Land Transport Authority
We Keep Your World Moving

SAFETY NEWS

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FEATURED ARTICLES

INTRODUCTION

The 17th Annual Safety Award Convention (ASAC) was held at the Singapore Polytechnic Convention Centre on 15th September 2015. Mr. Michael Lim, Chairman of LTA was the Guest of Honour for the event, which saw an attendance of about 1000 guests comprising LTA staff, QP teams, contractors, sub-contractors and professionals from the construction industry. ASAC was inaugurated in 1999 to give due recognition to deserving contractors for their relentless effort in raising the safety and health standards at their worksites. At the same time, it recognises their contribution to protecting the environment and the public.

Figure 1: Guest of Honour, Mr. Michael Lim, Chairman of Land Transport Authority, delivering the opening address

THEME OF ASAC 2015

The theme for this year's Convention was "***Skilled Workforce: Towards a Safe and Productive Worksite***".

This theme was chosen to highlight the importance of having a skilled workforce to increase safety and productivity in the worksite. LTA strongly advocates raising the competency of its workforce, and has pioneered the requirement for more skilled workers in the construction sector.

In his opening address, Mr Michael Lim, Chairman of LTA highlighted: "LTA strongly believes in employing more skilled workers into the construction industry to meet its current challenges. This is because the value of a skilled worker lies not only in his productivity, but also in his ability to appreciate the risks and hazards associated with the works".

NEW AWARD

In line with the theme to recognise the importance of skilled workers, a new award, the ***WSH Officer Recognition Award***, was introduced this year.

The Workplace Safety and Health (WSH) Officer Recognition Award is the first of its kind to reward an individual instead of a team, and aims to recognise WSH Officers who have demonstrated exemplary performance and made significant contributions to promote and enhance the health and safety of workers. It also aims to encourage contractors to place greater emphasis and value on WSH Officers in their workplace.

Potential candidates from rail and road projects were nominated and evaluated based on rigorous scoring criteria by the LTA Project Teams and Safety Division. The winner for this inaugural award was Mr. Andy Tan Soon Kiat from Tuas West Extension Contract 1688 Shanghai Tunnel Engineering Co. Ltd., who received a certificate and a specially customised trophy.

THE ASAC COMPETITION AND CHALLENGE SHIELD

The ASAC competition is divided into four categories:

Minor – Civil contracts with value below $20m
E&M – E&M contracts with value above $20m
Major – Civil contracts with value between $20m to $50m
Mega – Civil contracts with value above $50m

A total of 59 contracts participated in this year's competition. The contractors were scored based on their monthly Environmental, Safety and Security (ESS) assessments, safety performance statistics and a round of internal audit conducted by LTA's project management teams. Five finalists were subsequently short-listed from the Mega Category to compete for the Contractors' Challenge Shield. They were then audited by an independent Panel of Judges based on their site conditions, WSH practices and overall WSH management system. They also had to deliver a theme-related presentation at the Convention. The scoring criteria were 80% based on the results of the site audit and 20% on the presentation at the convention.

The past winners of the Challenge Shield include Contract 909 Gammon Construction Ltd (2010), Contract 916 McConnell Dowell South East Asia Pte Ltd (2011), Contract 920 Shanghai Tunnel Engineering Co., Ltd (2012), Contract 921 Ssangyong Engineering & Construction Co., Ltd (2013) and Contract 923 Samsung C&T Corporation (2014).

PANEL OF JUDGES

The Panel of Judges comprised of senior representatives from the Ministry of Manpower (MOM), Building and Construction Authority (BCA), Institute of Engineers Singapore (IES) and National University of Singapore (NUS).

Figure 2: Panel of Judges (from left): Dr Goh Yang Miang (IES), Professor Michael Chew (NUS), Mr. Tan Chee Kiat (BCA) and Mr. Chan Yew Kwong (MOM)

The Panel of Judges were impressed with the 5 finalists for their exemplary WSH management and site practices observed during their site audits. The Judges also applauded the initiatives developed by the 5 finalists to promote safety and productivity in their worksites through the employment of skilled workers, re-training of workers to increase their skill sets and leveraging on technology to improve productivity. In his speech, Chief Judge Mr. Chan Yew Kwong observed: "It is important that the construction industry works towards a stage where safety and productivity works hand in hand to bring us to a higher level."

