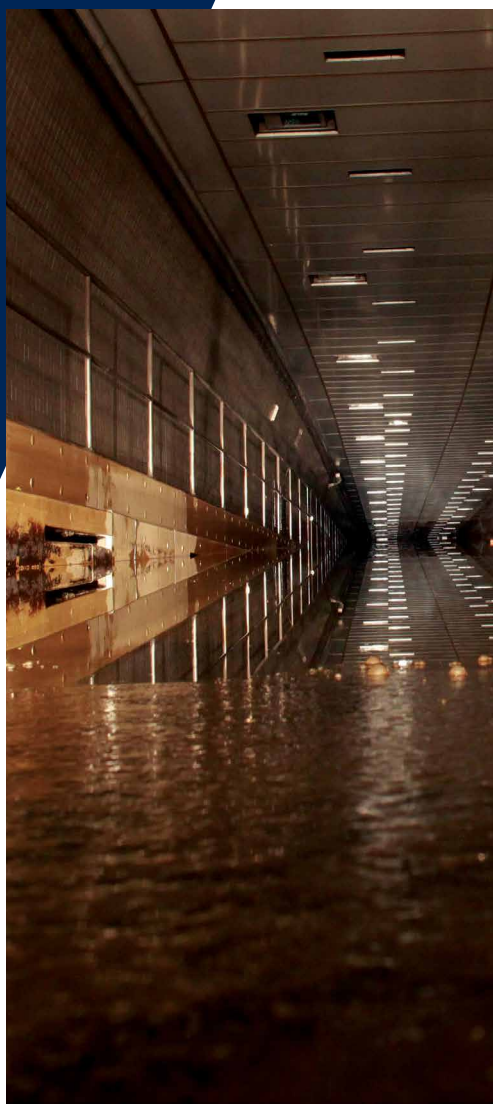
ILC DOVER

BEYOND BOUNDARIES™

# ILC Dover Flood Protection Systems

## Case Study:  Superstorm Sandy

**The storm surge from Superstorm Sandy was approximately 14 feet above Mean Sea Level**



*ISSUE*

In the wake of the devastation associated with Superstorm Sandy, various State and local agencies in the greater New York City area have implemented protection schemes to make the infrastructure more resilient to future weather events. Sandy's impacts included the flooding of the New York City Railway system, as well as damage to the Consolidated Edison power grid. This paper will examine the impact of that event and examine the efforts to protect this infrastructure against future weather events.

The Metropolitan Transportation Authority is North America's largest transportation network, serving a population of 15.3 million people across a 5,000-square-mile travel area surrounding New York City through Long Island, southeastern New York State, and Connecticut. The MTA network comprises the nation's largest bus fleet and more subway and commuter rail cars than all other U.S. transit systems combined. Consolidated Edison is a public utility providing gas and electric services to New York City and West Chester County, NY.

Supplemented by high tide, the storm surge from Superstorm Sandy was approximately 14 feet above Mean Sea Level. This storm surge impacted millions of individuals and businesses and had a devastating effect on regional infrastructure. The public transportation system was adversely affected with many flooded subway tunnels in the greater NYC area.  As a result of the subway tunnel flooding, service was suspended for several days for much of the system.  The tunnels suffering the worst flood damage were out of service for several weeks.  It has taken years for the subway stations to be repaired and then upgraded to address future flood events.

In addition to the impact on the public transportation infrastructure, flooding from Sandy also resulted in damage to several Consolidated Edison power generating stations, severely impacting the electric power grid in the metropolitan New York area.  More than 2 million customers lost electrical power as a result of Sandy.  4 days after the storm, more than 1.3 million customers were still without power.

## *RESPONSE*

As a result of an investigation by Homeland Security through efforts at Pacific Northwest National Labs and the University of West Virginia, ILC Dover was contacted based on its expertise in engineered inflatables. With many years of experience developing solutions for blimps, aerostats, spacesuits and inflatable space habitats, ILC Dover was able to bring together the engineering expertise to develop a Tunnel Plug system that would react the water loads for a breached subway system. This Resilient Tunnel Plug (RTP) was developed and tested to meet these very stringent requirements. In 2013 (less than 1 year after Superstorm Sandy), during a demonstration of the RTP in NYC with the Governor's office and MTA leadership in attendance, ILC Dover agreed to develop flood protection systems that would be lightweight, compact, stored at point of use, and efficiently deployed and retracted. The effort occurred in concert with the MTA, several A&E firms, and consultants in the flood protection business which resulted in novel concepts. These concepts were proven through detailed design efforts culminating in prototype systems that were tested beyond Superstorm Sandy flood levels. While other solutions may provide flood protection, the obvious advantages to ILC Dover's lightweight, point-of-use systems is minimal manpower and time needed to deploy such systems, with the resulting benefit of minimal down time to the protected infrastructure.

