

Tritium Release Reduction based on Release Trend Analysis

JASON SHIN

Korea Hydro & Nuclear Power co.

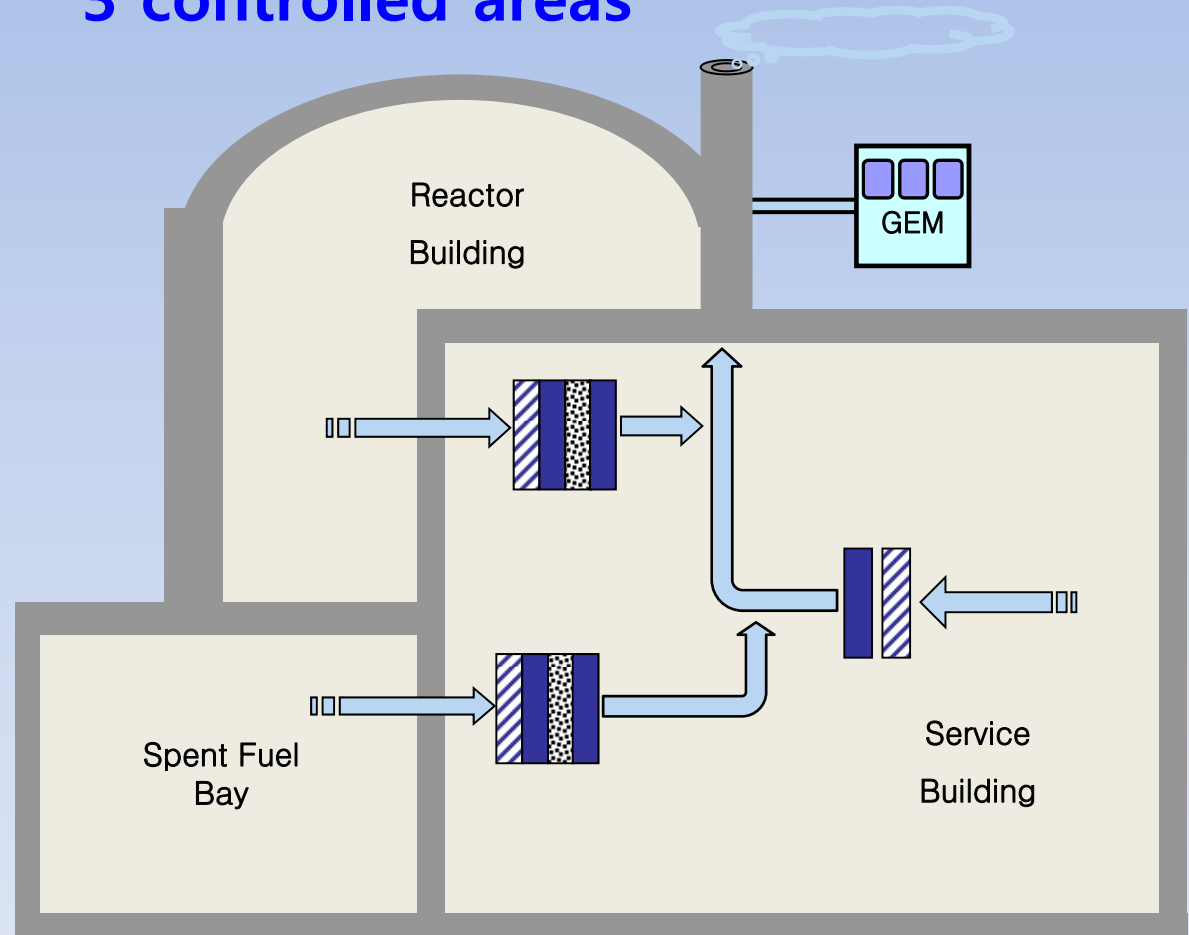
Location of Wolsong NPP II



- Wolsong NPP II has 2 units, Unit 3 & 4.
- They are PHWRs (Pressured Heavy Water Reactors).
- They generate and release tritium.

