

Introduction of High Speed Jet Pool Scrubbing Test Facilities

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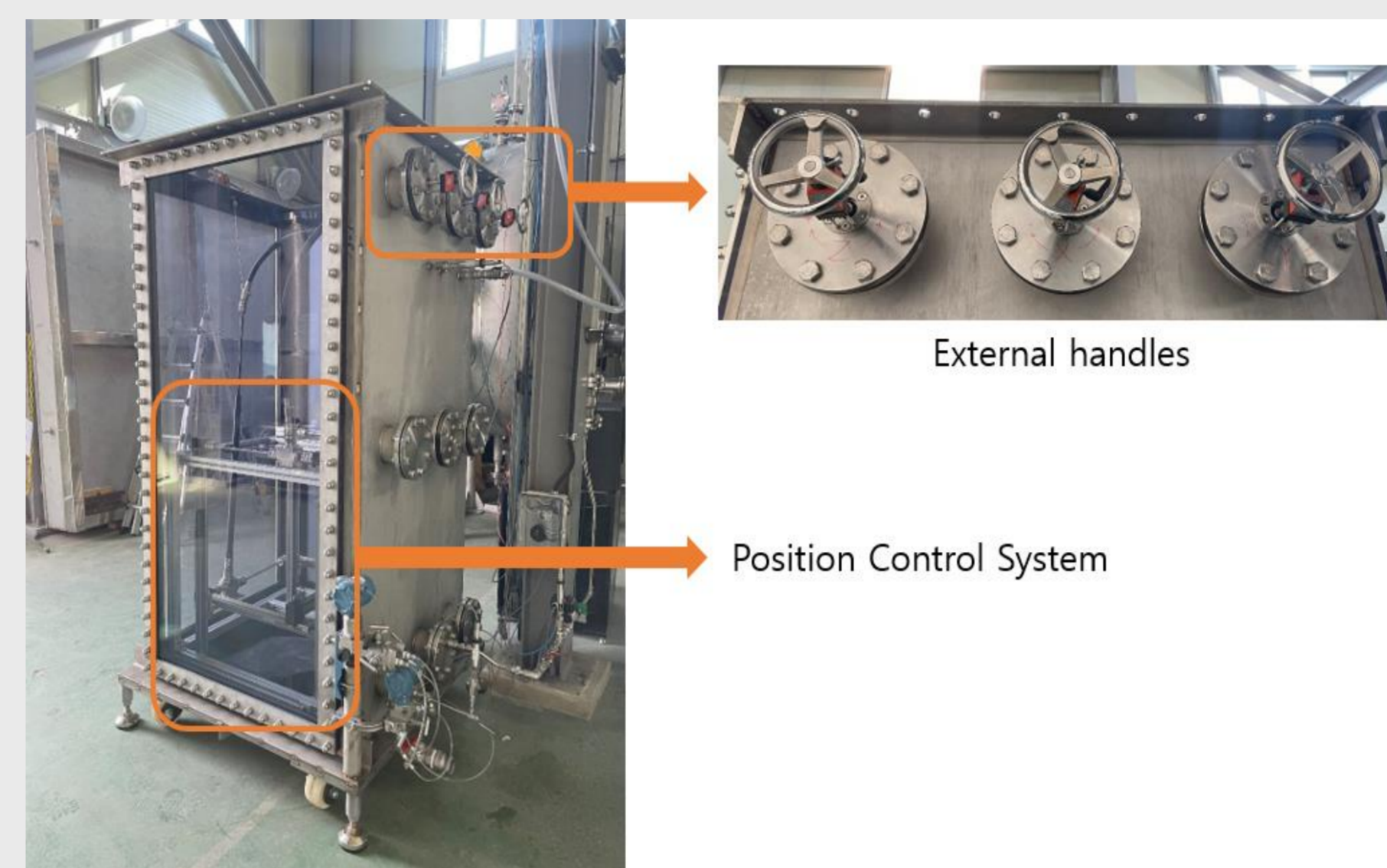
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Abstract

Since Fukushima nuclear power plant accident in 2011, Nuclear Safety Act in Korea was revised and accident management plan of all operating plant should be submitted including severe accident. In the condition, SGTR accident is one of the most important accident should be considered, because fission product is released without passing containment. It is essential to develop an aerosol jet pool scrubbing model to evaluate a risk of SGTR accident. The experimental devices was built for this research purpose, and intend to produce data for the development of aerosol decontamination models through future experiments.

