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Published March 2020/DAM-Q0120/8929

ON THE COVER: USACE’s Prompton Dam near Honesdale, PA.

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It is a unique coincidence that USSD is embarking on an update to our strategic plan in 2020 because the first step in conducting strategic planning requires 20/20 Vision, i.e. clarify your vision and set a clear direction. Last summer the USSD Board of Directors (Board) determined the timing was right to update the Strategic Plan which was rolled out in the summer of 2014. Great strides were made by the previous Board to create a vision for our Society. The current Board has updated our vision of the future and revised our mission statement to describe what we do, how we do it and who we do it for. We began with a member survey last fall to develop an inventory of interests and what our members care about. The inventory was used to define the strategic domains where we will dedicate resources to reach our vision of a vibrant and valuable future. A number of strategic objectives were developed and prioritized for each domain to describe what we will do to achieve success.

An update of the strategic plan is occurring in conjunction with our efforts to strengthen the governance of USSD. Good governance begins with a qualified Board that is active and involved in our organization. The Board received training in non-profit/association governance in October 2019. We learned some obvious things like, good Boards can be better, and the best Boards make things happen, as opposed to keeping things from happening, by focusing on the appropriate governing mode. We were also educated on our fiduciary obligations which are the most essential elements of our role as a Board member. A clearer understanding of the governing modes and our fiduciary obligations has resulted in important changes in our operations and how the Board will function going forward. The Board’s work to strengthen governance and update the strategic plan will guide us to our future by building on our strengths, addressing our weaknesses, minimizing risks, and taking the greatest possible advantage of chances for success. The Ask the Board Town Hall originally scheduled for during the conference will instead be held as a webinar. Watch your inbox for more information. Also, the 2020 USSD Conference and Exhibition has been postponed due to concerns surrounding COVID-19. See page 12 of this magazine and stay tuned for details.

Denise Bunte-Bisnett
President, USSD

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ICOLD Releases World Declaration on Dam Safety

For almost a century, the International Commission on Large Dams (ICOLD) has made dam safety one of its highest organizational commitments. After a year of exchanges between the Board and National Committees (USSD is the U.S. National Committee), the Board adopted the final document in October 2019.

The World Declaration on Dam Safety can be accessed at ussdams.org/resourcecenter/icold or on the ICOLD website https://www.icold-cigb.org.

Events Updates

- The 27th Congress-89th Annual Meeting will be held in Marseilles, France on June 4-11, 2021. Learn more at https://cigb-icold2021.fr/en/generalinfo/welcome.

USSD Call for Abstracts

CONGRESS CALL FOR ABSTRACTS

Authors may submit abstracts for the 27th Congress in Marseilles to the USSD ICOLD Congress Paper Committee beginning April 13, 2020 through May 25, 2020.

- Papers can be submitted to info@ussdams.org beginning April 13, 2020
- More information to follow on ussdams.org and in the monthly e-newsletter.

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Build Better Together
USSD Dam
Decommissioning Committee

BY COMMITTEE CHAIR: JENNIFER BOUTRY, VICE-CHAIR: KEVIN SCHNEIDER

To address the growing need to engage in the dam decommissioning conversation, the USSD Dam Decommissioning Committee formed in 1998 with Richard Armstrong and Thomas Mudd as the first committee chair and vice chair. The original committee members were R. Michael Akridge, Lee DeHeer and Wayne Edwards. The committee was formed to develop and provide technical guidance on dam decommissioning to support the engineering and natural resource community. Advocating for dam removal was not a part of the committee terms of reference as many USSD members believed that advocacy for dam removal would be counter to USSD goals and objectives.

The Aspen Institute invited Wayne Edwards (Committee Chair) to join a diverse group to discuss implications of dam decommissioning. This group met eight times over a two-year period (2000-2002) and published the book “Dam Removal: A New Option for a New Century.” Wayne Edwards also chaired the ICOLD Dam Decommissioning Committee from 2005 to 2011, which published dam decommissioning guidelines including case histories (www.icold-cigb.org).

The USSD Dam Decommissioning Committee organizes a technical session on dam decommissioning at USSD Annual Conferences (see 2001 through 2019 proceedings). The committee organized and led technical workshops on dam decommissioning at the 2008 USSD Workshop in Portland, OR. 2015 USSD Workshop in Oakland, CA, and during the 2013 ICOLD meeting in Seattle, WA. In 2014, USSD committee members Jennifer Bountry and Tim Randle participated in a USGS Powell Center Working Group to produce papers on the synthesis of ecological and physical responses of dam removal (https://powellcenter.usgs.gov/view-project/526ae54ae4b0be4db9fbf979).

Several papers are available from this working group effort that provide great accounts of dam removal responses. In 2015, USSD presented the Award of Excellence in Constructed Projects to USSD member, Barnard Construction, for the completion of a monumental dam removal project on the Elwha River in Washington State (see July 2015, Issue No. 166). This award recognized the important role of dam decommissioning as one tool to address aging infrastructure that does not meet current environmental goals such as fish passage.


Learn More!

“Dam Removal: A New Option for a New Century”
Book by Wayne Edwards

Dam Decommissioning Guidelines Case Histories
www.icold-cigb.org

Synthesis of Ecological and Physical Responses of Dam Removal
https://powellcenter.usgs.gov/view-project/526ae54ae4b0be4db9fbf979

Guidelines for Dam Decommissioning Projects
https://www.ussdams.org/resource-center/publications/white-papers

Sediment Analysis Dam Removal Guidelines

The committee was formed to develop and provide technical guidance on dam decommissioning to support the engineering and natural resource community.
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ELEVATE
2020 USSD Conference and Exhibition

EDITOR’S NOTE: All events are subject to change.

Join us in the Mile High City for the 2020 USSD Annual Conference and Exhibition. Be a part of this premier technical event for dam and levee professionals. Learn from industry experts, share experiences, connect with colleagues, build new relationships, and collaborate with other world-class professionals dedicated to advancing the role of dam and levee systems in society.

TECHNICAL PROGRAM
We have an outstanding program under the leadership of technical program chair Elena Sossenkina of HDR. The program will start with the annual Legacy Lecture, where Kenneth Hansen will share his knowledge and wisdom on the advancement of the engineering practice for concrete dams, and Jim Lindell will talk about LeRoy Francis Harza, the “Dean of Hydroelectric Engineers.” All attendees are encouraged to participate in USSD committee meetings. Concurrent technical sessions will feature five tracks with more than 100 presentations.

NEW IN 2020: INTERACTIVE PRESENTATIONS
This new format brings a number of changes to the previous poster session. Four sessions will be offered within the conference tracks and will include the ability for in-depth discussions and one-on-one interactions. Each of the four sessions will focus on two or three general topics.

