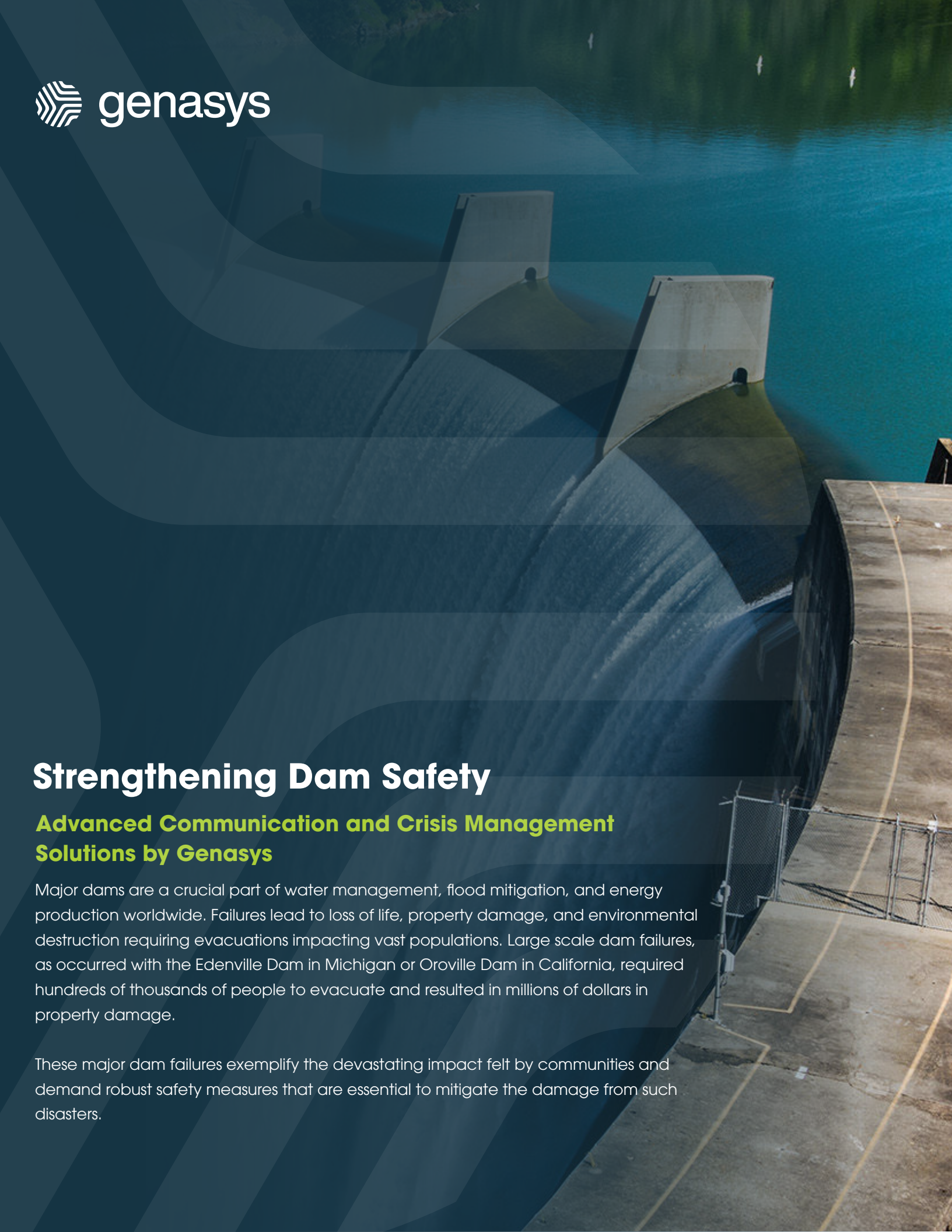

Strengthening Dam Safety

Advanced Communication and Crisis Management Solutions by Genasys

Major dams are a crucial part of water management, flood mitigation, and energy production worldwide. Failures lead to loss of life, property damage, and environmental destruction requiring evacuations impacting vast populations. Large scale dam failures, as occurred with the Edenville Dam in Michigan or Oroville Dam in California, required hundreds of thousands of people to evacuate and resulted in millions of dollars in property damage.

These major dam failures exemplify the devastating impact felt by communities and demand robust safety measures that are essential to mitigate the damage from such disasters.