Introduction

- After Fukushima accident, countries around the world are tightening regulations to ensure that nuclear power plants are capable of coping with severe accidents.
- If water is injected into the secondary side of the steam generator in an external water injection state, which is one of the accident management strategies, there is a possibility that pool scrubbing will occur at high speed in the event of a steam generator tube rupture.
- In the case of high speed jet pool scrubbing model, there has been less active research around the world. Therefore, experimental facilities to develop a high speed jet pool scrubbing model was established in the study.



Position Control System

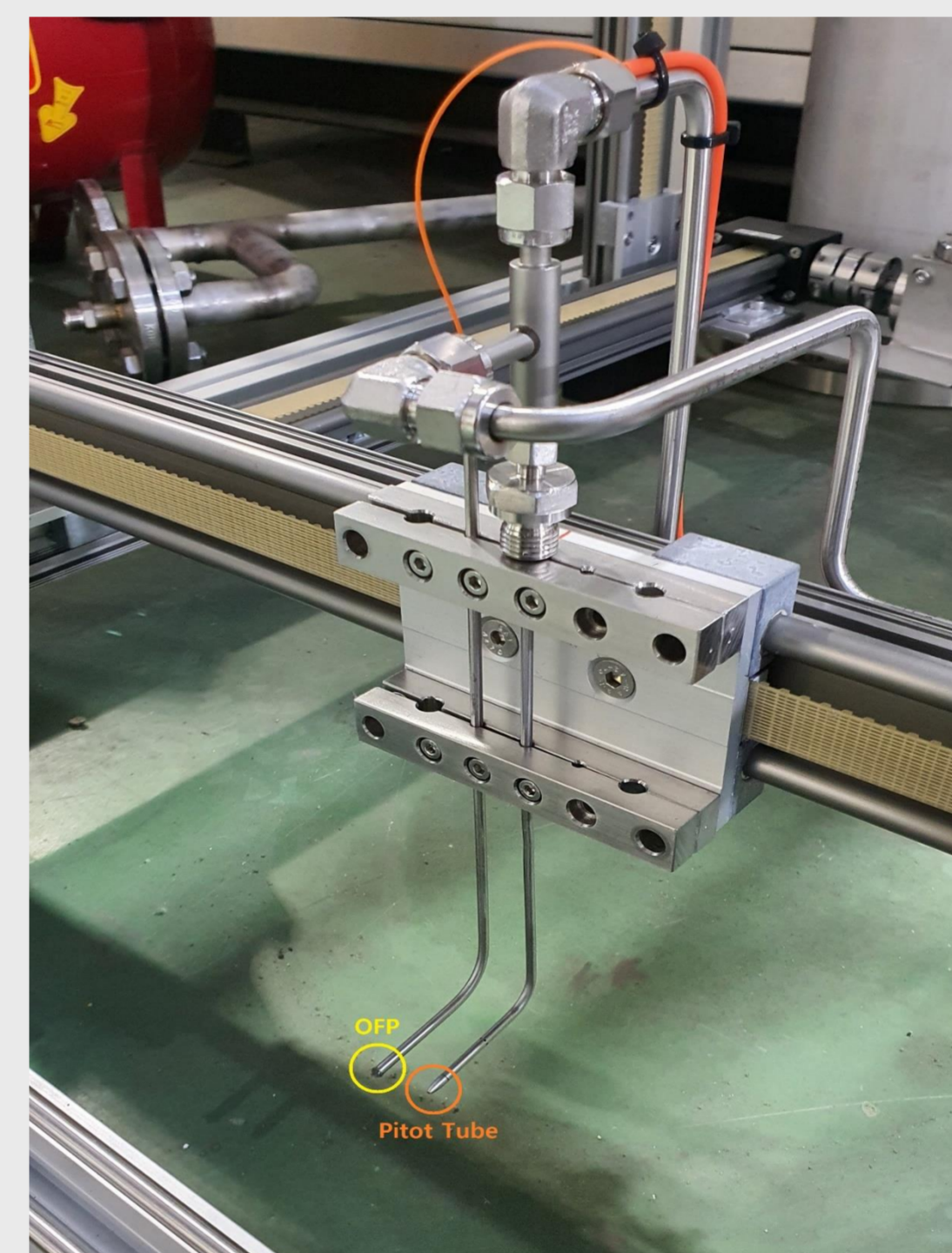
- It is possible to shift a point measuring equipment accurately using the system, such as optical fiber probe(OFP) or pitot tube, without water leakage.
- It is designed to allow movement to the X, Y and Z axes through external handles.
- The indicators are also installed, so accurate movement is possible.