EXHIBITION – SOLD OUT!
Seventy-eight companies and agencies will display their products and services. Continental breakfasts, lunches, breaks and receptions will take place in the exhibit hall.

CONFERENCE WRAP PARTY
You won’t want to miss the Wrap Party at the History Colorado Center in downtown Denver. Learn about Colorado’s beer history, connection to the Apollo II Lunar Mission, life at Mesa Verde 800 years ago, the 1930s Dust Bowl, and today’s Rocky Mountains. Explore four floors of interactive displays, videos and exhibits. The party is included in full registration fee.

FIELD TOUR
Morning and afternoon tours will be offered to the Bureau of Reclamation laboratories in Lakewood, for an additional fee of $40.

5K FUNDS RUN/WALK
The 6th annual FUNds Run/Walk supports the USSD Scholarship Fund. Participate in person or virtually. Details on date and time to be announced. Contribute a minimum of $350 to the USSD Scholarship Fund and your logo/name will be displayed as a Partner in Education on the 5K poster.

CAREER FAIR
The U.S. Society on Dams (USSD) Young USSD’S Young Professional (YP) Committee’s Student Outreach Subcommittee is organizing a career fair as part of the 2020 USSD Conference. Holding the conference in Denver presents a unique opportunity to host an industry-specific career fair in a city that understands the importance of dams and levees and with strong academic programs focused on this subject.

Can’t Miss: Workshops
Several workshops, organized by USSD Technical Committees, will be held during the conference.

- Probabilistic Flood Hazard Analysis
- Tailings Dam Safety Management and Engineer of Record
- Communication during the “Golden Hour” – Risk and Crisis Communication Strategies for Dam Safety
- Earthquake Shaking and Ground Failure Hazards for Dams, including Automated Real-time Inspection Prioritization
- Evaluation Principles for the Monitoring of Dams and Their Foundations
- Power Skills Workshop

Learn more
Online: www.ussdams.org/2020-ussd-conference
Email: 2020conference@ussdams.org

CONFERENCE POSTPONED
As concerns surrounding COVID-19 continued to increase, the Board of Directors voted to cancel the conference, which was set for April 20-24, and will be evaluating the possibilities of securing a new date for later this year.

This unprecedented event has been difficult for everyone as we’ve attempted to understand COVID-19 and its impacts. In the end, we must do whatever it takes to keep everyone safe and healthy.

We hope that a new date can be identified shortly and the excellent program that was planned for April transferred to a new date.

The information on these pages was accurate as of press time. Visit the USSD website for the most recent information on the conference and other events: www.ussdams.org.

We are all in this together, and together we will get through this. On behalf of USSD, thank you for all your support.

Best regards,
Sharon Powers
Executive Director, USSD
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What’s New in DAM DECOMMISSIONING

BY USSD DAM DECOMMISSIONING COMMITTEE

Acknowledgments for contributing authors:
Jennifer Bountry, Tom Hepler, Seth Gentzler, Wayne Edwards, Tim Randle, and American Rivers

The building of dams to provide for growth, development, and national security has been an important part of economic and social development of the United States. Thousands of existing dams now support a multitude of benefits. The most common uses of dams and reservoirs are the management of water for industrial and municipal supply, agricultural, flood risk reduction, recreation, and hydropower generation purposes. Dams and reservoirs also provide valuable wildlife and fishery enhancement. Today, the U.S. National Inventory of Dams includes 90,000 structures.

Several changes have occurred in the past decade to limit the construction of new dams and to create more interest in the removal of existing dams. Although the design of dams is typically based on a 50-year economic life, most designed dams are intended to last indefinitely with proper maintenance and periodic repairs. Without proper operation and maintenance, dams may deteriorate and can ultimately create public safety hazards, which must be corrected. Also, as societal values change some dams are considered undesirable from an economic, environmental, or other public interest or political standpoint. When any dam becomes a safety hazard that is uneconomical to repair or is deemed undesirable for other environmental or cultural reasons, dam decommissioning, including dam removal, may be a viable alternative. Decommissioning is defined as the full or partial removal of an existing dam and its associated facilities or significant changes to the operations thereof. The cost of decommissioning a dam varies depending on location site conditions and the volume and quality of reservoir sedimentation. Each situation is different and must be considered on a case-by-case basis.

American Rivers recently announced that 82 dams were removed in 2018, reconnecting 1,230 miles of rivers, improving public safety and recreation opportunities, and revitalizing fish and wildlife in communities nationwide. These projects are a reflection of years of
The Carmel River Reroute and San Clemente Dam Removal Project is a legacy project showcasing natural river recovery following removal of a 106-foot-tall concrete arch dam, the relocation of over a million cubic yards of accumulated sediment, and the restoration of historic riverine habitat (Figure 2). The dam was built in 1921 on the Carmel River as a water supply project and created an approximately 1,425-acre-foot reservoir. In the early 1990’s, The California Division of Safety of Dams (DSOD) determined that the dam was a seismic hazard and by the early 2000’s the reservoir had sedimented in to the point of no longer serving a water supply purpose (less than 100 acre-feet of capacity). In addition, the dam was an impediment to fish passage.

Granite Construction was selected as the dam removal design-builder in 2013 and construction began in 2015. The channel restoration consisted of a unique approach to river step-pool and riffle morphology construction on a deformable bed in an attempt to restore gradient and passage continuity to parts of the upper watershed while allowing natural channel evolution (Figure 3). The approximately $80 million construction project was completed in late 2016.

Three years following the dam removal, the restored river channel has significant native recruitment with absolute riparian vegetation cover of 60%. South-Central California Coast steelhead are migrating through the project reach, along with Pacific lamprey, which have never before been documented upstream of the dam (Figure 4). These successes follow winter storms in 2016/2017 that reconfigured the constructed channel and resulted in the need to reevaluate monitoring methods and performance metrics. The unanticipated movement of step pool boulders during two-, 10-, and 45-year events provides opportunity to question the original channel design and construction, the fish passage criteria that drove the design, and expectations around long-term stability.
KLAMATH RIVER RENEWAL PROJECT
2019 UPDATE
CONTRIBUTED BY SETH GENTZLER

The Klamath River Renewal Corporation (KRRC) was formed in 2016 to oversee the decommissioning of four dams on the Klamath River (Iron Gate, Copco No. 1, Copco No. 2, and J.C. Boyle) in partnership with the states of California and Oregon (Figure 6, Figure 7, Figure 8). Under terms of the amended Klamath Hydroelectric Settlement Agreement (KHSA), PacifiCorp, the current owner of the hydroelectric facilities, will transfer ownership of the dams to KRRC, and KRRC will seek approval from the Federal Energy Regulatory Commission (FERC) to decommission them, through license transfer and surrender activities. In 2017, AECOM was selected to serve as the Technical Representative to support the KRRC with preliminary design, compliance and permitting, procurement and program management.

