The Kori Nuclear Power Plant in South Korea Uses Liqui-Cel® Membrane Contactors for Dissolved Oxygen Removal to Prevent Corrosion and Carbon 14 Production

Dissolved oxygen is a leading source of corrosion in water systems and it is carefully monitored and controlled in nuclear power plants. The Korean Electric Power Institute (KEPRI) has installed Liqui-Cel Membrane Contactors in the Kori nuclear power plant in South Korea. The membranes have been in operation since 2000 and have successfully met the rigorous demands of the nuclear power industry.

The Kori unit 1 plant is a Pressurized Water Reactor type reactor (PWR). The membranes are used to remove dissolved oxygen from water in the Primary Make-up Water Storage Tank. The water is continuously recirculated through the membrane contactor system in an effort to keep the dissolved oxygen level low. Dissolved oxygen is controlled to very low levels in this system in order to prevent corrosion of piping and equipment. Dissolved nitrogen is also controlled to prevent the formation of Carbon 14.

Kori Unit 1: Reducing Production of C14 and Replacing Hydrazine Injection

Kori unit 1 is a Pressure Water Reactor (PWR). The reactor is continuously fed boronated water which is used to control the neutron flux inside the reactor. The boron is continuously consumed and is replenished from the primary make-up water system.

The water in this primary feed tank is typically blanketed with nitrogen or covered with a rubber bladder to prevent oxygen from entering the storage tank. Before Liqui-Cel Contactors were installed, hydrazine was typically used to control the dissolved oxygen level in the DI water system feeding this tank. The breakdown of hydrazine and the nitrogen blanket increased the amount of dissolved nitrogen in the water.

Researchers at KEPRI have found that dissolved nitrogen in the reactor feed water leads to an increased production of carbon 14 in the power plant. The nitrogen forms carbon 14 when it absorbs neutrons in the reactor. Carbon 14 is a long-term environmental contaminant and the engineers sought ways to minimize its production at the plant.

Engineers at the facility investigated new ways to control the dissolved oxygen and nitrogen in the water feeding the reactor. Membrane contactors were installed because they simultaneously remove both dissolved nitrogen and oxygen from the water.

Liqui-Cel Membrane Contactor for Degassing

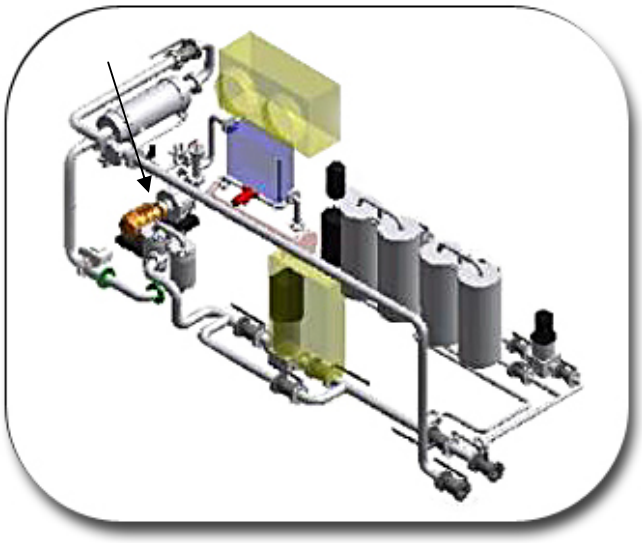

Figure 1 – Three Dimensional Front Diagram of Degassing Equipment at Kori NPP

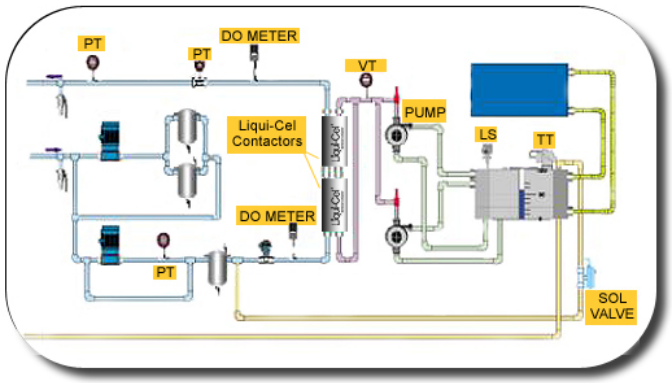

Figure 2 – P&ID of Degassing Equipment at Kori NPP

As illustrated in Fig. 2, the Kori plant uses a deep vacuum. This operating condition lowers the partial pressure of all gasses that are in contact with the water. This creates a driving force to remove all gasses that are dissolved in the water.

Two 10 x 28 Liqui-Cel Membrane Contactors remove 90% of gasses. Figure 3 lists the operating parameters.

Kori NPP System Efficiency

The membrane contactors offer an efficient chemical free process for removing dissolved gasses from water. The elimination of hydrazine from the process creates a safer working environment for the employees of the plant.

Additionally, the Contactor's ability to remove dissolved nitrogen as well as oxygen allows the plant to reduce the formation of C14 and make the plant more environmentally friendly as indicated in the efficiency rating in Figure 3.

To gain a better understanding of how the contactors actually work, you can view an animated product tour that demonstrates a cutaway view of the contactor. Go to www.liqui-cel.com

You can also request a system sizing for your specific application by going to the "contact us" section of our website.

Figure 3 Kori NPP Operating Parameters

End user	Kori Nuclear Power Plant
Module	Liqui-Cel® 10X28-X40 Membrane Contactors
Water Flow	34m3/h (150 gpm)
Temperature	50 °C (122 °F)
Vacuum	0.03 kgf/cm2 (23 torr)
Number of Contactors	2 in series
Purpose of System	DO Removal
Operation Mode	Vacuum
Efficiency	95.7 %

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