

# Improvement of Spent Fuel Inspection System

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## 1. Introduction

The primary purpose of Spent Fuel Inspection System is to detect the mechanical defects of spent fuel assemblies drawn from a reactor by the visual inspection and ultrasonic inspection devices. Visual inspection is to observe the surface of the spent fuel assemblies by using radiation-resistant and water-proof camera. The purpose of ultrasonic inspection is to detect the fuel rod defect in spent fuel assemblies which mechanical defects were detected by visual inspection first. Since the visual inspection system on SKN 3&4 nuclear power plant is located at a relatively long distance from spent fuel handling path, it causes the delay of the fuel inspection time, and eventually leads to the extension of refueling operation period. For these reasons, the position of visual inspection system has been changed from Cask Loading Pit (CLP) to the refueling canal, and it contributes reducing fuel inspection time and operator exposure, and increasing efficiency of work.

## 2. Body

### 2.1 Composition of Fuel Inspection System

The Spent Fuel Inspection System primary consists of Fixed Fuel Inspection Stand, Movable Fuel Inspection Stand, Visual Inspection System and Ultrasonic Test (UT) System. The camera of Visual Inspection System which is originally placed on the Fixed Fuel Inspection Stand is designed to perform the surface of the whole spent fuel assemblies unloaded from reactor core by the visual inspection device on top of CLP. UT probe of Ultrasonic Test System placed on the Movable Fuel Inspection Stand has been designed to detect the defect of fuel rod in spent fuel assembly in Spent Fuel Pool (SFP). Ultrasonic Test System is designed to find the defected fuel rods using the UT probe when the radiation level is higher than the reference value. UT probe is installed on the manipulator and operated in

the water, and the manipulator is designed in the form of X-Y Table for UT probed to be conducted between each of the fuel rods. The original location of the Fuel Inspection System and fuel handling path in Aux. Building is illustrated in Figure 1.

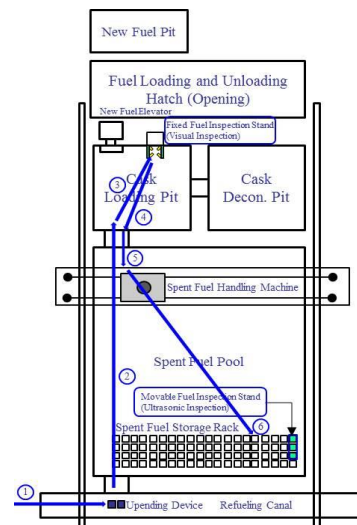


Fig. 1. Original Fuel Handling & Inspection Path.

### 2.2 Fuel Handling with Fuel Inspection System

Fixed Fuel Inspection Stand is located on top of the CLP and camera of Visual Inspection System has originally installed on the Fixed Fuel Inspection Stand. The surface of the spent fuel assembly has been scanned by camera attached to the inspection stand which moves up and down. Since the visual inspection has performed on the CLP, the spent fuel assembly erected as vertical position by upending device on refueling canal had to move to the CLP through SFP, and back to SFP to store it in the Spent Fuel Storage Racks after visual inspection. And then spent fuel assembly with the defect on the surface as a result of visual inspection is detected using Ultrasonic Test System. For this reason, fuel handling path without considering convenience cause the delay of the fuel inspection time and eventually leads to the extension of refueling operation period.

### 2.3 Improvement of Fuel Inspection System

Movable Visual Inspection Stand which is located above the upending device has been additionally installed as a purpose of fuel inspection which contributes reducing the fuel inspection time and operator exposure, and increasing efficiency of work. It is composed of under frame and upper frame, and four (4) set of the non-browning camera with the light. They are installed on the refueling canal. The Movable Visual Inspection Stand is illustrated in Figure 2.

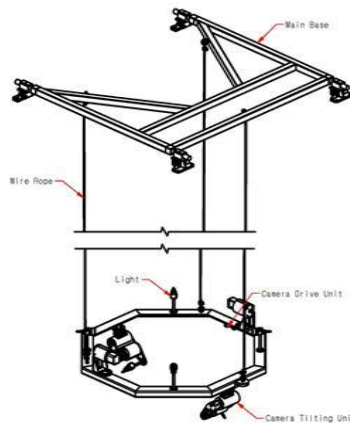


Fig. 2. Movable Visual Inspection Stand.

Visual inspection can be performed in the middle of unloading operation of spent fuel assemblies which is moved from upending device to hoist box of fuel handling machine at the same time. Thus, there is no need to have a time for only visual inspection of spent fuel assemblies. In addition, efficiency of work can be increased due to the reduced fuel inspection time. Furthermore, Fixed Fuel Inspection Stand used for visual inspection need not to be purchase on the following project because the role of the Fixed Fuel Inspection Stand and the Movable Visual Inspection Stand is overlapped, so it reduces purchase cost. The changed location of the Fuel Inspection System and fuel handling path in Aux. Building is illustrated in Figure 3.

Approximate time for fuel handling and inspection in Aux. building has been calculated as shown in Table 1 and 2. Actual operation time can definitely vary with field conditions. Occupying Movable Visual Inspection Stand instead of using Fixed Fuel Inspection Stand reduces fuel inspection time (about 7 minutes) and ultimately decreases the refueling operation period.

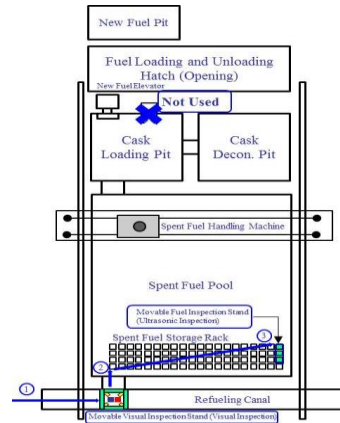


Fig. 3. Changed Fuel Handling & Inspection Path.

Table 1. Handling Time using Fixed Fuel Inspection Stand

| Equipment             |         | Speed (m/min) | Moving Distance (m) | Lead Time (min) |
|-----------------------|---------|---------------|---------------------|-----------------|
| Fuel Handling Machine | Bridge  | ~ 15.2        | 25                  | 3               |
|                       | Hoist   | ~ 1.5         | 5                   | 5               |
|                       | Trolley | ~9.1          | 15                  | 2               |
| Upending Device       |         | 2             | N/A                 | 2               |
| Fuel Inspection       |         | N/A           | N/A                 | 3               |
| <b>Total</b>          |         |               |                     | <b>15</b>       |

Table 2. Handling Time using Movable Visual Inspection Stand

| Equipment             |         | Speed (m/min) | Moving Distance (m) | Lead Time (min) |
|-----------------------|---------|---------------|---------------------|-----------------|
| Fuel Handling Machine | Bridge  | ~ 15.2        | 13                  | 1               |
|                       | Hoist   | ~ 1.5         | 5                   | 5               |
|                       | Trolley | ~9.1          | 10                  | 1               |
| Upending Device       |         | 2             | N/A                 | 2               |
| Fuel Inspection       |         | N/A           | N/A                 | N/A             |
| <b>Total</b>          |         |               |                     | <b>8</b>        |

### 3. Conclusion

The location of visual inspection has been changed from on top of CLP to the refueling canal by using Movable Visual Inspection Stand. It contributes reducing fuel inspection time and operator exposure, and increasing efficiency of work and finally it decreases the refuel operation period.

### REFERENCES

- [1] M.G.Shin, Specification for Fuel Inspection System, KEPSCO-ENC (2013).
- [2] C.B.Shim, Tech. Manual for Spent Fuel Handling Machine, Doosan Heavy Industry Construction (2012).