

Body contamination during the cleaning of additionally installed ALPS pipes

October 26, 2023

Tokyo Electric Power Company Holdings, Inc.

1. Summary

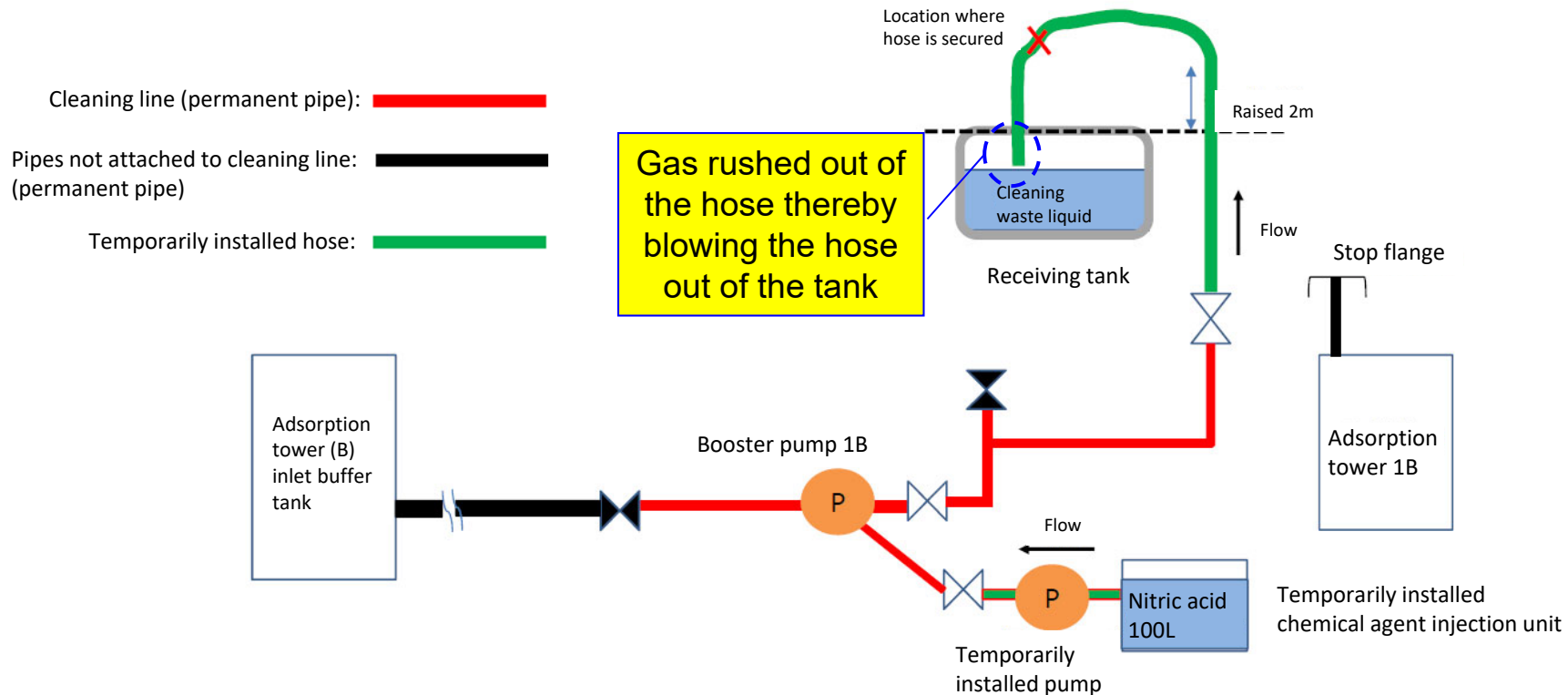
- Around 10:40 AM on October 25, 2023, when the inside of the additionally installed ALPS crossflow filter outlet pipe was being cleaned, a hose temporarily installed to transfer cleaning waste liquid into a receiving tank was dislodged and splashed cleaning waste liquid onto workers that were working nearby.
- The alarm of the APD (beta rays) of one of the aforementioned contractors who quickly put the end of the hose back inside the receiving tank went off.
- Due to the possibility of body contamination of the workers engaged in work nearby, they were taken to the ER and measured for contamination. Results showed that out of the five workers, the two workers onto whom the cleaning waste liquid was splashed, and two other workers who cleaned up the splashed liquid, had been subjected to body contamination, and the fifth worker showed no signs of body contamination.
- The four workers who tested positive for body contamination were decontaminated, and the decontamination of the two workers who cleaned up the splash liquid has been completed. Although the contamination level of the two workers onto whom the cleaning waste liquid was splashed has decreased, we were unable to decontaminate them to the point where the decontamination level fell below the criteria for removal from the controlled area (4Bq/cm²) so they were transported to the Fukushima Medical University Hospital.
- Nasal cavity smear tests were also performed on the five contractors who were measured for contamination, and it was confirmed that there is no intake. Furthermore, the results of the ER doctor's diagnosis showed no signs of heat burns from the chemicals and that it is unlikely that there will be heat burns from the radiation.
- The two contractors who were transported to the Fukushima Medical University Hospital have been diagnosed and admitted. They will be put under observation for approximately two weeks while decontamination is repeated. Protectively, reduce skin contamination while decontaminating. They are then diagnosed with the effects on the skin two weeks later. From the results of the diagnosis at present, it is expected that the probability of skin damage is low.
- It has been determined that the end of the hose was blown out of the tank as a result of a sudden rush of gas created by the reaction between the cleaning agent (nitric acid) and carbonate that had accumulated inside the pipe.
- The inside of the additionally installed ALPS building was decontaminated today (October 26).

