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Culligan International Company  
Commercial-Industrial Systems  
QUALITY WATER AT WORK<sup>®</sup>

## POWER PLANTS JOB REPORT

No. 272

# CULLIGAN<sup>®</sup> MULTI-TECH<sup>™</sup> SYSTEM MEETS WATER QUALITY NEEDS OF SOUTH CAROLINA ELECTRIC & GAS

A need to upgrade to new technology, reduce operation and maintenance costs, and conserve water led engineers and plant operating personnel of South Carolina Electric & Gas Company's McMeekin Station to do a complete replacement of the water pretreatment system.

The pretreatment system now installed uses a Culligan Multi-Tech clarification and filtration system that reduces turbidity to less than 0.3 NTU. Filtered water from the Multi-Tech System is sent to the plant demineralizer system to produce boiler feedwater makeup of approximately 18 megohm-cm resistivity. The new Multi-Tech clarification and filtration system was installed in the spring of 1991, and has been performing satisfactorily ever since.

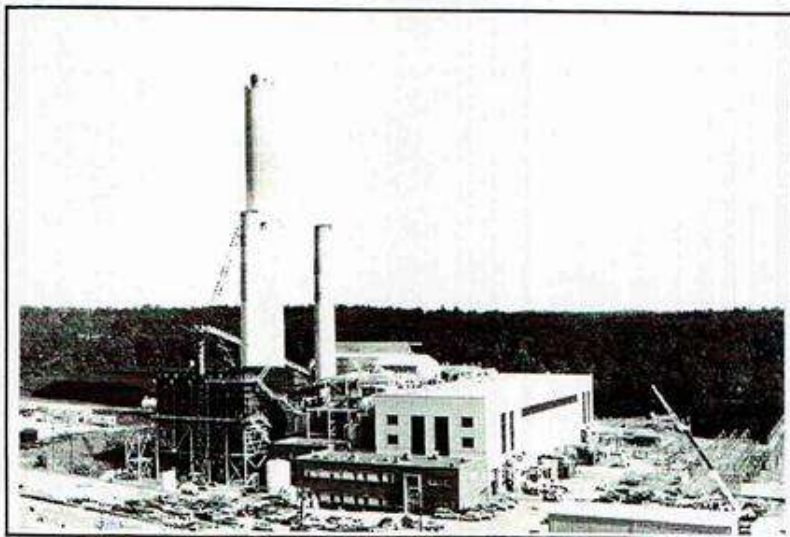
### Background

McMeekin Station consists of two base-loaded turbine generating units rated at 125 MW each. Each unit has a 2400 psia Combustion Engineering boiler with steaming rate of 910,000 lb/hr. A central water treating system supplies all of the plant water needs. Continuous average boiler feedwater makeup demand for both units is approximately 30 gpm with a maximum demand of 150 gpm. Raw water is supplied from Lake Murray, a 50,000-acre lake created by an earthen dam for power generation.

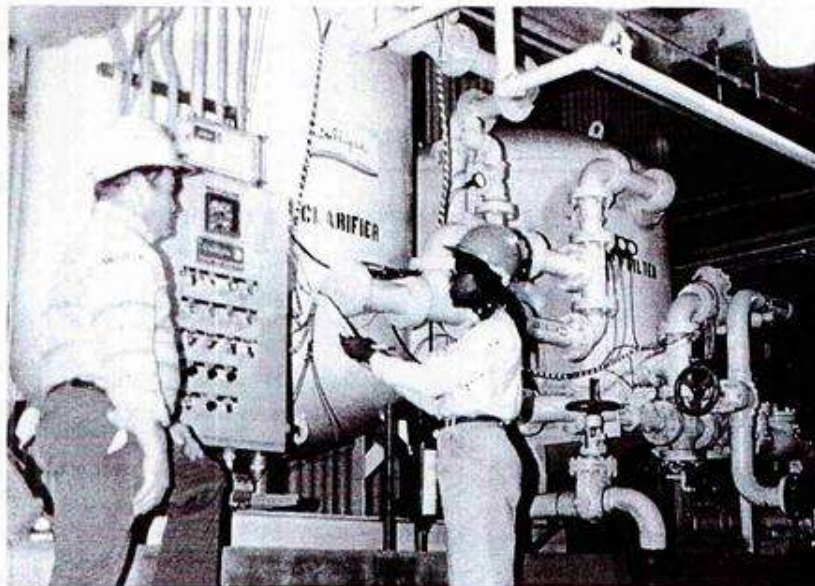
The original pretreatment system consisted of a solids contact clarifier followed by three anthracite coal gravity filters. Two chemical feeders fed alum and soda ash to the clarifier. A third spare feeder was occasionally

used to feed clay to the clarifier. Filtered water was sent to an underground clearwell where it was pumped to a filtered water storage tank or directly to the demineralizer system. The pretreatment system which was originally installed more than 30 years ago had been deteriorating over the years. A major difficulty was sludge blanket formation; it required almost 24 hours for the clarifier to build the sludge blanket needed for efficient clarification. To circumvent this inefficiency, plant personnel operated the clarifier and filters 24 hours a day. As a result, the clearwell that received filtered water often overflowed, wasting approximately 94,000 gallons of filtered water per day. This filtered water had to be pumped to the fly ash pond, incurring unnecessary pumping costs.