FINALISTS' PRESENTATION

This year's finalists comprised of teams from DTL3 Contract 922 Samsung C&T Corporation; DTL3 Contract 925 GS Engineering & Construction Corp; DTL3 Contract 925A KTC Civil Engineering & Construction Pte Ltd; DTL3 Contract 930 SK E&C Singapore Branch, and TWE Contract 1688 Shanghai Tunnel Engineering Co. Ltd.

Each finalist was given 15 minutes to showcase their good practices based on the theme of the Convention with a presentation and a theme-related skit. At the end of the finalists' presentations, the audience also had the opportunity to vote for their preferred presentation through Short Message Service (SMS).

The audiences thoroughly enjoyed the skits put up by the 5 finalists, who demonstrated a sound understanding of the theme and wowed the audiences with their imaginative and entertaining performances. The winner of the Best Theme Presentation Award went to Contract 922 Samsung C&T Corporation, who won the audiences over with their colourful mascots and lively performance.

Figure 3: Skit presentation by DTL3 Contract 922 Samsung C&T Corporation

CONTRACTORS CHALLENGE SHIELD (ASAC CHAMPIONS)

For the first time in ASAC's 17 year history, two finalists - GS Engineering & Construction Corp (GS E&C) and KTC Civil Engineering & Construction Pte Ltd (KTCCE) were crowned as the champions for ASAC 2015 and both walked away with the Contractor's Champion Trophy and the Challenge Shield. In his speech, Mr Chan Yew Kwong remarked: "The results of the scoring by the Panel of Judges led to a very interesting conclusion…where two top contractors had the same score... and so for the first time, there will be joint winners for the 17th ASAC".

Figure 4: DTL3 Contract 925 GS Engineering & Construction Corp and Contract 925A KTC Civil Engineering & Construction Pte Ltd proudly receiving the LTA Contractors Challenge Shield

AWARDS CONFERRED DURING ASAC 2015

The following awards were presented during the Convention:

- ***Certificate of Excellence*** to 5 finalists from the Mega category, 1 from Major category and 1 from E&M category.
- ***Certificate of Merit*** to 4 contractors from the Mega category, 1 from Major category, 1 from Minor category and 3 from E&M category for consistent good WSH performance over the assessment period.
- ***WSH Officer Recognition Award*** to 1 WSH Officer for his commendable dedication and contribution towards Workplace Safety and Health.
- ***Project Safety Commendation Award*** to the LTA Project Safety Committee with the best effort and WSH performance in ensuring and promoting excellent WSH standards at its worksites.
- ***Best ASAC Theme Presentation*** to the finalist of the Mega category for delivering the best theme presentation as voted by the audience.
- ***Construction Environmental Merit Award*** to 2 contractors who have shown consistent environmental management at their worksites.
- ***Accident-Free Million Man-hours Recognition Award*** to 13 main contractors with a considerable accident-free man-hour milestone without reportable accidents or major incidents.
- ***Most Improved Contractor Award*** to 2 main contractors with significant improvement in their WSH standards.
- ***QPS Safety Award*** to 3 QPS teams with proactive contribution towards addressing Workplace Safety and Health (WSH) issues.
- ***Sub-contractors' Safety Recognition Award*** to 7 sub-contractors with significant contribution to good WSH performance.

Christopher Thio
Deputy Safety & Health Manager
Safety Division

Best ASAC Theme Presentation Award

Figure 5: Mega Category (Finalist) – DTL3 Contract 922 – Samsung C&T Corporation

Project Safety Commendation Award

Figure 6: Project Safety Commendation Award – Mr. Song Siak Keong, Director (DTL3 CT3)

WSH Officer Recognition Award

Figure 7: WSH Officer Recognition Award – Mr. Andy Tan Soon Kiat – TWE Contract 1688 – Shanghai Tunnel Engineering Co. Ltd.

