Historically, the Long Island grid has only been connected to the US main grid through New York City and through a small interconnection in southwest Connecticut. But for at least 30 years there have been plans to build a submarine cable connection across the Long Island Sound to provide a direct connection with the New England transmission grid. Concerns about the potential environmental impact of such an interconnector, especially on the delicate aquatic ecosystem, have prevented previous schemes from gaining the required statutory approvals.

However, ABB together with TransÉnergie US has successfully developed a $120 million project utilizing environmentally friendly High Voltage Direct Current (HVDC) Light technology to provide a 330 MW, 40 km link of cable buried below the ocean floor, with short underground sections connecting to converter stations on each shore.

Improved reliability
The Cross Sound Cable is a critical tool for the Independent System Operators (ISO) in New York and New England since it will enable them to improve the reliability of their power supply systems by increasing their capability to share generation plant capacity. It is estimated that it could reduce the potential for blackouts in Connecticut by more than 50 per cent.

The Cross Sound Cable will provide economic benefits to the regions of Connecticut, New York and New England by facilitating electricity trading among power generators and customers and promoting market competition.

The need for access to more power is particularly important to the Long Island Power Authority (LIPA), which serves nearly 1.1 million electric customers and has experienced major increases in demand in recent years. This is largely due to a 20 per cent rate reduction in 1998 and is compounded by a real estate boom, which has sparked the development of expansive homes on the northeast and southeast forks of the island.

During the months of June, July and August 2002, LIPA delivered 6,609,112 MWh of electricity, which is a ten per cent increase from last year’s record figures, and represents a 22 per cent increase in summer power demand since LIPA took ownership of the transmission system in 1998.

Merchant transmission link
The builder, owner and operator of the interconnector is Cross Sound Cable Company, owned by United Capital Investments, the unregulated subsidiary of United Illuminating Company and TransÉnergie US, a subsidiary of the transmission division of Hydro-Quebec, which conceived the project as a privately-owned merchant transmission link, rather than a conventional regulated transmission link.

So rather than being solicited or planned by an ISO or other regulatory authority it is driven by market-based opportunities. The investors have assumed 100 per cent of the financial risk of the project, foregoing any guaranteed recovery of their investment through mandatory charges to ratepayers. Instead it will charge those customers who use it.

An underwater cable routed across Long Island Sound was the natural choice to link the Long Island and New England power grids since the path for a traditional land-based transmission line would adversely impact considerably more people and property along its path. HVDC, rather than conventional HVAC, is now

The Cross Sound Cable Interconnector uses HVDC Light technology to provide a vital submarine cable connection between the transmission grids of New England and Long Island, New York.

Cross sound goes underground

Figure 1. The Cross Sound Cable provides a high voltage subsea power interconnection linking the Long Island and New England power grids. The 330 MW link uses HVDC Light technology.
well established as the optimum transmis-
section technology for this type of submarine
cable link. Indeed, the world’s first com-
commercial HVDC link – built by ABB nearly
50 years ago – was via a submarine cable
providing a 20 MW interconnection between
the island of Gotland and the mainland of Sweden. Today, the combined
transmission capacity of all the sub-sea
and underground HVDC cable links in the
world is more than 8000 MW.

**HVDC Light**

ABB’s new HVDC Light technology was
selected for the Cross Sound Cable. Whereas
classical HVDC is most cost effective in the
high power range, above approximately 250
MW, HVDC Light comes in unit sizes rang-
ing from a few tens of MW up to 330 MW,
and for DC voltages up to +/-150 kV.

HVDC Light consists of two elements:
converter stations and a pair of advanced
technology cables – the DC circuit is not
connected to ground so two conductors
are needed. The converter stations are
voltage source converters employing state
of the art turn-on/turn-off insulated gate
bipolar transistor power semiconductors.
The circuit is therefore quite different to
classical HVDC, which employs converter
stations based on thyristor valves.

The HVDC Light cable is of extruded
construction and the selected materials
provide high mechanical strength, high
flexibility and low weight. They are pro-
tected by solid insulation and contain no
insulating or cooling fluids, unlike some
older cable systems still in operation,
which makes them environmentally friend-
ly. The cables will have an installed life of
at least 40 years.

Unlike conventional HVDC, HVDC Light
does not rely on the AC network’s ability
to maintain a stable voltage and frequency.
This means that less reinforcement is
required for the local grid as well as
providing extra flexibility regarding the location of the converters in the AC system.

The HVDC Light design is
based on a modular concept with a number of standardized
sizes. Most of the equipment is
installed in enclosures at the
factory, which makes the field
installation and commission-
ing short and efficient (typical-
ly three to four weeks com-
pared with the three or four
months required for conven-
tional HVDC).

