CASE STUDY - CIVIL

Emergency Warning System in Puerto Rico

Early warning and assessment network for 37 dams

Figure 1: Dos Bocas Dam, Puerto Rico

Background

Puerto Rico is tectonically very active, the island is situated on a complex plate boundary between the Caribbean and the North American plates. Major fault lines are located off the coast, such as the Puerto Rico Trench to the north and the Muertos Trough to the south with strike-slip faults crossing the island itself. This results in frequent and sometimes damaging earthquakes, such as the M7.3 quake that occurred in 1918 and the more recent swarm of events of 2019-20 during which a M6.4 quake was recorded.

Puerto Rico invested significantly in large-scale dam infrastructure in the early part of the 20th century and as a result has 37 major dams with high-hazard potential, providing hydro electric power, water supply and artificial reservoirs.

The Puerto Rico Electric Power Authority (PREPA) selected Genasys to provide an Emergency Warning System (EWS) to protect residents and visitors downstream of the 37 dams. Constant monitoring is required due to the potential risk associated with dam failure. Monitoring will also be used to assess induced seismicity resulting from the dam structures themselves. Güralp was selected to provide the instrumentation for the seismic element of the project.

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The Güralp solution

When evaluating providers for this critical infrastructure projects, in addition to high-performance instrumentation, the customer was also seeking an experienced technology partner to guide them through the deployment process.

Our comprehensive product portfolio was an important factor, as we were able to identify instruments that precisely matched the customers project specifications, from sensitivity requirements to environmental durability, without compromise.

The flexibility of our instrumentation for system integration was also a key feature, our Minimus-based devices support multiple connectivity and data transmission options, enabling the customer to adapt the architecture to each dam's unique deployment infrastructure requirements.

> *"After thorough evaluation, Güralp emerged as the clear choice, and our experience has consistently validated that decision.*
>
> *From our very first interaction, Güralp's team demonstrated an exceptional level of expertise and professionalism. Their engineers took a proactive approach to understanding our specific requirements, asking the right questions and helping us clarify technical needs we hadn't fully articulated ourselves. This consultative support during the solution design phase proved invaluable, ensuring we selected the optimal configuration for our use cases rather than simply purchasing off-the-shelf products."*

Alvaro Rojo Perez, Chief Technology Officer, Genasys

The Fortimus digital accelerometer

The Fortimus is a strong motion accelerometer with an integrated Minimus digitiser, particularly suited to Earthquake Early Warning. With a wide output acceleration response band of DC - 315 Hz, Fortimus allows for a range of user-configurable settings, including a remotely adjustable gain of ±4 g, ±2 g, ±1 g or ±0.5 g. This allows the instrument response to be matched to the environment in which it is deployed for optimum performance.

Figure 2: The Fortimus

The internal Minimus digitiser delivers advanced 'smart' 24-bit seismic ADC conversion and a host of features that make the Fortimus the ideal 'plug-and-play' solution for rapid deployments and networked arrays.

For Earthquake Early Warning applications, features include industry standard triggering algorithms (STA/LTA and Threshold); multi-instrument voting to mitigate false positive alerts; Common Alert Protocol (CAP) for automated emergency warning; plus an ultra-low-latency mode which when used with our GDI protocol means network transmission can be achieved in 40 milli-seconds (network dependent).

Deployment is straightforward, with a lightweight and portable form factor that weighs in at 1.9 kg and measures just 165 mm diameter × 84 mm. The LCD touchscreen display acts as a systems interface to provide sensor feedback and levelling information during deployment.

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The Fortimus is capable of streaming multiple data feeds independently, prioritizing the highest data quality with the lowest latency. Multiple instruments can be bulk updated with configuration files making them particularly suited to networked arrays over large distances.

Discovery is the user friendly interface used to configure Fortimus which includes admin and user logins to protect against unauthorized data access. Discovery provides additional features for users of our Minimus-based products including:

- Instrument Management - Easily register and acquire real-time State-of-Health (SOH) parameters from telemetered systems; remotely update digitiser firmware and upload configuration files to multiple units simultaneously.
- Data Quality Assurance - Analyse seismic data for quality and verification purposes.

Discovery enabled the Güralp technical team to provide a significant amount of remote support to the project team during and after the deployment process.

Network design and deployment

A network of 37 Fortimus (one at each dam) monitors local seismic activity and any potential structural issues within the dam buildings. This includes induced seismicity that may arise from the increased pore water pressure.

Implemented as a sparse array, the network will provide a regional monitoring system that is capable of alerting for potentially damaging shaking resulting from a seismic event.