Another difficulty with the original pretreatment system was excessive maintenance. There was no automatic control to shut down the pretreatment system operation in case of chemical feed system malfunction. When this happened, pH would run out of control, the clarifier would not perform properly, and high turbidity water would bleed downstream to the clearwell and to the demineralizer system. The same problems occurred if the flow rate were changed, so the pretreatment system was run at constant flow rate. Startup of the pretreatment system required 16 man-hours of labor (two men all day) to slug-feed soda ash until



General view of the McMeekin power station of South Carolina Electric & Gas Company.



*Joe Richardson, plant analyst (left), and engineer Angie Webb check the Multi-Tech water treatment system.*

the right pH was restored, backwash the filters, and pump out and refill the 30,000 gallon clearwell. The demineralizers also needed to be backwashed because of the high turbidity loading experienced during the pretreatment system upset conditions.

#### **The Solution**

The job of upgrading the water pretreatment system was the responsibility of SCE&G Engineer Angie Webb. The Culligan® Multi-Tech™ system was selected based on the successful results on river water observed at two nearby industries by SCE&G chemist John Pearrow and engineer Kevin Wicker, combined with low total evaluated cost. The challenge was to continue supplying filtered water to the demineralizers while the replacement clarifier and filter could be installed. Webb's solution was to remove two of the three filters to make room for the new Multi-Tech system, and to keep the clarifier and third filter in service. This was possible because of significantly less space required for the Multi-Tech system.

According to SCE&G plant

analysts Joe Richardson and Stanley Sheeley, the two men responsible for water treatment system operation, installation of the new Multi-Tech system was fairly simple and quick, because the system was pre-piped and skid-mounted. A section of wall was opened, two filters were removed, the new clarifier/filter unit was moved into place, and piping and electrical connections were made. Once the Multi-Tech system was started up, making good quality water, and the analysts were comfortable with the system controls, the old clarifier and third filter were then dismantled and removed.

#### **New System Description**

The new pretreatment system installed at McMeekin Station is a Culligan Multi-Tech system which consists of one depth clarifier (72" dia x 60" SS) and one depth filter (72" dia x 48" SS). The system also includes three chemical feeders; one for alum, one for polymer and one common spare. The main control panel with a GE programmable logic controller (PLC) provides automatic operation and backwash

control of the Multi-Tech system. A Hach 1720 turbidity analyzer monitors the turbidity of the Multi-Tech system effluent. The system is designed to operate at 150 GPM and can handle a peak flow rate of 200 GPM. Raw water comes from Lake Murray through an inlet submerged 100 feet below the water surface, and travels through two 60-inch diameter pipes to the McMeekin Station. Water is delivered at 72 psig at an average temperature of 55 °F. Turbidity of the lake water varies from 1.7 to 7.0 NTU, with an average solids level of 20 ppm and total dissolved solids level of 62 ppm. The pH of lake water is typically 7.4.

As the lake water enters the pretreatment system, alum and polymer are injected into the water lines through an in-line static mixer for coagulation and flocculation. The chemically treated water flows through the Multi-Tech clarifier tank in a down-flow manner. Pin floc formed by chemical feed clings to the surface of the clarifier media as it passes through the 3 1/2 ft. of media. Additional coagulation and flocculation occur as the water travels through this tortuous path. The Multi-Tech clarifier typically reduces the turbidity of the raw water by about 90%.

Clarifier effluent with significantly reduced turbidity is then sent to the multi-media depth filter for polishing. The Multi-Tech depth filter contains three layers of media plus underbedding materials. Very coarse material of light density is used at the top. The layers become progressively finer in the lower layers. As water flows downward through the three media, progressively finer particles are trapped, providing efficient filtration throughout the entire media bed. This optimization of the filtration process is not possible in single-media filters, because finer particles tend to clog the media in the top few



Water for boiler feed comes from 50,000-acre Lake Murray through these inlet pipes. The lake was created by the earthen dam seen in the foreground.

The capability of operating the new Multi-Tech system on demand eliminated wasting 94,000 gal/day of treated water and associated chemical and pumping costs.

Chemical costs have been reduced by over 55% because of significantly lower chemical dosages required with Multi-Tech™ system compared to the conventional clarifiers. Optimization of chemical dosages and elimination of the waste of treated water also contributed to the savings in chemical costs.