2. Sequence of events

Sequence of events	
Around 5:30am	<ul style="list-style-type: none"> Morning meeting, TBM-KY
Around 7:30am	<ul style="list-style-type: none"> Field KY, commencement of work
Around 10:40am	<ul style="list-style-type: none"> Cleaning waste liquid splashes onto workers when a hose comes loose End of the hose immediately put back into the receiving tank and simple cleanup of the splashed liquid
Around 11:10am	<ul style="list-style-type: none"> TEPCO notified Contaminated PPE of the five workers taken off and simple body decontamination implemented
12:28	<ul style="list-style-type: none"> First worker with body contamination arrives at the ER (worker who was the closest to where the water splashed)
12:32am	<ul style="list-style-type: none"> Commencement of decontamination of first worker
12:40	<ul style="list-style-type: none"> Clause 25 (first notification) notification made
12:42	<ul style="list-style-type: none"> Four remaining workers arrive at the ER and decontamination procedures commence
13:08	<ul style="list-style-type: none"> Entry to the additionally installed ALPS building restricted to essential personnel only
14:45	<ul style="list-style-type: none"> It is confirmed that there is no intake of radioactive substances by the five workers It is confirmed that one out of the five workers was not subject to body contamination, and decontamination of two of the workers is completed
19:23	<ul style="list-style-type: none"> It is determined that the remaining two workers cannot be decontaminated to the point where the contamination level is below criteria for removal from the controlled zone
19:52	<ul style="list-style-type: none"> Clause 25 (second notification) notification made
20:59	<ul style="list-style-type: none"> Two workers leave for the Fukushima Medical University Hospital
22:25	<ul style="list-style-type: none"> Arrival at the Fukushima Medical University Hospital
00:10	<ul style="list-style-type: none"> The two workers are diagnosed and admitted to the hospital. They will be put under observation for approximately two weeks while decontamination is repeated. Protectively, reduce skin contamination while decontaminating. They are then diagnosed with the effects on the skin two weeks later. From the results of the diagnosis at present, it is expected that the probability of skin damage is low.

3. Event details

- In conjunction with the operation of ALPS, carbonate that accumulates in the pipes is melted with nitric acid to clean them.
- Gas produced through the chemical reaction of carbonate that had accumulated inside the pipes and the cleaning agent (nitric acid) rushed out of the hose that was leading into the receiving tank causing it to blow out of the tank and splash cleaning waste liquid onto two contractors that were working nearby thereby contaminating them.
- It is assumed that the two workers that cleaned up the splashed waste liquid were contaminated either during the cleaning process or when they removed their PPE (anorak suit).