HVDC Light stations are
compact and need little space
and can easily blend into the local sur-
roundings. The stations are designed to be
unmanned and are virtually maintenance
free with operation either carried out
remotely or even automated. No commu-
nication links are required between the
converter stations. HVDC Light also
comes equipped with measurement and
control systems that enable power trading.

Prior to the Cross Sound Cable project,
HVDC Light was already proven in projects
such as Gotland (Sweden), Directlink (New
South Wales to Queensland, Australia) and
Eagle Pass (US to Mexico).

**Cable path**
The Cross Sound Cable is designed to pro-
vide a 330 MW connection between New
England and Long Island, operating at
+/−150 kV DC and 1175 A. The cable’s
southern terminal on Long Island is a new
substation at the site of the decommis-
sioned Shoreham nuclear power station in
Brookhaven, New York, where the DC is
converted to 138 kV AC. A short
underground land cable connects the
station to the submarine cable.

“The submarine cable heads north across Long Island Sound for 40 km, before coming to land on the eastern shore of New Haven Inner Harbour”

The submarine cable heads north across
Long Island Sound for 40 km, before com-
ing to land on the eastern shore of New
Haven Inner Harbour. The cable route was
carefully chosen to minimize environmen-
tal impacts. The northern terminal is a
new converter station, which converts the
DC to 345 kV AC.

Prior to burial, the two 125 mm diame-
ter DC cables were bundled and laid on
the sandy seabed within a precisely defined
corridor across Long Island Sound. It was
deployed by the specially designed sea-
A spider vessel with a positioning system capable of maintaining its position to an accuracy of less than 1 m. A hydraulic jet plough was then used to bury the cables to a depth of up to 2 m. This environmentally sensitive technique uses a controlled jet of pressurized water to create a trench, around 1 m wide. The trench is not excavated and back-filled as in land-based construction. Instead during the installation process the trench remains filled with loose, fluidized sediments into which the cables settle immediately.

Jet ploughing is widely acknowledged to be a more controlled and less sediment-disturbing installation method than mechanical ploughing and dredging. It is also extremely fast and efficient, and the whole cable laying process was completed in just four days. The seabed can self-restore to its natural contours very quickly.

**Environmental considerations**

Respect for the local environmental conditions were paramount throughout the project, not least because an earlier project had been denied because it would have crossed a large portion of cultivated shellfish beds in New Haven Harbour. In response to concerns the project was able to avoid all but 230 m of the actively cultivated beds by locating the cable within the federal navigation channel (FNC) in the harbour, where no shellfish cultivation takes place.

For the 580 m section of the cable between the FNC and landfall at New Haven the cable installation used directional drilling to create a tunnel beneath the seabed so that the cable could be housed in a plastic conduit, and avoid disturbing the shoreline.

There will also be no adverse impact to temperatures in the seabed or surrounding waters. The temperature increase at the seabed directly above the cable will be less than 0.1°C, with a related increase in water temperature measured in millionths of a degree. These increases are negligible and well within annual temperature variations in New Haven Harbour and Long Island Sound.

The cable will not result in any major changes to magnetic fields affecting navigation or animal life. This is because the twin-cable design, with equal and opposite current in each cable, largely cancel the cable’s magnetic field. The design will produce only a slight magnetic field that will result in a negligible magnetic compass deviation of less than one degree in the narrow area above the cable. Since it is a DC system the cable will not produce any AC electromagnetic fields, which are frequently associated with health concerns.

**Interconnection**

The Cross Sound Cable was completed in mid-2002 and commissioned in just fifteen days. Beyond this rapid completion, its capability to transmit electricity over long distances with efficient operation at a lower investment level than conventional HVDC power transmission systems, demonstrates the applicability of HVDC Light technology in larger MW applications.

Cross-Sound Cable’s completion was followed closely by another HVDC Light installation called the Murraylink project in Australia. Murraylink, the world’s longest underground high voltage interconnection, can transfer 220 MW of power between the states of Victoria and South Australia (see PEi May 2001). The interconnection was developed by Murraylink Transmission Company, also a subsidiary of TransEnergie, was put in operation in October 2002 to help relieve South Australia’s anticipated energy supply shortages.

Both the Murraylink and Cross Sound HVDC Light systems are equipped with fast response control systems that enable power trading over short dispatch periods, making them especially suitable for operation in deregulating and privatized power markets.

"Both the Murraylink and Cross Sound HVDC Light systems are equipped with fast response control systems that enable power trading over short dispatch periods.”

The Cross-Sound link is expected to improve the reliability of power supply in the Connecticut and New England power grids, while providing urgently needed electricity to Long Island. The HVDC Light connection is also designed to promote competition in the New York and New England electricity markets by enabling electricity to be traded among power generators and customers in both regions.