Report on
Industrial Accident on G/F, Sludge Dewatering House, Stonecutters Island Sewage Treatment Works on 7 May 2010

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1. Brief Description of the Accident

On Friday 7 May 2010 at about 2:10 p.m., a team of four workers comprising Worker A, Worker B, Worker C, and Worker D received a fault call from the shift team for the repair of the three-way chute at the discharge of Centrifuge No. 8 on the G/F of the Sludge Dewatering House (SDH). Worker A brought with him a portable hydrogen sulphide (H_2S) gas monitor to the workplace.

The established work procedures required that the workplace be inspected to ascertain safety before commencement of work. For that, the team noted the following at the scene before the accident occurred:

a. The portable H_2S gas monitor did not register any hazardous level of H_2S. The monitor did not flash, beep, or vibrate.
b. The lighting condition of the scene was satisfactory.
c. The ventilation fans were operating.

The team considered the environment of the workplace satisfactory.

At around 2:25 p.m., the team was approaching the discharge of Centrifuge No. 8 for work. Worker B and Worker C were at Position 1, and Worker A and Worker D at Position 2 as shown in Appendix 1. Upon arriving at the accident scene (Position 1), Worker B at first did not experience any discomfort. However, when he crouched down for inspection, he suddenly felt dizzy and then collapsed.

When Worker A noticed that Worker B held a strange posture, he asked Worker C and Worker D to check what had happened to Worker B. Worker C and Worker D came close to Worker B one after the other trying to move Worker B out of the scene but in vain. They felt dizzy and collapsed too.

Worker A called his supervisor, Worker E, over the phone informing him of the incident. Worker A then rushed to the scene followed by another worker working nearby. They successfully moved Worker D out of the scene. Worker E arrived at the scene and successfully brought Worker C out of the scene too. But when Worker E returned trying to rescue Worker B, he also felt dizzy. Worker A, with the help of other colleagues who arrived at the scene wearing full face respirator masks, successfully moved Worker E,

Worker C, and Worker B out to open area and waited for the ambulance.

All of them were quickly sent to hospital for treatment. At the time they were admitted to hospital, Worker B, Worker C, and Worker D were unconscious and Worker E felt sick. Subsequently, they were separately discharged from hospital on 8, 10, and 20 May 2010.

2. Investigation Findings

a. The accident occurred at the equipment hall on the G/F of the SDH that housed the sludge conveyors and other equipment. The equipment hall measured about 50 m (L) x 30 m (W) x 2.5 m (H) (Photo 1) and was not a confined space. Mechanical ventilation was provided for the equipment hall by using 9 nos. of wall-mounted ventilation fans (Photo 2), 8 nos. of wall-mounted pedestal fans, and 19 nos. of wall-mounted blower fans. At the material time, the mechanical ventilation system was operating normally.

b. The equipment hall on the G/F of the SDH was equipped with 7 nos. of fixed type H_2S sensors at low level at approx. 0.35 m above floor level (Photo 3). The sensors were under periodic calibration, with the most recent calibration carried out in April 2010. Based on records, between 2:00 p.m. to 3:00 p.m. on 7 May 2010, the H_2S gas level registered by the H_2S sensor installed nearest to the accident scene had exceeded 50 ppm. As for the other six H_2S sensors installed within the hall, they did not register any abnormal levels of H_2S. To confirm the proper function of the sensors, they were tested again on 12 May 2010 and found to be operating normally.

c. The portable H_2S monitor Worker A brought with him to the workplace was also tested and found to function normally.

d. Upon investigation, it was found that the inspection door fixed at the lower end of the inclined screw conveyor located next to the three-way chute at Centrifuge No. 8 (Photo 4) was not in place. The inspection door had been removed and put aside. That made the enclosed sludge conveyor not airtight. H_2S gas emanating from the sludge could escape from the enclosed conveyor through the inspection door opening into the atmosphere.

e. Based on records, the involved Centrifuge No. 8 was tripped and needed to be resumed operation very urgently earlier in the morning on the accident date by various work teams. It might be that one of the teams had forgotten to replace the inspection door after the urgent resumption work. The exact details however could not be identified. The situation that the inspection door has not been put back in place was considered rare as it had never happened before.

f. The area where the accident occurred and the vicinity of it in the equipment hall had been designated as a potential H_2S gas risk area (see purple area in Appendix 1) and was clearly fenced off by rails and chains. Staff working in that area was required to observe the specific safety instructions for working in the area. Investigation found that the working team had followed the safety instructions by notifying the operator of the SDH before work; not to work alone by forming a team to work within that area; paying attention to the H_2S concentration in the work environment; and monitoring the air quality continually during work. However, they did not bring with them and put on any respirator masks or other breathing apparatus as stipulated in the safety instructions posted at the entrance to the works area.

3. Cause of the Accident

Based on the following information collected during the investigation, it was believed that the accident was caused by the exposure of the four workers to a high concentration of but localized H_2S gas that accidentally escaped and accumulated at the accident scene at the material time.

a. Worker A's portable H_2S monitor did not alarm at the time of accident
b. Worker B did not experience any discomfort while standing but collapsed after crouching down
c. Worker C and Worker D collapsed when they attempted to raise Worker B from the low position

It was believed that high concentration of H_2S gas escaped from the enclosed conveyor system, through the inspection door opening, into the atmosphere in the vicinity. As H_2S is 1.2 times heavier than air, the H_2S gas sank and accumulated at low level at the accident scene. When Worker B crouched down at the spot, he inhaled the H_2S gas and collapsed. When Worker C and Worker D rescued Worker B from the low position, they also inhaled the H_2S gas and collapsed.