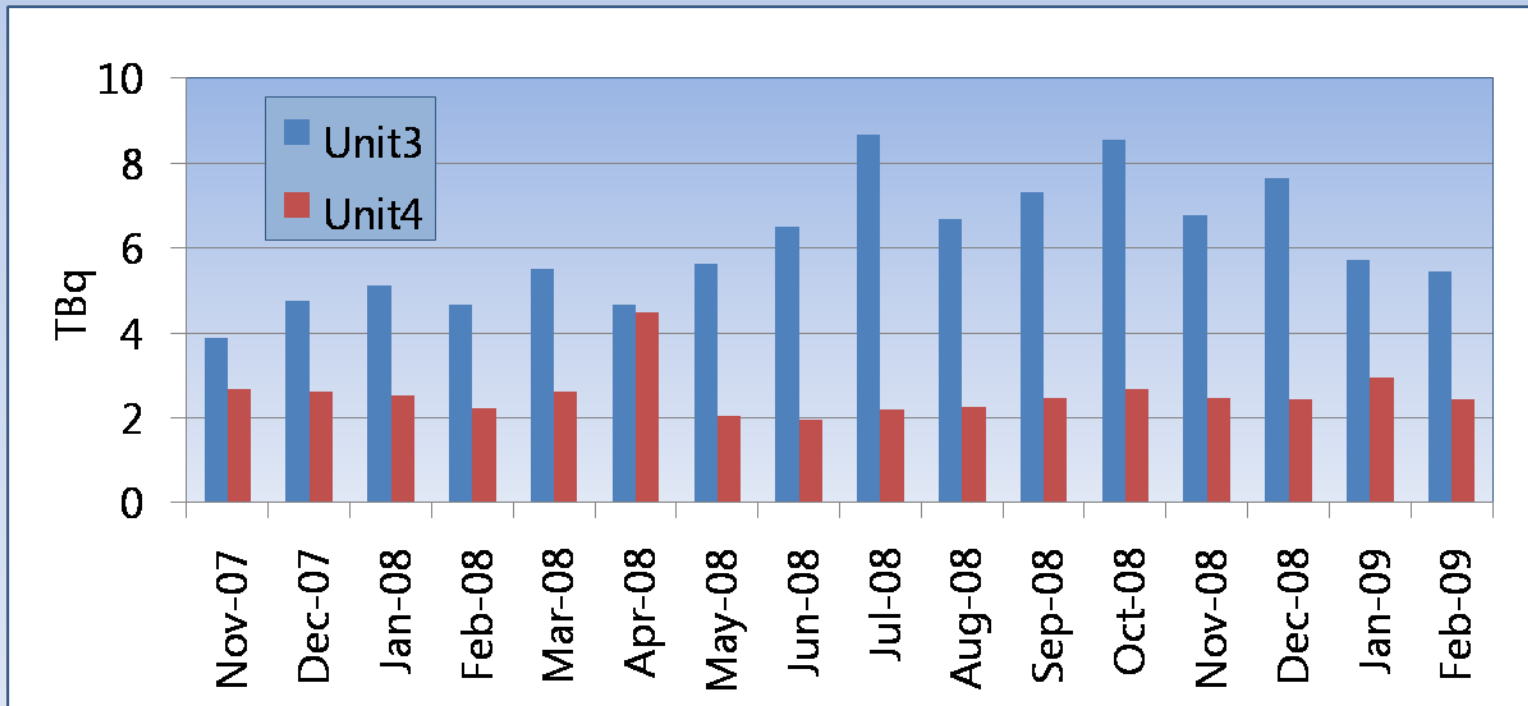
Ventilation System of Wolsong 3 & 4

one common stack for the effluence from
3 controlled areas



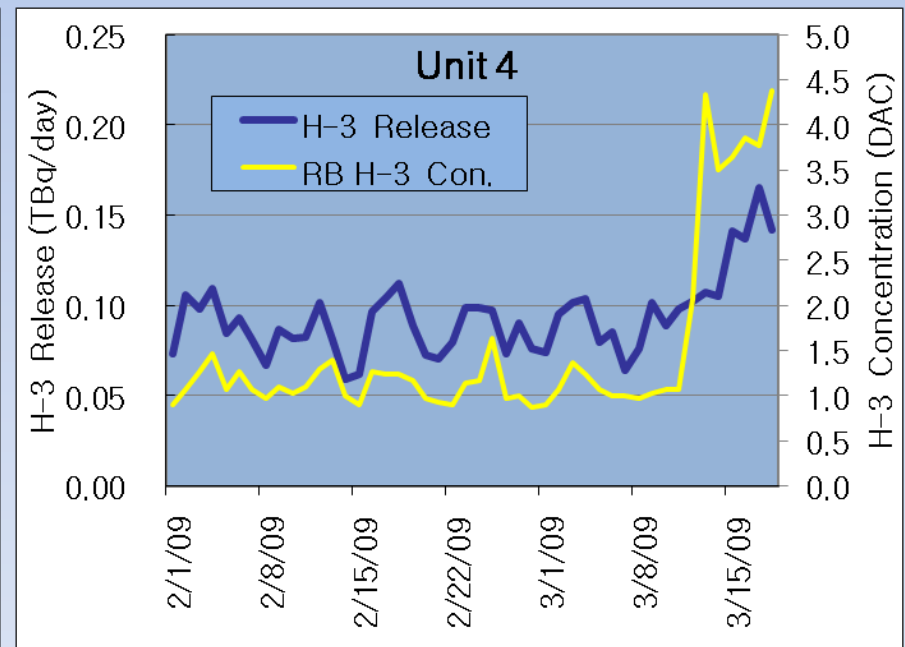
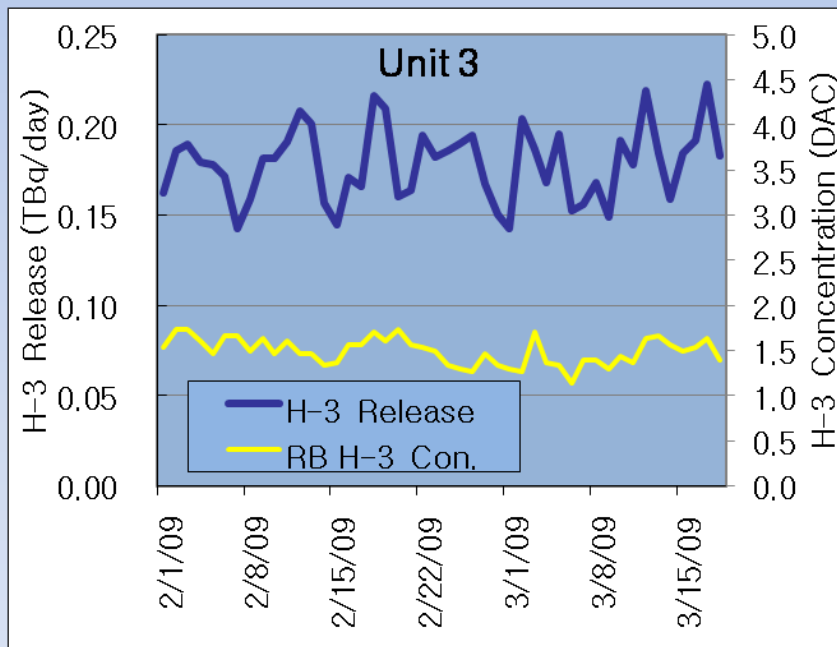
Monthly Release of Airborne Tritium

- Increase amount from Unit 3's release sustained compared to Unit 4's
- What would be the cause?



Ambiguity on Tritium Release of Unit 3 & 4

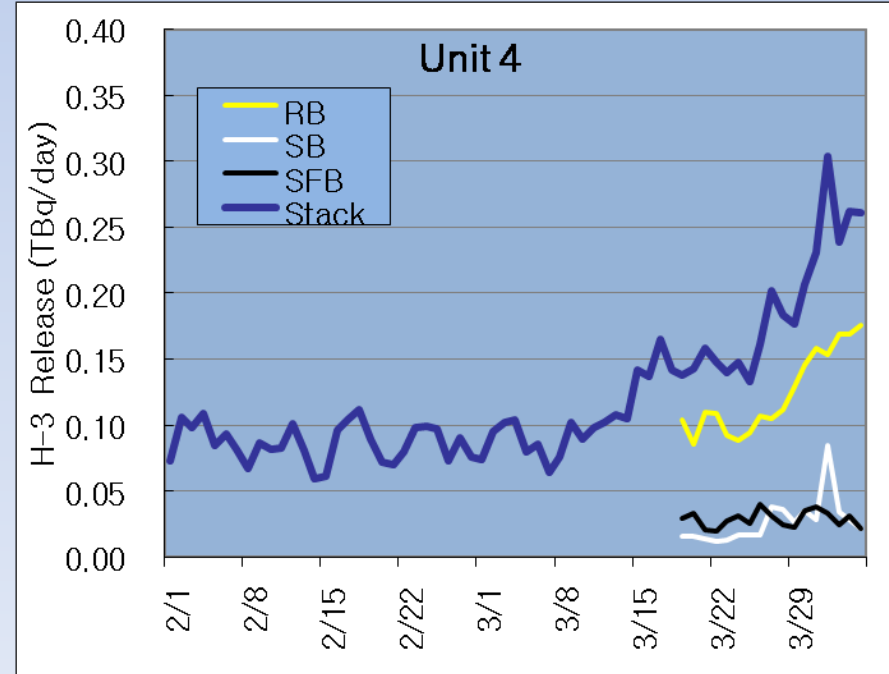
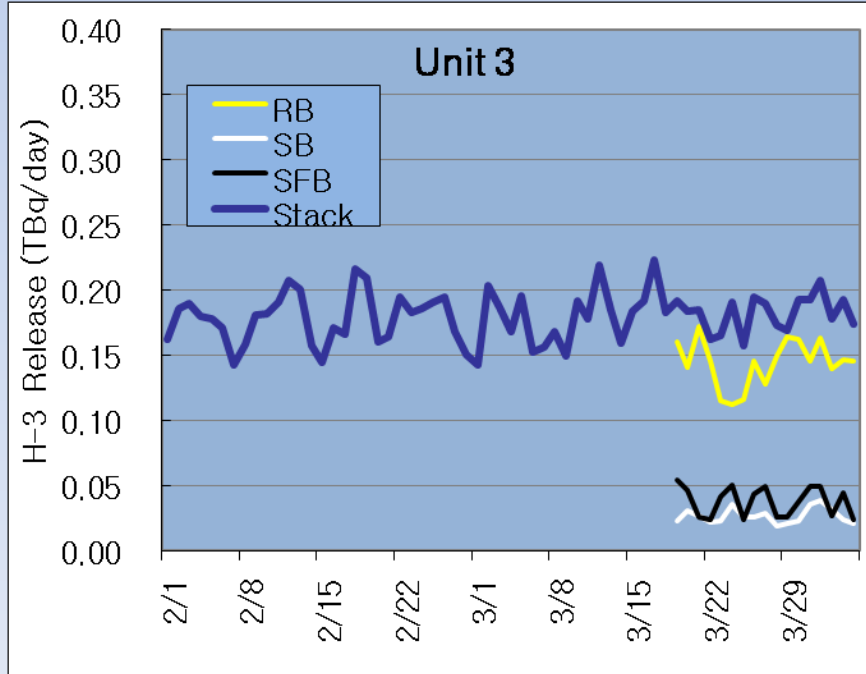
- Unit 3' tritium concentration in air of the reactor building was a little higher than unit 4's. (not more than 1.5 times)
- But Unit 3' tritium release was much higher than unit 4's. (more than 2 times)



