

# Energy Storage Provides Grid Resilience During Severe Storm Conditions

## The Situation

On September 7th, 2017, the Dominican Republic was in the path of Hurricane Irma, a Category 4 storm originating in the Atlantic Ocean with torrential rain and wind speeds of 155 mph. More than 5,500 people were evacuated from the Dominican Republic in anticipation of the hurricane that resulted in storm surges, flooding, and destruction across the island.

AES Dominicana owns and operates power generation assets in the Dominican Republic including two of Fluence's Advancion energy storage systems deployed at their facilities, Andres and Los Mina Dominican Power Partner (DPP). The two systems are each 10 MW, 30-minute duration energy storage systems providing frequency response to the grid. Advancion's frequency control algorithm autonomously responds to deviations in grid frequency and either charges or discharges the batteries to counteract the deviation and achieve the target frequency.

In anticipation of Hurricane Irma's arrival, the grid operator requested that both energy storage systems be kept

online and operational during the storm. The two energy storage systems are unmanned facilities co-located within or next to thermal operating plants. They are operated by the thermal plant control room and are remotely monitored by the Fluence Services Team to ensure proper operation and to provide the local operators with remote assistance if required.

As the storm struck, almost 40% of the generation assets on the island were forced to shut down and several transmission and distribution circuits were cut off, putting additional stress on the system. There were some periods during the storm where only a few power plants and the energy storage systems were online.

## Storm Resilience in Action

During the storm, power lines were damaged, distribution lines were disconnected in zones that had risk of flood or high winds, and some power plants had to go offline. These events resulted in volatile fluctuations in grid frequency and both energy storage systems performed

significantly more work than usual in order to stabilize the frequency.

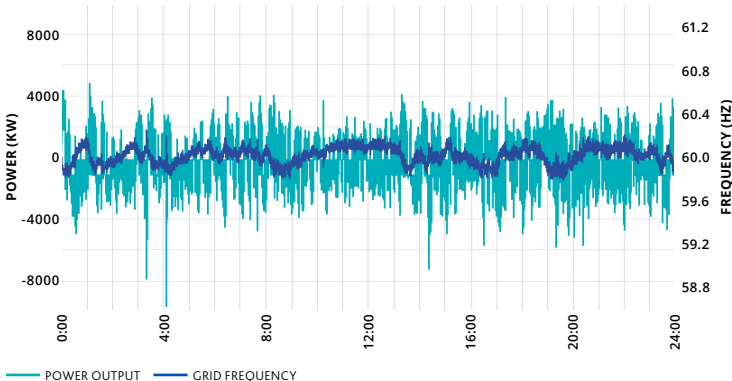
The Andres system, housed in a building enclosure, is a 10 MW, 30-minute duration energy storage system installed in June 2017 in Santo Domingo. The graph on the left shows the measured frequency and corresponding power output of the system under typical operating conditions. The grid frequency in the Dominican Republic is maintained within their standard operating frequency band of approximately 59.8 to 60.2 Hz. To counterbalance changes in frequency, the MW output of the energy storage system ranges from +4.8 MW to -9.7 MW.

The graph on the right shows a dramatic increase in the measured frequency range during the storm, from 59.3 to 60.8 Hz. The energy storage system rapidly counterbalanced the volatility, and even charged and discharged at maximum capacity (10 MW) on a number of occasions.

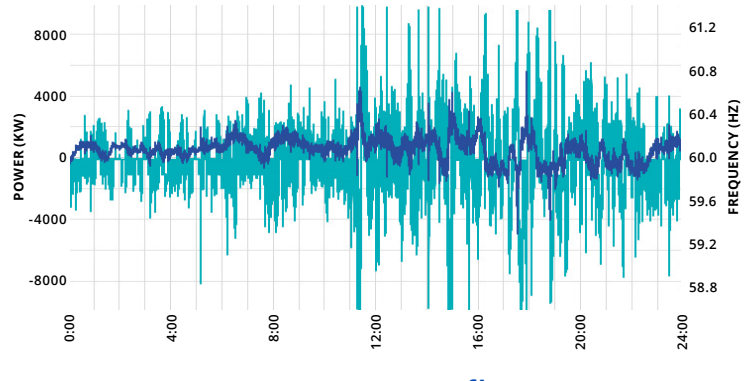
The period of increased frequency disturbances lasted for more than 10 hours and the Andres energy storage system delivered 56.5% greater energy throughput than under typical operating conditions.