Time and labor required to startup the Multi-Tech system has been significantly less — 30 minutes versus 24 hours for the original conventional clarifier. Maintenance on the new Multi-Tech system has been low, consisting of replacement of small parts such as a check valve and valve diaphragm. Floor space required for the Multi-Tech system is significantly less than a conventional clarifier. The space previously occupied by the clarifier was used to install a new

two-train, three-bed demineralizer system, leaving freed-up space of 20 ft. × 20 ft.

The entire project was handled by Angie Webb. All process design and drawing work was done in-house. Ms. Webb investigated similar Multi-Tech systems installed elsewhere, specified the process and components, and selected an outside contractor to dismantle the old equipment and to install the new Multi-Tech system. According to Ms. Webb, the selection of the Culligan system took into consideration both capital and operating costs.

Start-up was provided by personnel from Culligan headquarters in Northbrook, Illinois, assisted by David Williams of Culligan Water Conditioning of Mt. Pleasant, South Carolina, an independently - operated Culligan dealership.

All SCE&G personnel are satisfied with the consistent performance and low operating cost of the Culligan Multi-Tech system.



A turbidimeter provides constant readout of turbidity in the product water, here registering 0.1 NTU. The turbidimeter also can prolong rinse cycles if needed.

inches. Because of the highly efficient clarification and depth filter polishing, the Multi-Tech system consistently produces water of less than 0.3 NTU turbidity. A Hach 1720 turbidity analyzer monitors the turbidity of the Multi-Tech system effluent.

Water from the Multi-Tech™ system is sent to a 30,000-gallon underground clearwell. From the clearwell it is pumped to a 20,000-gallon filtered water storage tank or to the demineralizer system for further treatment. Water quality from the existing demineralizer system has been approximately 18 megohm-cm resistivity.

The Multi-Tech System delivers about 200,000 gallons of filtered water in each service cycle between backwashes. The system is backwashed every four to five days, based on pressure differential of 10 psi across the entire Multi-Tech system or on the effluent turbidity. When a set pressure differential or effluent turbidity is reached, an alarm sounds and the operator initiates backwash by a pushbutton. The system also has the capability of automatic backwash.

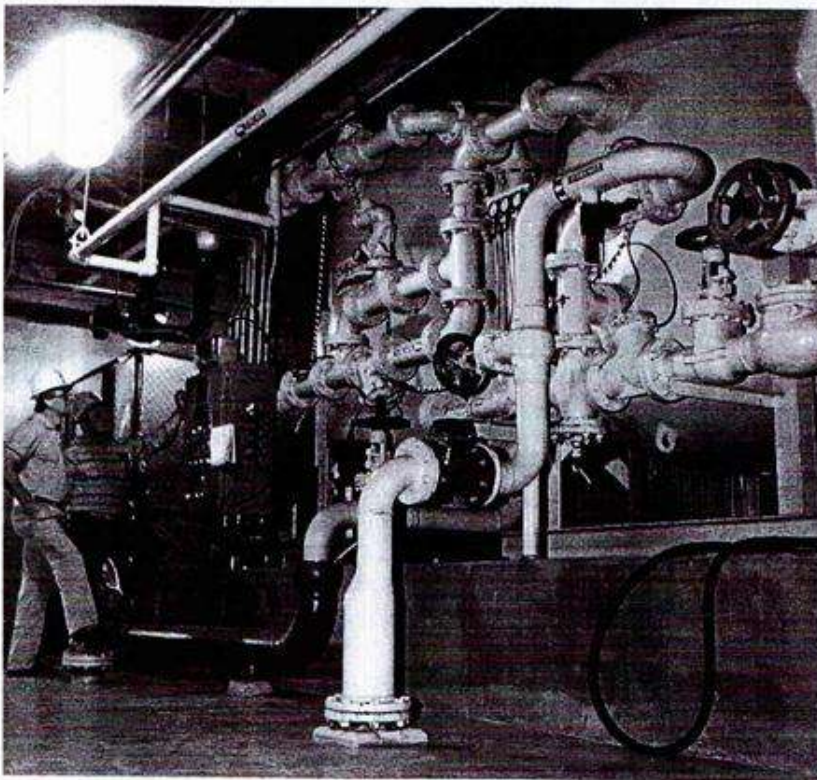
Backwash water is drawn from the clearwell and the filtered water storage tank. All steps of the backwash/rinse sequence are performed automatically, and controlled by a programmable logic controller.

#### **The Benefits of New Multi-Tech Pretreatment System**

Performance of the pretreatment system has been improved. The turbidity of the effluent from the new Multi-Tech system has been consistently below 0.3 NTU, compared to that from the original pretreatment system of 1 NTU. Performance of the system is no longer sensitive to the raw water temperature or flow rate. Consistent system performance eliminated upsetting the demineralizer operation and fouling of the resin caused by the high turbidity loading.



*A chemical feed system injects alum and polymer into the incoming water for coagulation and flocculation.*



*Plant analysts Stanley Sheeley (left) and Joe Richardson reported that the Multi-Tech system reduces turbidity of incoming water to less than 0.3 NTU.*