Background

To meet the needs for failed fuel detection and dry cask storage preparation, Westinghouse offers a portable, time-tested and reliable vacuum canister sipping service. The system is designed to identify failed fuel assemblies containing one or more leaking fuel rods. Identification is based on detecting gaseous fission products that have accumulated within individual fuel rods during reactor operation. When fuel rod cladding is breached, these fission products are released into the coolant surrounding the fuel assembly. The canister sipping process isolates the fuel assembly and draws a vacuum above the assembly, which allows further release of fission gas products. These products are then captured and quantitatively analyzed.

The system consists of a set of two electropolished stainless steel tubes or canisters connected at the top and bottom with a sliding lid that utilizes inflatable seals. The sipping fixture is placed underwater, normally in the cask pad area of the spent fuel pool, and is connected to the two independent sipping control consoles via two 100-foot umbilical cables.

The consoles consist of a control programmable logic controller (PLC), radiation detector with a lead shield, solenoid valves, air dryer and vacuum pump. The consoles are connected to a laptop computer which is used to monitor and control the system as well as log the output from the detectors. Each independent console has the ability to initiate safety mechanisms automatically in the case of temperature or pressure anomalies.

The process is to insert a candidate assembly into the sipping chamber and seal the chamber. An air space is created above the fuel assembly and the air in the space is evacuated using a vacuum pump. The resulting reduction in pressure induces fission gasses inside fuel rods to be released and migrate into the evacuated space.

The vacuum pump draws from the space and in-line instruments are used to analyze for relative amounts of activity from fission gasses.
Description
Vacuum canister sipping services consist of pre-site, on-site and post-site activities.
• Pre-site activities consist of equipment preparation, system checkout and the development of a site-specific procedure
• On-site activities consist of equipment mobilization, dry system checkout, wet checks, testing and demobilization. Westinghouse personnel will provide all installation, operation and analysis services. Fuel-handling services can also be provided upon request.
• Post-site activity consists of the preparation of a final report.

Benefits
The vacuum canister sipping system process provides the following benefits:
• A dual-can design that allows alternate use for maximum fuel assembly processing rate
• A system design that allows a safe process with a minimal volume for sipping, providing the highest level of gas-based detection sensitivity
• A clean, light and compact polished stainless steel fixture that is easily installed, and designed to minimize height to closely match the spent fuel rack elevation
• State-of-the-art detection electronics, control and logging software, including a customized scintillation chamber
• A minimized pool-side equipment package that is compact to accommodate tight floor space
• Redundant safety measures including inflatable seals, an easily and quickly removed sliding lid, thermocouples, level switches and a PLC-based control system for failsafe operation
• A tri-nuke filter connection option for contamination-limiting operation

Deliverables
Wesnghouse will provide pre-planning and coordination for the use of the leak detection system. Our personnel will make every effort to provide a successful, accurate and safe measurement campaign. Detection results will be independently verified. After the campaign, the final report will be issued detailing the following:
• An outline of the campaign progress and actions
• An analysis of the inspection results
• Copies of all the data obtained