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Understanding Dam Safety and Risks

Dam Safety Fundamentals

Dam safety is a critical aspect of infrastructure management to protect life, property, ecology, and, in some cases, power generation. It is imperative to ensure the structural integrity and operational stability of dams. Regular inspections, maintenance, emergency planning, and risk assessments help prevent failures that can lead to catastrophic floods.

Common Causes of Dam Failures and Floods:

- **Structural Issues:** Poor design, construction flaws, or lack of maintenance can compromise dam integrity
- **Hydrological Factors:** Excessive rainfall and inadequate spillway capacity can lead to overtopping and erosion.
- **Seismic Activity:** Earthquakes can cause structural damage or trigger landslides that impact dam stability.
- **Operational Errors:** Human error, like mismanagement of water levels, can precipitate dam failures.
- **Deliberate Attacks:** Dams can be targets for terrorist attacks which can cause significant damage.
- **Environmental Factors:** Erosion and excessive sedimentation can lead to structural weakness over time if left unchecked. Understanding these factors is essential for prioritizing effective safety measures and ensuring long-term dam resilience.

The Devastating Impacts of Failure

Dam failure severely jeopardizes the safety of anything in the downstream inundation zone, with sudden releases of water causing significant fatalities, as evidenced by the 2017 Oroville Dam failure in California, which led to the evacuation of tens of thousands of residents. More than the preparations for 100-year and 500-year storm events, dam breaches result in a wall of devastating water destroying nearly everything in its path.

Flooding from dam breaches also results in injuries and long-term health risks from waterborne diseases and other pathogens, not to mention potential impacts to other critical infrastructure. Socially, communities face displacement, resulting in long-term homelessness and psychological trauma.

Economically, property damage is immense, destroying homes, businesses, and infrastructure like roads and bridges, leading to costly repairs. Agriculture suffers greatly, with flooded farmland destroying crops and livestock, impacting food supply and revenues. Utility disruptions are common, affecting electricity, water, and sewage systems, and increasing recovery costs.

Dam failure from reservoirs eliminates drinking water supply instantaneously. Environmentally, dam failures can devastate ecosystems, erode landscapes, destroy habitats, and spread pollutants, leading to long-term ecological damage.

Legally, dam failures often result in lawsuits and regulatory fines and can drive changes in safety regulations. Historical case studies, such as the Banqiao and Teton Dam failures, illustrate the profound human, economic, environmental, and legal impacts, underscoring the critical need for robust dam safety measures.

Current Challenges in Dam Safety

Dam operators and emergency responders face several challenges, including aging infrastructure, climate change, and limited resources. Aging dams require extensive maintenance and upgrades to meet modern safety standards. Climate change introduces more frequent and intense weather events, increasing the risk of dam failures. The incident rate of 100-year storms (1.0% chance of annual occurrence) is now modeled to occur three times as often, according to a Princeton University study. Additionally, limited funding and resources constrain the ability to implement necessary safety measures to account for this weaking infrastructure and diminished capacity to contain more frequent, torrential storms.

Eastern Wisconsin Dam Evacuations (July 2024): Eastern Wisconsin experienced severe flooding due to heavy rains and a dam breach. This breach led to significant evacuations and localized damage.

Nashville, Illinois, Dam Failure (July 2024): When severe storms with heavy rains and tornadoes hit Illinois, a nearby dam overflowed. This prompted evacuations for hundreds of residents. Some homes experienced significant flooding, and first responders were dispatched to ensure safety.

Unexpected Rapidan Dam Failure in Minnesota (June 2024): The Rapidan dam suffered from partial failure due to an intense rainstorm that caused the Blue Earth River to overflow. This resulted in power outages for around 600 households and severe erosion around the dam, although no mass evacuations were ordered as the main structure held. The dam was already known to be in disrepair.

Almost 4,100 dams are categorized at the same risk level and condition, or worse, as the Rapidan Dam, according to an NBC News Analysis. These incidents illustrate the ongoing risks associated with extreme weather and the necessity for vigilant dam monitoring and maintenance.

By understanding these challenges and past incidents, we can better prepare for and mitigate the risks associated with dam safety. And no matter the upgrades, maintenance, and stabilization to modernize dams, breaches and failure remain possible from those ever-present forces outside of human control.