✂ There was an event at unit 4 in March-2009, but it has no relation with the theme.

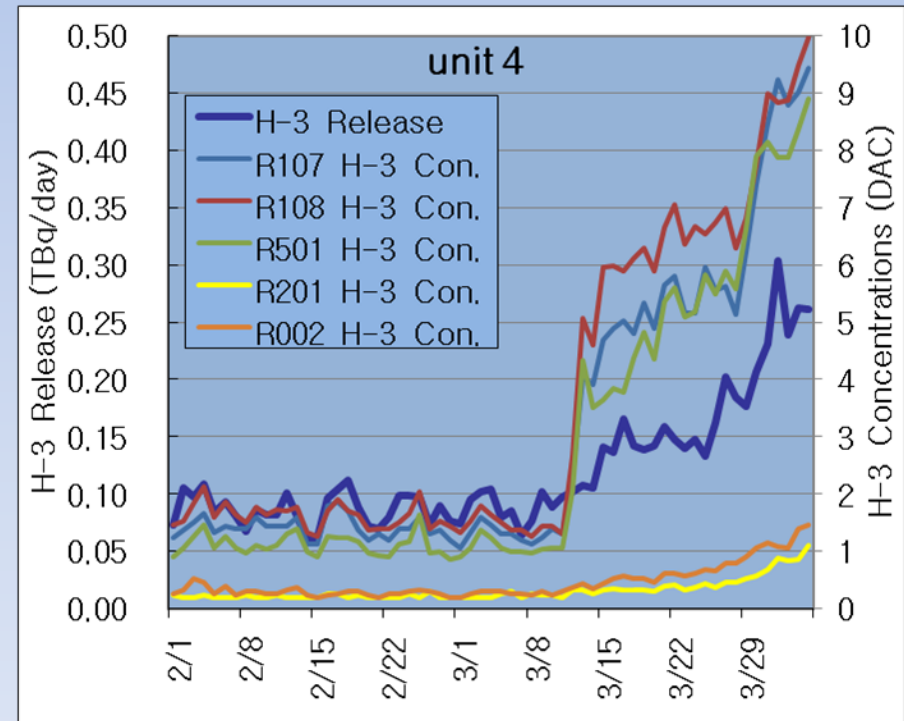
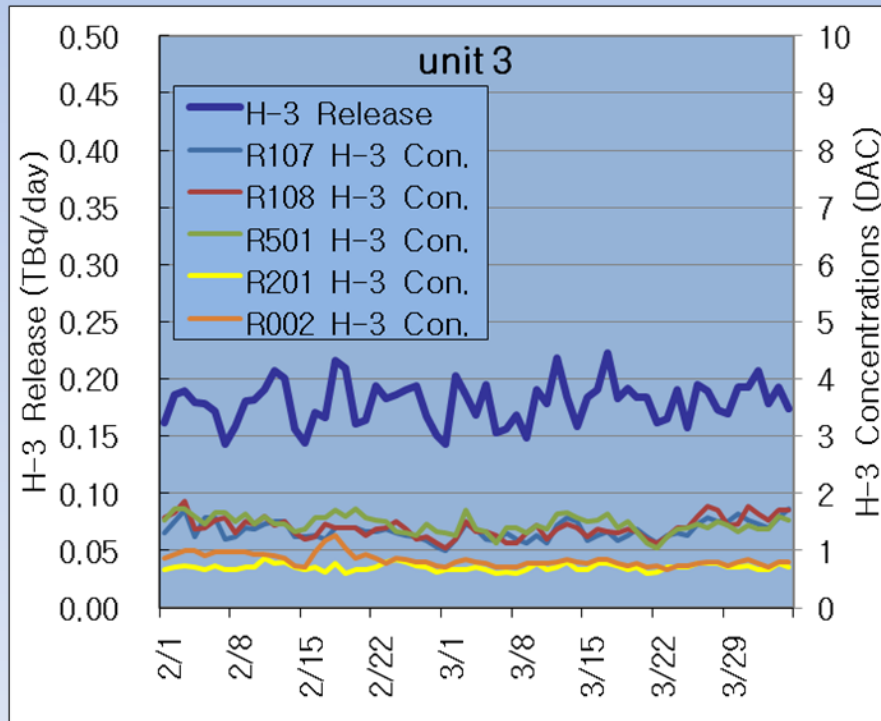
Respective Tritium Release from the 3 Controlled Area

- Investigated tritium release rates respectively from Reactor Building, Service Building and Spent Fuel Bay
- Dominant release was from RB as expected