Certificate of Excellence

Figure 8: Mega Category (Finalist) – DTL3 Contract 922 – Samsung C&T Corporation

Figure 9: Mega Category (Finalist) – DTL3 Contract 925 – GS Engineering & Construction Corp

Figure 10: Mega Category (Finalist) – DTL3 Contract 925A – KTC Civil Engineering & Construction Pte Ltd

Figure 11: Mega Category (Finalist) – TWE Contract 1688 – Shanghai Tunnel Engineering Co. Ltd.

Figure 12: Mega Category (Finalist) – DTL3 Contract 930 – SK E&C (Singapore Branch)

Figure 13: Major Category – Rail Expansion Contract 1761 – Gammon Construction Limited (Singapore Branch)

Certificate of Merit

Figure 14: E&M Category – DTL Contract 960 – ST Electronics Ltd

Figure 15: Mega Category – DTL3 Contract 923 – Samsung C&T Corporation

Figure 16: Mega Category – DTL3 Contract 936 – Sato Kogyo (S) Pte. Ltd.

Figure 17: Mega Category – DTL3 Contract 937 – GS Engineering & Construction Corp

Figure 18: Mega Category – TWE Contract 1685 – Jurong Primewide Pte Ltd

Figure 19: Major Category – CRFP Contract RD 258 – KTC Civil Engineering & Construction Pte Ltd

Figure 20: Minor Category – CRFP Contract RD 287 – CCECC Singapore Pte Ltd

Figure 21: E&M Category – DTL Contract 953 – Siemens Pte Ltd

Figure 22: E&M Category – DTL Contract 955 – ST Electronics Ltd

Construction Environmental Merit Award

Figure 23: E&M Category – TWE Contract 1682B – Gammon Pte. Limited

Figure 24: Mega Category – DTL3 Contract 923 – Samsung C&T Corporation

Figure 25: Mega Category – DTL3 Contract 930 – SK E&C (Singapore Branch)

Accident Free Million Man-hours' Award

Figure 26: Category 1 (Contracts $120 million and above and achieved above 2 million accident free man-hours) – DTL3 Contract 922 – Samsung C&T Corporation

Figure 27: Category 1 (Contracts $120 million and above and achieved above 2 million accident free man-hours) – TWE Contract 1685 – Jurong Primewide Pte Ltd

Figure 28: Category 1 (Contracts $120 million and above and achieved above 2 million accident free man-hours) – TWE Contract 1688 – Shanghai Tunnel Engineering Co. Ltd.

Figure 29: Category 2 (Contracts below $120 million and achieved above 250,000 accident free man-hours) – RCSG Contract ER391 – Or Kim Peow Contractors (Pte) Ltd

Figure 30: Category 2 (Contracts below $120 million and achieved above 250,000 accident free man-hours) – RCSG Contract ER403 – Sato Kogyo (S) Pte. Ltd.

Figure 31: Category 2 (Contracts below $120 million and achieved above 250,000 accident free man-hours) – RCSG Contract ER412 – Hwa Seng Builder Pte Ltd

Figure 32: Category 2 (Contracts below $120 million and achieved above 250,000 accident free man-hours) – CRFP Contract RD258 – KTC Civil Engineering & Construction Pte Ltd

Figure 33: Category 2 (Contracts below $120 million and achieved above 250,000 accident free man-hours) – CRFP Contract RD259 – Huationg Contractor Pte Ltd

Figure 34: Category 3 (For E&M Projects and achieved above 250,000 accident free man-hours) – DTL Contract 952 – Siemens Rail Automation Holdings Limited

Figure 35: Category 3 (For E&M Projects and achieved above 250,000 accident free man-hours) – DTL Contract 953 – Siemens Pte Ltd

Figure 36: Category 3 (For E&M Projects and achieved above 250,000 accident free man-hours) – DTL Contract 960 – ST Electronics Ltd

Figure 37: Category 3 (For E&M Projects and achieved above 250,000 accident free man-hours) – TWE Contract 1682A – Powen Electrical Engineering Pte Ltd

Most Improved Contractor Award

Figure 38: Category 3 (For E&M Projects and achieved above 250,000 accident free man-hours) – TWE Contract 1682B – Gammon Pte. Limited

Figure 39: DTL3 Contract 932 – Sato Kogyo (S) Pte. Ltd.