Genasys Solutions for Dam Safety

Genasys offers advanced communication and monitoring solutions that enhance dam safety and preparedness. In times of potential dam failure, clear and timely communication is vital to coordinate response efforts and inform the public. By integrating Genasys solutions into dam safety protocols, authorities can enhance their preparedness, improve response times, and build resilient communities.

The Protect Platform

The Protect Platform of Protective Communications enhances dam safety by improving communication, coordination, and emergency response. This platform is composed of Genasys Protect, Evertel, and Acoustics. solutions integrating advanced technologies to ensure that emergency responders can manage crises effectively and efficiently. Genasys Protect stands out with its ability to provide real-time data, facilitate seamless communication, and offer actionable insights that are crucial during dam-related emergencies.

LRAD & ACOUSTICS for Clear Communication

Long Range Acoustic Devices (LRADs) and Genasys ACOUSTICS are crucial for communicating quickly to the immediate area most threatened by dam failures.

These long-range acoustic speakers broadcast live or pre-recorded voice messages that can be heard above background noise from long distances. Advanced models can be clearly heard at distances over 3.5 kilometers (2.17 miles) in a 360° radius.

These alert tones and voice broadcasts immediately command the attention of everyone in the area to take appropriate action without delay. They bridge the gap for people who do not have access to mobile phones, are unhoused, or are limited by visual impairments that prevent them from receiving alerts through other channels.

During evacuations, LRADs & ACOUSTICS can deliver critical information and instructions to residents immediately. They continue functioning when power and cellular networks are down, ensuring alerts go out even in extreme emergencies.

These devices can inform maintenance crews and other personnel about routine operations or potential hazards, enhancing overall safety and operational efficiency around the dam site. For example, if a dam operator needs to initiate a controlled release of water to manage reservoir levels, ACOUSTICS can be used to alert nearby workers and residents to move to safety zones.

By facilitating clear communication in both emergency and routine scenarios, LRADs & ACOUSTICS play a vital role in maintaining safety in the vicinity of dams.

Genasys Protect for Public Notification

Genasys Protect keeps communities informed through multi-channel mass notifications and alerts.

Send geographically targeted notifications through multiple channels, including SMS, ACOUSTICS, social media, and voice calls, and ensure all residents receive timely and accurate information – regardless of opt-in status or preferred communication methods.

During dam breaches that require evacuations, speed is paramount. Genasys Protect utilizes the fastest channels, including SMS and ACOUSTICS, to alert everyone in affected areas quickly to get them out of the path of the impending flood. Speed up the alert process with templates, pre-recorded messaging, and Quick Launches that work in a couple of clicks. Additionally, by integrating dam sensors that detect breaches or damage you can instantly send custom automated alerts that reach everyone who could be affected.

Beyond evacuations, Genasys Protect keeps residents informed on reconstruction scheduling, service disruptions, estimated recovery times, and general safety information. Channels such as email or social media provide space for detailed information. By providing clear instructions and updates, ALERT reduces confusion and enhances public safety.

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Genasys Protect for Emergency Planning

Genasys Protect also streamlines emergency planning and evacuations and accelerates decision-making with smart zones and a common operating picture. It enables efficient action by providing a clear, real-time overview of the situation as it unfolds. Genasys Protect allows for effective cross-agency collaboration, ensuring that all relevant parties have access to the same information.

Genasys Protect can integrate dam breach estimations and flood maps to estimate how water will spread and which areas it will impact. Pre-defined zones facilitate fast communication and decision-making. In the event of a dam breach, managers can quickly identify affected zones and deploy targeted evacuation orders to expedite moving people to safety.

Additionally, Genasys Protect supports resource identification, traffic management, and public notification, making it easier to coordinate evacuation efforts and manage the crisis. By maintaining a common operating picture, dam managers can work seamlessly with first responders and emergency managers, ensuring a unified and efficient response.

With direct outputs from the software, the Genasys Protect public app allows dam operators and first responders to reach the public through a dedicated app that conveys direct information, including evacuation warnings, shelter information, road closures, and more. The public app is also beneficial during the repopulation efforts as an emergency has subsided and people are allowed to return to their homes.

Internal and External Collaboration with Evertel

Genasys Evertel enables instant and secure internal and external messaging and communications, crucial for dam safety operations. It supports real-time communication among all participating emergency management and first response agencies even when emergencies cross jurisdictional boundaries.