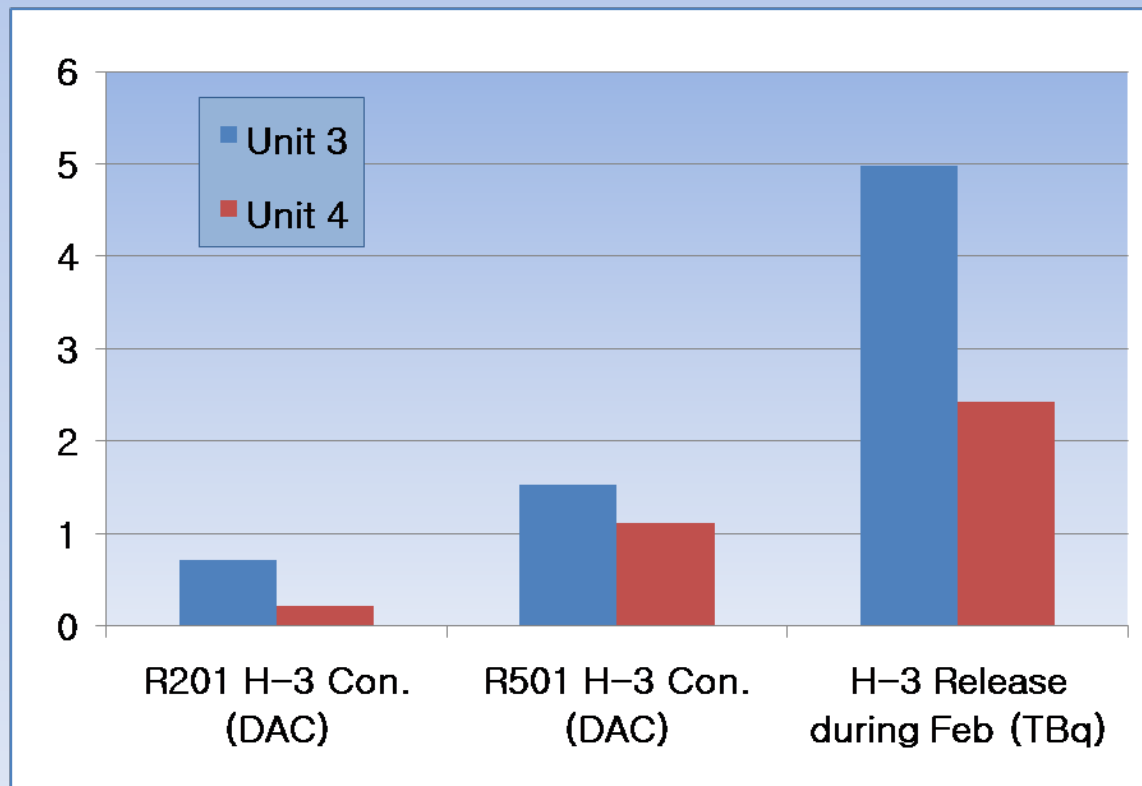
Analysis Release Rate versus Concentration

- In-depth study for relationship between tritium release rate versus airborne concentrations in RB



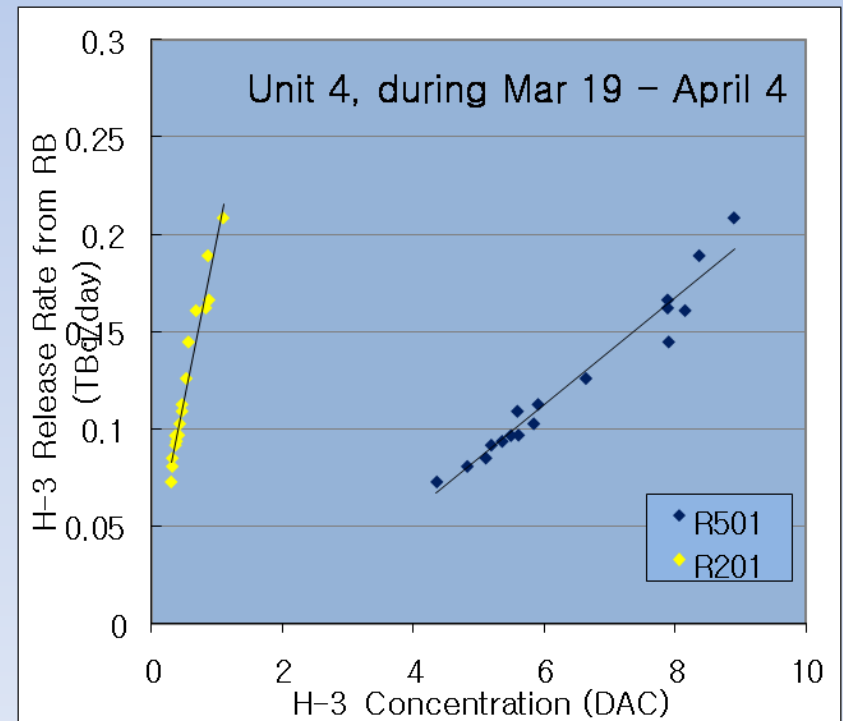
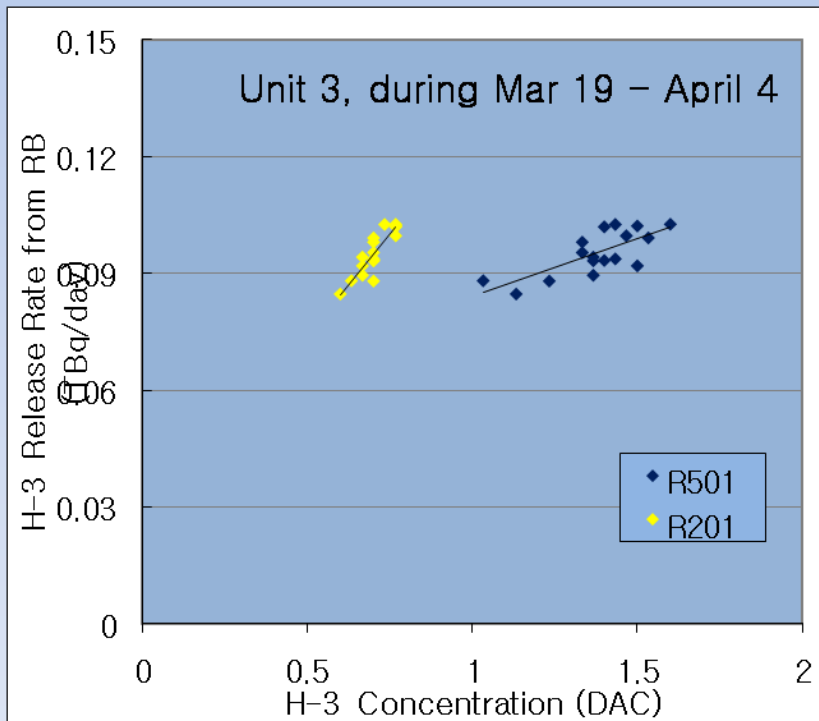
R201 and R002 vs Other Areas

- Unit 3' concentrations in R201 and R002 were lower but much higher than unit 4's.

