PRE-OPERATION TESTS OF A PYROPROCESS INTEGRATED INACTIVE DEMONSTRATION FACILITY

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PRIDE (PyRoprocess Integrated inactive Demonstration facility)

Pyroprocessing Handling active metal and deliquescence molten salts materials

An inert atmosphere environment is required

- ❑ Leak tightness to minimize air ingress into the argon cell / Prevent air ingress when transfer material into the cell
- ❑ Negative pressure control for a safety reason
- ❑ Closed argon re-circulation system
- ❑ Remote operation and maintenance

- ◆ The PRIDE has been developed to fulfill these requirements
- ◆ The impurity (oxygen and moisture) level of the inert cell is controlled below 50ppm

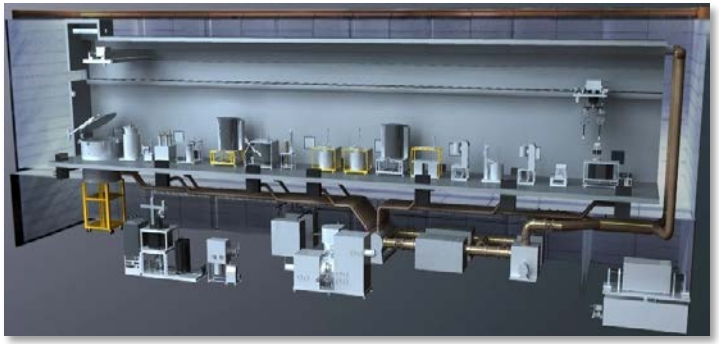
Performance evaluation is in progress.

OVERVIEW OF PRIDE

Overview of PRIDE

- Purpose
  - To evaluate performance (cold-run) and scale-up issues of full-spectrum pyroprocessing technology
- Construction and Operation Plans
  - Design : 2007 ~ 2008 (2 years), Construction : 2009 ~ 2011 (3 years)
  - Operations : 2012 ~
- Main Features
  - Pyroprocess test & demonstration with depleted uranium or surrogate up to engineering scale
  - Argon gas-filled cell for pyroprocessing work (impurity level below 50ppm)
  - full remote operation and maintenance concepts
  - Argon cell size: 40m(L) × 4.8m(W) × 6.4m(H), about 1200 m^3