Experimental Facility



Visible Water Tank

- The visible water tank has the size of 1m x 1m x 2m. In order to withstand hydraulic pressure and protect from corrosion, the frame is made with stainless-steel frame.
- It has three sides of polycarbonate windows to visualize the jet pool scrubbing by using cameras and led lamps. There are nine flanges on one side, which are used for installation of instruments such as pressure gauges, thermometers, and differential pressure gauges, and for installation of position control system and air supply piping.
- The tank has ports at the top and bottom for water supply and drainage.



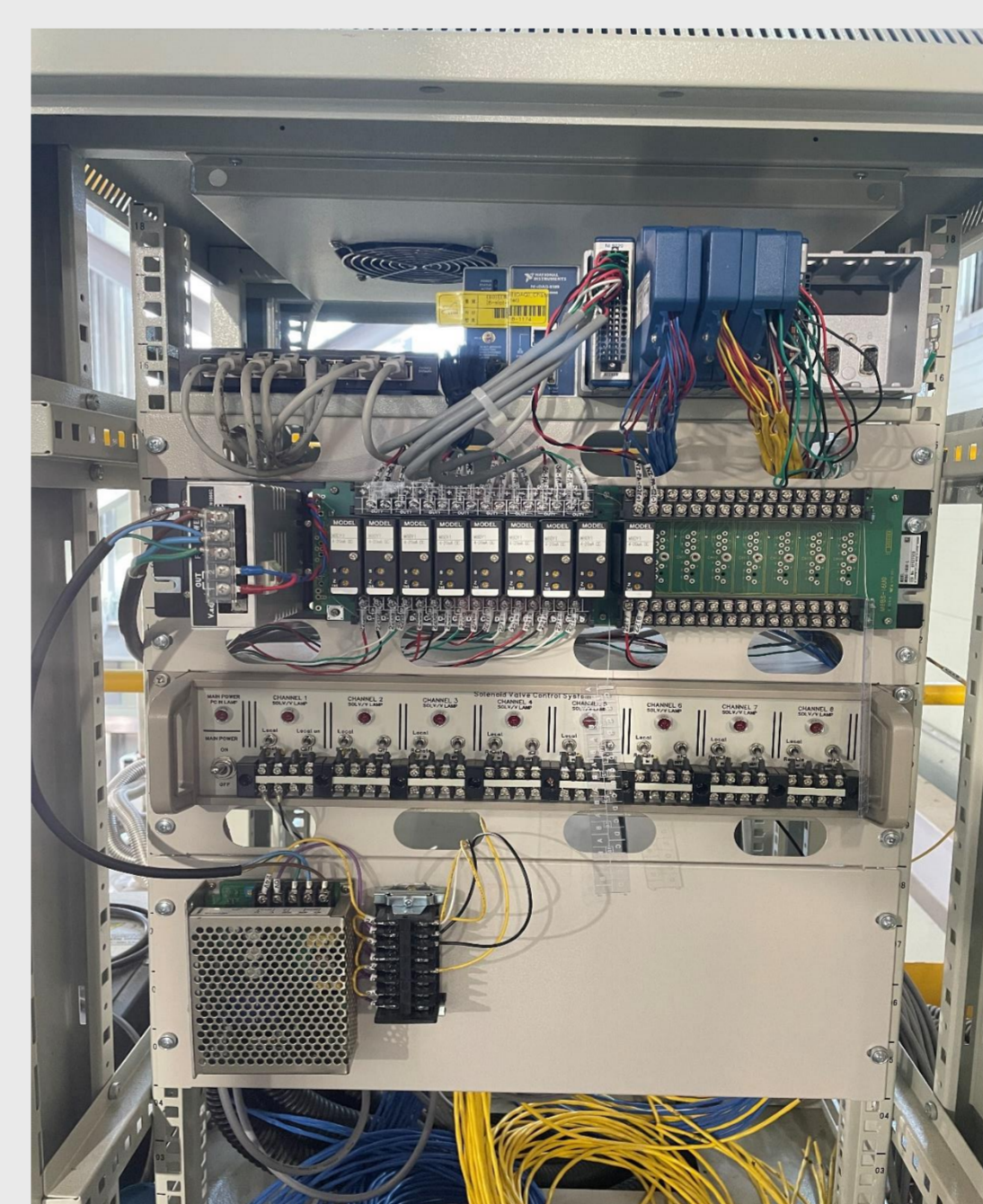
OFP and Pitot Tube

- OFP and pitot tube installed in the position control system.
- The void fraction is measured using OFP. OFP is one of the most common tools for measuring void fraction in gas-liquid two-phase flow condition.
- Jet velocity is measured using pitot tube. The pitot tube was installed at the measurement point and the velocity was calculated by measuring the difference between total pressure and static pressure. In order to obtain the gas density at the measuring point, static pressure and temperature data were used.