As of April 2019, formal or informal consultations are in progress with all regulatory agencies, and FERC applications for transfer and surrender have been submitted. In addition, the Draft EIR was released for public review in December 2018. A Board of Consultants was convened in mid-2018 at the request of FERC to

HOOSIER DAM REMOVAL PROJECT
2019 UPDATE
CONTRIBUTED BY TOM HEPLER

The Hoosier Dam Removal Project was located in Chatham County, North Carolina, on the Rocky River within the Cape Fear River Basin. The dam was a concrete overflow structure constructed in 1922 and consisted of a slab and buttress section with eight bays, flanked by a reinforced concrete cantilever section on the left abutment, and a 1.5 MW powerhouse on the right abutment (Figure 5).

The privately-owned dam carried a low hazard rating, with a maximum structural height of 30 feet and a total length of 330 feet and impounded a reservoir of 97 acres (known as Reeves Lake). Power generation ceased in January 2016 due to fire, and a deep scour hole was identified below the dam that had undercut a portion of the cantilever section.

The dam owner’s representative, Unique Places LLC, received funding from the National Fish and Wildlife Foundation to remove the dam and restore the Rocky River site, with the primary goal of reconnecting Critical Habitat for the Cape Fear Shiner, a federally listed endangered species, while ensuring protection of a sensitive species of freshwater mussel. Wildlands Engineering and Schnabel Engineering collaborated on testing and characterization of the reservoir sediments, permitting, and development of a river diversion and dam removal plan. Reservoir drawdown began on June 26, 2017 and was facilitated by the excavation of a 4- by 4-foot opening through the back wall of the powerhouse.

Following approval of a Nationwide Permit 53 by the U.S. Army Corps of Engineers for removal of the low-head dam, a work crew from the U.S. Fish and Wildlife Service (under the National Fish Passage Program) began removing the dam on Oct. 23, 2018 using two hydraulic excavators. Concrete demolition proceeded quickly from the left abutment to the powerhouse, working within the river channel, for removal of the majority of the structure by Nov. 9, with natural erosion of sediments downstream. Over 2,000 cubic yards of concrete rubble was buried above the ordinary high-water mark on the left abutment. Reinforcing steel and mechanical equipment were removed from the site for disposal.

Demolition was completed on the right abutment in June 2019 during low flow, followed by final site restoration work.

Figure 5. Concrete demolition of Hoosier Dam in North Carolina that began on the dam’s left abutment (Aaron Aho, Unique Places LLC).

Figure 6. Copco No. 1 Dam and Powerhouse

Figure 7. Iron Gate Dam and Powerhouse

Figure 8. Copco No. 2 Dam and Powerhouse

Figure 9. J.C. Boyle Dam and Powerhouse
review various aspects of its technical design and costs. The individuals approved by FERC for participation on this panel have expertise in dam construction and removal, engineering, aquatic and terrestrial biology, construction cost estimating, insurance, and bonding for large infrastructure projects.

In April 2019, the KRRC finalized and signed a contract with a design-build construction firm, Kiewit Infrastructure West Co. Kiewit has extensive experience in major construction projects, including most recently the emergency reconstruction of the Oroville Dam spillways, which involved removal and repair of both the main flood control and emergency spillways in less than 18 months as well extensive debris and sediment removal, development of access roads, and other work. The initial award authorizes design, planning, permitting support, native seed bank development, and other preparation for the later drawdown of the reservoirs. This work is underway and as of March 2020, Kiewit Infrastructure has submitted their final 60% design.

Figure 8. J.C. Boyle Dam and Spillway Gates
DAMS AS CRITICAL INFRASTRUCTURE:
Cybersecurity and Infrastructure Security Considerations

SUBMITTED BY CRAIG FREER, MICHELLE YEZIERSKI, AND ENRIQUE E. MATHEU
CYBERSECURITY AND INFRASTRUCTURE SECURITY AGENCY

The nation’s critical infrastructure provides essential services that serve as the backbone of our economy, security, and well-being. There are 16 critical infrastructure sectors whose assets, systems, and networks are so vital to the United States that their incapacitation or destruction would have a debilitating effect on national security, economic security, public health, or safety. The nation relies on these sectors for the power used in homes, the water we drink, the transportation that moves us, the stores we shop at, and the communications we rely on to maintain contact with friends, family, and colleagues.
Effective critical infrastructure risk management depends on the ability of owners and operators to engage across sectors.

Due to the connections and interdependencies between critical infrastructure sectors, damage or disruption to one type of facility within a sector can cause cascading effects or impact continued operation across other sectors. Understanding upstream and downstream dependencies is important for assessing risks and vulnerabilities and for determining the appropriate steps to take to increase security and resilience. Effective critical infrastructure risk management depends on the ability of owners and operators to engage across sectors to facilitate a shared understanding of risk and integrate a wide range of activities to manage cross-cutting, cross-sector risks.

Each of the 16 critical infrastructure sectors has a dedicated executive agency to serve as the Sector-Specific Agency (SSA). Each designated SSA provides a focal point for collaboration among owners and operators; other federal departments and agencies; and state, local, tribal, and territorial entities on sector-specific issues pertaining to critical infrastructure security and resilience.

The Cybersecurity and Infrastructure Security Agency (CISA) serves as the lead for eight critical infrastructure sectors, including the Dams Sector. Assets in the sector include: dam projects, hydropower plants, navigation locks, levees, dikes, hurricane barriers, mine tailings, and industrial waste impoundments. As a result, this sector provides critical water retention, delivery, and control services that support other sectors and critical functions across the nation. A national, coordinated effort is necessary to optimize the collective efforts of public and private stakeholders so they are better positioned to support and implement effective risk management approaches addressing the most significant threats and hazards affecting this sector.

**Cybersecurity and Infrastructure Security Considerations**

Several factors can affect the critical infrastructure security and resilience posture of the Dams Sector. These factors stem from the convergence of people, processes, technology and environmental elements. Both natural and man-made, either deliberate or accidental, events have the potential to damage or disrupt infrastructure assets within the sector. In addition, as physical infrastructure becomes more reliant and indeed interconnected with complex cyber systems for operations, the sector may be more vulnerable to certain cyber threats, including transnational threats. Vulnerabilities because of increased connectivity and disruptive digital technology, supply chain threats, and lack of system updates can expand the potential attack surface across the physical and cyber domains.

Increased geopolitical tensions can also influence the security posture of critical infrastructure facilities as demonstrated earlier in the year in the wake of international events that had the potential for retaliatory aggression against U.S. interests. As stated in the corresponding National Terrorism Advisory System (NTAS) Bulletin, government officials and private sector partners were urged to remain vigilant in the event of a potential threat.