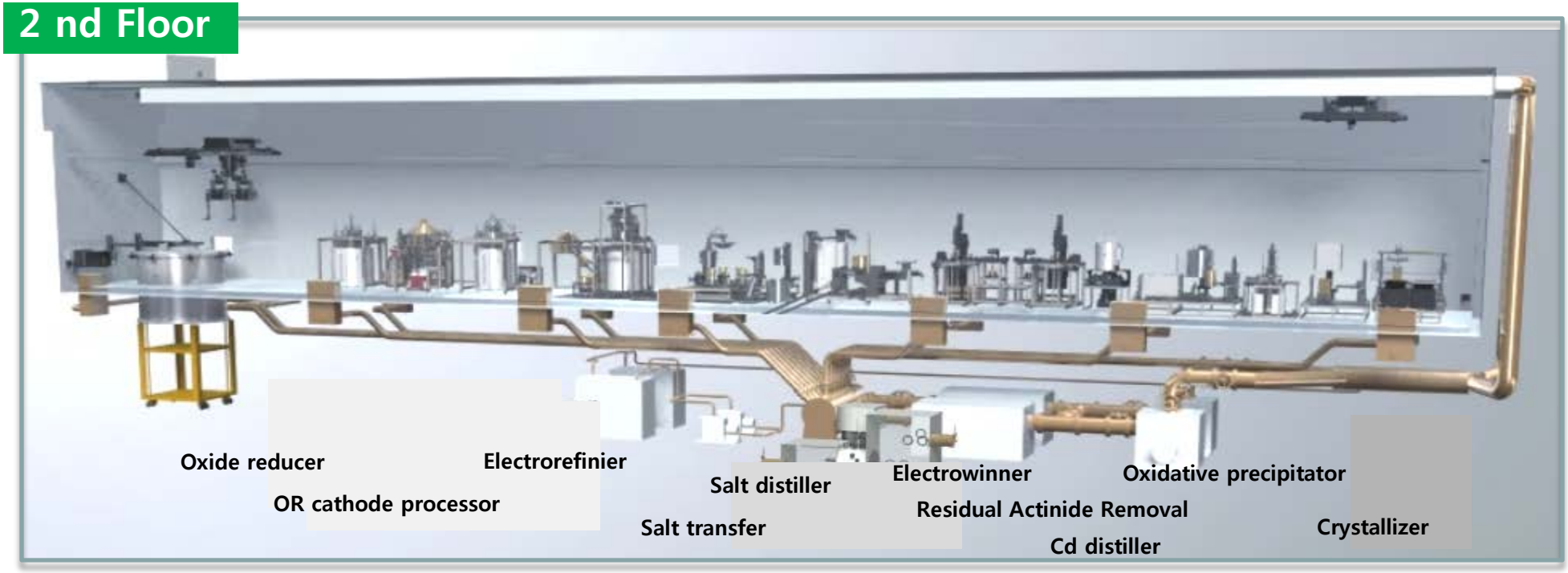
PRIDE



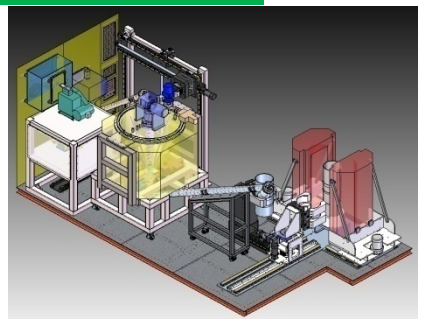
Bird's-eye view

Overall Layout of PRIDE

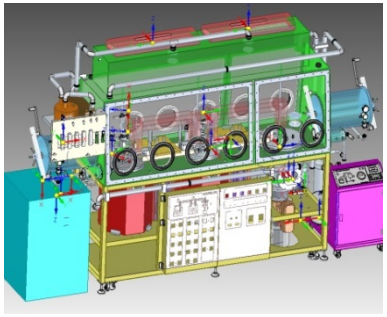
2 nd Floor



1 st Floor



Solidification equip.



U-chlorinator

U ingot casting furnace

Kiln-type voloxidizer

PRIDE Layout – 2nd Floor

- 10 main equipment for 4 pyroprocesses
  - Installation of 14 process equipment has been completed in the Ar cell.

Reduction Process

1. Electrolytic reduction equipment
2. Electrolytic reduction cathode processor

Refining Process

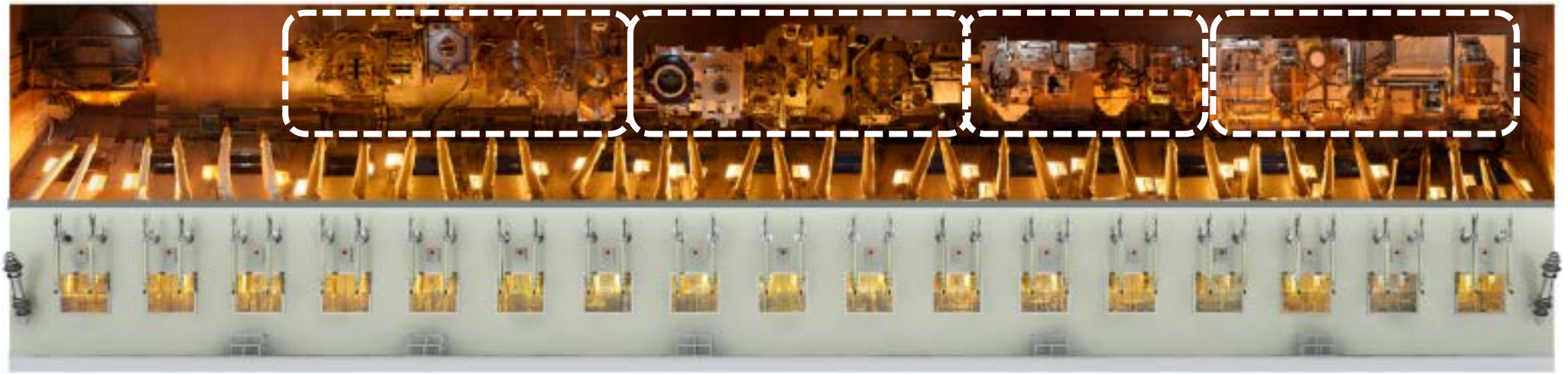
3. Electrolytic refiner
4. Molten salt transfer system
5. ER salt distiller (Cathode processor)