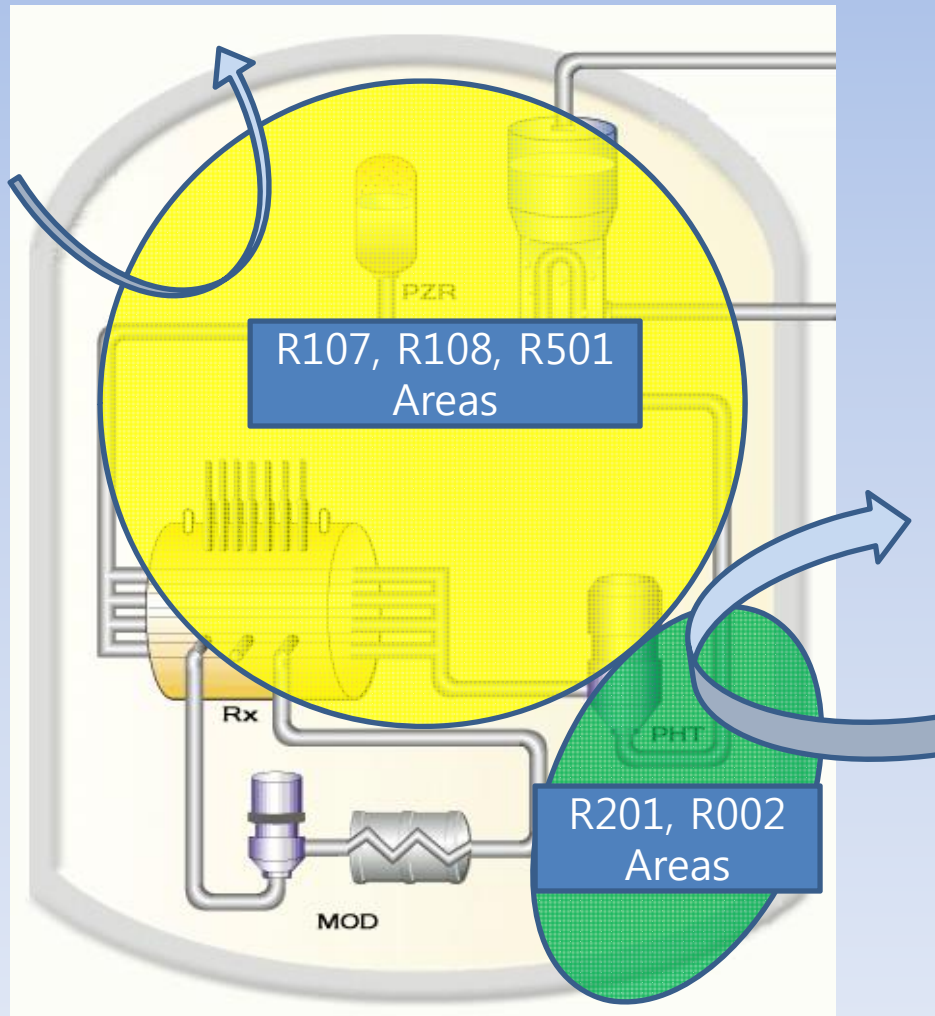


R201 and R002 vs Other Areas

- Proportionality of the release rate was sensitive with the concentrations in R201 and R002 compare to the other areas.



The Reason Why R201

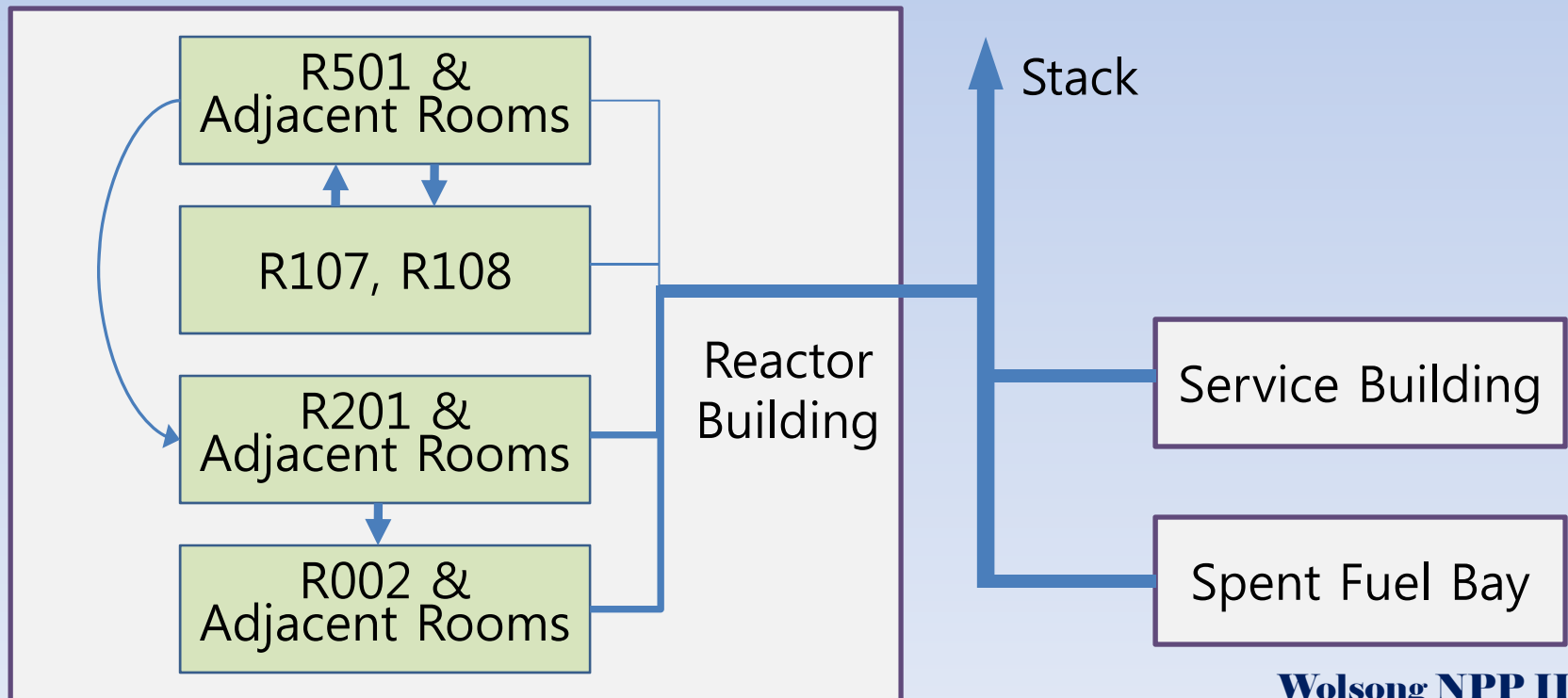


- R107, R108, R501 areas have high tritium concentration but low vent flow
- R201, R002 areas have low tritium concentration but high vent flow
- ✂ Air of R002 was flown from R201: both airborne concentrations are similar

