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New York Power Authority prevents costly anchor strikes

Proactively guarding marine assets

CASE STUDY

New York Power Authority

Executive summary

The New York Power Authority (NYPA) is the largest state electric utility in the United States. It operates the Long Island Sound Submarine cable system (Y-49) which delivers critical power to Long Island. Installed in 1991, the underwater section of Y-49 comprises of four independent self-contained fluid filled cables buried an average of 10 feet in the seabed and crossing between New Rochelle to the north and Hempstead Bay to the south.

Y-49 experienced anchor strikes in 2004 and 2014 to the submerged portion of its transmission circuit in Long Island Sound. In both incidents, the damage resulted in significant power loss and cable oil leaking into the Sound. Repairs and clean up spanned several months with crews working 24/7 under severe weather conditions in water up to 100 feet deep. Numerous measures were undertaken to reduce environmental impact during the cable restoration. The total cost of both repairs was USD 70 million.

To avoid further incidents, NYPA searched for a cost-effective solution that would make the buried cables visible to vessels, warn NYPA when shipping movements indicate anchoring might occur and then automatically send a safety message to the vessel to prevent anchoring.

NYPA chose a Vesper Marine solution. Guardian Asset Protection is used to electronically mark the cable zone for vessels to see on their electronic navigation systems, collect AIS data transmitted by the vessels and send it via secure internet connection for analysis, then transmit a safety message directly to the vessel appearing to anchor around the cable field. The alert message will appear on the vessel's on-board electronic display and notify NYPA that the message was sent and received.

"This new system enables NYPA to track vessels in the cable area and provide an enhanced level of protection to help eliminate anchor strikes and the resulting environmental impact, through virtual buoys and safety alert notifications," says Robert J. Schwabe, Director, Asset and Maintenance Management for NYPA.

Plans are underway to implement the same solution to protect ice breakers operating near the water inlets and submerged rock hazards of the Niagara Power Project and underwater cables in the East River, Hudson River and Lake Champlain.

> "Anchor strikes will soon be regarded as events from a bygone era"
>
> Gil C. Quiniones, President and CEO
> New York Power Authority

Background

The New York Power Authority (NYPA) is the largest state electric utility in the United States. It operates the Long Island Sound Submarine cable system (Y-49) which delivers critical power to Long Island. Installed in 1991, the underwater section of Y-49 comprises of four independent self-contained fluid filled cables consisting of three phases and a spare (A, B, C, Spare), where the spare can be configured to replace any one of the other three cables. Crossing between New Rochelle to the north and Hempstead Bay to the south, the separation distance is approximately 600 feet where the majority of vessels normally cross the cable area and narrows to a few feet as the cables come to shore. The cables are buried an average of 10 feet in the seabed in water depths up to 100 feet with protection mats over cables near the shore.

The Y-49 cable system is operated at 345 kV with an average load of 600 MW. The cable operates with a dielectric fluid, DCL 45, at a pressure of 160 psi. In case of a breach in any of the cables, the flow control system automatically transitions to a stage that reduces the cable fluid pressure, limiting the fluid loss to the surrounding environment.
A positive pressure and flow are required to maintain the integrity of the cable insulation by preventing sea water from entering the cable until repairs are performed.

The Problem

The Y-49 experienced anchor strikes in 2004 and 2014 to the submerged portion of its transmission circuit in Long Island Sound.

The first was attributed to a barge working in the area that broke loose with its anchor impacting a cable. This caused significant damage and was at a water depth of around 100 feet impacting diver operations.

The second incident was the result of intentional anchoring in the cable field impacting the C phase cable, causing power loss and cable oil leaking into the Sound. In this instance, a vessel dropped a 20,000 lb. anchor that descended at least 10 feet into the seabed resulting in penetration of the cable.

The cost of each repair was around USD$35 million. Repairs and clean up spanned several months with crews working 24/7 under severe weather conditions. The costly operations were carried out in 100 feet of water and as the cable is buried in the seabed, an additional 10 feet at the anchor strike points. A cable laying vessel was brought to the location to facilitate repairs and splice in a replacement cable section. Numerous measures were necessary to prevent environmental impact during the cable restoration.

Failed cable leg lifted from seabed for repair

The Challenge

As a result of the two anchor strikes, NYPA investigated technologies that could prevent intentional anchoring within a cable field. Justification for implementing a system was based on the repair cost and potential environmental impact of an incident.

NYPA initiated a search for a cost-effective solution that would alert vessels of the buried cables. It needed to warn NYPA when shipping movements indicated anchoring might occur and automatically send a safety message to the vessel.

Their initial research led to a transmission company in California that had implemented a vessel monitoring solution for their cable. It relied on third party AIS data. If there was an indication of potential anchoring within the cable area, the vessel Maritime Mobile Service Identity (MMSI) number and name would be relayed to the US Coast Guard who would contact the vessel to warn them. This solution required a 24/7 manned operation.

