Radiation safety management for opening and closing of S/G man-way

Radiation Safety Department

The 1st Plant, Wolsong Nuclear Power Site

KOREA HYDRO & NUCLEAR POWER CO., LTD

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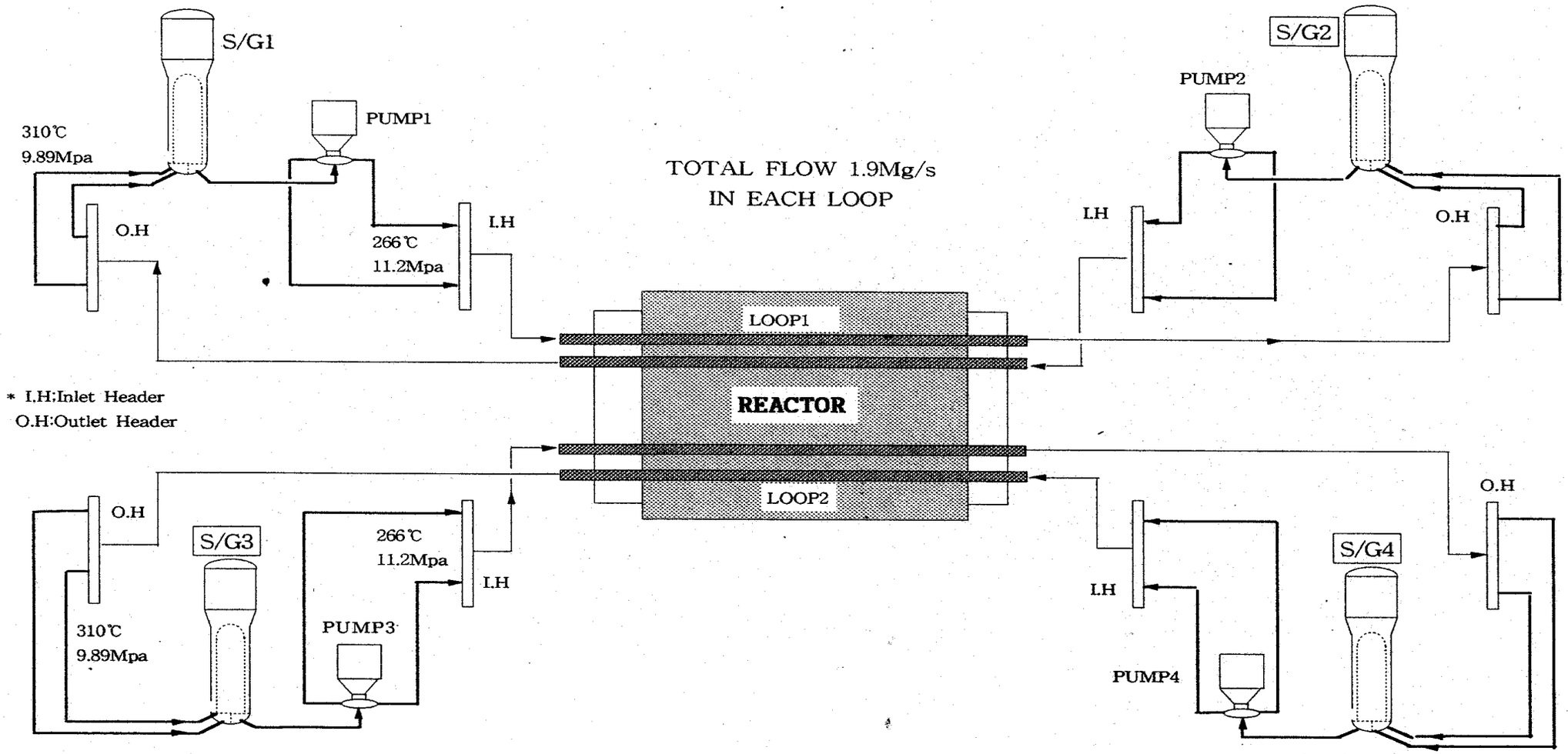
Introduction

