NOTES OF THE HAZOP MEETING

	Date:	10 January 2008
	Location:	Conference Room B, 11/F, Grand Central Plaza, Tower 2, 138 Shatin Rural Committee Road, Shatin, N.T.
	Participants:	Benita Kung – Maunsell (Chairperson) Echo Leong – Maunsell Carol Tse – Maunsell Anthony Keung – Maunsell Lawrence Ho – DSD/HATS Andrew Yuen – DSD/HATS Chan Wai Lam – DSD/HATS Alan Tong – DSD/ST2 Nicky Poon – DSD/E&MP David Pickles – ARUP Paul Taylor – ARUP

No.	Item
1	**Opening by Chairperson**
1.1	The Chairperson welcomed the participants and introduced the background of the HAZOP meeting. The Chairperson recapitulated that any unintended release of sodium hypochlorite and ferric chloride would, if not handled appropriately, lead to possible incompatible mixing of chemicals and produce highly toxic chlorine gas. This HAZOP meeting focused on prevention of incompatible mixing of sodium hypochlorite and ferric chloride within the SCISTW site boundary during the construction of HATS Stage 2A expansion works. It was noted by all that the chemical storage tanks and the pipe gallery containing the ferric chloride dosing pipes within SCISTW were all founded on piled foundation and would thus unlikely be affected by the Stage 2A construction works.
2	**Review and adopt agenda**
2.1	The agenda was adopted unanimously.
3	**Brief description on detailed design of HATS ADF project**
3.1	ARUP introduced the background of the HATS ADF project. Chlorination using direct purchase of sodium hypochlorite (disinfectant) with dechlorination using sodium bisulphite (dechlorination agent) was confirmed to be the disinfection option for HATS Stage 2A. Sodium hypochlorite would mainly be transported by barges in light of environment, transport and safety concerns.
3.2	ARUP clarified that, at present, no significant changes of the SCISTW reference design produced under the Stage 2A EIA consultancy would be made. Hence, the reference design would form the basis for discussion.
4	**Brief description on HATS 2A on disinfection facilities**

4.1	Maunsell introduced the SCISTW Stage 2A upgrade facilities and the layout of the proposed sodium hypochlorite delivery pipelines (to be laid inside a reinforced concrete pipe trench) and the existing ferric chloride dosing pipelines (inside an existing reinforced concrete pipe gallery on piled foundation) in SCISTW. As illustrated in **Figure 14C.8** of the Draft EIA Report, Maunsell identified the critical areas in which incompatible mixing of spilled chemicals might take place. The areas include: i. Delivery pipelines adjacent to the proposed sludge holding tanks. ii. Delivery pipelines between the proposed influent pumping station and the proposed chemically enhanced primary treatment facilities. iii. Area where the proposed interconnection adit runs parallel to the ferric chloride and sodium hypochlorite pipelines.. iv. Area in close proximity of the proposed electrical substation.
4.2	ARUP clarified that as sodium bisulphite would not cross path with the ferric chloride storage and delivery areas due to the large separation of the pipelines locations, thus risks regarding incompatible mixing with sodium bisulphite was considered not possible due to Stage 2A construction works and hence would not be further discussed in this HAZOP.
4.3	Maunsell reported that some precautionary measures had already been made in the ADF EIA study. According to **Figure 14C.8 & Figure 14C.9A** of the Draft EIA report, Maunsell summed up that: i. Pipes delivering hypochlorite to the storage tanks and day tanks would be protected by an external sleeve in a pipe-in-pipe configuration so it is less vulnerable to leakage. ii. The hypochlorite pipes were to be placed in a buried reinforced-concrete pipe trench to contain any spillage of chemicals in case of pipe failures. iii. The section of hypochlorite pipe trench running adjacent to the existing pipe gallery containing the ferric chloride dosing pipes would be wrapped by heavy-duty impervious membrane to provide an additional barrier to any leaked chemicals to prevent mixing. iv. Any leaks from the storage tanks would be contained within their respective bund walls.
5	**Discussion on construction activities of the new plant equipment**
5.1	It was noted that the construction methods of the proposed HATS Stage 2A facilities would be as follows:

New plant facilities under Stage 2A	Foundation Construction Method
Influent pumping station with eight centrifugal pumps	Excavation with diaphragm wall techniques
Chemical enhanced primary treatment (CEPT) facilities - Two rapid mixing chambers - Four flocculation tanks - Eight double-deck sedimentation tanks	Use of existing piles installed previously under HATS Stage 1
Sludge treatment facilities - One sludge holding tank - Eight sludge dewatering centrifuges	Bore Piling

