



## Application: Tap Changer

*ISOPur Fluid Technologies eliminates carbon buildup in transformer oil and greatly reduces oil turn-over, saving the company man-hours and money*

### Introduction

Consolidated Edison Company of New York (Con Edison), a regulated utility, provides electric service in New York City and most of Westchester County. The substation, located on Staten Island, NY, is one of the largest custom power factor correction stations in the world.

When the tap changers were opened for servicing, there was visible evidence of a significant reduction of carbon buildup on the glass insulators and, more importantly on the contact points (see Figures 1 & 2).

### The Challenge

Con Edison was experiencing carbon buildup on the glass insulators as well as the copper contact points in two of their tap changers. The contamination caused arcing and reduced dielectric KV levels, creating an unstable environment within the fluid. As the transformer oil became heavily contaminated, the insulation was reduced causing erosive wear and dangerous short circuiting.

Extremely contaminated fluid, if left untreated, increases the potential for volatile conditions. Previous efforts to control contamination included a station shut down every three months for draining, cleaning, and servicing of transformers.

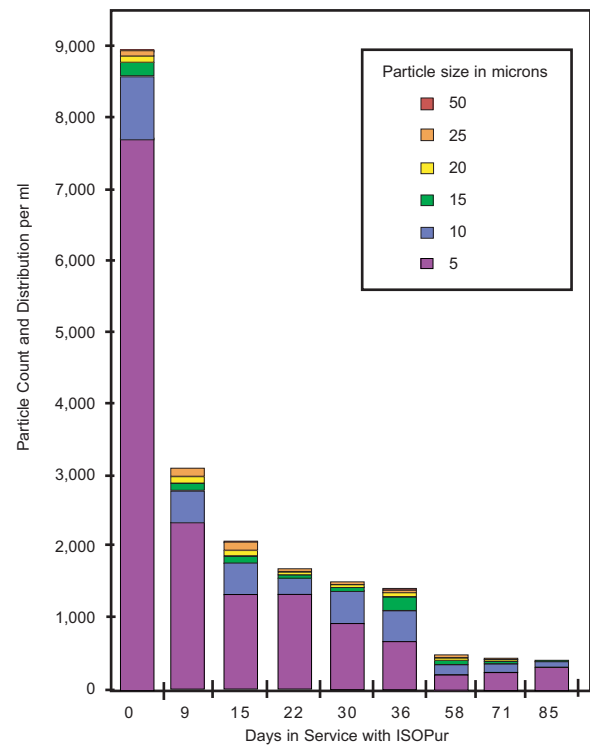
The use of fine filtration (3-5 microns) could not eliminate the carbon contamination because the average size of carbon particles are generally in the 0.1 to 0.5 micron range and are much too small to be collected by filters.

Tests were conducted using ISOPur Balanced Charge Purification (BCP) technology. The oil analysis results are displayed in Graph 1.

### The Solution

In July 2003, ISOPur installed two purification systems in a kidney loop on each of the two dedicated 2000 gallon fluid reservoirs. Immediately following start-up of the IOSPur systems there was a positive effect not only on the carbon contamination but the entire transformer oil system.

Graph 1: Past Transformer Oil Analysis



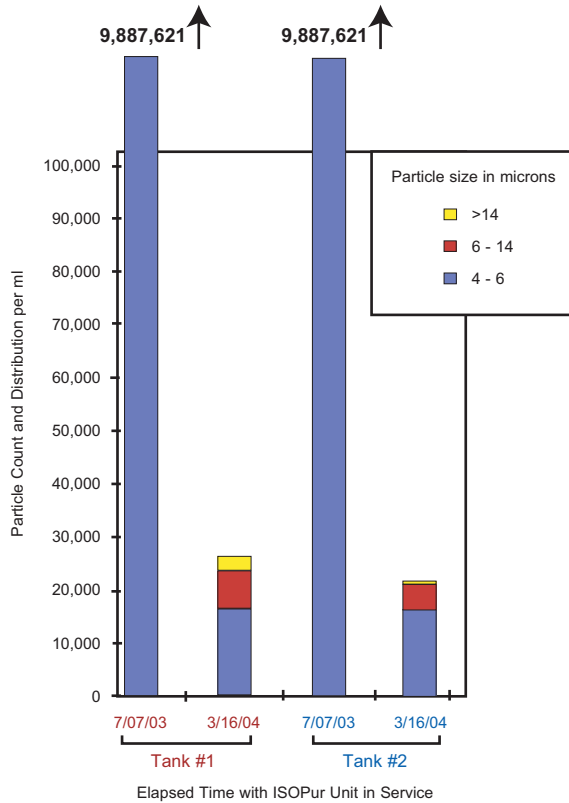
Gas-in-oil Analysis - Days in Service vs. Gas Type

|                | 0      | 9      | 15     | 22     | 30     | 36     | 58     | 71     | 85     |
|----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| Hydrogen:      | 0.1    | 20     | 32     | 49     | 69     | 78     | 105    | 171    | 0.5    |
| Oxygen:        | 22,300 | 26,000 | 28,100 | 11,400 | 26,200 | 10,400 | 22,100 | 26,500 | 12,000 |
| Nitrogen:      | 44,100 | 56,400 | 60,800 | 25,500 | 56,400 | 23,200 | 41,700 | 60,600 | 27,800 |
| Methane:       | 0.1    | 3      | 7      | 8      | 22     | 21     | 44     | 78     | 39     |
| Carb.Monoxide: | 0.1    | 0.1    | 2      | 21     | 63     | 74     | 96     | 230    | 94     |
| Carb. Dioxide: | 208    | 91     | 81     | 181    | 55     | 77     | 80     | 86     | 86     |
| Ethane:        | 0.1    | 0.1    | 1      | 0.1    | 3      | 2      | 7      | 13     | 6      |
| Ethylene:      | 1      | 10     | 14     | 12     | 41     | 31     | 90     | 158    | 84     |
| Acetylene:     | 8      | 44     | 56     | 42     | 114    | 79     | 248    | 398    | 244    |
| T.C.G.         | 9      | 77     | 112    | 131    | 312    | 285    | 590    | 1,048  | 467    |

All figures are parts per million - 0.1 = < 0.5 ppm or non detectable

Tanks 1 and 2 oil samples were taken at installation and again nine months later. Graph 2 shows the positive effect on the carbon contamination as well as on the entire transformer oil system.

Graph 2: Con Ed Transformer Oil Tank Analysis



In addition, the physical condition of the fluid has improved after less than a year of purification. Oil samples were taken at installation and then again nine months later.

Figures 1 & 2 exhibit a comparison of the tap changer application at Con Edison. The ISOPur I-50 units were installed in June of 2003. Figure 1 is the tap changer before the Balanced Charge Purification (BCP) technology was implemented. Note the carbon and sludge found on the base and on the screw plate contact points.

Figure 2 is the tap changer after 10 months of continual oil purification with the ISOPur system. Note the clean appearance and removal of carbon contamination. Sludge has also been removed from the contact points, leaving them scoured and shiny.

### The Return

Prior to the ISOPur installation, the tap changers were drained, cleaned, and serviced every three months because of contaminated transformer oil. Throughout the ISOPur purification process, the substation has extended servicing to every six months and will look to reduce this expensive downtime to a mere once per year. In addition to reduced costs, dangerous arcing has also been largely reduced due to the enhanced condition of the oil. Renewed oil quality has resulted in a positive return on investment.

Figure 1: Before ISOPur (taken 04/03)



Figure 2: After ISOPur (taken 04/04)