Steam Generator(S/G)



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Problem

- Increasing and spreading concentration of tritium in the air located in the reactor building after Man-Way Open
- Lowering the efficiency of work due to the weight of lead vest provided to workers for radiation protection at narrow space such as inside the Man-Way

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Alternative

ALARA Committee

- **ALARA Committee**

A. The ALARA Committee('14.06.13) before the 14th O/H of Wolsong #2

B. Agenda

- The 1st issue : plan for radiation safety management of the 14th O/H of Wolsong #2

- Background : applying the specific standards for effective radiation safety management during O/H

ALARA Committee

Target Dose per unit work

work list	collective dose (man-mSv)			
	2010 (11th O/H)	2012 (12th O/H)	2013 (13th O/H)	2014 (14th O/H)
DN Tube inspection and reinforcement				
Other fueling machine inspection				
Fueling machine inspection				
ISI and Feeder thickness measurements				
S/G ECT and Plugging				
Opening and closing of S/G man-way				
S/G Lancing and FOSAR				
PAR installation				
Pressure Tube inspection equipment performance test				
Local Area Coolers (LAC) preventive maintenance				
Reactor Coolant sub-System inspection				
Reactor Moderator sub-System inspection				
Reactor Coolant System pumps inspection				
. . .				

ALARA Committee

Plans for opening and closing of S/G man-way(Ctn'd)

- Target : 19 man-mSv

Dose rate (mSv/hr)	Degrees of air pollution (DAC)	Main measurement of radiation protection
Open : 0.4 ~ 5.0 Close : 0.3 ~ 0.5	H-3 : 0.5 ~ 1,000 P : <1.0 I : <MDA	Wearing lead shielding vest and breathing air regulator

ALARA Committee

- **Plans for opening and closing of S/G man-way**

- Installing lead shielding for hot spot inside the F/C (before works)

- Posting radiation information at the entrance of the F/C

- Wearing exclusive shoes for high radiation dose in order to prevent from loose contamination

- Providing lead shielding clothes at the entrance of the F/C area separation (Radiation Safety Team)

- Installing temporary ventilation facility (Machinery Team)

- Designating and operating low radiation dose area around shutdown cooling heat exchanger (Radiation Safety Team)

- Working at the low level of radiation controlled area for a man-way volts inspections

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Review of work plans and Pre-Job Briefing

1. 개 요

가. 목적 : 증기발생기 #2,4 맨웨이 개폐

나. 수행부서 : 기계팀

다. 작업일정 및 소요인원

(1) 일정 : '14.07.07 ~ '17.07.08(개방), '14.07.18 ~ '17.07.19 (2일간)

(2) 인원 : 한수원 1명, 한전KPS 10명

2. 작업계획

가. 작업내용 : 증기발생기 #2,4 맨웨이 개폐

나. 작업 수행절차

- ○ 맨웨이 개폐장비 설치
- ○ 외부덮개 및 내부덮개 개방
- ○ 수실내부 중수 제거 및 점검
- ○ 내부덮개 및 외부덮개 폐쇄
- ○ 볼트너트 토크 타이팅

다. 특기사항 : 없음

3. 예상피폭선량

가. 예상 피폭선량

구 분	'13년 실적	'14년 (예상)	비 고
피폭선량(man-mSv)	16.16	19	
작 업 기 간 (일)	2	2	
투 입 인 원 (명)	10	10	
작 업 물 량	22MD	22MD	

월성2호기 제14차 계획예방정비

작업전 회의(Pre-Job Briefing)

일시 : 2014년 7월 7일 (13:10)	회의장소(주관자) : 2호기 작업자 대기실 (발전차장)
작업내용(작업부서) : S/G 맨웨이 개방작업 (기계팀)	

I. 작업에 참여하는 모든 사람이 아래 사항에 대해서 충분히 이해하고 있음을 확인한다.

1. 작업 범위
- ☑ 작업 개요 및 범위를 이해하고 있는가 ?
- ☑ 작업 절차는 수립되었는가 ?
- ☑ 동시 병행작업/별도지역에서의 작업은 있는가 ?
- ☑ 작업전 모의 훈련이 필요한 가 ?
- ☑ 작업중 삼중수소 누설 우려가 있는가 ?
- ☑ 산업안전 위해 요소는 있는가 ?