This facilitates comprehensive planning ahead of emergencies and coordinated responses during emergencies. The platform includes encrypted messaging, video calls, and data sharing, essential for quick decision-making and crisis management.

During emergencies, emergency managers can instantly share updates and coordinate responses through Evertel. This capability ensures efficient collaboration on critical information like water levels, structural integrity, and weather forecasts, enhancing overall response effectiveness.

Beyond emergencies, Evertel improves daily operations by facilitating routine inspections and maintenance. Operators can share inspection results and maintenance schedules in real time, ensuring all team members are informed and can coordinate their activities. This continuous communication streamlines workflows and enhances the overall safety and efficiency of dam operations.

Evertel allows messaging that meets or exceeds state and federal laws requiring compliance and security standards often needed post-emergency.

Expert's Guide to Practical Implementation and Best Practices

Training and Planning

U.S. Federal Emergency Management Agency (FEMA) experts produced the "Emergency Operations Planning: Dam Incident Planning Guide" and the "Federal Guidelines for Dam Safety: Emergency Action Planning for Dams" offering a comprehensive guide to preparing an Emergency Action Plan (EAP). Creating such a plan requires:

- **Coordination:** Collaborate with all relevant entities, including local emergency management, the National Weather Service (NWS), and other agencies to align responsibilities and communication protocols.
    - **Information Exchange:** Ensure timely and accurate sharing of information about dam conditions, procedures, and responsibilities during incidents.
- **Planning:** Develop detailed emergency evacuation plans based on worst-case scenarios, including initiation of warning systems, identification of critical facilities, evacuation procedures, and re-entry protocols.
    - **Trigger Conditions:** Establish conditions for activating the EAP, such as protective action orders, community capability limits, and the need for mass care.
    - **Emergency Levels:** Define categories like High Flow, Non-Failure, Potential Failure, and Imminent Failure to guide response actions.
    - **Public Outreach:** Prepare zones to facilitate public outreach and deploy appropriate channels to reach everyone in the community.

Implementation and Best Practices

Coordination & Planning

The Emergency Action Plan (EAP) must involve all relevant entities and agencies. This ensures clarity on responsibilities and addresses key emergency planning issues like notification order, backup personnel, communication alternatives, and procedures for nights, holidays, and weekends. Genasys Evertel facilitates quick communication among all parties throughout the planning process and during emergencies, ensuring everyone stays informed and can act swiftly.

Emergency evacuation plans should be developed before an incident occurs, based on worst-case scenarios. These plans should cover emergency warning initiation, pre-incident planning, critical facilities identification, evacuation procedures, routes to high ground, traffic control, vertical evacuation/sheltering in place, emergency transportation, safety measures, and re-entry protocols.

Coordination between local emergency management authorities, the National Weather Service (NWS), and Weather Forecast Office (WFO) is crucial for timely information exchange and effective evacuation planning. Dam Inundation studies should be used to aid in the development of evacuation plans.

Public Outreach

With Genasys Protect a common operating picture is shared among all participating stakeholders, greatly speeding up decision-making and public outreach. Use geographic information systems (GIS) data layers and inundation mapping to create zones. These tools inform comprehensive planning and flexible responses to emergencies.

Key data for establishing zones includes U.S. Census Blocks, topographic data, school districts, fire/police districts, and existing preparedness plans. Genasys Protect accounts for vast amounts of data to algorithmically generate intelligent zones for each user. Additionally, these zones can be edited and changed on the fly during emergencies or in initial planning stages.

Communities must ensure the public understands evacuation zones. Public outreach campaigns like "Know Your Zone" are essential. The Genasys Protect public website and app provide a public-facing map with clear, vetted information. Based on zones, this allows the public to see if they are affected or under evacuation orders, as well as staying updated without overwhelming 911 call centers.

When evacuation and alerting zones are selected, emergency messages should include five essential elements:

- **Source** – Say who the message is from.
- **Threat** – Describe the dam incident and its impact.
- **Location** – State the impact area boundaries in a way that can be easily understood (use street names, landmarks, and natural features).
- **Guidance/Time** – Tell people what protective action to take, when to do it, how to accomplish it, and how doing it reduces impacts.
- **Expiration Time** – Tell people when the alert/warning expires and/or when new information will be provided. (This is most likely to be used in the case of severe weather warnings or watches that might only last a specific length of time.)