These early investigations and engineering efforts by ILC Dover have resulted in the development of multiple products capable of solving these complex challenges. ILC Dover has developed solutions based on a waterproof membrane backed by woven, high-strength webbing (utilizing various high-tech fibers such as Kevlar). These solutions are much lighter, yet stronger than rigid flood protection systems made from aluminum or steel. This process resulted in patented solutions including Stairwell Flex-Gate®, Flex-Wall® and Flex-Cover®, that have been used throughout the Greater NYC area.

## *MINIMIZE DOWNTIME*

One example of minimizing downtime was observed in a more recent weather event (Hurricane Hermine) threatening New York City. ILC Dover flood protection solutions have been installed at 60 street-level stairway entrances for the MTA subway system. Competitor's systems (procured prior to development of the ILC Dover Stairwell Flex-Gate®) consisting of rigid steel barriers protect other street-level stairwell entrances to subway stations. The size and weight of these competitive systems demand they be stored remotely.

Based on time to retrieve and deploy the competitor's system, at least one street level subway entrance was taken out of service for several days prior to the predicted landfall of the storm. Because the predicted storm track changed direction just prior to making landfall, the street-level subway stations protected by ILC Dover products were never taken out of service (resulting in no lost MTA revenue or commuter inconvenience). By contrast, the time it took to remove and store the competitor's rigid steel solutions was over 1 week, due to changing priorities of the maintenance staff to address more immediate needs.

Another example of minimizing ongoing costs of resiliency can be found in ILC Dover systems installed at 3 different power generating facilities. The dramatic footage of the power substation explosion on October 30th, 2012 is a reminder of the need to protect critical infrastructure from the devastating effects of flood water. This event combined with other issues throughout the power grid plunged millions of people into darkness and left some without power for days.

The systems designed to protect these power generating facilities from future weather events offer the same benefits as the horizontal Stairwell Flex-Gate®; they are lightweight, stored at point-of-use and can be rapidly deployed with minimal manpower, allowing last minute deployment in the event of a threatening weather event.

ILC Dover, working with various A&E firms, designed and manufactured flexible flood barriers (Side Deployed Flex-Wall®) which are stored at point of use, and can be deployed in minutes with minimal labor to protect these facilities against future weather events.  After these systems are designed and manufactured, the team at ILC Dover works with the Construction firm to ensure the systems are properly installed, and people responsible for maintaining the infrastructure are properly trained in the deployment and retraction of these flood protection systems.

The ILC Dover Flex-Wall® systems consist of a waterproof membrane attached to a high-strength webbing structure. They are folded up and stored in cabinets at the side of openings. When the threat of flooding is imminent, the cabinets are opened, a supporting cable is pulled across the opening, attaching to a receiver on the opposite side of the opening. Then the flexible flood barrier is pulled across the opening (much like a shower curtain) and clamp bars are then bolted to the side and bottom to form a seal. To maintain personnel training in support of storm readiness, these systems are to be deployed and retracted at least one time per year. With lightweight, point-of-use stored systems, each of these training exercises has minimal impact on the ongoing operations of these facilities.

By comparison, competitive systems (known generically as "stoplogs") are heavy, bulky and typically require off-site storage. Due to their size and weight, stoplog systems require extra manpower and costly heavy equipment to deploy, with longer lead times in advance of threatening weather events. The deployment issues are experienced by the maintenance staff at every storm readiness training event throughout the year making competitive products more costly and time consuming.

## *SUMMARY*

ILC Dover solutions have been selected as the flood protection system of choice in numerous competitive bid situations in New York City and beyond. Working through the complex specification and bidding process, ILC Dover has developed collaborative relationships with several Architectural and Engineering firms in the wake of Superstorm Sandy, as well as excellent working relationships with various General Contracting firms tasked with rebuilding the infrastructure in the greater NYC area.

Designing and manufacturing flood protection solutions capable of meeting complex customer requirements including adequate flood protection with minimal leakage rates, impact protection (from floating debris inevitable in flood waters) along with minimal weight and bulk (facilitating point-of-use storage) requires an engineering team with a deep understanding of material science, load transfer at the flexible membrane/ infrastructure interface, and the expertise of years of developing solutions for challenging environments. The team at ILC Dover has invested many engineering hours, leading to 4 patents and hundreds of delivered systems protecting billions of dollars of infrastructure with significantly less than 1% cost for that protection. A growing awareness of the need to protect critical infrastructure (both public and privately owned) in coastal and waterfront cities around the globe will lead to a continued need for innovative flood protection systems.

# BEYOND BOUNDARIES™

Innovators at our core, we develop engineered solutions for our customers' complex problems. Recognized globally for our flexible containment solutions, ILC Dover serves customers in a diverse range of industries, including pharmaceutical and biopharmaceutical manufacturing, personal care, food and beverage, chemical, aerospace, healthcare and government agencies. At ILC Dover, quality is a culture, not a measurement. Our customers will tell you that we cater to their every need and that we're highly innovative, responsive, dedicated and competitive. We have been innovating since 1947. ILC Dover's visionary solutions improve efficiency, safeguard workers and product, and prevent disasters — proof that we are on the front line of business excellence.

**Engineering evolution beyond boundaries.**

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MKT 0250 Rev A

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