Indicators”
- Tracking skew between “Work as Imagined” and “Work as Done”
- Advanced Inquiry Methods (Dialectic, Multiple Realities, etc.)
- Focus on “Valid” and “Reliable” methods
- Avoiding E3 Errors (solving the wrong problem precisely)
- Triangulation approaches to overcome conflicting/mixed signals
- Safety Culture and Process Improvement Programs
What I Can Talk About in 20 Minutes

- What is risk & crisis
- Socio-Technical Systems (people and organizations too!)
- Understanding utility of “uncertainty” as a management variable
- Setting performance expectations (“Expected” performance)
- Use of “Leading Indicators”
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- Avoiding E3 Errors (solving the wrong problem precisely)
- Triangulation approaches to overcome conflicting/mixed signals
- Safety Culture and Process Improvement Programs
Safety

• Searching for "safety"

• DWR wants to ensure safety

• Community wants to feel safe
Risk Perception – Insurance

“Regarding dams and private insurance. My understanding, which I confirmed, is that private insurers are not insuring dams (other than surety bonds for construction) and that they don’t think it’s a viable business opportunity because the potential losses are so high (liability insurance) and the costs of repair / reconstruction are so high (property insurance). I think it would be very difficult to get them to insure dams.”

Former California Insurance Commissioner
Oroville CAC “Opportunities”

• CAC has baton from Ad Hoc
• Take a leadership role in Proactive Risk Reduction
• Dam is not going to ‘fail’ tomorrow….BUT
  – Current techniques are deficient
  – Takes decades to implement substantial improvements
  – Aging infrastructure with unknown service life
  – Climate Change
  – Two (2) evacuations in 50 years, statistics says it will happen again!
• Critical to start laying a resilient foundation today!
Recommendations (Mini Projects)

- Re-engage the IFT to review progress on ‘lessons to be learned’
- Formalize community impacts for discharges 150,000 cfs to 700,000 cfs
- Explicit definition of ‘safety’ (what does ‘safe’ mean?)
- Be financially accountable for “Performance” (Compensation Fund)
- Perform detailed assumption audits (all dam infrastructure)
- Scrutinize Asset Management (not just plans but performance)
  - What is it supposed to do?
  - What is it actually doing?
  - Where are the differences?
  - Use on both physical assets as well as methods/procedures
- Require Life-Cycle Management Today!
  - Target service life
    - Components
    - Assemblies
    - System (where are the ‘weak’ links?)
  - Target maintenance and intervals
  - Life-cycle based budgeting, then track within expectations or not?
Failure is Time-Dependent

- Decreasing Failure Rate
- Constant Failure Rate
- Increasing Failure Rate

- Burn-In Failures
- Constant (Random) Failures
- Wear-Out Failures

- Few (if any) Risk Analyses identify time at which failure rates increase

- Most Risk Analyses Characterize the "Constant" Failure Rate
Limited “Imagination” for Scenarios

Failure Scenarios

- Credible: 70%
- Non-Credible: 20%
- Unrecognized & Credible (Not Considered): 10%

Berkeley
UNIVERSITY OF CALIFORNIA
NOTE, THESE REGIONS ARE NOT DISCRETE, BUT VERY FLUID AND TIME-DEPENDENT!!

### Consequences of Failure (Cf)

<table>
<thead>
<tr>
<th>Less Uncertainty</th>
<th>More Uncertainty</th>
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<tbody>
<tr>
<td><strong>Traditional Quantitative Risk Analysis</strong></td>
<td><strong>Unfolding Events</strong></td>
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<tr>
<td>“Probabilities”</td>
<td>Active Flooding</td>
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<tr>
<td>Well-Structured Well-Defined Bounded</td>
<td>Hurricane Aftermath</td>
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</table>

<table>
<thead>
<tr>
<th>Less Uncertainty</th>
<th>More Uncertainty</th>
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<tbody>
<tr>
<td><strong>Anticipated Events</strong></td>
<td><strong>Unanticipated Unfolding Events</strong></td>
</tr>
<tr>
<td>“Earthquakes”</td>
<td>CRISIS</td>
</tr>
<tr>
<td>“1,000 year storm”</td>
<td>Ill-Structured Un-Defined Un-Bounded</td>
</tr>
<tr>
<td>“Possibilities”</td>
<td></td>
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</tbody>
</table>

**NEED DIFFERENT TOOLS/METHODS/STRATEGIES FOR EACH REGION!**

If all you have is a hammer in the toolbox, everything looks like a nail.”