4. Measures to Prevent Recurrence of the Accident

It is considered that the accidental escape of H_2S gas from the enclosed sludge conveyor system is the direct cause of the accident. The existing safety procedures are considered adequate as the workers might have been protected from the accident if they had put on respirator masks during work as required by the procedures. However, the chance of re-occurrence and the severity of the consequences could be reduced by enhancing low level air ventilation at this potential H_2S gas risk area to disperse localized presence of H_2S, and enhancing detection arrangements to give on-the-spot

warning to workers nearby. In this respect the following measures will be taken:

a. The existing working procedures and guidelines to work on the sludge conveyors will be reviewed and amended to prevent unintended opening of the conveyor inspection doors.
b. The existing mechanical ventilation system for the workplace will be further enhanced to prevent accumulation of gas at low level. Mobile ventilation fans will also be provided.
c. The existing fixed type H_2S monitoring system at the workplace will be enhanced to provide local audible and visual alarms. Additional sensors will be provided.
d. Safety briefings, training, and refresher training for staff on the safe working procedures and guidelines will be conducted more regularly, at least once every six months. For new staff, the safety briefing and training shall be provided before carrying out duties. Moreover, safety audits on the compliance of the safe working procedures and guidelines will also be more regularly conducted at least once every six months.

Report Prepared by:

Drainage Services Department
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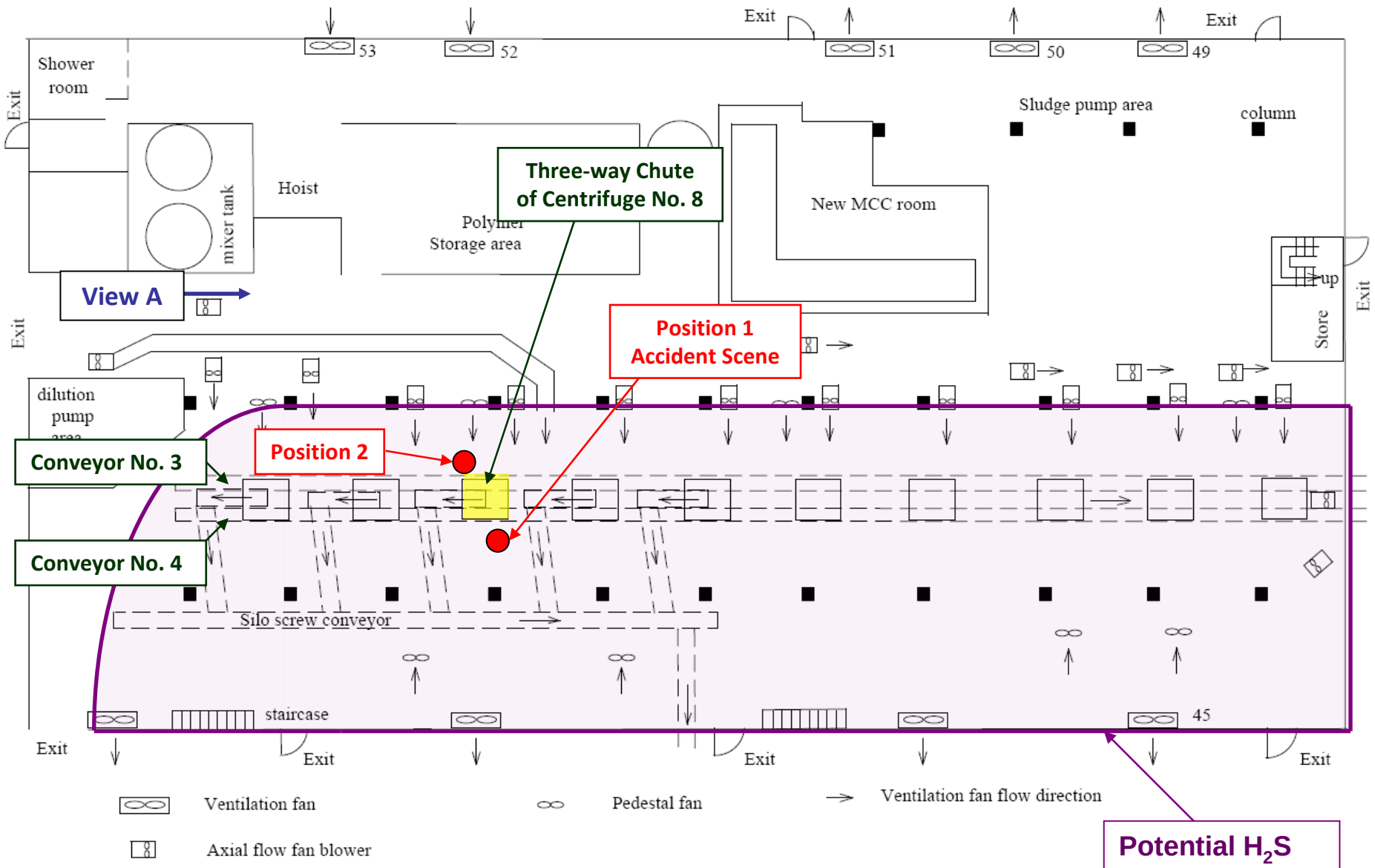
Appendix 1



Layout Plan of G/F of Sludge Dewatering House, Stonecutters Island Sewage Treatment Works

Photo 1: Sludge Dewatering House Equipment Hall (View A)

Photo 2: Wall-mounted Ventilation Fan (9 nos.)

Photo 3: Fixed Type H_2S Sensor (7 nos.)

Photo 4: Three-way Chute of Centrifuge No. 8