Assessment of Tritium Release Rate

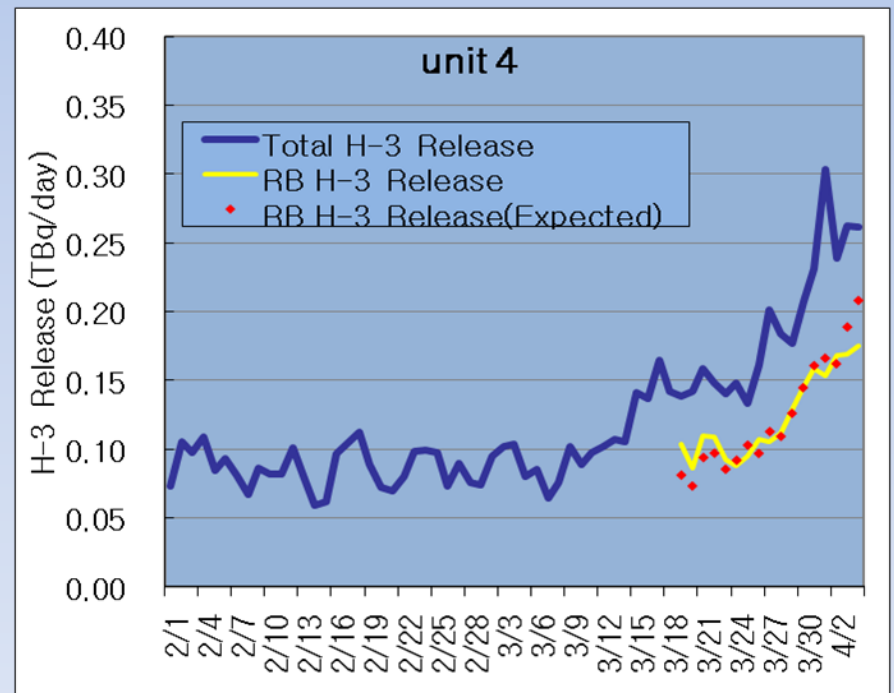
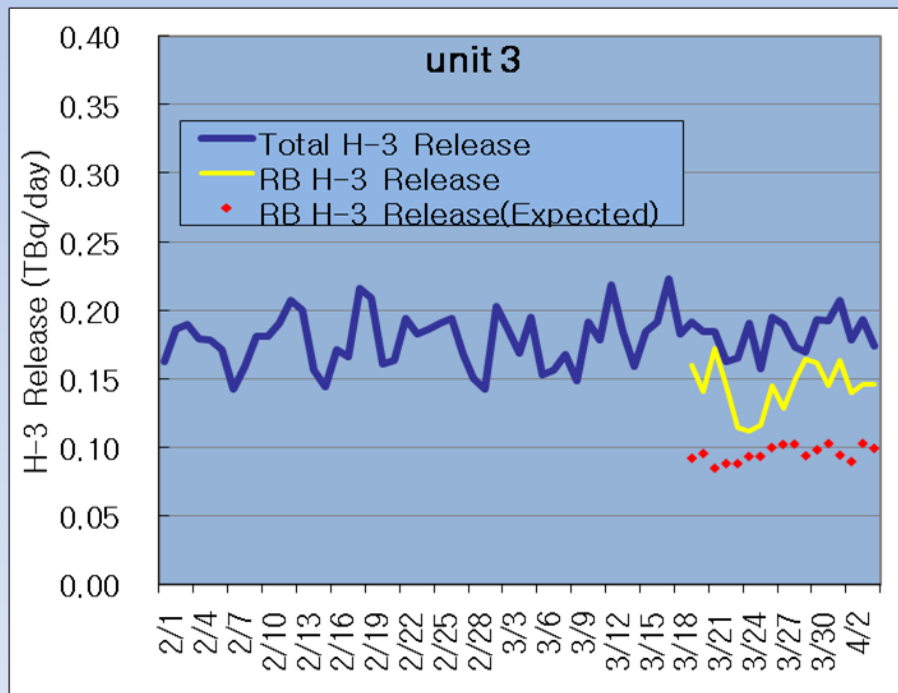
- Analysis of measurement data of tritium concentration and designed flow rates of controlled areas

$$\text{Release Rate} = \Sigma(\text{Local Concentration}_i \times \text{Vent Flow}_i)$$



Tritium Release Measurements vs Estimate

- The measured release roughly agreed with estimated value but there was a little difference at unit 3.

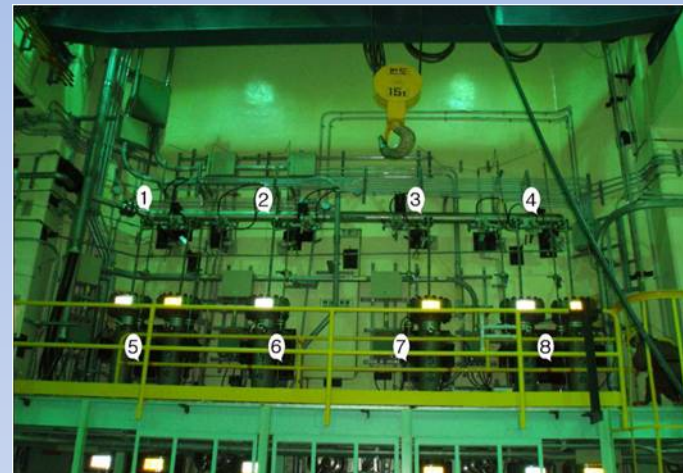


Possible Assumption

- leak of heavy water containing lots amount tritium in R201
 - Some small leak as 0.1L of heavy water could cause dominant portion of daily tritium release, especially with the Moderator.
- The leak should be near ventilations.
 - This could explain the difference between the measurement and the estimate for release rate.

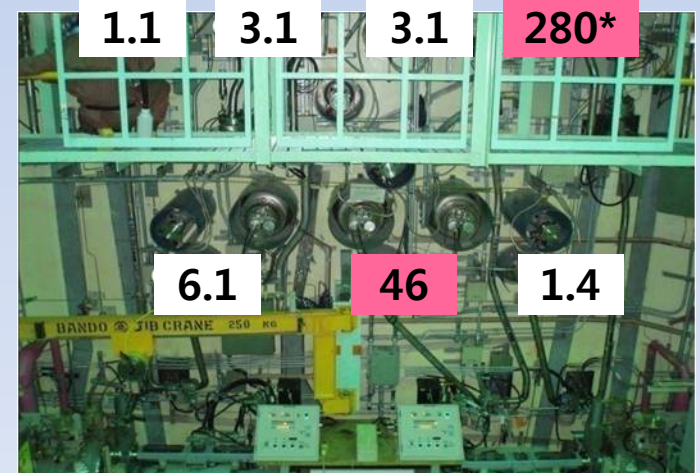
Intensive Survey on R201

- It is difficult to find the leak point because heavy water evaporates easily and spreads out quickly in the wide area of R201
- We divided R201 into many divisions and checked tritium concentration each division.



Leak Points

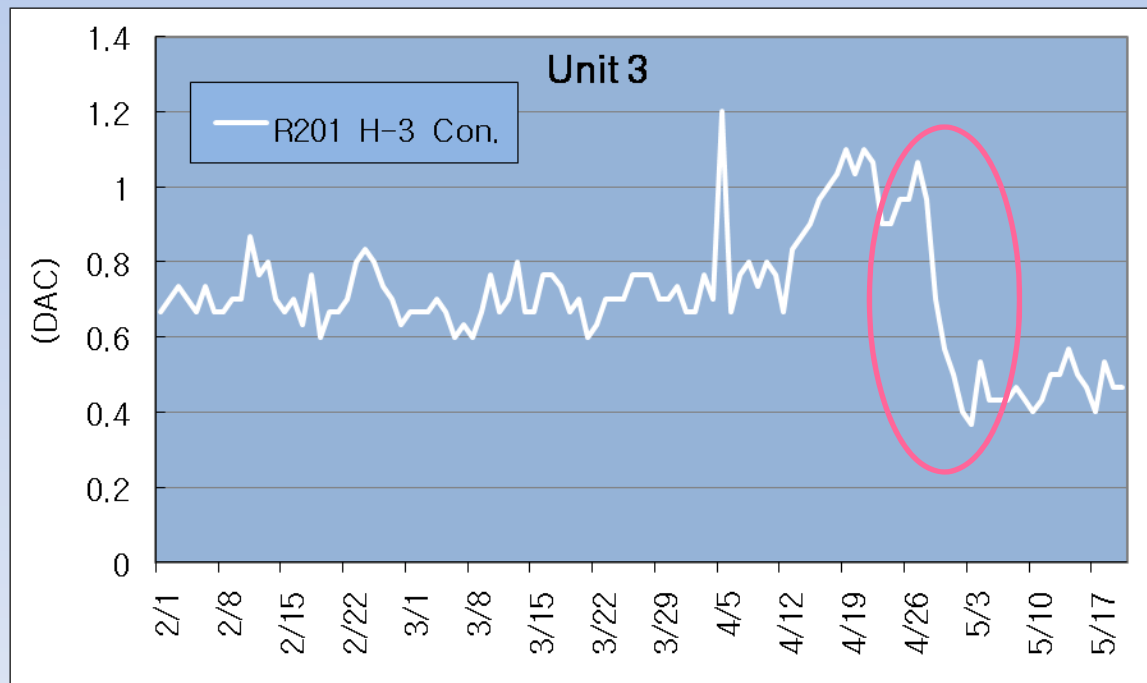
- There were 2 positions which have high tritium concentration.
- Found 2 leak points on Liquid Injection System related to the Moderator System.