There are a variety of actions that facilities across the Dams Sector can consider in response to heightened alert conditions. These options for consideration, which range from general awareness activities to specific actions addressing cyber and physical protection, are aimed at decreasing the likelihood of a successful attack and reducing its potential impacts. See Clip and Save section on page 21.

The specific cyber and physical protection actions highlighted do not constitute a prescriptive set applicable to all cases and conditions; they only represent general options for consideration. The implementation of a full suite of cybersecurity and physical security measures, processes, and programs specifically tailored to the facility should be informed by the corresponding risk assessments. Dams Sector owners and operators are encouraged to request access to the Dams Portal within HSIN-CI to gain access to additional resources that may assist them in making risk-informed decisions such as the Dams Sector Cybersecurity Framework Implementation Guide, Dams Sector Protective Measures Handbook, and Dams Sector Crisis Management Handbook.

**Conclusion**

Strengthening the security and resilience of the Dams Sector is a shared responsibility between all relevant stakeholders, including owners and operators, government entities, and non-government organizations. Active engagement among these stakeholders fosters mutual understanding and trust, promotes information sharing and practical exchanges, and galvanizes support for joint public-private efforts. Engagements that promote planning, prioritization of resources, exercises, and training greatly contribute to the success of national preparedness efforts and effective and timely responses to incidents and undesired events.

CISA will continue working in collaboration with partners across all sectors to defend against today’s threats and build a more secure and resilient infrastructure for the future. The threats we face today – digital and physical, man-made, technological, and natural – are more complex, and the threat actors more diverse, than at any point in our history. CISA is at the heart of mobilizing a collective defense as we lead the nation’s efforts to understand and manage risk to our critical infrastructure.

For more information about CISA and the work we do visit www.cisa.gov.
From new construction of dams and reservoirs to rehabilitation of aging water infrastructure and dam embankment seismic stability improvement projects, Phillips & Jordan brings the necessary experience and resources to tackle the toughest projects. Phillips & Jordan is the right partner for your dam and reservoir project.
**HEIGHTENED AWARENESS AND VIGILANCE**

**Adopt a state of heightened awareness:**
- Log in or request access to the Homeland Security Information Network-Critical Infrastructure (HSIN-CI) to review available information.
- Monitor NTAS advisories for indications of elevated or specific threats.
- Leverage any available opportunities to stay informed of threat information through the corresponding state or major urban area Fusion Center as well as bulletins and alerts from the Federal Bureau of Investigation.
- Consider partnering with information sharing and collaboration groups established within other sectors with relevant interdependencies (examples could include the Water and Wastewater Systems Sector, Energy Sector, and Transportation Systems Sector).
- Connect with CISA’s Protective Security Advisors (PSAs) and Cyber Security Advisors (CSAs).

**Provide initial or refresher training:**
- Conduct initial or refresher training for staff on security awareness, physical security, and cybersecurity best practices.

**Increase organizational vigilance:**
- Ensure your security personnel are monitoring key internal security capabilities and that they know how to identify anomalous behavior.
- Flag any known indicators of compromise and adversary tactics, techniques, and procedures for immediate response.
- Communicate with the appropriate stakeholders and let them know about relevant changes to the security posture of your facility.

**Confirm reporting processes:**
- Remind facility personnel how and when to report an incident.

**Prepare your organization for quick action:**
- Ensure your emergency call tree is up to date and rehearse it regularly.
- Minimize coverage gaps in personnel availability.
- Review your crisis management program and ensure the corresponding plans are up to date, to include your emergency action plan, security plan, recovery plan, cyber incident response plan, and business continuity plan as applicable.
- Conduct a tabletop exercise with key personnel as a reminder of key steps to follow during an incident, including not only operational personnel but also other areas such as public affairs and general counsel.

**Backup:**
- Backup all critical information and store backups offline.
- Test the ability to revert to backups during an incident.

**Know your systems and who has access to them:**
- Sign up for CISA cyber assessments.
- Secure external access to critical cyber systems.
- Identify all unnecessary ports and protocols and disable them immediately.
- Restrict physical access to critical cyber assets and media to limited authorized users.
- Review account access controls to critical cyber systems utilizing the least privilege concept, confirming access control lists, and ensuring that accounts with access to critical or sensitive information or processes are modified, deleted, or deactivated immediately after personnel leave or when users no longer require access.

**Report:**
- Report cybersecurity incidents by contacting CISA at CISAServiceDesk@cisa.dhs.gov to help serve as part of the early warning system.

**Password management:**
- Change all default passwords or implement physical controls for cyber systems where changing default passwords is not technically feasible.
- Encourage staff to update their passwords.

**Vulnerability scanning and patching:**
- Increase scans of networks and systems and institute appropriate patching of known system vulnerabilities.
- Check US CERT for potential threat signatures from suspected IP addresses or malicious activity.
- Update antivirus on critical cyber systems to include industrial control systems.
- Monitor critical networks in real-time for unauthorized or malicious access alerts, log events, or incidents.

**Application whitelisting:**
- Conduct a review to ensure that only approved programs run on networks.

**Penetration testing:**
- Conduct phishing, social engineering, and malware exercises.
- Conduct tests that attempt to hack into your systems to test security of the systems and the ability to defend against attacks.
**ACTIONS FOR PHYSICAL PROTECTION**

**Identify:**
- Ensure you are aware of your critical assets.
- Recognize other assets and facilities that may indirectly relate to or impact your operation.

**Connect:**
- Establish relationships with the surrounding community and local law enforcement.
- Confirm current contacts are up to date.

**Report:**
- Remind personnel to contact local law enforcement if they notice suspicious activity in or near your facility’s entry or exit points, parking areas, restricted areas, or immediate vicinity.

**Monitor:**
- Increase roving patrols around restricted areas and vary timing and frequency of patrols to prevent identification of patterns of activity.
- Require escorts for non-facility personnel such as contractors and visitors or temporarily prohibit all non-facility personnel.
- Increase screening of all vehicles, personnel, and items entering and leaving the facility.
- Immediately conduct testing or maintenance on security systems, such as intrusion detection systems and cameras, to ensure they are fully functional; increase inspection frequency of security equipment, such as fencing and locks.
- Maintain full-time lighting on outdoor critical assets and additional lighting for remote areas.

**Secure:**
- Secure keys, access cards, uniforms, badges, and delivery vehicles, and increase inventory checks of these items.
- Restrict access to critical assets to essential personnel only.
- Consider establishing a two-person rule for access to critical assets.
- Add an additional layer of security to assets of interest using barriers, such as bollards and vehicle access points to increase standoff distance.
- Reinforce barriers, fences, and entryways that lead to critical assets.

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The 2016-2017 winter storms brought record-breaking precipitation to the Northern California Sierra Nevada Mountains including the Feather River watershed. On Feb. 7, 2017, the Oroville Dam’s 179-foot wide Flood Control Outlet (FCO) Spillway chute was releasing water to control the Lake Oroville reservoir level in accordance with the prescribed operations plan.