Winning Process

6. LCC Electrowinner
7. RAR process equipment
8. Cadimium distillation equipment

Salt Treatment

9. Oxidative precipitator
10. Melt crystallizer

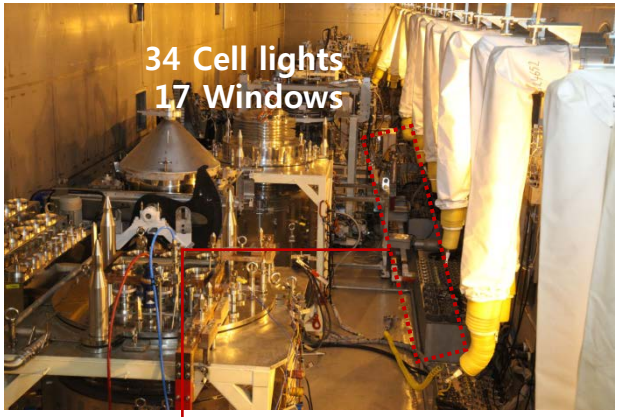


Top view of the inside of Ar cell (40.3 m length)

Cell Equipment of PRIDE Ar Cell

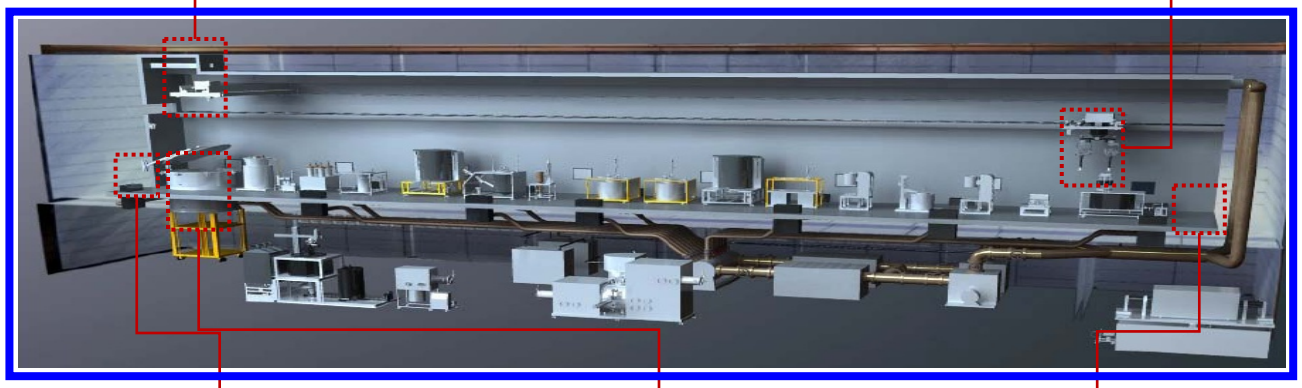
Crane handling hoist

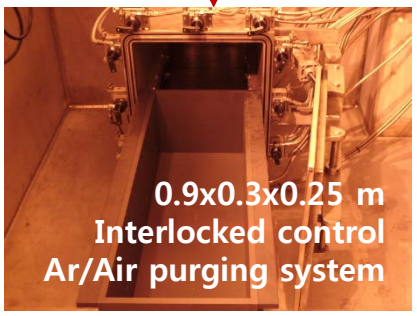
In-cell Crane



Inside of the PRIDE Ar Cell

Feed-throughs



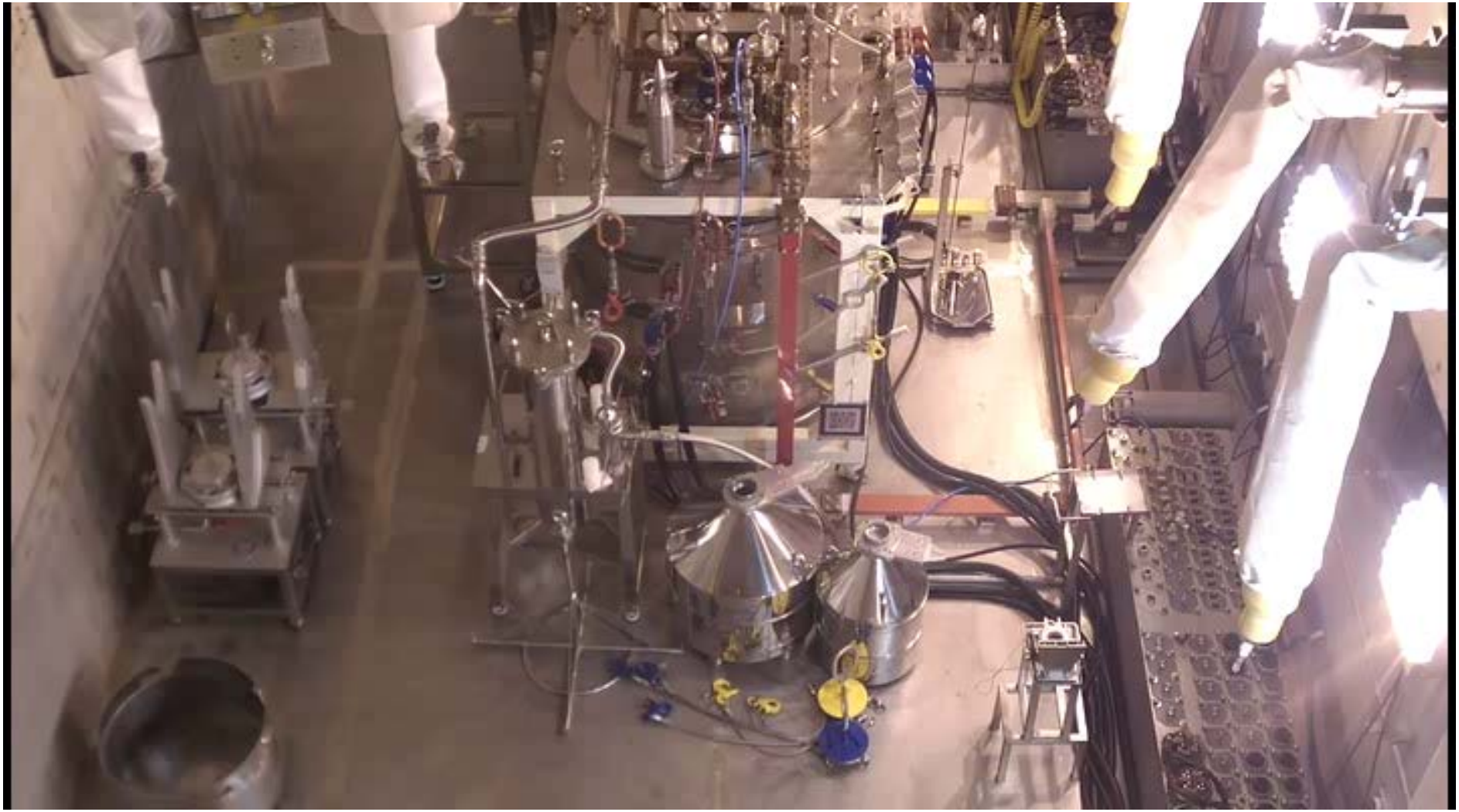