		- Two sludge cake storage silos	
		Effluent tunnel	Tunnel Boring Machine (TBM) / Drill and Blast
		Odour control facilities – provision of a two-stage odour treatment (i.e. biofilter plus activated carbon)	Bore Piling
		Electrical substation and switch gear building	Bore Piling
		Interconnection adit	Trenchless technology (e.g. micro tunneling)
		Sewage Conveyance System under Stage 2A	**Construction Method**
		Influent Tunnel "L" and its Production Shaft and Riser Shaft	Excavation with diaphragm wall techniques for shaft and TBM/ Drill and Blast for tunnel
5.2	For influent pumping station, Maunsell Engineering Team explained that excavation works using diaphragm wall techniques would be required to construct the deep pumping station. To prevent excessive ground settlement which would affect the chemical pipelines. Maunsell Engineering Team proposed to keep a 3-metre clearance between the excavation works and the hypochlorite pipelines as far as possible and adopt a set of settlement and vibration limits to mitigate potential hazards. ARUP agreed in principle with Maunsell but suggested that the settlement and vibration limits would be decided during the detailed design stage.		
5.3	As the proposed facilities would be located on reclaimed land, DSD/ST2 suggested monitoring work should be done to avoid excessive ground settlement during construction. ARUP suggested that settlement markers would be installed and monitored to detect any ground settlement. It was noted that the existing ferric chloride pipelines would not be prone to settlement impact as they were laid inside a pipe gallery which had a rigid structure on piled foundation. DSD/ST2 advised that there had been no record of damage since its commissioning in 1997.		
5.4	DSD/HATS commented that tunnel works would not cause any significant impact as the proposed drill & blast work would be carried out in notable depth below ground and thus would not affect the pipelines which would be located near ground surfaces.		
5.5	ARUP agreed that using bored piles would be able to minimize any settlement and vibration impacts.		
5.6	ARUP suggested that good site management of construction activities would help reduce potential hazards. The sodium hypochlorite delivery pipeline from the seawall to the storage tanks would only be used during barge unloading. Under normal operation, the pipe would be used 2 to 3 times per week for 4 hours each time. It was suggested that during the barge delivery of sodium hypochlorite, nearby construction works prone to cause damage to the pipeline should be avoided whenever possible.		
5.7	The following mitigation measures for the delivery pipelines were proposed: i. Regular checking of pipelines to detect any leakage/damage. ii. Set up monitoring system to check for vibration and settlement. iii. Develop action plan(s) for situations where vibration or settlement level is found to exceed the set limits		
5.8	As per the HATS ADF Final EIA Report, it was agreed that, as an additional precautionary measure to safeguard the catastrophic failures of both the hypochlorite and ferric chloride storage tanks at the same time, a physical barrier would be placed between the hypochlorite and ferric chloride storage tanks during the construction stage before the new above ground structures for HATS Stage 2A were erected to block the spilled chemicals from causing		

	incompatible mixing.
5.9	More detailed discussion was made on the desktop hazard log as attached.
6	**Discussion on operation activities of electrical substation**
6.1	Maunsell reported that major operational hazard would include fire, flash and arc due to failure of electrical appliances. However, the electrical substation would be intrinsically safe as the following precautionary measures would apply: i. Operation of the substation to a strict code of practice. ii. Effective monitoring and reporting mechanism. iii. Use of XLPE power cables. iv. Use of explosion-proof materials in building the electrical substation
6.2	Detailed discussion was made over operational activities of electrical substation and was reported in the hazard log as attached. Taking into consideration that the location of the proposed electrical substation would be too close to the sodium hypochlorite unloading area and the ferric chloride storage area, DSD/HATS proposed to relocate the substation to the location next to the proposed chlorination contact tank area. It was unanimously agreed by the participants and Maunsell Engineering Team would provide an updated layout in due course.
7	**Any other business**
7.1	There were no other issues and the meeting was adjourned at 12:15pm.

Potential Construction/ Operational Hazards Induced By Proposed New Plant Facilities at SCISTW

General Precautionary Measures

- Set up monitoring system for vibration and settlement control
  - Employ vibration detectors and settlement markers
  - Develop action plan(s) for situations where vibration or settlement level is found to exceed the set limits (vibration limit would be in the order of 10 mm/s; settlement limit: would be in the order of 25mm)
- Strict Traffic Management
  - Designated delivery route and off-loading area for delivery trucks
- Close supervision and monitoring by safety officers. Report any damage of the disinfection facilities to operators for remedial actions
- Provide indication / signs for sodium hypochlorite and ferric chloride pipelines
- Regular checking of chemical delivery pipelines
- Provide a physical barrier between the sodium hypochlorite tanks and the ferric chloride tanks during the construction stage before the new above ground structures for HATS Stage 2A are erected