During this operation, the FCO spillway suffered a catastrophic failure of the lower chute area eventually resulting in the loss of approximately 1400 feet of the lower chute, including the scour of more than 1.6 million cubic yards of soil and rock materials. On Feb. 11, 2017, the FCO spillway suffered a catastrophic failure of the lower chute area eventually resulting in the loss of approximately 1400 feet of the lower chute, including the scour of more than 1.6 million cubic yards of soil and rock materials.

Oroville Dam is located on the Feather River in Northern California. At 770 feet tall, this earth embankment is the tallest dam in the United States. With its 3.5 million acre-feet of storage, Lake Oroville is the second largest reservoir in California, supplying water to cities as far south as San Diego. The Oroville Dam, reservoir, and hydropower plant facility comprise the flagship of the State Water Project (SWP), which is owned and operated by the State of California, Department of Water Resources (DWR).

EXCERPTED FROM THE NOMINATION PACKET PREPARED BY MICHAEL ROGERS
the Emergency Spillway (Figure 1) was used for the first time since the project was completed in 1968. During this operation, significant erosion and scour caused by water flowing over the Emergency Spillway (Figure 2) led authorities to fear for the safety of the spillway structures, resulting in the activation of the Emergency Action Plan and evacuation of about 188,000 people from downstream communities.

The Oroville Dam Spillway Incident of 2017 was one of the most serious dam safety occurrences in the United States in many years. As the tallest dam in the United States and the keystone of California’s SWP, Oroville Dam and Lake Oroville stand as a steadfast monument to water resource development in the USA during 20th century.

The resulting damage to the FCO (Figure 3) was catastrophic, and the decision was quickly made by the DWR (dam owner) that the entire spillway chute needed to be replaced. The critical design driver was that the spillway had to be operational – at least for restricted flows – by Nov. 1, 2017 in order to pass potential flows during the following winter. Ultimately, the entire FCO concrete chute would need to be replaced.

The entire Oroville Spillways Recovery Project was successful due to the contributions of hundreds of dedicated managers, engineers, scientists, construction and support staff. There were many challenging aspects of this recovery, including replacement of the eroded foundations in the FCO and Emergency Spillways. Roller-compacted concrete (RCC) was selected as the preferred method and materials to replace the eroded foundations (Figure 4). RCC was also selected for construction of a new apron at the Emergency Spillway in order to prevent soil erosion near the spillway control structure during future operations (Figure 5).

**INNOVATIVE TECHNOLOGIES**

Significant innovative uses of RCC technologies in the project are listed below.

- **Temporary Use of RCC for Spillway Chute and Gravity Walls.** The use of RCC for the FCO Spillway chute reconstruction was initially proposed as shown in Figures 6 and 7, which included a temporary RCC chute and 20-foot-high gravity chute walls that would be available for use during the 2017-2018 winter season, but was later replaced with a conventional reinforced concrete chute and walls during the 2018 construction season. The gravity walls were formed using Hilfiker Baskets – typically used for reinforced earth walls – with reinforced shotcrete overlay for the vertical walls. The advantage of this approach is that it allowed the formation of a competent chute during the limited construction period. The RCC portion of the chute was rated for about 100,000 cfs.
• **Temporary High-Strength RCC Chute Surface Overlay.** For the first winter season following the incident (2017-2018), a portion of the FCO would have exposed RCC. In order to strengthen the resilience of the chute surface, a high-strength, cement-enriched mix of RCC was developed for use as a surficial wearing surface. This material was required to have an early strength higher than the base RCC mix to allow flows on the FCO Spillway chute as early as Nov. 1, 2017 (Figure 8). Based on cylinder testing during the full-scale trial placement, the enriched RCC mix design was established as 300/175 lbs/yard$^3$ of cement/fly ash, which was expected to produce RCC with an unconfined compressive strength of about 4,000 lbs/in$^2$ at 28 days, and about 6,000 to 8,000 lbs/in$^2$ at one year.

• **Unformed RCC 1:1 Slopes.** A key factor in the RCC design was construction simplicity in order to provide for fast RCC placement. RCC forming was identified as a critical path operation, which pushed overall chute recovery completion date beyond Nov. 1, 2017. In a bold move, all RCC forming was deleted from the construction scope. Unformed 1:1 slopes were added, utilizing the natural 45-degree angle of repose for the RCC material combined with the full-scale envelop of the chute.

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![Emergency Spillway - completed RCC apron.](image)

**Figure 5.** Emergency Spillway – completed RCC apron.

![Main FCO Spillway refurbishment scheme with RCC backfill.](image)

**Figure 6.** Main FCO Spillway refurbishment scheme with RCC backfill.

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with an innovated modification to standard equipment adding an angled, vibrating plate that could be used to seal the 1:1 sloped surface (Figure 9). For the FCO Spillway chute, the outside slopes of the foundation replacement were designed to be unformed at a 1:1 slope (Figure 7) in order to expedite and simplify construction. The RCC structural section provides a stable and robust structure against static and dynamic loads, including potential overtopping of walls during the interim 2017-2018 winter flood season.

- **Unformed RCC 4:1 Slope on the FCO Chute Surface.** The preponderance of the FCO Spillway chute where RCC is placed as the foundation replacement material has a spillway chute slope of 4H:1V (Figure 10). The placement of the final enriched layer of RCC on a 4:1 slope is an innovative method for this project as there were no known occurrences of RCC placement on 4:1 slopes anywhere in the world at the time this spillway design concept was developed. For the base RCC foundation replacement structure, the design intent included placement of RCC in horizontal lifts with a free-form 4:1 slope in the main chute area (Figure 11).

- **Utilization of Eroded Rock and Debris for RCC Mix Aggregates.** The initial incident resulted in erosion of more than 1.6 million cubic yards of hillside material, much of which came to rest in the Feather River. The intent for the RCC mix design was to use on-site materials for RCC
aggregates, primarily the rock materials eroded during the February 2017 incident (Figure 12) that were later dredged from the Feather River. These eroded materials had been stockpiled in several areas around the project site. Initial investigations into the RCC mix design commenced shortly after the incident, using the dredged rock. These materials were crushed in several test programs, including preparation of RCC concrete cylinders. The results of these tests showed that an initial sorting process was necessary to remove fine-grained materials (silt, sand and gravel) finer than 1 inch in diameter. This provision was included in the final specification for the RCC aggregates. To simplify the preparation of RCC aggregates, the specification was developed using only two types of aggregates: coarse and fine. The coarse aggregate was specified as ASTM C33, Size Number 357 [8] with a maximum aggregate size of 1.5 inches. The fine (sand) aggregate was a custom blend. In addition, the sand equivalent value requirement was set to be no less than 35 when tested in accordance with ASTM D 2419.