- Bernard Baruch
The Johari Window Model

- Known to self
  - Open area or Arena
  - Blind spot

- Not known to self
  - Hidden area or façade
  - Unknown
<table>
<thead>
<tr>
<th>Known to self (i.e. US Dams)</th>
<th>Not known to self (i.e. US Dams)</th>
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</thead>
<tbody>
<tr>
<td><strong>Known to others</strong></td>
<td>PFMA/RIDM</td>
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<td></td>
<td>Triangulation</td>
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<td>Leading Indicators</td>
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<td>Reliability-Centered Maintenance</td>
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<td>Resilience Engineering</td>
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<td>High Reliability Organizations</td>
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<td>Life-Cycle Management</td>
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<td>Total Quality Management</td>
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<td>Crisis Management Preparedness</td>
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<tr>
<td><strong>Not known to others</strong></td>
<td>Detailed design calculations</td>
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<td></td>
<td>Performance characteristics</td>
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<td>&quot;Surprises&quot;</td>
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<td>New Technologies</td>
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</table>
Risk Management Pledge

I  State Your Name  PROMISE TO APPRECIATE THE VALUE AND IMPORTANCE OF UNCERTAINTIES IN CIVIL SYSTEMS AND HELP DECISION-MAKERS AVOID ‘CONFIDENT IGNORANCE’ BY ARMING THEM WITH PRAGMATIC INFORMATION AND AVOIDING OVER-SIMPLIFICATION AND E3 ERRORS (SOLVING THE WRONG PROBLEM PRECISELY). I ALSO PROMISE TO TRIANGULATE ANSWERS INSTEAD OF RELYING SOLELY ON ONE TECHNIQUE.
Questions

Dr. Rune Storesund, D.E.ng. P.E., G.E.
Executive Director
Center for Catastrophic Risk Management (CCRM)
University of California, Berkeley

rune@berkeley.edu
+1 510 225 5389
THE STATE OF DAM SAFETY PROGRAMS IN THE UNITED STATES

PRESENTATION TO THE OROVILLE CITIZENS ADVISORY COMMISSION MEETING, 28 MAY 2021

ERIC HALPIN, PE
HALPIN CONSULTANTS LLC
As a US Army Corps of Engineers Infrastructure Leader (1980-2019):
- Owner and Self Regulator of +3,000 Dam and Levee Systems & Safety Programs
- Vice Chair of the National Levee Safety Program
- Primary Interface with Accountability to the Administration, Congress, and the Government “Watch-Dogs”
- US Government Lead for International Partnerships with Spain, Netherlands, Japan, and United Kingdom on Safety Programs
- Registered Professional Engineer (1988)

As Private Consultant: (2018-present)
- The Same Thing for Clients in Industry
DISCUSSION TOPICS

01 WHAT CONSTITUTES A STATE-OF-THE-ART DAM SAFETY PROGRAM?

02 HOW DO SUSTAIN THE STATE-OF-THE-ART PRACTICE?

03 WHAT TRENDS SHOULD WE BE AWARE OF?
Good governance never depends upon laws, but upon the personal qualities of those who govern. The machinery of government is always subordinate to the will of those who administer that machinery. The most important element of government, therefore, is the method of choosing leaders.

— Frank Herbert —
WHAT IS IN A STATE-OF-THE-ART DAM SAFETY PROGRAM?

The State of the Dam Safety Industry
TRADITIONAL DAM SAFETY PROGRAM FOCUS (1968-TODAY)

- Compliance with Design Standards as a Measure of Safety
- Inspection and Monitoring for Performance Concerns
- Safety Assured by Regulation?
Traditional View of Infrastructure Safety

Focused on the Infrastructure (not people, hazard, or consequences)

Focused on How We Built Them, Not How They’ll Perform (not integrated systems – think New Orleans)

Focused Compliance with Design Standards as a Measure of Safety, Assured by Regulation
This is what following standards only has resulted in...

- Huge Variation in Risk
- Over and Under Investment in Risk Management
- Wrong Priorities
- Poor Understanding
- Dynamics!

One Size Doesn’t Fit All!
MODERN DAM SAFETY PROGRAM FOCUS (SINCE 2000)

- Understand How Things Can Fail and the Risk Associated
- Risk Informed Decisions
- Sharing Responsibilities Via Improved Communication
- Governance: People, Process, & Policy
Why is a Strong Risk Framework Necessary?

Integration Via is Credibility:
- Dam Systems and the Environments they exist in are Complex and Dynamic
- Problems that You Can Understand are Problems That Can Be Solved
- Clear Relationships Within Governance: Policies, Processes, and People/Organizations

Built for the Long Haul
- Enduring Across Multiple Generations
- Adaptable to Evolving Practice, Science, Data, and Research
Risk Informed View of Infrastructure Safety

Risk = f(Hazard, Performance, Consequences)

What are the hazards and how likely are they to occur?