2. 방사선안전관리
- ☑ 작업 계획은 충분하게 검토 되었는가 ?
- ☑ 작업장 방사선(능) 정보는 알고 있는가 ?
- ☑ 개인 방호장구는 적절하게 검토 되었는가 ?
- ☑ 피폭저감 대책은 수립 되었는가 ?
- ☑ 작업장 추가 납차폐 설치가 필요한 가 ?
- ☑ 임시 공기 조화 설비/텐트 설치가 필요한가 ?
- ☑ 오염 확산 방지 조치가 적절하게 되어 있는가 ?

3. 의무/책임
- ☑ 개인 방호에 대한 1차 책임은 본인에게 있음을 알고 있는가 ?
- ☑ 작업 중 비정상 상황 발생시 방사선안전관리원에게 통보 해야 할 의무가 있음을 알고 있는가 ?
- ☑ 작업 후 작업장 정리 정돈는 작업자에게 있음을 알고 있는가 ?

4. 문제발생 인식
- ☑ 문제발생시 누구에게 연락해야 하는가?
- ☑ 위험완화대책은 무엇인가?

II. 주요 내용

1. 작업자 방호 장구
- 수실 개 : 플라스틱 호흡기 착용 (잔류 중수 제거)
- 수실 외 : [illegible], 여과식 호흡기 착용
2. 중수 누설 대비 사항
- 중수 회수 용품 준비 (방사선)
- : 비닐봉지, 제염지, 제염도구 등

III. 기타 사항

1. 작업 절차
- 원자로과 : 맨웨이 개방 → 수실 내 잔류 중수 제거 → 맨웨이 임시 커버 설치
- 검사과(ECT) : 수실 nozzle 커버 설치 → 맨웨이 Air Blower 설치
2. 맨웨이 개방 작업전 Air Blower 가동 확인 후 작업 진행

번호	부서	직위	성명	서명
1	안전관리		최상오	
2	보건물리		최수현	
3	〃		이재은	
4			김용배	
5	티빈		김범빈	

번호	부서	직위	성명	서명
6	KPS		우재광	
7	〃		장상현	
8	〃		오형준	
9	〃		강병진	
10	엔소코		조광연	

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Review of work plans and Pre-Job Briefing

- Checking work condition to take appropriate measures
- Planning a schedule of Man-way work
- Determining how many workers we need

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Mock-Up Training-Procedure for Man-Way Open

Preparation

Removal of outer cover

Removal of inner cover

Installation of temporary cover

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Mock-Up Training- Outfit of radiation protection

Main workers

(Encapsulated plastic suit)

Sub workers

(Breathing air regulator)

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Installing Air Line

※ Before the operation begin, HP arrange air lines to offer workers

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Installing stepping and Providing lead shielding clothes at F/C

- Installing the F/C area separation for passengers
- Providing exclusive shoes for high radiation dose in order to prevent spread of contamination
- Attaching sticky mat for removing polluted matters

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Installing stepping and Providing lead shielding clothes at F/C

- **Lead shielding clothes : in case of inability of shielding from radiation source with high external dose**
- **Providing lead shielding clothes in order to reduce external exposed dose for sub workers**

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Installing lead blanket inside the F/C

※ There are difficulties for tube at the Face of Reactor inside the F/C to shield due to the tube curves.