**SUMMARY OF TECHNICAL ACHIEVEMENTS**

In summary, the use of RCC for the foundation replacement provided a robust solution for the Oroville Emergency Recovery – Spillway Task Force. RCC was used to backfill the eroded bedrock chasm within the original damaged FCO Spillway chute area with a high-strength cementitious material, which provided support for the future reinforced-concrete spillway slabs and walls. The RCC was placed within the limited time window to construct an operational FCO Spillway chute for the

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2017-2018 winter flood season. Several aspects of this application of RCC were innovative, including the expedited time frame for design and construction; RCC placement on a 4:1 slope with sloping walls; use of an enriched RCC overlay for a robust surface on a high-capacity/high velocity chute spillway; and RCC placement in a challenging rock foundation, using a combination of vibratable RCC with and without mix enrichment with grout.

The RCC solution utilized the reuse of scoured rock debris, and had the least environmental impacts of the alternatives considered. It provided a robust bidding climate as a majority of the construction means and methods were well known in the dam construction industry. It provided a competitive bidding process, which resulted in a low unit bid price. Once started, the RCC was placed continuously and rapidly to complete the FCO and Emergency spillways recovery within the limited time frame.

The contractor, Kiewit Corporation, was instrumental in the success of RCC uses with its commitment to a quality constructed product in a timely manner. The contractor’s willingness for innovation to develop new ways to place RCC on a challenging foundation was instrumental in achieving the desired design intent. The speed of construction, economy of materials (including the reuse of scoured/eroded rock), innovative contractor placement methods, and material adaptability to variable foundation conditions made the use of RCC as foundation replacement in the FCO Spillway chute an ideal solution for Oroville Emergency Recovery Project.

In recognition of the aforementioned project achievements using RCC, the International Commission on Large Dams (ICOLD) in association with the Chinese National Committee on Large Dams and the Spanish National Committee on Large Dams recognized the Oroville Spillways Recovery Project as an RCC Milestone project in Kunming, China in November 2019 (Figure 13). Former USSD President and current ICOLD President, Mike Rogers was present in China to accept the award on behalf of DWR. Mike, Global Practice Leader for Dams at Stantec was the lead design engineer for RCC activities during the project.

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ABSTRACT

This paper investigates the effects of out-of-plane deformations in spillway walls and piers on Tainter gate members with an Inlet Intake structure located in Southern California used as a case study. The results of this study demonstrate that the deformations in walls and piers may cause significant increases in demand to capacity ratios (DCRs) of already stressed Tainter gate strut arms potentially leading to overstress or even failure during a seismic event. Therefore, it is recommended that Tainter gate analyses in high seismic regions should consider gate-wall interaction for the seismic load case including a post-seismic evaluation to determine operability after a seismic event.
INTRODUCTION

In the current state of practice, existing spillway Tainter gates are typically analyzed independent of the spillway walls and piers. There is little documentation on best practices for taking into account gate-wall interaction in the analysis of spillway gates outside of the generalized two-dimensional analytical criteria presented in the United States Army Corps of Engineers (USACE) Engineering Technical Letter (ETL) 110-2-584 (USACE, 2014). This USACE criteria only treats the piers as supports for the gate with no discussion on the potential effects of imposed pier deformations on the gate. This paper presents a case study to evaluate the effects of gate-wall interaction on existing spillway Tainter gates as part of dam safety spillway assessments and provides a suggested best practice guideline for their analysis as part of a retrofit or rehabilitation design.

A spillway is an important component of a dam facility and plays a vital role in the controlled or uncontrolled release of water during flood events. A controlled spillway has operable gates attached to the spillway walls and piers that can regulate the amount of discharge. Tainter gates are considered to be one of the most economical and suitable types of gate for controlled spillways. A typical Tainter gate consists of a cylindrical damming surface referred to as a skin plate, which is stiffened and supported by curved vertical members called vertical ribs. The downstream face of each vertical rib is attached to horizontal girders that span the gate width. The horizontal girders are supported by two end frames that consist of strut arms at each horizontal girder location and bracing members spanning between the struts. Strut arms converge at the trunnion which is typically anchored to the pier through a trunnion beam. The gates rotate about a pin at the centerline of the trunnion and incorporate lubricated or self-lubricating bushings to reduce frictional moments about the pin during gate operation. Figure 1 shows an overall view of a typical controlled spillway, and Figure 2 shows the primary Tainter gate components.

Imposed deformations from spillway structures only impact the connected gates if adjacent walls and piers have differential movement and try to either compress, stretch, and/or rack the gates. This differential movement can be created during a seismic event in the cross-channel direction from loading demands such as 1) soil dynamic loads on the outermost walls of the spillway, 2) inertial and hydrodynamic loads causing out-of-phase deflections between adjacent walls and piers, and 3) differential deformations within an individual wall or pier between the downstream trunnion connection location and the upstream skin plate contact location on the walls or piers.
due to a variation of stiffness created by curved ogees (creates different wall and pier heights along the length of the wall). These deformations are transferred from the walls and piers to the spillway gate members which may cause additional bending and shear in the Tainter gate strut arms that was not anticipated or accounted for in their original design.

A case study was performed on an Inlet Intake Structure located in Southern California that is composed of walls and piers resting on a curved slab creating an oggee-like discharge surface. A three-dimensional finite element model was created that included the gates and the walls, piers, and slab of the reinforced concrete structure to investigate the effects of gate-wall interaction on the Tainter gates. The modeling and analysis was performed using the finite element software SAP2000. The steel member capacities were determined using the American Institute of Steel Construction (AISC) Manual of Steel Construction, 14th Edition (AISC 360-10) using the Load and Resistance Factor Design (LRFD) approach (gate frame element capacities were determined internally in SAP2000 using this AISC reference). The load carrying capacities of the members are reported in terms of DCRs found by dividing the factored demand by the design capacity. A member with a DCR of 1.0 would be considered at its design capacity. A member with a DCR of 1.2 would be considered loaded to 20% beyond its design capacity.

**INLET INTAKE STRUCTURE CASE STUDY**

The structure used for this case study was an Inlet Intake Structure located in Southern California. The inlet structure starts at 20.25 feet tall and gradually increases in height going downstream with the invert sloping down. The length of the gate structure is approximately 43.9 feet long, and it is controlled by three 13-feet-wide by 18.5-feet-tall Tainter gates. Figure 3 and Figure 4 show as-built drawings of the inlet intake structure. The Tainter gates are supported by a trunnion assembly directly bearing on the piers. There is no diaphragm bracing or downstream vertical truss bracing members on either gate. The gates are each operated by two wire rope hoists. Figure 5 and Figure 6 show as-built drawings of the Tainter gates. Photo 1, Photo 2 and Photo 3 shows site photos of the inlet intake structure and Tainter gates.