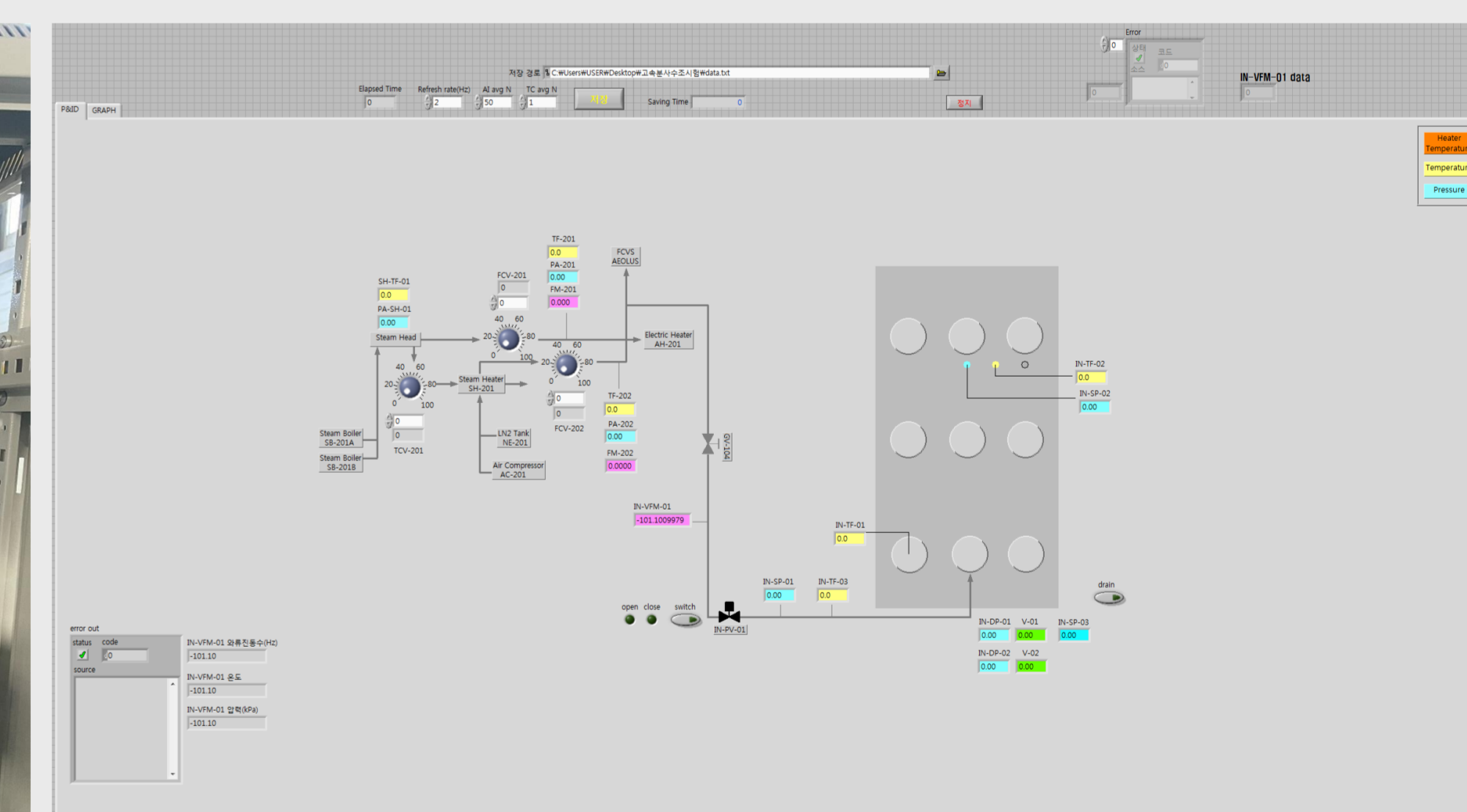


Visualization System

- Visualization system is construct to observe the shape of the jet against velocity.
- The system consists of a high-speed camera, a light, a diffuser, a control laptop, and a transport device.
- The diffuser used polycarbonate material to create uniform lighting conditions.