Small & Large equipment Transfer Lock System

2 Gravity Tubes

Operation area

PRIDE Ar Cell

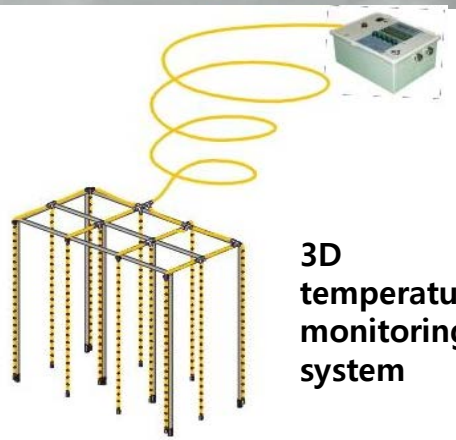


All equipments have been designed to be remotely operable and maintainable.

Utility systems of PRIDE Facility

- PRIDE Utility system for control of cell operation conditions
  - Argon supply system, cooling system, purification system, relief system
  - Concentration of impurity: oxygen < 50 ppm, moisture < 50 ppm
  - Cell temperature: 25~40 ℃
  - Cell pressure: -50 ~ -30 mmAq

- Sensor system for monitoring the cell states
  - Concentration of oxygen and moisture, off-gas (chlorine)
  - Pressure in the cell
  - Cell temperature: 153 points in the cell



3D temperature monitoring system

Leak test

Ar charging

Investigation of effects of LTL

PRE-OPERATION TESTS OF PRIDE

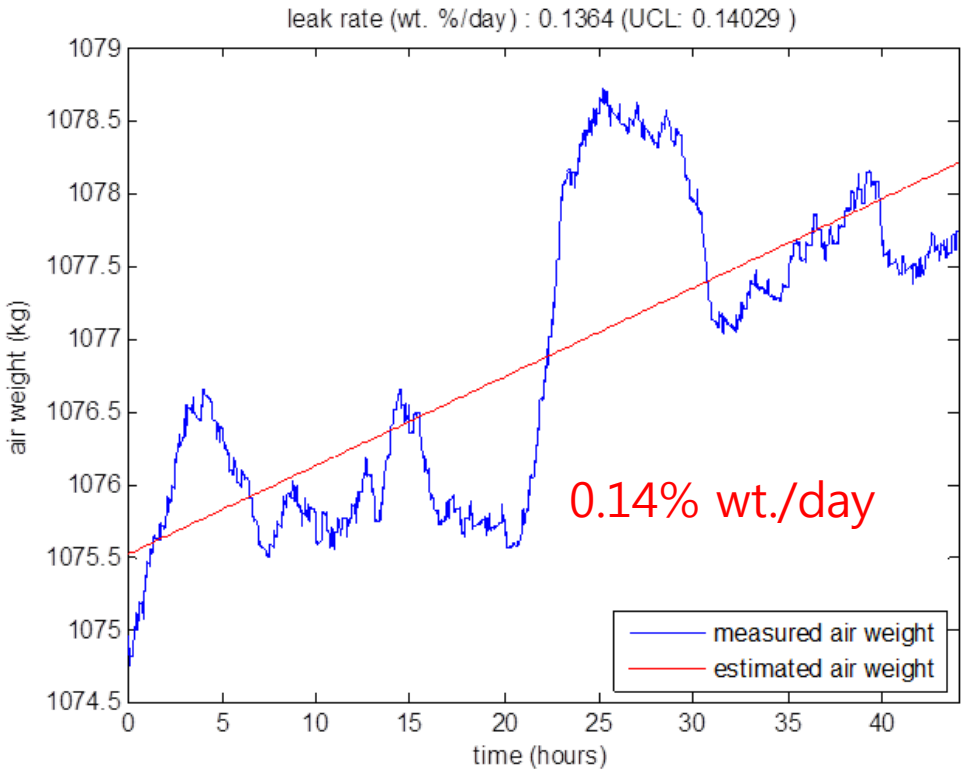
Pre-operation Test: Leak Test

- Measurement of leakage rate (ingress rate)
  - Pressure decay method
  - According to ANSI/ANS 56.8