The strength analysis of the Tainter gates of the inlet intake structure was performed using a finite element analysis (FEA) approach utilizing a non-linear static analysis to determine the utilization ratios of the Tainter gates members only due to the out-of-plane motion.
of the walls and piers of the inlet structure. The non-linear static analysis was performed using the SAP2000 analysis software. The FEA model included three tainter gates (two outer and one middle tainter gate) and the inlet structure walls, piers, and foundation slab.

The model geometry and meshing were constructed within SAP2000 and the actual curved shape of the ogee foundation slab was captured. Frame elements were used for Tainter gate struts, girders, and braces while thick shell elements were used for the gate skin plate, ribs, and trunnion plates. The reinforced concrete intake structure walls, piers, and foundation slab were also modeled with thick shell elements. The tapered exterior walls were modeled by changing the shell thickness as a function of height. See Figure 7 and Figure 8 for an isometric view of the three-dimensional (3D) SAP2000 model. The walls, piers, and foundation slab were considered to be cracked and their moment of inertia were reduced based on USACE EM 1110-2-6053 (USACE, 2007). The moments of inertia for the walls, piers, and foundation slab were multiplied by 0.35 in one model (case 1) and then 0.80 in another model (case 2) to give a lower and upper bound on the effective stiffness.

The wall and pier elements extended to the centerline of the foundation slab and their nodes were merged creating a fixed connection. The foundation slab was assigned nonlinear area springs, set to the subgrade modulus in the vertical translational degree of freedom and made artificially stiff in the lateral translational degrees of freedom. Compression-only non-linear springs were assigned to the bottom of the skin plate nodes oriented normal to the sill surface, and the Tainter gate trunnion/hinge nodes were attached to the walls and piers by rigid links. Interaction between the skin plate edge and wall/pier face was modeled using non-linear gap links between the wall/pier and adjacent skin plate edge along the length of the side seal to replicate the one inch gap between them. When the wall/piers first start to deform, the out-of-plane restraint only occurs at the trunnion hinge location. Once the one inch gap at the skin plate is exceeded, the skin plate also starts restricting the out-of-plane motion of walls and piers.
A linearly increasing (with respect to elevation) nonlinear static load was applied to the outer walls of the inlet structure in the cross channel direction as shown in Figure 10. A force based deformation technique was used over the displacement controlled technique to capture the differential deformation of the wall between location 4 (i.e. trunnion pin) and location 2 (i.e. wall at top of gate). No other loads were applied on the Tainter gates directly. Thus, the bending moment and shear imposed on the strut arms were only due to the out-of-plane deformation of walls caused by the applied nonlinear static load. The static load factor was increased, starting from value of 0.5, until the wall reached its plastic deformation limit. Maximum DCRs in the strut arms were reported for each factored load case. The deformations at four locations on the spillway wall were also exported: 1) top of gate 2) wall at top of gate 3) top of wall and 4) trunnion pin as shown in Figure 9. Table 1 and Table 2 summarize the results of the analysis.

Elastic and plastic deformation limits for the wall with a 0.35 moment of inertia reduction multiplier are 0.83 inches and 4.08 inches respectively (case 1). Elastic and plastic deformation limits for the wall with a 0.80 moment of inertia reduction multiplier are 0.36 inches and 3.57 inches respectively (case 2). Elastic and plastic deformation limits for the wall were calculated using pushover analysis in SAP2000. Hinge type was selected from Table 10-8 (Concrete Columns) in ASCE 41-13. There were three regions established for wall deformations 1) Elastic region- In this region there is no significant damage to the walls; however, the strut arms might experience overstress due to the additional loading, 2) Plastic region- Once the walls cross the elastic deformation limit they will start experiencing permanent deformations and damage, and the spillway walls may or may not fail before imposing significant deformation to the strut arms that could lead to overstress, 3) Failure Region- In this region walls are anticipated to fail due to excessive deformation and will no longer impose deformation on the gate (inlet structure has collapsed). Table 1 and Table 2 show the summary of the results from SAP2000 with the elastic region denoted in green, the plastic region denoted in yellow, and the failure region denoted in red. There is a sudden increase in the slope of the curve (shown by a black vertical dashed line in Figure 11) that indicates the Tainter gate top contacting the pier side face and a further increase in differential deformation
between the trunnion pin (location 4) and wall face at top of gate (location 2).

CONCLUSION AND RECOMMENDATION
The Inlet Intake structure analysis results shows that differential deformations between adjacent walls and piers supporting Tainter gates can cause significant increases in DCRs of already stressed Tainter gate strut arms. In case 1 there could be an additional DCR of 0.22 in the strut arm when the wall deformation remains in the elastic region due only to the imposed pier/wall deformations. In case two, there could be an additional DCR of 0.11 in the strut arm when the wall deformation remains in the elastic region due only to the imposed pier/wall deformations. If the walls are ductile enough and are allowed to deform further in the plastic region additional strut arm DCRs above and beyond those resulting from traditionally used isolated gate loads can be significantly higher than the above values.

It was also found that once the skin plate assembly touches both the wall and pier on each side, it will start restricting the deformation of the wall adjacent to the skin plate edge while the wall downstream near the gate trunnion will continue to deform. This creates more differential deformation along the length of the strut as the pier begins to twist, and the strut arm DCRs start rising more rapidly. This can be seen in Figure 11 at a differential deflection of around 2.5 inches at the top

Table 1. Maximum DCR in Tainter Gate Strut Arm - Case 1

<table>
<thead>
<tr>
<th>Static Load Factor</th>
<th>Location 1 - Differential deflection at top of gate (in)</th>
<th>Location 2 - Differential deflection of wall at top of gate (in)</th>
<th>Location 3 - Differential deflection at top of wall (in)</th>
<th>Location 4 - Differential deflection at trunnion (in)</th>
<th>Max DCR in Strut Arm</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5</td>
<td>0.27</td>
<td>0.46</td>
<td>0.61</td>
<td>0.60</td>
<td>0.22</td>
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<td>1.0</td>
<td>0.55</td>
<td>0.91</td>
<td>1.22</td>
<td>1.21</td>
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<td>1.5</td>
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<td>1.83</td>
<td>1.81</td>
<td>0.65</td>
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<td>3.47</td>
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Table 2. Maximum DCR in Tainter Gate Strut Arm - Case 2

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<tr>
<th>Static Load Factor</th>
<th>Location 1 - Differential deflection at top of gate (in)</th>
<th>Location 2 - Differential deflection of wall at top of gate (in)</th>
<th>Location 3 - Differential deflection at top of wall (in)</th>
<th>Location 4 - Differential deflection at trunnion (in)</th>
<th>Max DCR in Strut Arm</th>
</tr>
</thead>
<tbody>
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<td>2.82</td>
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of wall (when the top of gate displaces by two inches).