The customer is installing the sensors with assistance from local contractors. Each Fortimus is installed in a secure case which is then located at or near the top of the dam, with connection to power and Ethernet. Güralp is providing ongoing advice regarding best practise for the installations and remote support to verify the data quality meets the objectives of the project.

Figure 3 and 4: Station Installation

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Outcome

The Fortimus were delivered in 2025, with the full rollout of all instrumentation in the project, including the seismic element, due for completion in 2027. One of the first stations to be deployed detected a M6.5 off the coast of the Leeward Islands to the southeast of Puerto Rico on 27th October, 2025.

> *"We were impressed by the extensibility of Güralp's platform. Knowing that our needs may evolve, having a partner with the capability to develop custom solutions and support future enhancements gives us confidence in the long-term viability of our investment. Güralp has proven to be more than a supplier, they are a committed partner in our mission."*

Alvaro Rojo Perez, Chief Technology Officer, Genasys

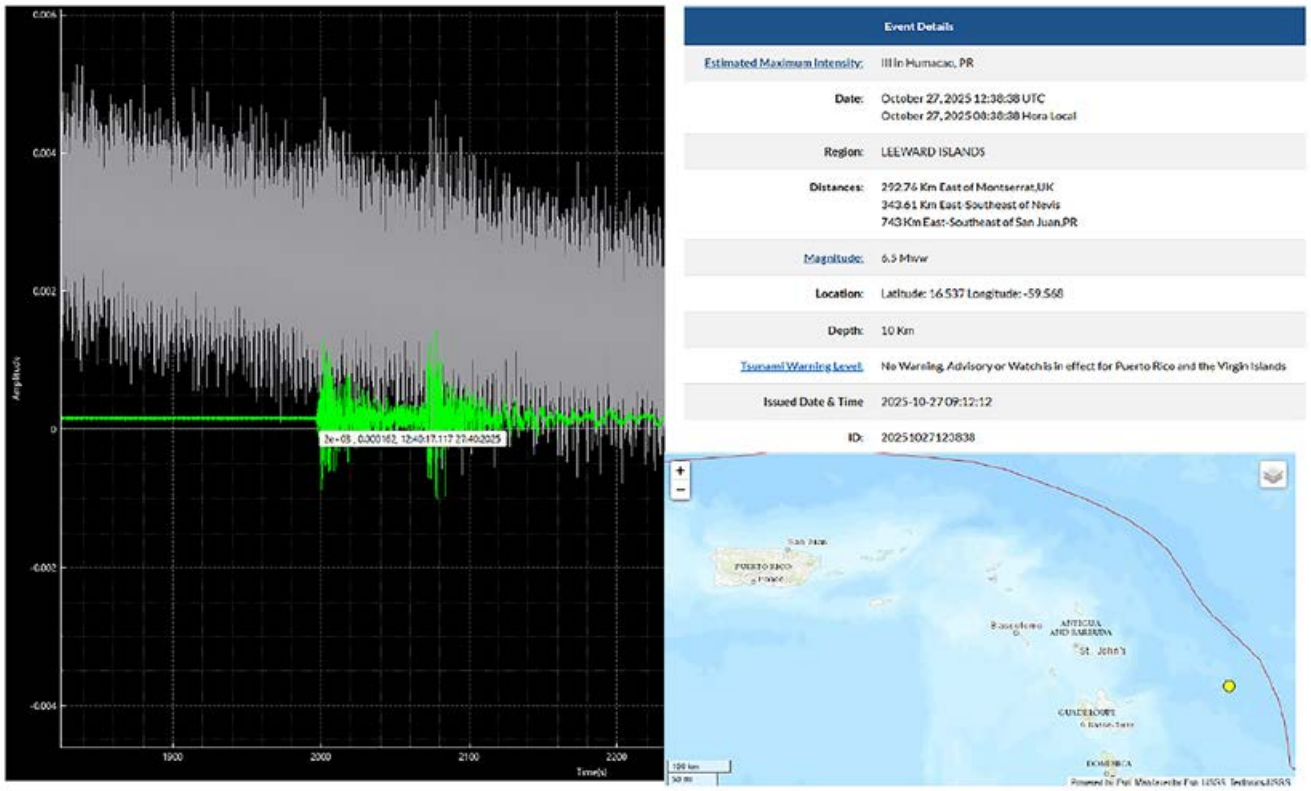

Figure 5: Waveform of a M6.5 event that occurred on 27.10.2025, off the coast of the Leeward Islands to the southeast of Puerto Rico

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