  - Computation of ingress rate of the air weight
    - -125 mmAq initially
    - 4 hours for stabilization

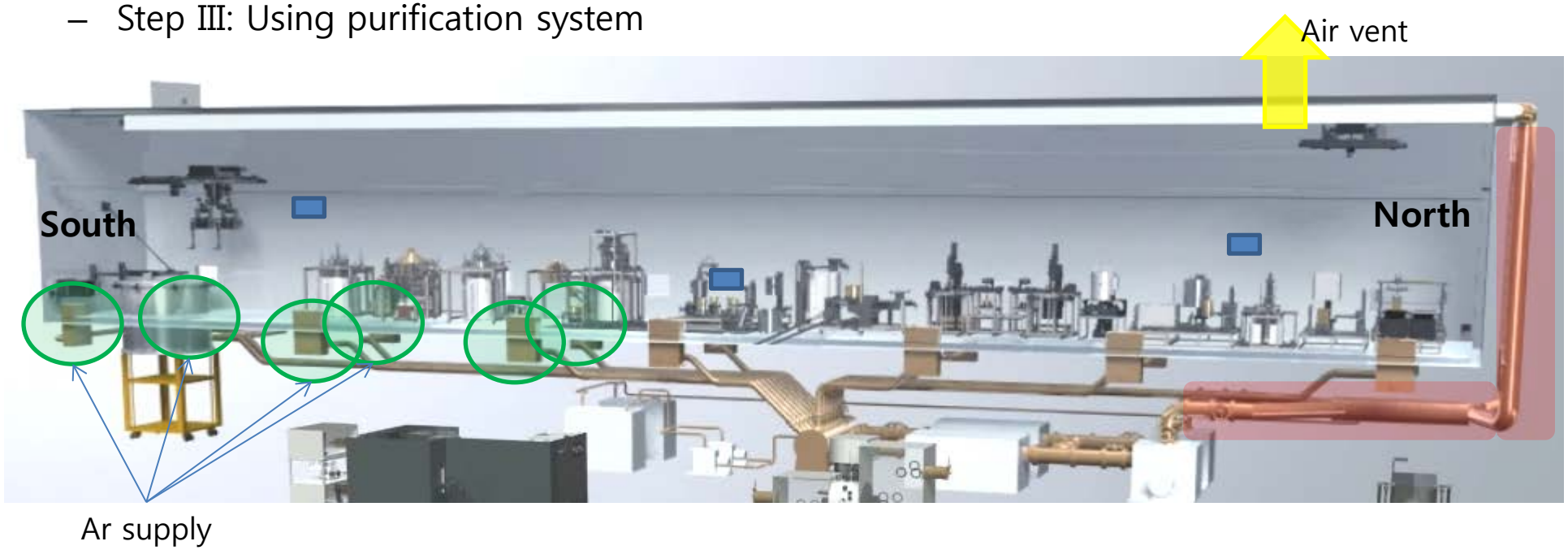
    - Measurement for 2 days
      - Cell pressure
      - 154 temperature line sensors