The results in both cases 1 and 2 indicate that the inlet structure wall and pier differential deformations in the cross-channel direction (especially when other gate demands acting directly on the gate concurrently during a seismic event such as dead, hydrostatic, inertial, and hydrodynamic loading are included) could potentially impose significant loading demands on the gates when compared to load combinations that are typically used to analyze isolated Tainter gates per USACE ETL 1110-2-584 (USACE, 2014) criteria. This could potentially lead to yielding, rupture, and ultimately failure of the gates. It is anticipated that the findings of this study may be influenced by a number of variables including but not limited to the relative stiffnesses and strengths of the different structural elements, the magnitude of loading in the cross-channel direction, whether or not and how adjacent piers/walls are tied together, the magnitude of the gap between the skin plate and the piers/walls (and potentially including a gap at the trunnion if a trunnion tie system is used to resist thrust rather than a pier thrust plate), etc. Additional case studies investigating these variables would be prudent to determine if they support the conclusions of this study or if they provide additional insight that may not have been captured herein.

**REFERENCES**

American Society of Civil Engineers (ASCE) 41-13, Seismic Evaluation and Retrofit of Existing Buildings, 2013.
United States Army Corps of Engineers (USACE) Engineering Technical Letter (ETL) 1110-2-584, Design of Hydraulic Steel Structures, 30 June 2014.
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First, work culture has drastically changed, and the employer-employee dynamic now looks significantly different today from previous decades. Prospective employees will ask themselves, What can your organization do for me? If there is not a clear career path with strong mentorship within your organization, that individual may not join your organization or will leave shortly after joining. A talented individual remaining with one organization for over thirty years will continue to be the exception. Thus, your organization must be exceptional to retain talent and attract other mid-level professionals to replace the inevitable departures. If not, your young professionals will be sought by other organizations who will provide them with a clear career path and a solid foundation for growth.

Further, the upcoming generations are bombarded with a wide array of choices and potential directions in career paths. The next question we need to answer is, How does our industry stand out? This part is tricky; we aren’t building many new dams or levees in the United States and are instead tasked with maintaining and improving this critical infrastructure. Therefore, we must appeal to the next generation’s desire to provide sustainable benefits to society over the allure of constructing the next engineering marvel. Topics such as preserving and protecting the environment, improving social equity, and investing in communities that rely on this infrastructure must be encompassed within your appeal. Obviously, this doesn’t mean we have to lose sight of the fact that dams and levees are fascinating and incredible feats of engineering.

Lastly, we must invest in the next generation and take a long-term perspective for our organizations and the industry. We must find the right balance between short-term profitability (or cost-control for owners and regulators) and long-term investment in younger staff to ensure a healthy future for the industry and our own organizations. Consider the cost of replacing lost talent in your organization versus spending that money investing in younger staff to ensure they gain valuable and rewarding experiences. Improvement can still be made when it comes to sending younger staff to industry events such as USSD: ensuring high quality experiences in the field for inspections, investigations, and construction; and providing education and training opportunities. All of these can lead to growth, promotions, and increased responsibility for younger staff.

At USSD, the Young Professionals Committee and the Scholarship Committee have been working hard to build these tenets into our industry and our community. However, this effort will take work and investment in all aspects of the dams and levee industry to recruit and retain the next generation. Consider the above points and ask yourself, What can my organization do to attract the next generation? Above all, listen to younger professionals both inside and outside your organization for honest feedback regarding attracting and retaining your talent pool. We must be willing to learn, adapt, and invest for the future success of our industry.

Questions to Ask
- How do we attract future generations into the dams and levees profession and USSD?
- How do we recruit young and aspiring professionals?
- How do we retain top talent?
- What can your organization do for me?
- How does our industry stand out?
- What can my organization do to attract the next generation?
Life Members Invest in Future of USSD

In 2018, the Board of Directors voted to invest life member dues to advance the strategic efforts of USSD. USSD is in the process of updating its Strategic Plan and is poised to create new education and training programs, improve technology infrastructure, and explore opportunities that increase member value.

Life members pay the equivalent of 12x the regular individual dues rate and never receive another dues invoice. For those Life members attending the annual conference, a special breakfast and briefing from USSD’s President and Executive Director is held. Life members are listed in each USSD Bulletin issue as special recognition.

Want to be a part of this exclusive group? You can join online at ussdams.org or contact Sharon Powers at sharon@ussdams.org.

Kevin Zeh-Zon Lee, Ph.D., P.E.
Civil Engineer, Geotechnical Engineering Group 5
Technical Service Center
U.S. Bureau of Reclamation

Welcome New Life Member

“I have been working at the U.S. Bureau of Reclamation since 2006. As a geotechnical engineer at Reclamation, I have been involved in many Dam Safety projects. Many of my works are related to the evaluation of embankment dam performances subject to earthquake loading. I have referenced many USSD conference publications in the past as USSD is the primary outlet of technical information on dams. As such, being a USSD life member seemed like a good investment in my career, which would allow me to stay informed and engaged in the state-of-the-art knowledge of dam engineering. I would encourage all dam engineers to join USSD and contribute to the advancement of such [an] invaluable organization.”

USSD Announces Fall Workshop Series

Seven workshops will be presented during the Fall Workshop Series scheduled for Oct. 13-15, 2020 in Denver at the Lowry Conference Center.

- Leveraging PFMA to Perform SQRA (3 days)
- Dam Resiliency is More than Just Dam Safety (1 day)
- Instrumentation and Monitoring Performance of Dams (2 days)
- Water Management for Construction (1 day)
- Erodibility of Rock Spillways and Channels (1 day)
- Bureau of Reclamation’s Consequences Estimating Methodology (RCEM) (half-day, repeated twice)
- USACE Hydrologic Engineering Centers (HEC) LifeSim (half-day, repeated twice)

USSD continues to increase its training programs for dam and levee professionals. Through its Education and Training Committee, the Fall Workshop Series subcommittee under the leadership of Paul Eggers (GEI Consultants), selected the above workshops from a number of proposals submitted. The series is structured so that it maximizes the ability of participants to attend multiple workshops in one trip.
USSD Life Members*

George Barber
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Zoran Batchko, Retired - formerly Parsons Brinckerhoff
Ralph Beene
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John Bischoff, AECOM
Denise Bisnett, Santee Cooper
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Rodney Bridle, Dam Safety Ltd.
Edwin Campbell
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Woogu Kim, Hanyang University
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Richard Kramer
Paul Krumm, Nicholson Construction Company
Kevin Zeh-Zon Lee, U.S. Bureau of Reclamation
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Andrew Merritt
Donald Millikan
Mahmoudreza Mivehchi, BMP Engineering & Inspection Inc.
Paulo Monteiro, University of California, Berkeley
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*S List current as of Feb. 10, 2020

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