

## Laser Sensor Package Development for the SIT of Containment Structure

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### 1. Introduction

Various types of nuclear power plants are being constructed and operated in Korea, and in terms of regulatory control, a method of examining and evaluating the structural integrity of containment structure is being used.

Generally, after the construction has been completed, all containment structure go through a Structural Integrity Test (hereinafter SIT) in which the displacement occurring in a structure under greater internal pressure than it was designed for is measured and the result is comparatively assessed with the allowed criteria.

Most of the nuclear power plants in Korea are American type plants and their SIT uses the Invar-wire and Extensometer methods. These existing methods are expected to be used for the APR1400 plant currently being built unless some other reliable alternative technique is presented. This tendency can be observed in other countries, such as Japan, and there is thus insufficient effort to enhance the reliability of SIT through the implementation of the latest measurement technology.

Test using the Invar-wire and Extensometer methods contain problems such as inefficiencies in installation and inaccuracies in areas with micro-displacements, and regulatory agency and plants owner all recognize the need for improvements. Accordingly, improvements to SIT techniques through the introduction of the latest measurement technology can become an important factor in enhancing the competitiveness of Korean nuclear power technology, the construction ability of which has been acknowledged as world-class when Korea won the bid for UAE nuclear power plants.

### 2. Development and Verification

#### 2.1 Development of Laser Sensor Package

Laser sensor has proved its applicability in various industries including factory automation, and the fact that it can carry out wireless measurements gives it many advantages that can not only improve on the inefficiencies in installing the Invar-wire and

Extensometer but also be used as a constant safety surveillance system. To apply laser sensors to SIT, a package was developed that considered communication and power sections and the convenience of field installation.

For SIT, many laser sensors need to be installed inside the containment structure, and in case of acquiring data through a line, at least 8 or more cables are needed per sensor, including the power line. To resolve this problem, therefore, a multi-point signal dealing H/W was developed that used an integrated local wireless module, including router and link modules, which could utilize local wireless network to acquire the measurement value of each sensor and transmit it to a PC.

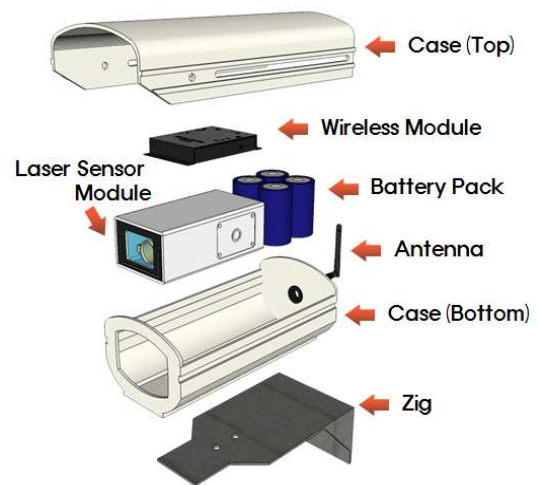


Fig.1. Laser Sensor Package

## 2.2 Verification & Measurement Program

To verify the measurement capability and durability of laser sensor package under pressurized environment, a proof test was carried out using a 1/20 steel miniature containment structure.

To simulate SIT process, pressure maintenance during the pressurization stage was divided into 6 stages.

- Peak pressure : 65.6psig(4.61kgf/cm<sup>2</sup>)
- Pressure step : 10, 25, 35, 45, 57, 65.6psig
- Pressure stabilization time : 15minute
- Measuring interval : 5minute

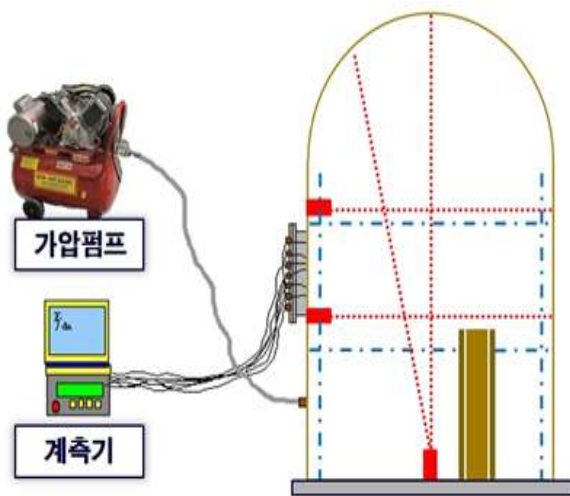


Fig.2. Outline of Proof Test

The results of the test showed that the developed laser sensor package not only revealed normal displacement behavior characteristics following pressurization and decompression but also sustained no physical damage, thus verifying that it maintained measurement applicability and needed durability.

A measurement program was developed for user convenience that can take the laser sensor data obtained using a wireless module and appropriately process the specific tasks demanded in SIT.

The laser sensor measurement program for SIT is software that aims to carry out smooth tests and efficient analysis of results, and it was developed by grafting such tools as pull-down menus and tree structures for the user convenience of field engineers. Also, because the program provided by the sensor module manufacturer generally has the capacity to indicate only one round of measurement value, a verification&correction program was developed as well that can measure distance in real time in a verification&correction test for verifying the performance of the laser sensor, and record multiple data items.

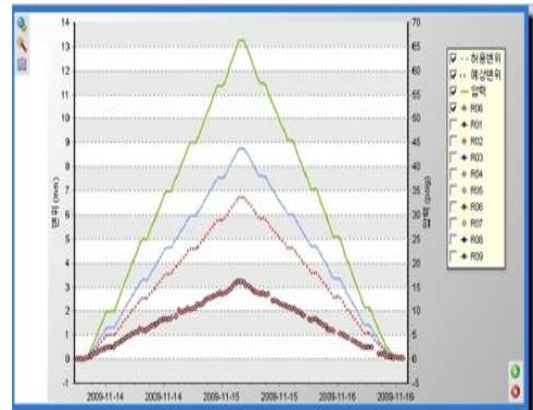


Fig.3. Measurement Program

## 3. Conclusions

The SIT of a containment structure is a process that must be carried out to substantiate the structural soundness of nuclear power plants after their construction. Developed laser sensor package has many advantages that can not only improve on the inefficiencies in installing the Invar-wire and Extensometer but also be used as a constant health monitoring system for long-life operation.

The results in this paper will not only contribute to solving problems that exist in the SIT techniques but also be used as part of the effort to obtain technical competitiveness in structures in order to dominate the overseas nuclear power plant market, which is receiving attention as a new national growth engine.

## REFERENCES

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