Design Study of PRIDE Facility

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I. Introduction

The PRIDE (PyRoprocess Integrated inactive DEmonstration) facility is essential to implement the pyroprocess which would be a promise option for the advanced nuclear fuel cycle. This facility is intended to demonstrate the engineering scale high-temperature molten salts system, interface technology between unit process, and advanced safeguards technology with fully remote operation concepts. It will also support the near-term mission to evaluate the integrated pyroprocess concepts and produce the reliable data for scale-up issues.

To achieve this mission, we are studying for the design technology of demonstration facility for advanced nuclear fuel cycle and the detail design works for PRIDE facility has been nearly completed.

II. PRIDE Facility Description

The PRIDE facility is a three story building and the PRIDE will be arranged as shown in Fig. 1, the second floor plan of the building. The facility has an argon gas atmosphere (argon cell) that have carbon steel frame with stainless lining plates and are surrounded by operating area. Fig. 1 is 2nd floor plan and a sectional elevation view of the PRIDE facility.

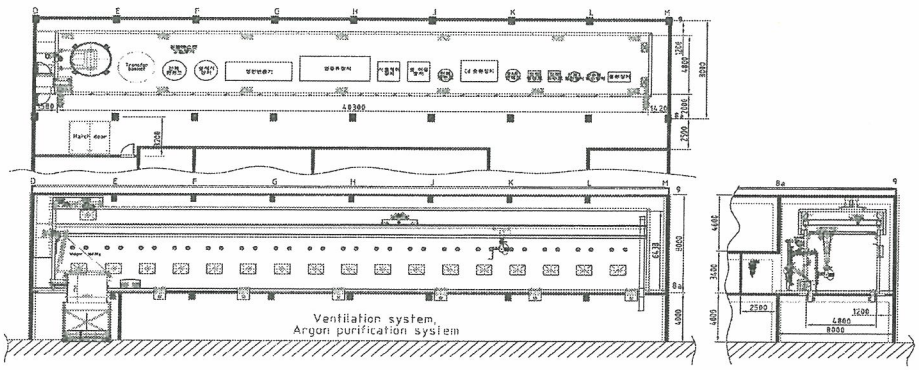

Fig. 1. PRIDE Operating Floor Plan and Sectional elevation View

PRIDE Facility Main Features

Fig. 2 shows the argon cell on the second floor and auxiliary equipments to operate the PRIDE facility on the first floor. The inner dimension of the argon cell is 40m × 4.8m × 6.4m. The main purpose of the argon cell is to provide inert-atmosphere area during pyroprocessing operations. In the argon cell, electrolytic reduction system, refiner system, salt distiller, drawdown vessel, winner, Cd distiller, and waste salt treatment equipment could be tested.

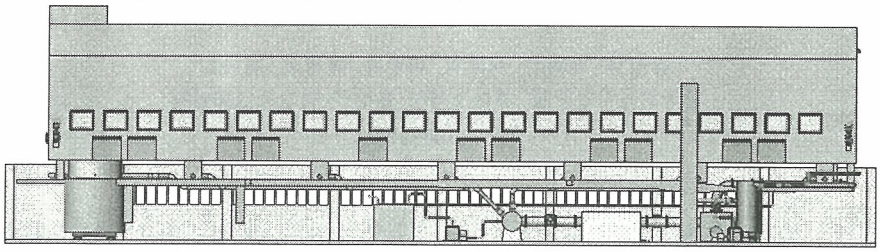

Fig. 2. PRIDE argon cell and argon system with operational equipments

Argon System Design

For argon environmental control of the PRIDE facility, the Ar system is provided with an argon supply, purification, exhaust, and cooling systems. To minimize the discharge of radioactivity, the pressure controls are designed to maintain a pressure from 10 to 200 below atmospheric pressure. At pressure above about -10mm of water, the emergency relief system will vent through the filters and ventilation system to the vent stack. At pressure above about +75mm of water, the emergency relief system will vent directly to the atmosphere. The cell is also provided with an emergency argon supply system to maintain the cell pressure in the event that normal additions of argon are insufficient to maintain the pressure. The reactive impurities in the argon atmosphere must be kept low and cooling of the cell atmosphere is necessary to remove the heat produced by the electric lights, furnace, motors, and etc. The design values of impurity level are 15 ppm water vapor and 40 ppm oxygen in the cell atmosphere. To minimize the air leakage through seals at the installed equipments, cell windows, feedthrough, small, large transfer lock, and gravity tube are designed with argon-pressurized double seals.

III. Conclusion

So far, the design technology on large scale inert atmosphere cell is not yet a mature technology in Korea for handling the high-temperature molten salts, but by our efforts is it possible to design essential equipments for large scale inert cell and the control system to maintain the inert atmosphere. Especially, the large transfer system for transporting the large equipments, small transfer lock system and crane system is newly designed to minimize leak rates of inert atmosphere and to repair by fully remote operation. These would be potential technology developments applicable for nuclear fuel cycle facility in near future. The innovative feed through, windows, and other devices are also designed to maintain the inert atmosphere and to satisfy the leak rate requirements of large scale inert cell. And safety evaluation is also performed to ensure the safety issues.

Acknowledgments

This work was supported by Nuclear Research & Development Program of the Korea Science and Engineering Foundation (KOSEF) grant funded by the Korean government (MEST).