How will the infrastructure perform in the face of these hazards?

Who and what are in harms way? How susceptible to harm are they? How much harm is caused?

Modern Infrastructure Program: Focused on People, Performance, and Risks
How Do We Sustain the State-of-the-Art Practice?

State of the Dam Safety Industry
What Shapes Dam Safety Programs?

Safety Programs Constraints:
- Legislation and Regulations
- Technical Policies
- Funding
- *State of the Practice*
Places Where Risk Informed Safety Programs are the State of the Practice

- United States & Canada
- South America
- South Africa
- Netherlands, Spain, England, France, & Others
- SW Asia & India
- Japan
- Australia & New Zealand
What Industry Will Extract from the IFT Report

Change
- The “no fail” branch in some event trees can transition to failure in other failure modes*
- Large Damage States are Impactful and can transfer risk within a system*.

Sustain
- Independent Review and Challenge of Past Assessments is Necessary
  - Debate is Encouraged
  - Failure and Incident Rates are Extremely Low, But Industry Always Learns From Them
- Considerations of Systems and Human Factors Is Consistent with (and already a part of) Risk Informed Practice*

* Part of the Federal Risk Review Effort
Key Technical References for Modern Dam Safety Programs

- Guidance documents are the backbone to use of Risk in Dam Safety
- Scalable, but Consistent
- Adaptable, but Equitable
- Employed Broadly in National and International Programs
Human Systems

Complex Interactions
- Can Increase Risk and Uncertainty

What do We Do About it?

Governance and Human Factors

External System Influences
- Political, Environmental, Economic & Social Factors

What Safety Programs Manage

Physical Systems
- Infrastructure
  - Emergency Spillway
  - Main Dam
  - Auxiliary Dam
- Projects in a Tulare/San Joaquin Valley Watershed

Complex Interactions!
- Can Increase Risk and Uncertainty
- What do We Do About it?
How Risk Informed Safety Programs Address Complexities

Coincident Loadings
Systems Operations
Breach & Non-Breach Risks
Gate Reliability
Time Dependent Reliability
Length Effects
Regional Events
How Risk Informed Safety Programs Address Human Factors

Reliability Analyses in Hydrologic Loading

Detection and Intervention Impacts in Fragilities

Remote Operations

Issuance of Warning

Evacuation Effectiveness

Gate Reliability Considerations:

- Remote Operations
- Site Access
- Crew Availability
- Gate Functionality
- Offsite Power Reliability
- Backup Power Reliability

Can Have 1-3 Orders of Magnitude in Effect on AEP of Design Loads (headwater)
Key Mitigating Measures for Human Factors

- Command and Control for Incident Decision Making
- Risk Informed Safety Programs
- Effective Communications and Public Awareness
- Collaboration with Key Stakeholders
- Training and Exercises
- Continuing and Periodic Evaluations
- Qualification Based Roles and Responsibilities
Looking Forward: Trends, Challenges, and Opportunities

The State of the Dam Safety Industry
Risk Directions

Risk Informed Decision Making Continues to Undergo Adaptive Management

- Extreme Events
  - Understanding their Severity and Likelihood
- Industry Bench
  - Building Capabilities to Support the Action
- Systems and Human Factors
  - Recognizing and Considering Complexity
- Governance
  - Modernizing Approach to People, Decision Processes, and Policies
Common Themes from Complex Incidents

Keep Improving
Sustain Independent Thought
We Need to Be Better Communicators
It’s Rarely About the Numbers
There’s a Reason It’s Called Civil Engineering
Challenges for Our Industry

- Simplifying Assumptions about System Interactions and Human Factors are Necessary and Appropriate
- Don’t Forsake the Governance Lessons that Have Served Us Well: Safety Programs
- Can We *Not* Afford to Implement Risk Concepts in Safety Programs?
“Most of the negatives in housing are probably behind us. The fourth quarter should be reasonably good, certainly better than the third quarter.”

Alan Greenspan

Overconfidence Bias
“TRUST IS A RISK THAT MASQUERADES AS A PROMISE.”
Thank You

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ITEM 6: SPILLWAY CAMERAS
Webcam view of Thermalito Diversion Pool and Forebay (in distance)
ITEM 7:
PUBLIC COMMENT

The Oroville Dam Citizens Advisory Commission will now take public comment.

We appreciate your input.
ITEM 8: ADJOURN

Thank you all for joining us today, our next Oroville Dam Citizens Advisory Commission meeting will be on August 27, 2021.