Figure 40: DTL E&M Contract 955 – ST Electronics Ltd

QPS Safety Award

Figure 41: DTL3 Contract 928 – ECAS-EJ Consultants Pte Ltd

Figure 42: TWE Contract 1688 – Calibre Consulting (Singapore) Pte Ltd

Figure 43: TEL C1 Contract T207 – Ronnie & Koh Consultants Pte Ltd

Subcontractors' Safety Recognition Award

Figure 44: 68 Systems & Project Engineering Pte Ltd

Figure 45: Advance Infrastructure Engineering Pte Ltd

Figure 46: Doo Ree Engineering & Trading Pte Ltd

Figure 47: Eng Lee Engineering Pte Ltd

Figure 48: Kori Construction (S) Pte Ltd

Figure 49: Tuksu E&C

Figure 50: Yongnam Engineering & Construction (Pte) Ltd

GS E&C's Skilled Workforce: Towards a Safe and Productive Worksite

INTRODUCTION

Contract 925 - Construction of Tampines East Station and associated tunnels project is part of Downtown Line Stage 3, undertaken by GS Engineering & Construction Corp (GS E&C). The project was awarded on 26 July 2011 and its contractual completion date is on 30 December 2016.

GS E&C has established its status as one of Korea's top-ranking company since it was founded in 1969 by achieving tremendous growth in the fields of architecture and civil engineering. GS E&C is a global construction corporation with 39 overseas branches spread over 28 countries and operating over 231 work sites. GS E&C is satisfying its customers with leading technologies and systems as it heightens its global project execution capabilities. Through continuous development of its human resource, acquisition of technologies and determined challenges and practices, GS E&C has set forth the stepping stones to leap as a Global Leading Company.

GS E&C has carried out many infrastructure projects in Singapore, including ongoing Rail projects such as Contracts C911, C913, C925, C937, T203 and T3008. GS E&C was also awarded with BCA's Green & Gracious Builder Scheme Award in 2014.

GS E&C's strong beliefs and efforts in hiring a skilled workforce have groomed it to be a well-established company in Singapore's construction industry. By retaining workers with better skills and experience, it can improve productivity in the worksite and cultivate workers to use safer work methods.

By hiring skilled workers, GS E&C has reduced its over-reliance on unskilled or general workers, thus minimising employees' turnover. In this article, GS E&C will share three initiatives related to a skilled workforce that have been beneficial to its project sites:

- Multi-Skilled Workers;
- Cardinal Rules; and
- Take 5 programme

MULTI-SKILLED WORKERS

Multi-skilled workers are deemed as trained and equipped with skills in more than one trade. For example, a multi-skilled worker is trained in scaffold erection, as well as in formwork erection. This strategic approach allows GS E&C to raise the quality of its workers, and at the same time, deploy workers to areas of work where their skills are highly sort after. For workers who are skilled in only one trade, they will not be deployed for tasks that they are not trained for, as they posed a higher risk of resulting in an accident, and thus, reduced productivity.

Only with multi-skilled workers, can GS E&C operate effectively with a reduced number of employees necessary to carry out certain trades throughout the project, thereby increasing both safety and productivity.

By continuously investing in employees' training programs, workers are assured that GS E&C values them, and have the full confidence that they will be able to execute the tasks safely. With safety standards and culture improved, it will also result in increased morale and productivity amongst workers.

Figure 1: On the job trainings conducted on site to increase the skill level of workers

Figure 2: Scaffold erected by a team of formwork erectors that are competent in scaffold erection

GS E&C CARDINAL RULES

To help embed occupational safety and health as the number one priority, GS E&C implemented and trained all employees to ensure everyone that works in its project has attained the basic safety knowledge required in accordance to its cardinal rules.