NYPA decided that preventive action needed to occur within 5 minutes – so an automated solution was the only reliable choice.

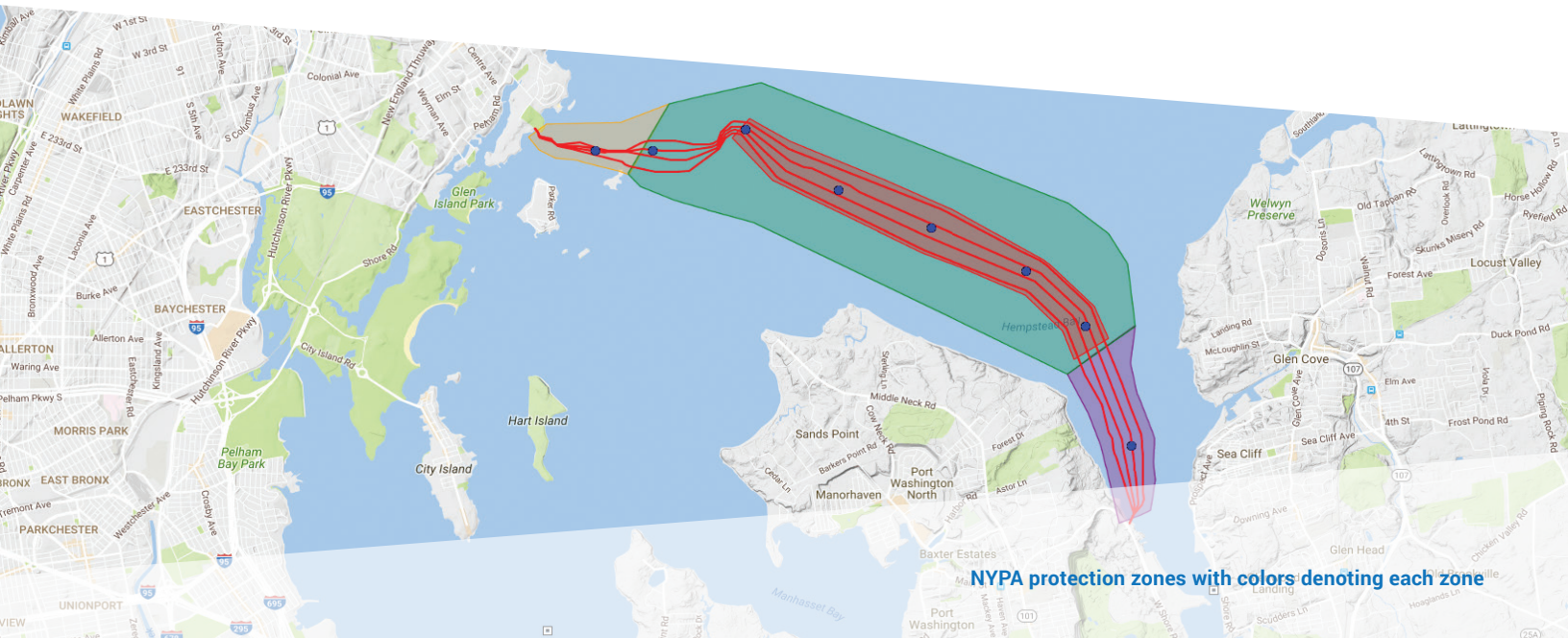
The California solution fell short on two essential features. First, NYPA needed an automated solution to send a timely addressed safety message directly to the vessel appearing to anchor within the cable field. Secondly, there needed to be visibility of the cable field through vessels' on-board electronic navigation displays.

The Solution

The Vesper Marine solution was chosen to protect NYPA's submerged cables.

Their Guardian Asset Protection solution addressed both the visibility of the cables on vessels' navigation systems as well as automating real time safety messages directly to any vessel that posed an anchoring threat.

The Guardian Asset Protection solution included Virtual AIS Stations that electronically mark the cable zone, eliminating the need to install and maintain expensive physical buoys. The cable zone is visible on the electronic displays of vessels in the area through their AIS.



NYPA protection zones with colors denoting each zone

The Virtual AIS Stations track AIS information from vessels in the area and send it via secure internet connection to Guardian cloud software where their course, speed and other vessel data is analyzed for anchoring behavior. A series of smart rules were created to determine what behavior to look for and what resulting actions to take.

When a rule is breached, Guardian triggers the Virtual AIS Station to send an automated safety message that appears directly on the vessel's electronic navigation display. NYPA is also notified of the alert and receives confirmation that the message to the vessel was received by their AIS.

