

## ABB Analytical - Silica

### Case Study: Water Injection at National Grid peaking plant

#### Silica monitoring for water injection system cuts NOx emissions at Long Island peaking power plant

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A new high pressure water injection system designed to reduce nitrogen oxide emissions from a peaking power plant in New York requires water with an ultra-low silica concentration. The twin-pack Pratt & Whitney kerosene-fired engines have a limit of 20 ppb silica in fuel and water entering the turbines. Higher silica values can coat the turbines, leading to decreased efficiency, engine damage, and costly downtime. Estimates for replacing damaged parts for the plant's 10 engines range as high as \$5 million.

The Operators and Engineers at National Grid chose the new Navigator 600 silica analyzer from ABB Instrumentation to monitor silica in the water to be injected. The Navigator 600 was selected because this analyzer needs little operator attention and reagent usage is comparably low. It's self-calibrating and self-cleaning, and provides a historical data log of alarms and events.

#### Decreasing nitrogen oxide emissions

National Grid installed the new \$4 million high-pressure water injection system and silica analyzer at its largest peaking generation facility in Long Island. The new system, shown in Figure 2, reduces NOx emissions by 50 to 60%.



Figure 1. ABB Navigator 600 analyzer monitors silica for new water injection system.

It automatically injects and mixes ultra-pure, high-pressure water into the kerosene fuel before it reaches the combustion chambers of the twin-pack FT4 aircraft engine generators. The injected water lowers the peak flame temperature in the engine, significantly decreasing NOx emissions.

As a result, the combustion turbine units with HP water injection facilitate compliance with current NOx emission standards. This installation phase serves half the twin-pack units. The station plans to expand the sys-

tem to the other five units in the near future.

### Operating in a bubble

National Grid's 550 MW generating station in Holtsville, NY consists of 10 twin-pack FT4 aircraft engine generators. The twin-pack engines can come online in as little as five minutes to serve the peak power requirements of Long Island.

Long Island now has electric interconnection cables from New Jersey and Connecticut. These cables, coupled with the recent economic downturn, have resulted in less demand on the National Grid steam generating units. The steam generating units provide NOx emission credits. Since the system operates in a "bubble" that puts a cap on its daily NOx emissions, National Grid has taken steps to lessen its emissions from other sources.

The new water-injection system at Holtsville provides more flexible power generation options and enhances compliance flexibility. The system permits the company to operate more competitively while lessening a precursor



*Figure 2. New high-pressure water injection system significantly cuts NOx emissions.*

to ozone or smog in the surroundings.

### Ensuring ultrapure water

The Holtsville station has an existing inlet air water spray system, installed in 2001, that "fogs" the incoming air to the engines. This fogging system acts to recover capacity and marginally curb NOx emissions during high ambient temperature operation of the twin-pack units.

As shown in Figure 3, a trailer with ion exchange resin beds purifies incoming city water. The water flows through a four-inch line to a 500,000-gallon storage tank.

Originally, the station relied on a conductivity monitor to gauge when the resin beds in the trailer were exhausted. This conductivity monitor was contained within the trailer and would automatically shut off the water when the conductivity rose to 0.5 micro-mhos.

After adding the new water injection system for the fuel, it was decided to install the ABB silica analyzer to check on the silica levels entering the storage tank. These levels can rise dramatically as the resin beds in the trailer near their limit and are exhausted.

### Controlling silica

Silica, because of its weak ionic bond, is the first contaminant to break through the exhausted resin beds. This break-through occurs before the DI water approaches 0.5 micro-mhos conductivity.

When the Navigator 600 analyzer was first put into service as trailer resin beds neared exhaustion, they were amazed to find that the silica content in the water going to the storage tank had risen to about 1600 ppb.

