# Pre-installation and Operation Inspection of a Demonstration Facility for Innovative High-Temperature Thermal Energy Storage

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## 1. Introduction

The Korea Atomic Energy Research Institute (KAERI) are constructing a facility to verify a Large-scale Liquid Metal Thermal Energy Storage(TES) for multifunctional utilization of nuclear heat sources. TES may be a cost-effective solution to Energy Storage System (ESS) of critical importance to success of renewable energy. In addition, TES using liquid metal has great advantage against Operation & Maintenance because of low possibility of corrosion. Through design, analysis, and experimental validation tests, the concept of high-temperature thermal storage using sodium has been being verified [1][2]. This work will enhance commercial viability and enable the development of competitive products and solutions. Additionally, by securing the technology base for TES and utilization, it can contribute to the development of future energy technology and related industries in that the importance of Operation & Maintenance is so high and critical to total life cycle cost [2]. In this paper, we explain a set of preliminary types and procedures of inspection before the installation and operation of the TES technology demonstration facility using liquid metal such as sodium, which must be handled in a well prepared manner [3] because of the nature of the working medium.

## 2. Procedures for Inspection

In this section, we describe the fabrication, installation, assembly, and inspection of the Innovative High-Temperature TES facility, including individual device testing and functional verification prior to operation.

### *2.1 Individual device testing*

Individual testing refers to the inspection of a single device or component, which is conducted from the early stages of production, through the assembly and installation processes, and culminates in the final testing of each individual device. The target devices for individual testing include single devices such as valves, tanks, and heat exchangers, which are inspected by the manufacturer prior to shipment. For valves, the inspection process follows procedures such as material inspection and dimensional inspection, as well as ANSI FCI 70/2(CL Ⅴ&Ⅵ), MSSP-61, and API 598 inspections. Tanks and heat exchangers, on the other hand, undergo nondestructive examination in accordance with ASME Section V, which is performed to detect flaws such as material defects, welding defects, and mechanical damage. [4][5][6][7].

### *2.2 Final Inspection*

Upon completion of the installation of individual devices, a final inspection is conducted for the entire system, which includes functional and performance testing of each device as well as a loop test to check for any abnormalities before and after installation. Additionally, the inspection involves a confidential test and a heater heating test for the entire system. If confidential and non-destructive testing are not conducted thoroughly, it may affect the purity of sodium during operation, thus inspection should be carried out though accurate procedures.

Flushing of piping and vessel internals should be performed after a work has been completed. The reason for flushing is to remove solid contaminants such as metal particles, chips, welding slag, grinding dust, rust, as well as organic substances such as oil, grease, and insoluble inhibitors that may have accumulated during equipment fabrication. Failure to remove such contaminants may lead to the following issues.

- Small passages, pumps, or valves can become clogged by particulate contaminants.
- Reacts chemically with sodium.
- Plugging can occur due to the solubility of components contained within sodium.

## 3. Conclusions

TES systems must be manufactured with confidence to the reliability of structures, systems, and components of variety, as they operate in high temperature environments of around 700 degrees in Celsius and the reliability gives great impact on the total life cycle cost of the system. This preliminary inspection procedure can be a useful tool to ensure the reliability and safety of the TES system by eliminating potential issues that may occur during its operation. The procedure refers to the process applied in the fabrication of the existing STELLA-2(sodium test facility) [3], can thus be applied to preventively remove the identified potential issues in the operation of the TES system, and would be updated while tested.

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