Safety message received by the vessel's electronic navigation display

Implementation

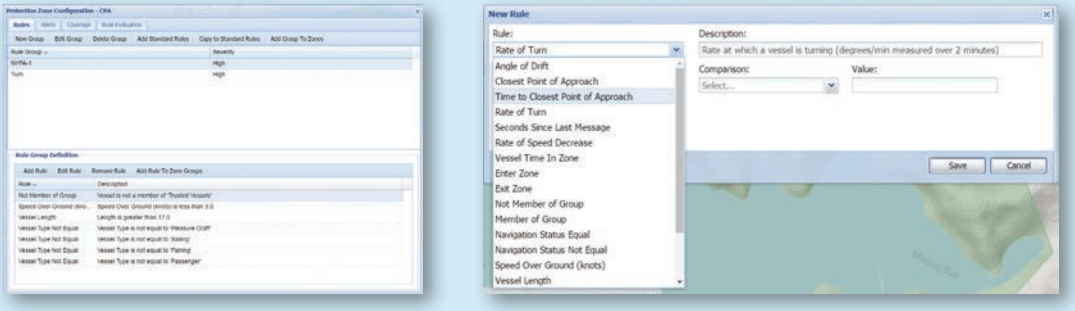
Virtual AIS Stations were installed at NYPA facilities located in the South Transition Substation and at the 20 story NYPA headquarters in White Plains. Vessel traffic is monitored several miles each side of the cable zone, as well as through the zone itself.

Five protection zones were defined for Y-49

1	Active 1200m centre zone
2	Active 500m north zone
3	Active 500m south zone
4	Cable zone
5	Anchor zone

Each zone was configured with different rules or rule sets and alerts based on the potential for anchor damage to the cable system.

Anchoring behavior is determined by analyzing changes in speed and direction of vessels over time. In the 1200m center zone, a vessel triggers an alert if its speed decreases greater than 1 knot/ minute averaged over two minutes. Whereas a vessel changing direction by more than 25 degrees at a speed less than 4 knots will trigger an alert in the cable zone.

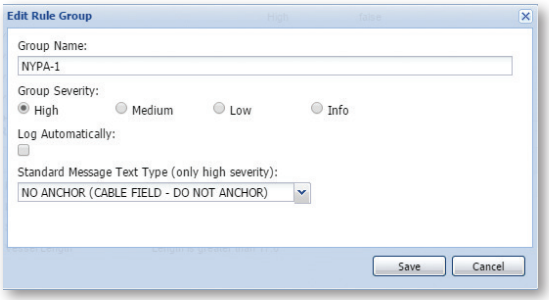


Rule configurations for cable zones

When a rule group is breached, a text alert is generated and sent to the vessel's electronic navigation system using its Maritime Mobile Service Identity (MMSI – a 9 digit identification number).

Different messages were created for each protection zone, ranging from a warning that the vessel is entering the cable area to a more critical "Do Not Anchor – Cable" in the cable zone itself. Following the transmission to the vessel, an automated response confirms that the message has been sent and received by the vessel's AIS.

To prevent constant alert messages to vessels working in the area and aware of the cable zone, a vessel group known as "Trusted" was developed. Maritime facility operators provide a list of their vessels and captains who are aware of the anchoring hazard. The list is updated as changes are made to the vessels and captains.



Configuring a message to send to the vessel navigation system

Alert received by vessel AIS

Cable laying vessel

Testing

NYPA contracted a work boat fitted with standard AIS and navigational equipment to test the system by behaving in a way that would break custom rules and thereby generate safety alerts.

The tests included

- Travelling across the cable area at different courses and speeds to ensure addressed safety messages were sent at the prescribed time and location
- Performing analysis in each protection zone to determine time of alert relative to time to anchor
- Ensure virtual cable markers were displayed on the electronic navigation display
- Confirm the distance at which electronic virtual markers for the cables were visible on their navigation display
- Recording the results on video
- Modifying rule sets based on the data obtained from testing

Guardian Asset Protection's playback capability was used to test the impact of rule changes on alert timings. Actual vessel movements were replayed with various rule scenarios to determine optimum rule configurations.

Benefits

Gil C. Quiniones, NYPA president and CEO said, "We're very excited about this pioneering new system, which contributes to the resiliency of our transmission network. While costly collisions between ships and underwater cables are becoming increasingly common, we hope that by adopting this proactive strategy, anchor strikes will soon be regarded as events from a bygone era."

Robert J. Schwabe, Director, Asset and Maintenance Management for NYPA, elaborated "This new system enables NYPA to track vessels in the cable area and provide an enhanced level of protection to help eliminate anchor strikes and the resulting environmental impact."

Next steps

NYPA is scoping the implementation of Guardian at sites in addition to the Y-49 site in Long Island Sound. Implementation is underway for protecting ice breakers operating near the water inlets and submerged rock hazards at the Niagara Power Project and protecting underwater cables in the East River, Hudson River and Lake Champlain.

Investigation is under way to add additional parameters that impact anchoring behavior such as weather conditions, wind direction and tidal flow into Guardian Asset Protection.

> "We are delighted that Guardian Asset Protection has been able to meet the needs of New York Power Authority. The relationship is very flexible and working with the team at NYPA has been great and symbiotic."

Jeff Robbins
Chief Executive Officer at Vesper Marine