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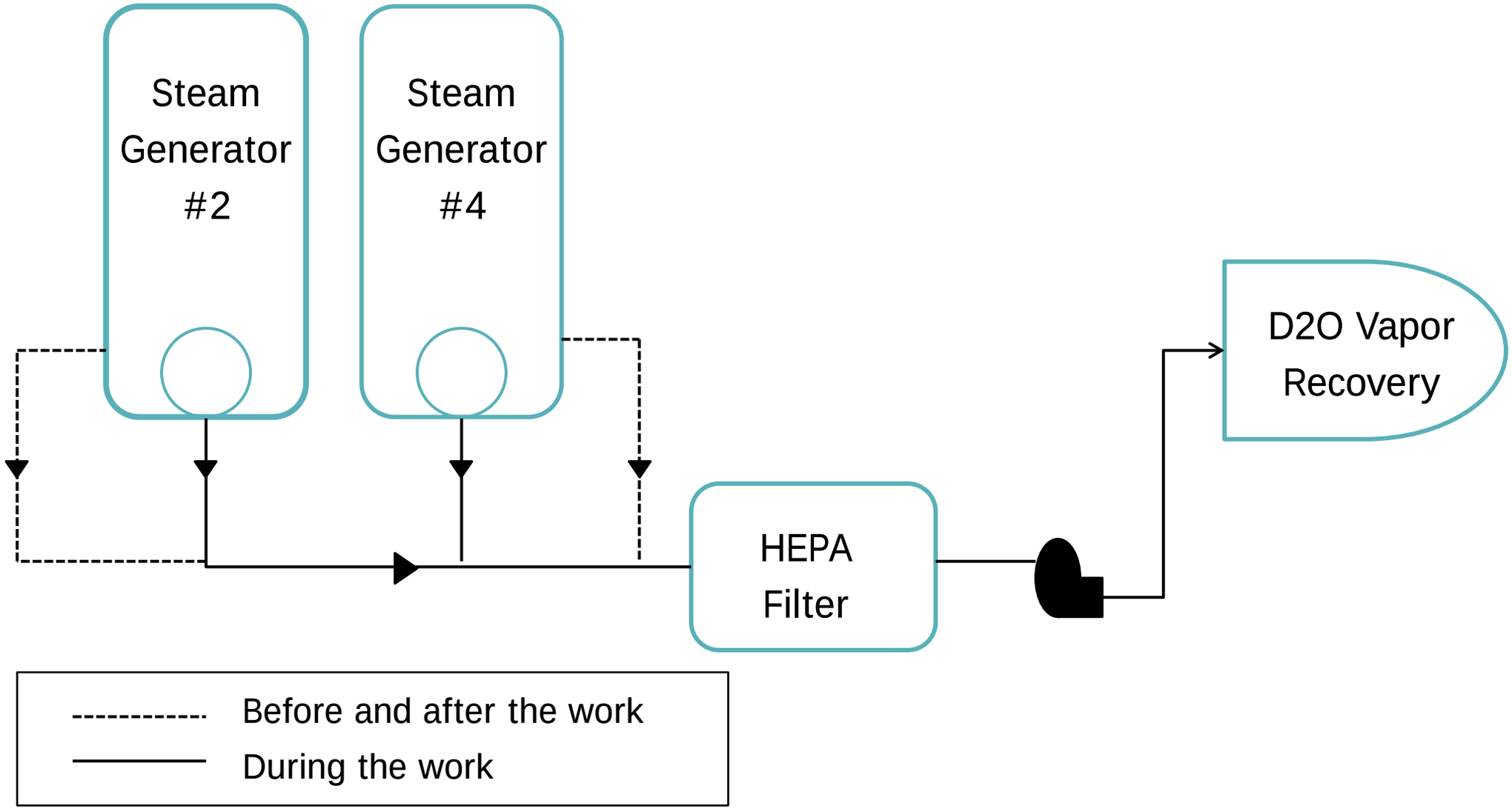
Installing Temporary Ventilation Fan