* concentration inside an envelope wrapping equipment

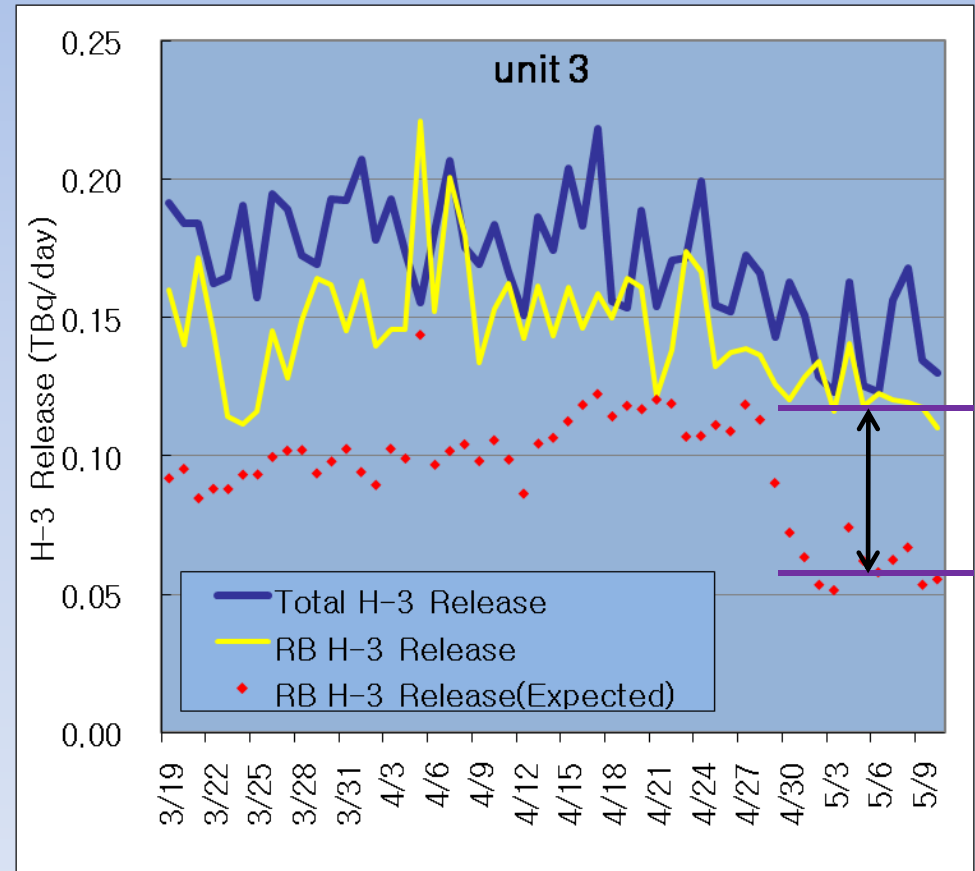
Airborne Tritium Concentration after Repair

- After repair, airborne tritium concentration in R201 went down.



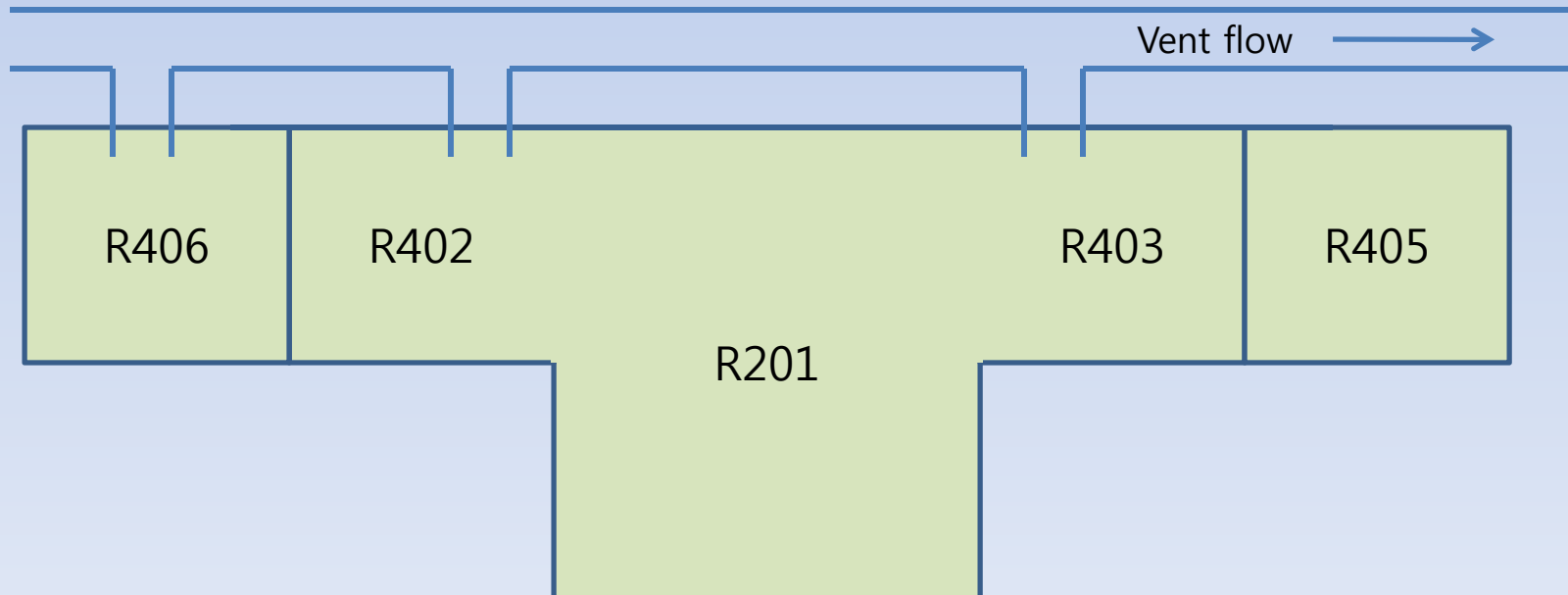
Tritium Release Rate after the Repair

- The tritium release rate decreased some
- But it was not enough as expected after repairing.
- Potentially additional leak near vents which has not affected local concentration measurement.



