# Development of Air-Tight Leak Chase System for In-Service Inspection of Pool Liner

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## 1. Introduction

The spent fuels not only in research reactor but also in nuclear power plant are stored in the pool to ensure the cooling of fuel and radiation shielding. For this purpose reinforced concrete including the stainless steel plate, called pool liner, is constructed.

The leak chase system, as a part of pool liner, is constructed between the pool liner and reinforced concrete to collect the leak coolant which caused from the damage of welding part in pool liner.

However, current leak chase system has the technical limitations for the in-service inspection of pool liner and for the prevention of radiation release to environmental.

To resolve these limitations, but also to monitor the pool liner in real-time, the air-tight leak chase system is developed and its characteristics are presented.

## 2. Background

### *2.1 Functional Requirements of Pool Liner*

The pools which may contain core supports, beam ports, experimental facilities and the spent fuels are an essential part to ensuring the sufficient coolant and the radiation shielding. The pool liner which installed inside the pool wall forms the coolant barrier, and shall include a system for detection and containing pool liner leaks to maintain adequate coolant levels and reduce radiation exposures to personnel.

10 CFR Part 50 ‘Appendix A Criterion 61, Fuel Storage and Handling and Radioactivity Control’ [1], Regulatory Guide 1.13 ‘Spent Fuel Storage Facility Design Basis’ [2] and NUREG-1537 ‘Guidelines for Preparing & Reviewing Applications for the Licensing of Non-Power Reactors [3] are describe the following requirements;

- Periodic inspections and testing,
- Detecting and containing spent fuel pool leaks
- Precautions to avoid the uncontrolled release

### *2.2 Technical Limitations for Leak Chase System*

Leak chase system is installed in the pool wall and pool floor. The pool wall leak chase system is installed ahead of concrete pouring and that makes the forming an air-tightness possible.

However the pool floor leak chase system does not form an air-tightness because the concrete pouring is precedent than the installation of pool floor leak chase system. So, visual inspection using underwater camera, inspection using vacuum box or sensor are developed for the in-service inspection of pool liner.

However these inspection methods are accompanied by long-time working and accessible area limitations, but also very difficult to find out the damaged location. Furthermore, immediate repairing action is required to prevent the additional coolant leakage when the leaking location is detected.

As an illustration of the currently applied leak chase system is shown in Fig. 1, for the pool wall leak chase system and the pool floor leak chase system.

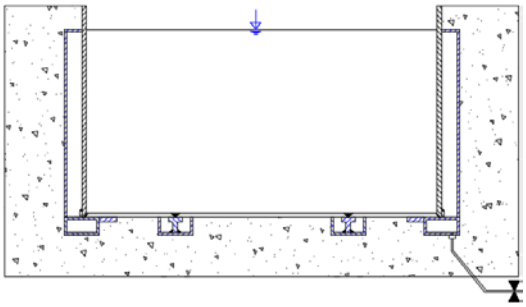

Fig. 1. Current design of leak chase system in current

### *2.3 Leakage at Spent Fuel Storage Pool*

Long-term, low-volume leakage in the spent fuel pool may exceed public health, regulatory limits and impact groundwater resources. But defining a pool water leak per day is very difficult, because evaporating coolant is to be considered simultaneously.

There were many occurrence of spent fuel pool leakage in U.S Nuclear Power Plants, Yankee Rowe in 2006, Brookhaven National Laboratory (BNL) in 1997, Salem in 2002 and India Point in 1990, Palo Verde in 2005, Salem in 2010, etc. In case of BNL leak, contaminated coolant leaked into the ground for 12 years and failed to detect the leaked water although numerous monitoring wells are added to the site. [4]

## 3. Air-Tight Leak Chase System

### *3.1 Characteristics*

To prevent the uncontrolled release of coolant, dual plate with double step components are developed to replace the single plate with channel component in current design. This makes the pneumatic inspection for the pool liner possible and find out the leaking location exactly.

Also, lower plate between the dual plates makes the coolant reservation for spent fuel cooling and prevents the uncontrolled lease of coolant into an environmental as a secondary coolant boundary in case of pool liner damage.

The air-tight leak chase system is composed of lower plate, double-step block, double-step embedded plate, double-step sleeve, leak collection box, drain pipe, and air supply nozzle. Fig. 3 shows the components. [5]

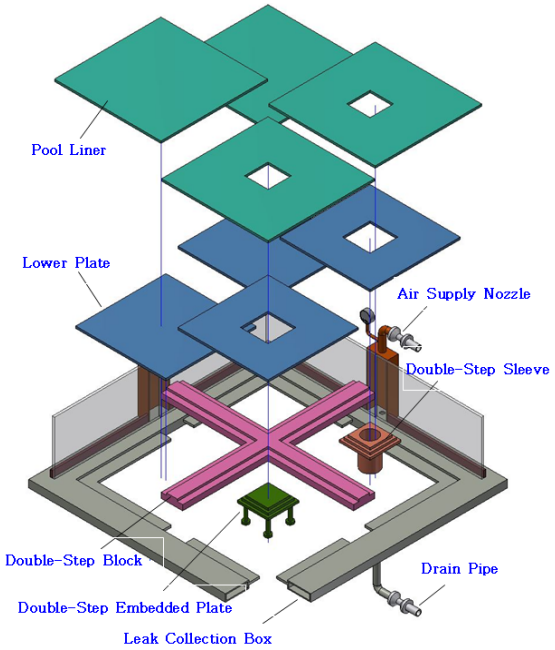


Fig. 2. Components of air-tight leak chase system

### *3.2 Leak monitoring method*

According to the air-tight geometry, the pneumatic inspection to the pool liner is possible. For the in-service inspection of pool liner, put the air into the system about 1.5~2 bar (g) and monitors the pressure gage and air bubble in the pool liner. The concept for pneumatic test for the pool liner is shown in Fig. 2.

Furthermore, real-time monitoring is possible if the air pressure is maintained constantly at the leak chase system during reactor normal operation.

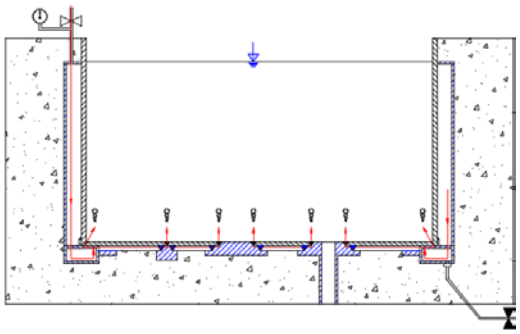

Fig. 3. Air-tight leak chase system for pneumatic test

### *3.2 Applications*

The air-tight leak chase system is applicable to the spent fuel storage pool in nuclear power plant as well as pools in research reactor.

At present, this system is applied to the KJRR pool liner design and additional construction cost is lower than one-30th the cost of pool liner (4m×16m, about 5 Ton, ASTM A240 304L, 9t). And maintenance cost is not required.

## 4. Summary

The pool liner with air-tight leak chase system satisfies the requirements described in regulation guide documents and IAEA documents, but also provides the real-time inspection method for the pool liner.

This technique is applicable to research reactor pool and spent fuel pool in nuclear power plant and increasing the safety of pool liner is possible.

## Acknowledgements

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## REFERENCES

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