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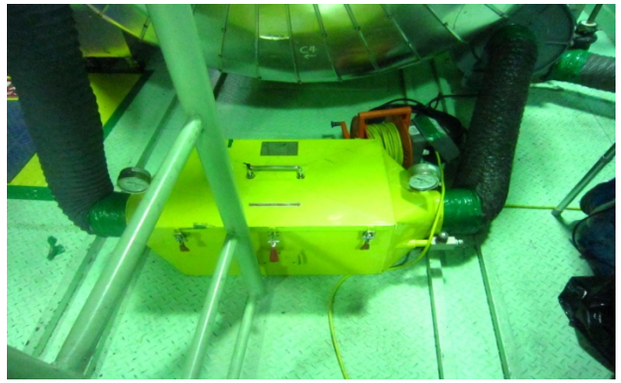
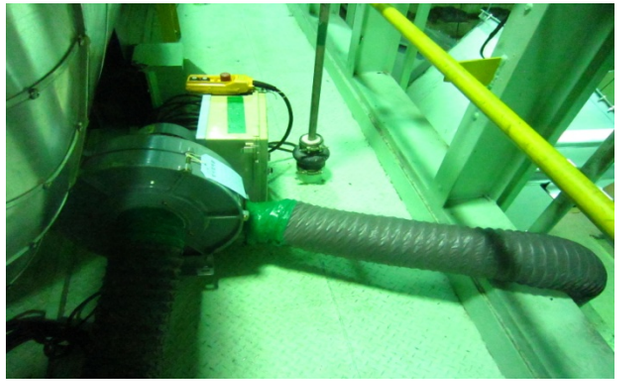
Installing Temporary Ventilation Fan