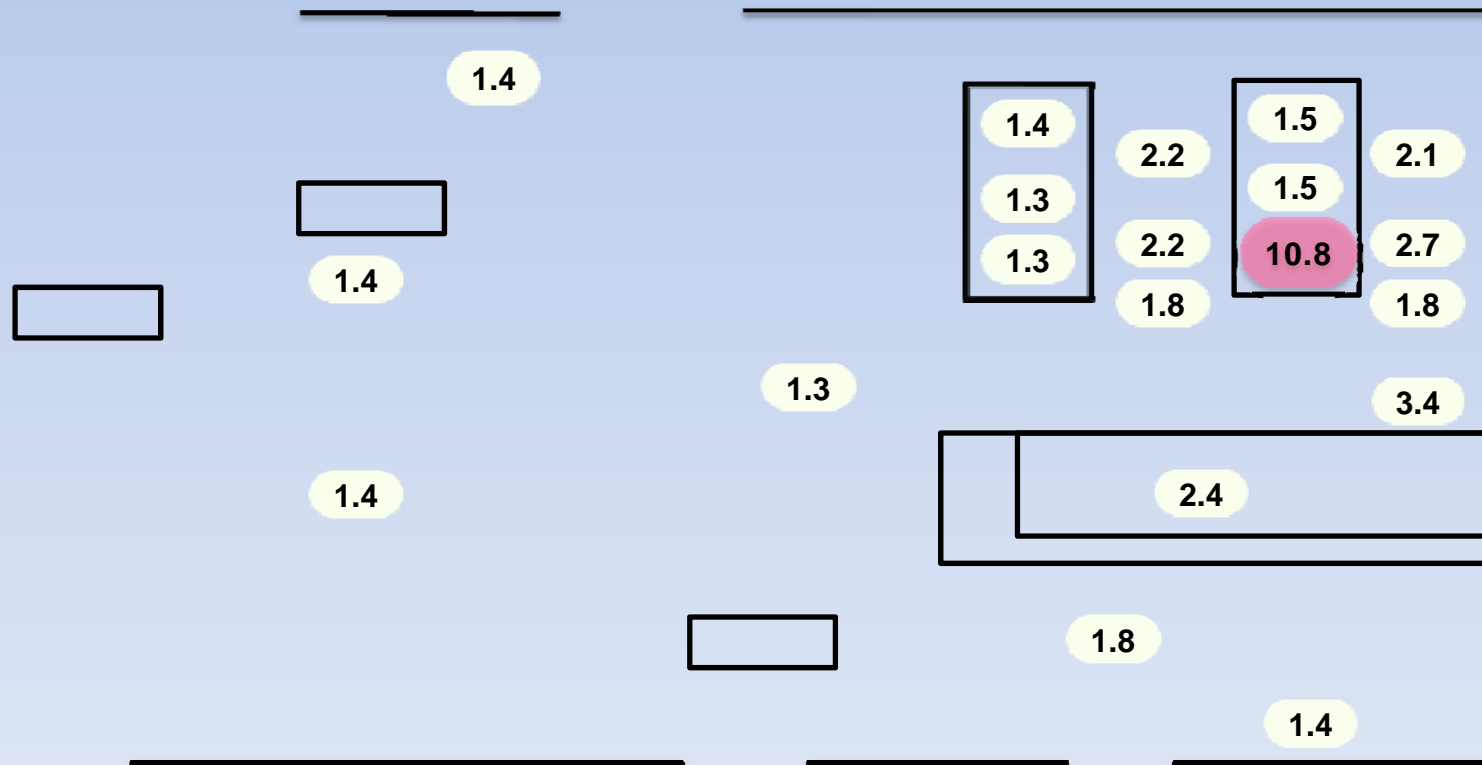
Further Research

- Reviewed further potential leak points near vents.
- Special attention to R402 which has many devices related to Moderator System and vents.
- R402 was located beside R201 and there was no wall between R402 and R201.



Intensive Survey on R402

- We collected samples and measured the tritium concentrations at every spot in R402



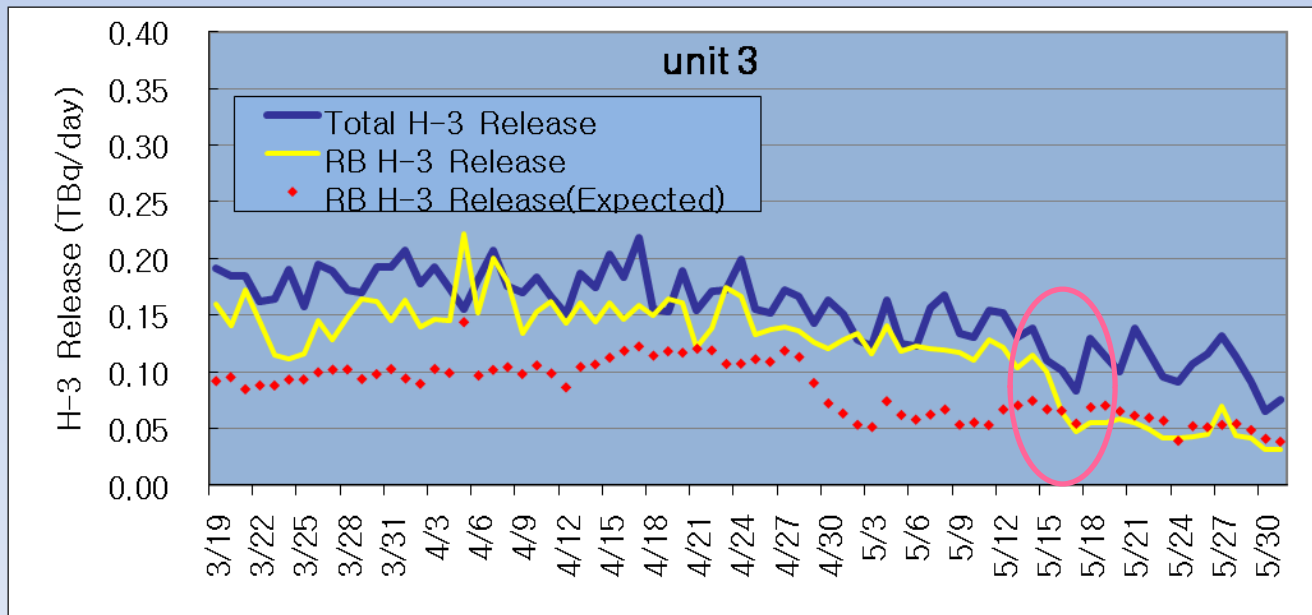
Leak Point in R402

- We found a leaking valve of Poison Addition System related to the Moderator System also.
- After we repaired it...



The Final Effect

- Tritium release rate dropped a half of the previous one.
- From RB it dropped to be a third of the previous rate and reached the expected level



Conclusion

- We can evaluate the release rate of radioactive material using regular measurements of local concentration with comparing to the designed vent flow rates.
- This method is useful to search leak points and lead to reduce the release rate.

Thanks for your attention.

Do you have any questions?