    - Estimation by the least squares
    - 95% upper confidence level

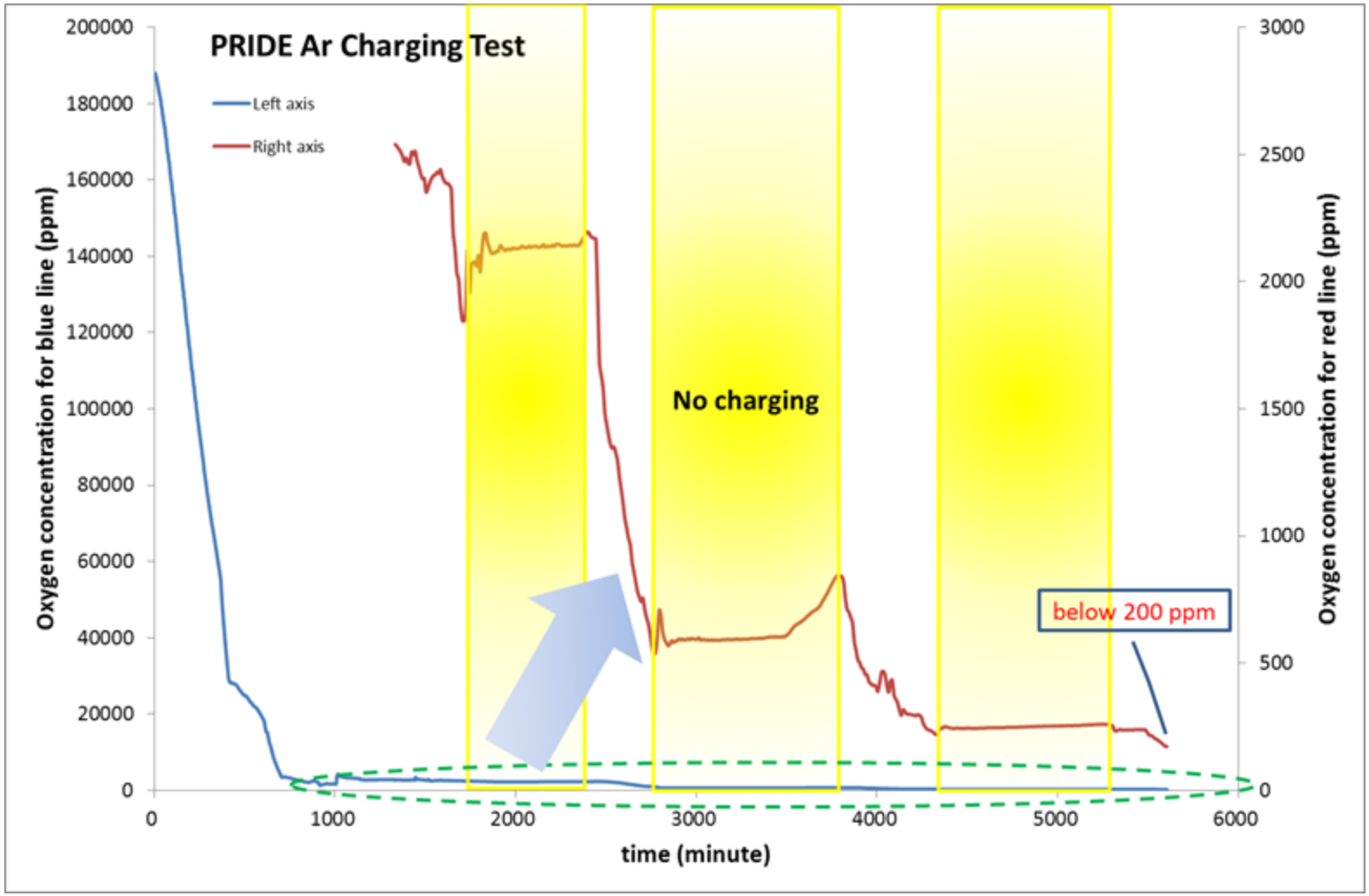


Pre-operation Test: Ar Charging

- Sweep-through purge
  - Oxygen & moisture concentration are monitored at 9 points
- Three steps for gas exchange
  - Step I: Ar charging into circulation pipes (red box)
  - Step II: Ar charging into the cell up to 200 ppm
    - Slightly positive pressure
    - From filter boxes on the floor of the cell
    - About 0.1 kgf/cm^2
  - Step III: Using purification system



Pre-operation Test: Ar Charging



Result of Step I and II (The step III result is not shown here)