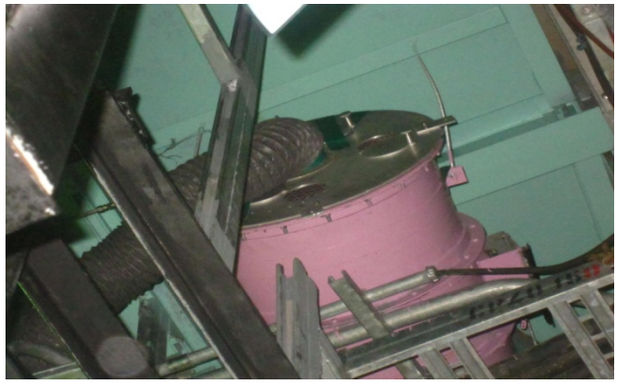
Man-Way Connection Part



HEPA-Filter



Fan



D2O Vapor recovery Inlet

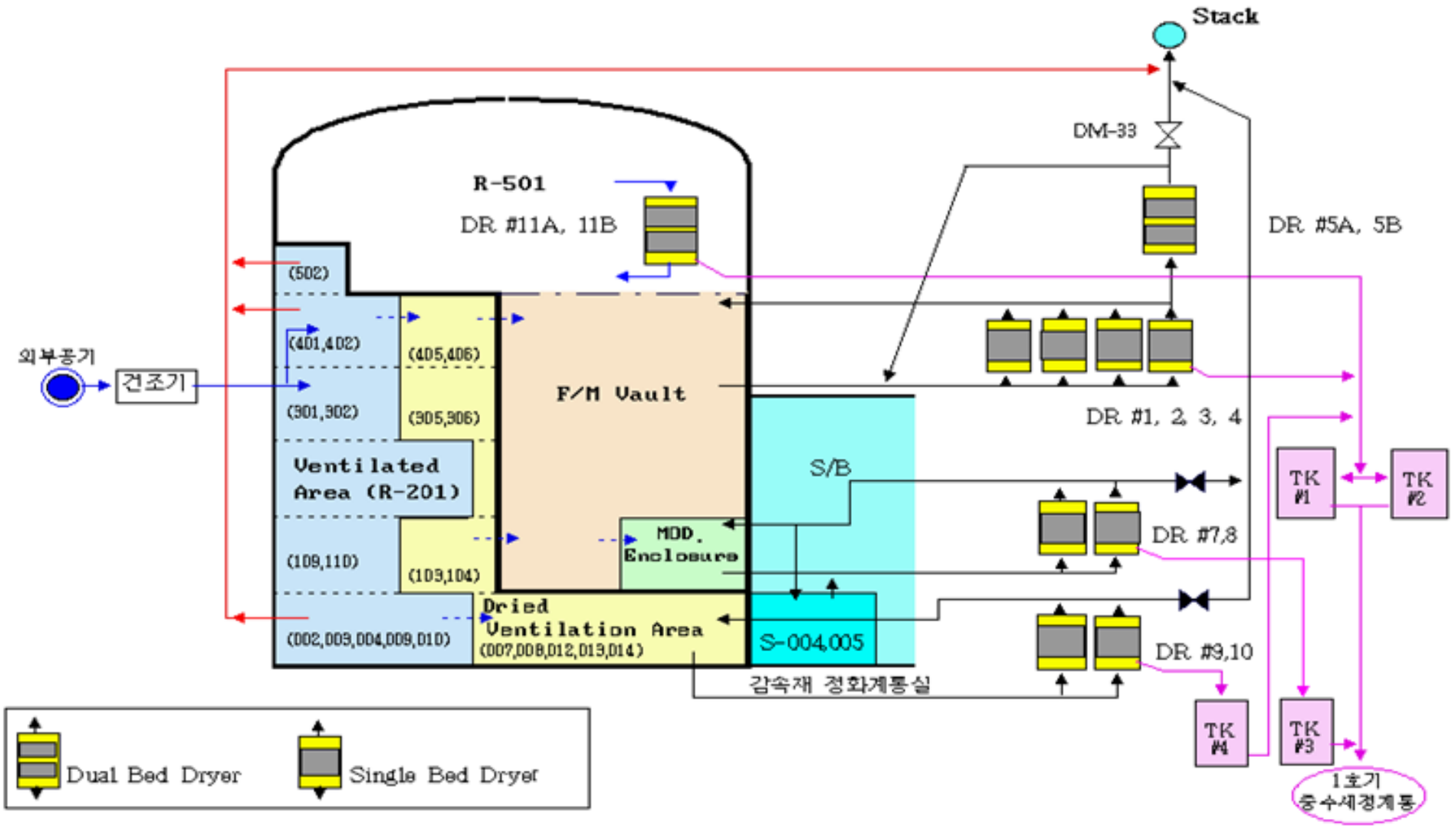
D2O Vapor Recovery System

A. Concept

- Recovering tritium steam leaked from the reactor building
- Purifying the air polluted by the leaked tritium water
- Regulating pressure of the fuelling machine room
- Reducing the over pressure occurred by LOCA in the reactor vault into the atmosphere level (Safety sub-system)

D2O Vapor Recovery System

B. Systematic diagram



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Conclusion

Case Review

Table of exposed dose during recent two O/H's

<unit : man-mSv>

	Target exposed dose	exposed dose	exposed dose rate(%)
the 12th O/H	8	16.73	209.1
the 13th O/H	24	16.16	67.3

Problems induced from recent two O/H's

- Man-way opening team and air blower installing team are different. So there is a problem spreading and increasing concentration of tritium in the air due to the install period confusion.

- Heavy weight of lead vest can lower the efficiency of work.

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Improvements

- **Table of exposed dose during latest O/H**

Working Period	2014.7.6~7.19	Collective exposure (man-mSv)	Objective	19
Man-days	78 man-day		Result	10.63
The maximum exposure	○○○	Exposed dose rate(%)		55.9%
The maximum/dose rate(mSv/h)	#2 : 3.5/0.25~0.4 #4 : 3.0/0.25~0.4	Concentration of tritum(DAC)		#2 : 4.5~1592 #4 : 4.3~1024

- **Providing light weight lead vest in order to improve efficiency of work**
- **Inducing workers to low radiation controlled area when they work on Cover Bolt Cleaning.**
- **Installing and operating Air Blower inside the F/C before and after man-way**

Conclusion

- It is very important to consider concentration of tritium at PHWR due to the fact that tritium contributes internal exposure to the workers.
- We have tried to reduce occupational exposure numerous times over the years. For example, as temporary ventilation fan was installed during the work as well as before and after work, we could keep concentration of tritium as low as possible.
- These kinds of cases can be good information to the others.

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Q&A

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