During emergencies, the first moments are the most crucial to avoiding loss of life. With Genasys Protect, templates can be created to greatly accelerate alerts. Quick Launch templates in Genasys Protect can account for a wide variety of different incidents and are prepared for different target audiences for quick deployment.

Outside of heavy rains, there are incidents when a dam failure is a no-notice event: terrorism, earthquakes, undetected structural failure. Communities must prepare for no-notice incidents as worst-case scenarios.

Regular inspections and maintenance can prevent many incidents, but destruction from terrorism, earthquakes and other events cannot be prevented by maintenance and monitoring. ALERT helps in these situations by integrating dam sensors to send automatic alerts to responders, emergency managers, and the public. This system ensures quick, coordinated responses to any incident.

By following these guidelines, dam operators, first responders, and emergency managers can significantly enhance their preparedness for potential dam failures, ensuring better protection for communities and critical infrastructure.

Genasys In Action

Genasys solutions have significantly improved dam safety and security in Puerto Rico, California, and Nevada. These cases demonstrate Genasys' vital role in public safety and crisis management.

Expanded Coverage in Puerto Rico

In Puerto Rico, Hurricanes Irma and Maria in 2017 highlighted vulnerabilities at the Guajataca Dam. With a breach endangering downstream residents, FEMA and the Puerto Rico Emergency Management Agency required a robust public warning system. Genasys provided nine ACOUSTICS systems capable of delivering clear alerts even during power outages.

These systems, with satellite connectivity, battery backup, and solar charging, ensured reliable communication and were the first in the U.S. compatible with IPAWS. This deployment met immediate needs and established a resilient framework for future emergencies.

In 2024, Genasys signed a definitive contract with the Puerto Rico Electric Power Authority to expand this project to 37 more dams. The project, fully funded by FEMA, will include integrating sensors and predictive analytics for early warnings.

Increased Security at the Hoover Dam

Genasys addressed security challenges at the Hoover Dam in Nevada, a critical hydroelectric power facility and national landmark. Traditional bullhorns and marine P.A. systems on patrol boats lacked range and clarity to keep boaters, fishermen, and intruders away from the dam's Lake Mead restricted water area. Genasys installed LRAD long-range communication systems with cameras, searchlights, and remote monitoring. These systems provide 24/7 surveillance and clear verbal commands out to 3,000 meters, enhancing security and reducing the need for manned patrol boats.

Enhanced Communications at Davis Dam

Similarly, at Davis Dam on the Colorado River between Arizona and Nevada, an LRAD system integrated with cameras and remote monitoring for continuous surveillance and effective deterrence was installed to replace patrol boats. LRAD's attention-commanding tones and clear voice broadcasts are keeping boaters and trespassers away from restricted areas.

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Protecting California Dams During Severe Weather

In California, the threat of severe flooding from heavy rain and snowmelt required advanced flood warning systems for hydroelectric dams. Many used sirens that couldn't convey detailed messages.

A California dam initially deployed an ACOUSTICS 360XT and later installed permanent ACOUSTICS DS-60 speaker arrays. Integrated with Genasys Command and Control software, the DS-60s offered customizable sound projection and remote activation. The high Speech Transmission Index of ACOUSTICS systems provides clear, intelligible notifications, greatly improving public safety and response during floods and water releases.

Ensuring Dam Safety with Advanced Emergency Communications

As we navigate the complexities of dam infrastructure and safety, the integration of cutting-edge emergency communication systems is paramount. Genasys, with its suite of advanced solutions, stands at the forefront of this vital sector, providing the tools necessary to safeguard communities and ensure rapid, effective responses in critical situations.

By leveraging these innovative solutions, dam operators can significantly enhance their preparedness and response capabilities. Genasys's commitment to excellence and continuous improvement ensures our products remain at the cutting edge of technology, adapting to new challenges and evolving needs.

Conclusion

The integration of Genasys products into dam safety protocols not only enhances the efficiency and effectiveness of emergency communications but also fosters a culture of safety and preparedness. As we continue to prioritize the protection of our critical infrastructure and the communities they support, Genasys remains a trusted partner in delivering solutions that save lives and mitigate risks.

Embrace the future of emergency communications with Genasys and ensure that your dam infrastructure is equipped with the best tools to face any challenge to keep people safe and informed. Together, we can build a safer, more resilient world.