4. Work plan and body contamination results



Planned dose for this task: 0.6mSv APD alarm setting: Gamma: 0.5mSv, Beta: 5mSv

Worker PPE, contamination status, internal/external exposure

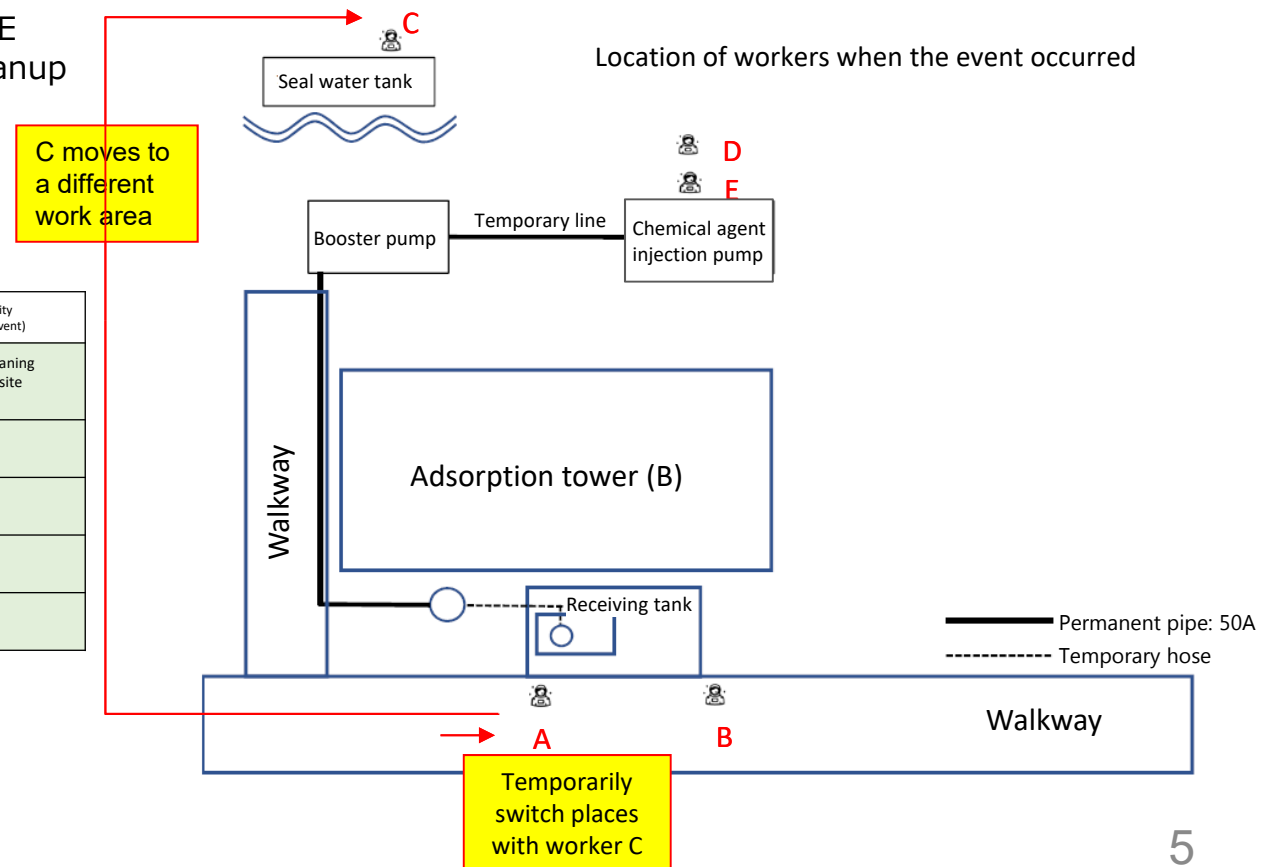
Worker	Age/ Gender	PPE	Contamination status (prior to decontamination)	Contamination status (after decontamination)	Internal exposure	External exposure (mSv)
A	20's, male	<ul style="list-style-type: none"> Double layered Tyvek* Double layered socks/ Double layered rubber gloves Full face mask Ring badge Crystal badge 	Entire body (more than 100kcpm)	Transported to hospital after decontamination	Nasal cavity smear showed no abnormalities Equal to B.G (60cpm)	γ : 0.11 β : 6.6
B	40's, male	* : After seeing that waste liquid had splashed, worker B put on an anorak suit before engaging in a simple wipe up of the splashed liquid	Lower extremities, both hands (3.5kcpm)	Transported to hospital after decontamination		γ : 0.07 β : 1.6
C	30's, male	<ul style="list-style-type: none"> Tyvek + Anorak Double layered socks/Triple layered rubber gloves Full face mask Ring badge Crystal badge 	No contamination	No contamination		γ : 0.16 β : 2.0
D	30's, male		Lower extremities (1.4kcpm)	No contamination		γ : 0.02 β : 0.2
E	40's, male		Lower extremities, both hands (13kcpm)	No contamination		γ : 0.02 β : 0.3