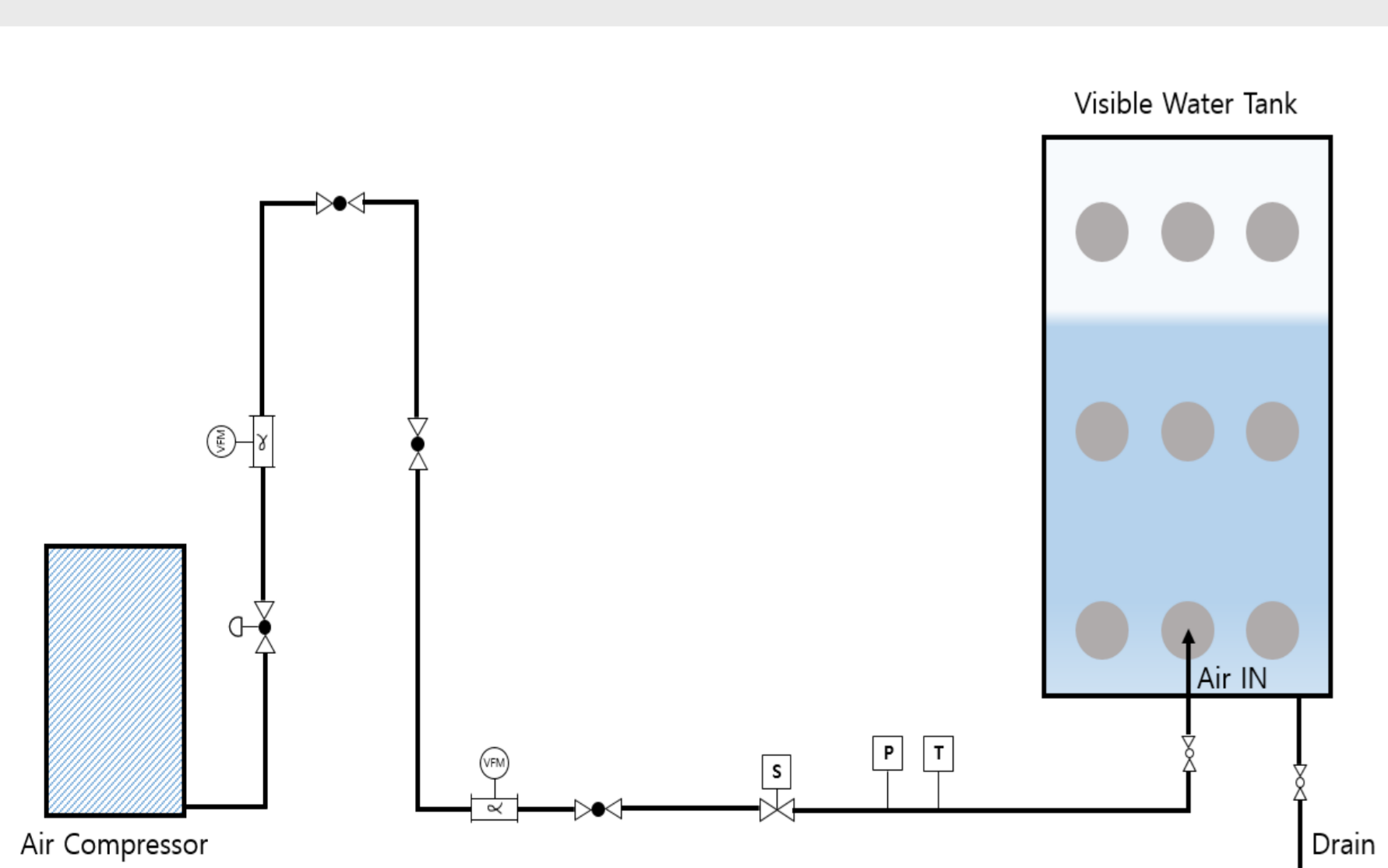


DAS



LabVIEW Front Panel

- The module receive output signals from instruments and transmit the electric signal to pc by Ethernet.
- The data was indicated using LabVIEW program.



Schematic Diagram Air Injection System

- Air is injected through submerged horizontal nozzle, which has outer diameter of $\frac{1}{2}$ inch.
- By using a vortex flow meter and a control valve, it is possible to control the flow rate of air.
- Instruments are installed to measure air pressure and temperature in the pipes.

Conclusion

- The decontamination model of aerosols released at high speeds in the steam generator in the event of an SGTR accident is essential for accident risk assessment.
- It is expected that the built experimental facility will be utilized to measure the hydrothermal properties of high-speed jet pool scrubbing and present an aerosol decontamination model through future aerosol experiments in the future.

Reference

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- K. Park, S. Kim, C. Kang, "Measurement of Void Fraction in the Horizontal Jet Pool Scrubbing Regime by Using Optical Fiber Probe", Transactions of the Korean Nuclear Society Virtual Autumn Meeting, December 17-18, 2020.

Acknowledgement

This work was supported by the National Research Foundation of Korea (NRF) grant funded by the Korea government (Ministry of Science, ICT, and Future Planning) (No. NRF-2017M2A8A4015280)