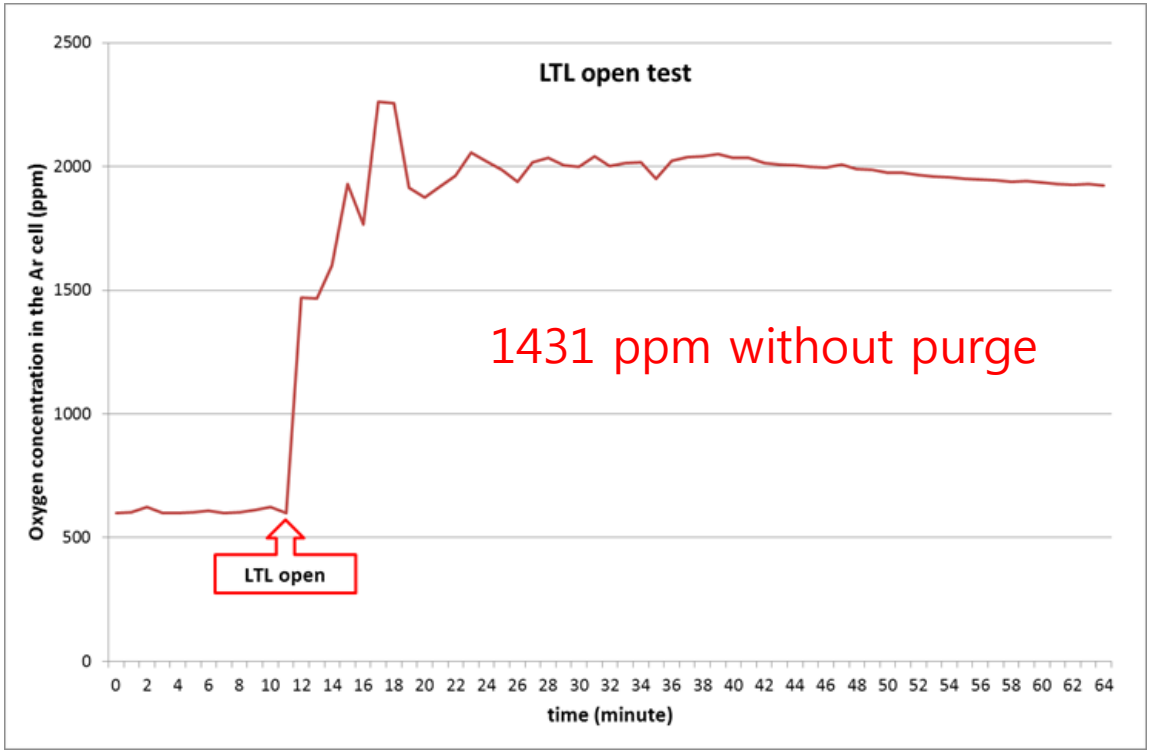
Pre-operation Test: Effects of LTL

Operation of LTL: Transfer of equipment/materials into/out of the cell

Pre-operation Test: Investigation of Effects of LTL

- LTL: Large equipment transfer lock system
  - Volume of LTL chamber: 12.1 m^3
  - Predicted increase of oxygen concentration by LTL open without purge: 2095 ppm
    → Purge of LTL chamber is required
  - Determination of the number of purge
    - Vacuum pump to 200 torr
    - 5 purges are required

$$y_j = y_0 \left(\frac{P_L}{P_H} \right)^j$$



	without purging	after purge
Estimated increased O2 concentration (ppm)	2095	39 (3 purges)
Measured increased O2 concentration (ppm)	1431	5 (5 purges)

Conclusions

- Development of PRIDE facility is completed in 2012
  - Provided with large Ar cell and utilities
  - Provided with 17 windows, each window with 2 MSMs
  - Provided with one large and small transfer lock, two gravity tube, one 3-ton over-head crane, one 1 ton hoist, and one BDSM in cell

- Pre-operational tests are going on to evaluate performances
  - Operational and functional test of operation equipment and utility systems
  - Leakage test of Ar cell and auxiliary systems
  - Ar charging and purification
  - Performances of cooling systems during equipment operation

- PRIDE will be used for testing integrity of unit process, adaptability of remote operation, safegaurdability, etc.
  - Ready for salt test

THANK YOU FOR YOUR ATTENTION