Worker A and worker B could not be fully decontaminated on site and were therefore transported to the Fukushima Medical University Hospital

5. Cause of the contamination

- The chemical agent injection pump repeatedly starts up and shuts down as gas is generated, but worker C, who was monitoring the tank, temporarily switched places with worker A after seeing that the receiving tank water level was not rising and the hose was not moving, and went to another area in which work was being done.
- When worker C temporarily switched places with worker A, he did not have worker A put on an anorak suit.
- Thereafter, the hose splashed waste liquid that adhered to, and seeped into, the Tyvek suit thereby contaminating the worker.
- Waste liquid also adhered to, and seeped into, the Tyvek suit worn by worker B that was near the tank thereby contaminating him.
- It is assumed that workers D and E were contaminated during the cleanup of the waste liquid or when they removed their PPE (anorak)

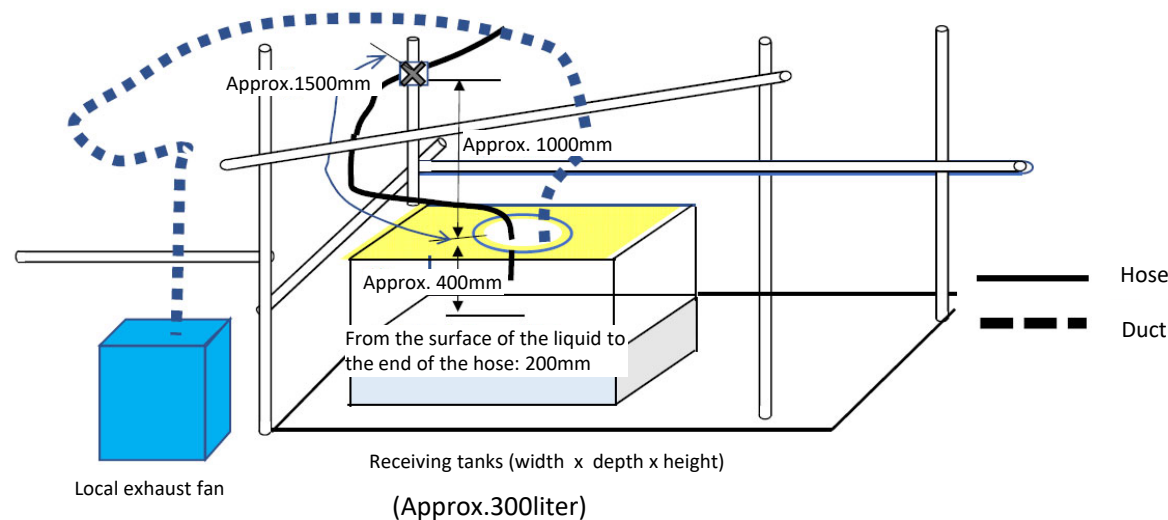
	Worker	Responsibility (when task started)	Responsibility (during the event)
Worker	C	Receiving tank monitoring	Clean up after cleaning other pipes, worksite relocation
	D	Chemical agent injection pump operation	Same as left
	E	Chemical agent injection pump monitoring	Same as left
	A	Receiving tank monitoring (assistance)	Same as left
	B	Receiving tank monitoring (assistance)	Same as left



6. The reason why the hose came loose

- Since the point on the temporarily hose where it is secured is a distance away from the tank, when the gas caused by the reaction between the carbonate and the nitric acid rushed out of the hose, it blew the end of the hose out of the tank.
- Since it was known that gas is produced by the reaction between the carbonate and the nitric acid, pipe cleaning is conducted while monitoring the gas inside the temporary hose, however when pipes were cleaned in the past there had never been enough gas generated to blow the hose out of the tank.

Conditions around the temporary tank (during cleaning)



7. Countermeasures

- Splashing countermeasures
 - Plan should be made about the point where the hose is secured so that it will not be blown out of the tank even if there is a rush of gas.
 - The work foreman and work manager shall check that the hose has been secured in the correct location according to plan prior to beginning this task.

- Contamination prevention measures
 - Workers shall make sure that they are wearing the correct PPE for the task at hand. Even workers that are not handling liquids shall wear anorak suits due to the possibility of contamination by splashing liquids.

(Reference) System diagram of additionally installed ALPS