### Andres

**OPERATION DURING TYPICAL WEATHER CONDITIONS**  
One week prior to Hurricane Irma, August 31, 2017

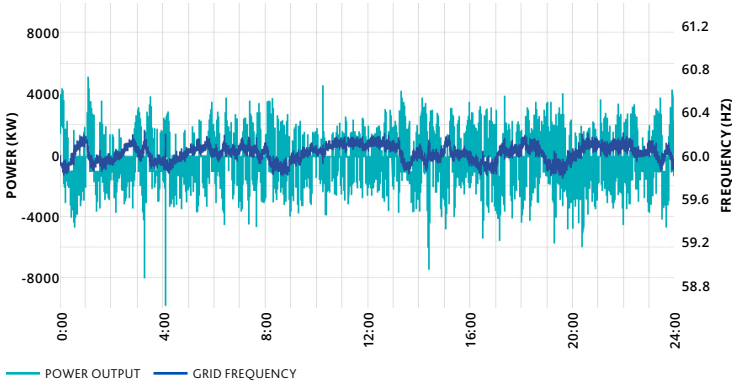


**OPERATION DURING SEVERE STORM CONDITIONS**  
During Hurricane Irma, September 7, 2017



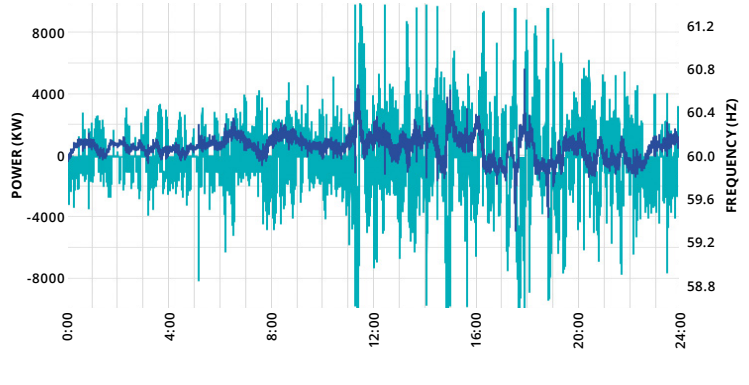
**OPERATION DURING TYPICAL WEATHER CONDITIONS**

One week prior to Hurricane Irma, August 31, 2017



**OPERATION DURING SEVERE STORM CONDITIONS**

During Hurricane Irma, September 7, 2017



The Los Mina DPP system, housed in four container enclosures, is a 10 MW, 30-minute duration energy storage system installed in April 2017 in Santo Domingo. The graph on the left shows the measured frequency and corresponding power output of the system under typical operating conditions. The grid frequency ranges from approximately 59.8 to 60.2 Hz with the MW output of the energy storage unit ranging +5.1 MW to -9.8 MW.

The graph on the right shows that the Los Mina DPP measured frequency range also increased significantly during the hurricane, from 59.3 to 60.8 with the power output ranging +9.8 MW to -10 MW (full capacity = 10 MW). The Los Mina DPP system delivered 59.8% greater energy throughput during the 10+ hours of increased demand.

**Conclusion**

Severe storm conditions created significant deviations in grid frequency and the energy storage systems provided rapid response

to counteract these deviations, maintain the target frequency, and support grid resiliency and stability. No energy storage outages were experienced at either site and the arrays maintained a total combined capacity of over 20 MW for the entire duration of the storm, demonstrating the technology's capability to perform continuously without issues and provide responsiveness under times of grid duress.

During the storm the arrays went from a typical operating range of approximately +5 MW to -9.8 MW each, to a wider range of +9.8 MW to -10 MW each, effectively requiring an additional +/-5 MW each, or 10 MW total to maintain a balanced frequency. Energy storage has been found to be 2.9x more effective than traditional power generation due to speed and accuracy\*. The additional power output delivered by the energy storage arrays during the storm is equivalent to instantaneously adding a thermal power plant of approximately 30 MW\*.

*\*Source: PJM regulation market benefits factor calculation.*

**Andres Advancion  
Energy Storage System**

**Location**

Santo Domingo, Dominican Republic

**Capacity**

10 MW Interconnected

**Duration**

30 minutes

**Key Application & Services Provided**

Frequency Regulation

**Enclosure**

Building

**Los Mina DPP Advancion  
Energy Storage System**

**Location**

Santo Domingo, Dominican Republic

**Capacity**

10 MW Interconnected

**Duration**

30 minutes

**Key Application & Services Provided**

Frequency Regulation

**Enclosure**

Containers



**About Fluence™**

Fluence, a Siemens and AES company, is the leading global energy storage technology solutions and services company that combines the agility of a technology company with the expertise, vision, and financial backing of two industry powerhouses. Building on the pioneering work of AES Energy Storage and Siemens energy storage, Fluence's goal is to create a more sustainable future by transforming the way we power our world. Fluence offers proven energy storage technology solutions designed to address the diverse needs and challenges of customers in a rapidly transforming energy landscape, providing design, delivery, and integration in over 160 countries.