Of course the large amount of water in the

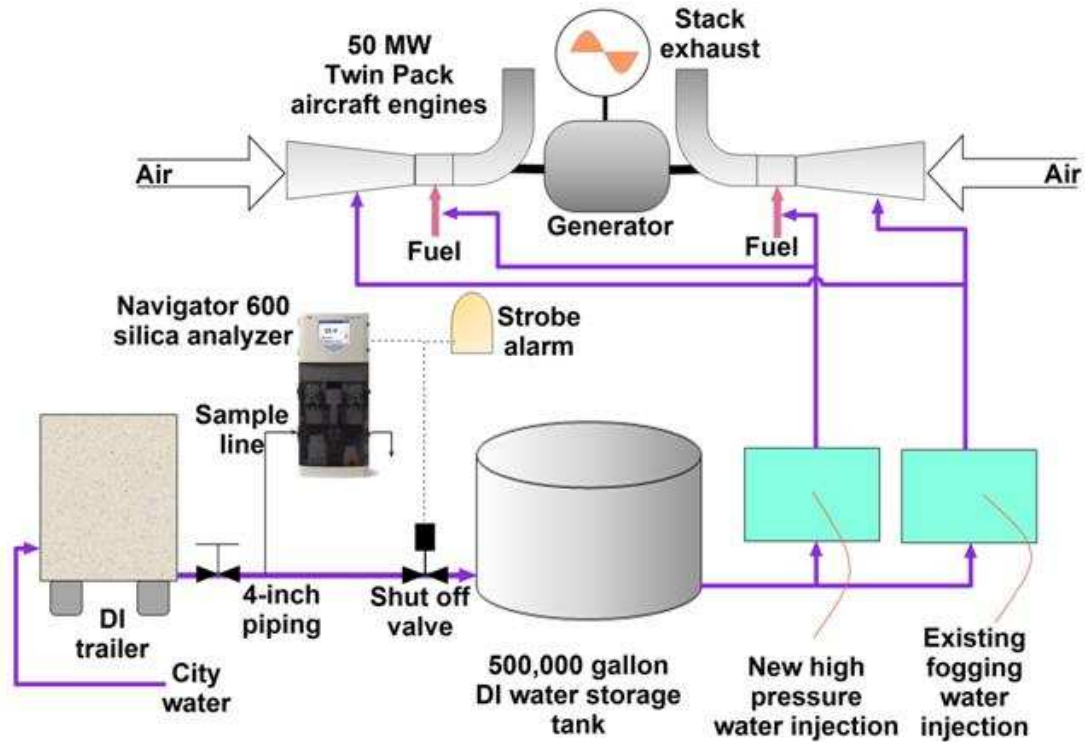


Figure 3. Simplified diagram of new high pressure water injection system at National Grid peaking plant.

tank dilutes the silica concentration. To check the silica level in the storage tank, they shut the trailer off and back flushed water from the storage tank to the ABB analyzer. The silica value measured by the analyzer dropped into the teens for the storage tank itself. This value met the engine manufacturer's specification but was uncomfortably near the limit. So they quickly learned the importance of monitoring silica from the DI trailer to maintain the purity of their injection water.

### Automatic shut-off

Water in the ¼-inch sample line to the ABB analyzer flows at a rate of three gallons/hour. Most of this overflows to a dry well. The Navigator 600 analyzer consumes only three pints/day of spent reagent chemical and water, which is collected for proper disposal. Lag time from the 4-inch line to the analyzer is about five minutes, and the time for an analysis is about eight minutes.

If sufficient empty volume exists in the storage tank, the trailer can fill it in three days or less. With the silica analyzer now monitoring the water entering the storage tank, Holtsville will be shutting off the DI trailer and ordering another sooner than previously. When the silica level in the line to the storage tank rises to 50 ppb during a fill cycle, an alarm contact on the Navigator 600 analyzer will automatically initiate shut off of water flow. The contacts will also energize a beacon strobe light to alert the operators.

They expect the silica level in the storage tank to gradually fall with time. When not in a fill cycle, they now continuously monitor the storage tank with the ABB analyzer, and the silica level has already dropped to 8 ppb.

To further diminish NOx emissions, National Grid plans to expand the concept of the HP water injection system to similar peaking stations within their system around Long Island.

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