Ref No.	Major Activity	Potential Hazard / Hazardous Scenarios	Anticipated Mitigation Measures[1]
Construction of new plant facilities and Sewage Conveyance System under Stage 2A			
1	Excavation works	▪ Settlement and/or vibration causing accidental damage to chemical storage / delivery facilities resulting in leakage	<u>Damage of chemical storage / delivery facilities</u> ▪ General precautionary measures to be implemented ▪ Close liaison with plant operators should be maintained at all times to minimize impacts during chemical deliveries and blasting operations ▪ Excavation running close or parallel to sodium hypochlorite delivery pipelines under road / pavement shall be avoided as far as possible
2	Piling works	▪ Excessive ground vibration leading to damage of chemical storage and delivery facilities which results in leakage	▪ General precautionary measures to be implemented ▪ Use bore piles instead of percussion piles in order to keep vibration to a minimum ▪ Maximise the distance between piling and delivery pipelines. Monitor vibration resulted from construction works to ensure the velocity and amplitude of vibration limit will not be exceeded
3	Installation of electrical and mechanical equipments	▪ Accidents initiated by electricity supply facilities installed close to the facilities causing damage to the storage tanks / pipe network ▪ Dropping of heavy machines	▪ General precautionary measures to be implemented ▪ Designated routes for delivery trucks ▪ Designation of off-loading area ▪ Effective traffic management ▪ Conduct hazard assessment and obtain Hot Work Permit before

[1] The anticipated mitigation measures shall be further reviewed and developed in the detailed design stage

		(e.g. huge pumps) causing damage of underneath pipelines ▪ Accidents associated with welding / hot works	starting welding / hot works
4	Mobilising and usage of construction equipment (e.g. drill rig, backhoe, bulldozer, dump truck, site vehicle etc)	▪ Construction plant overturns / crashes into the chemical facilities causing structural damage to the storage tanks and pipelines, resulting in leakage ▪ Crane operation accidentally hitting storage facilities	<u>Construction plant overturns / crashes</u> ▪ Control of truck transportation route ▪ Stability of the equipment should be checked and certified ▪ Location of any large-scale or high-elevated equipment should be agreed with SCISTW operator before delivery <u>Mitigation measures associated with crane operation</u> ▪ Close inspection and supervision to ensure proper operation of construction plants
5	Welding / Hot works	▪ Accidents involving fuels used in welding and sparks produced during welding, causing fire hazard to the neighbouring storage tanks ▪ Fire incidents during construction of Stage 2A sodium hypochlorite storage tanks compound	▪ To confine hot works in designated areas. ▪ Area within the boundaries of chemical storage facilities are subject to hazardous area control ▪ Conduct hazard assessment and obtain Hot Work Permit before starting welding / hot works
6	Shafts construction	▪ Excessive drawing down of groundwater table causing ground settlement and subsequent structural damage to the storage tanks and delivery pipelines ▪ Ground vibration if blasting is required	▪ General precautionary measures to be implemented (e.g. probing) ▪ Provide lateral support to excavation ▪ No explosives to be stored on-site or used close to the chemical storage compounds ▪ Maximise the distance between the tunnel shaft and delivery pipelines ▪ To adopt a blasting vibration limit in order to minimise the impact upon storage tanks and pipelines during blasting operations
7	Construction of tunnels with "drill and blast" or Tunnel Boring Machine	▪ Excessive drawing down of groundwater table during tunnel drilling, causing ground settlement and subsequent structural damages to the storage tanks and delivery pipelines ▪ Ground vibration if blasting required	▪ General precautionary measures to be implemented ▪ Conduct "Blasting Assessment" for SCS tunnels ▪ To adopt a blasting vibration limit in order to minimise the impact upon storage tanks and pipelines during blasting operations ▪ No explosives to be stored on-site or used close to the chemical storage compounds ▪ Close supervision and monitoring throughout the blasting operations
8	Delivery of chemicals and	▪ Spillage of chemicals	▪ Good traffic management on site

	construction traffic		▪ Separate delivery time or route in transportation of incompatible chemicals ▪ Proper signs / labels upon delivery trucks ▪ Designate specific holding areas for chemical trucks
Operation of Electrical Substation			
9	Operation of electrical substation	▪ Electrical faults or incidents causing an arc, breaking out of fire and hence causing an explosion in extreme cases	▪ To keep good practice in handling electrical equipments as per "Code of Practice for the Electricity (Wiring) Regulation" of EMSD ▪ To keep good practice in following corresponding rules being set by CLP ▪ To completely enclose and securely fix electrical equipment within solid walls or in strong metal casing in accordance with Electricity Supply Regulations – Chapter 406A ▪ Installation of radiant heat and blast barriers between transformers wherever appropriate ▪ Establish sound communication channel between CLP and SCISTW operators in case of emergency evacuation initiated from either side