GS E&C's cardinal rules set down the expectations that they have for all employees, visitors, subcontractors and third party workers whilst carrying out works in its sites. These cardinal rules are remembered and adhered to by the workforce at all times. This sets the minimum safety standard that is required of every individual.

The creation of a safe and caring culture by adopting the cardinal rules, with an added focus on employees' training, reinforces each and every worker's thoughts that they are responsible for their own safety, as well as for the safety of others around them.

Ensuring that the cardinal rules are understood by every employee is also key to a safe work site. To eliminate the gaps in communication between the different nationalities, the cardinal rules are translated into 3 other main languages, namely Mandarin, Bangladeshi and Tamil (Figure 3). These cardinal rules are printed in pocket sizes and distributed to workers at C925 and C937. These pocket sized cardinal rules will come in handy should the employees need to refresh themselves with the rules from time to time.

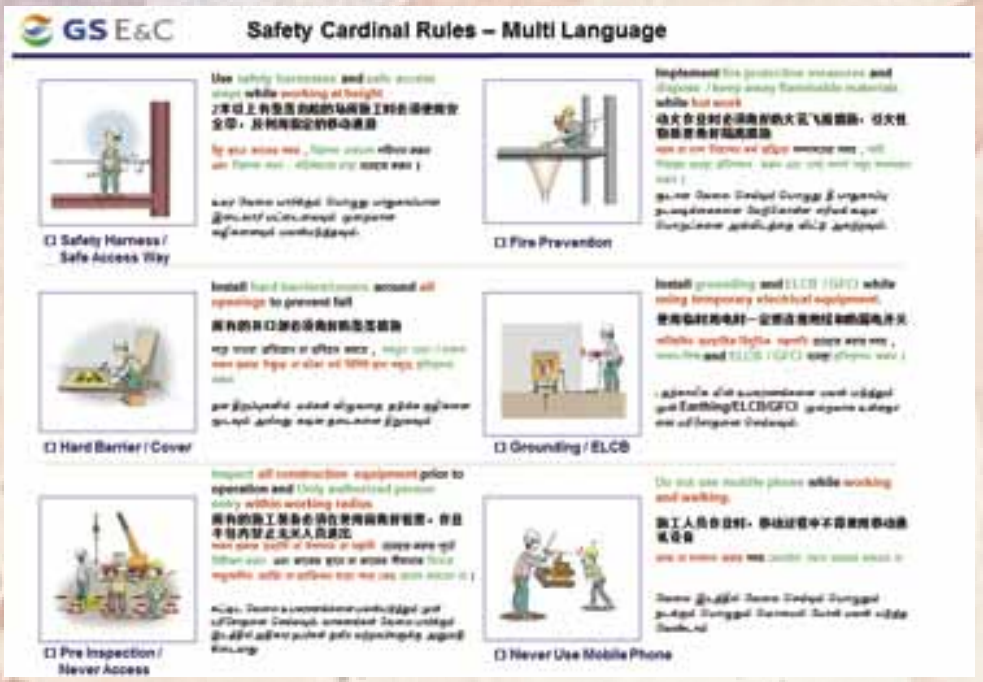

Figure 3: GS E&C Cardinal Rules in multi languages

TAKE 5 PROGRAMME

The Take 5 programme aims to remind workers about the workplace risks, and the effective ways to avoid them. The process of improving workplace safety does not stop even though the risks have been successfully identified. As the main contractor, GS E&C provides assurance to all workers by creating awareness of those risks identified, and effectively educating them through safe work practices.

C925 starts off each day with the Take 5 programme, which is a simple exercise that will take up 5 minutes. Firstly, the supervisor will brief the workers on their scope of work. Next, the workers will have to identify the work hazards and its associated risks, followed by determining the required Personal Protective Equipment (PPE) by cross checking on the Take 5 form (Figure 5).

Through this inclusive teaching process, the workers will be able to apply what they have learnt and help to maintain a safe working environment on site.

Figure 4: Workers in C925 are given pocket sized cardinal rules

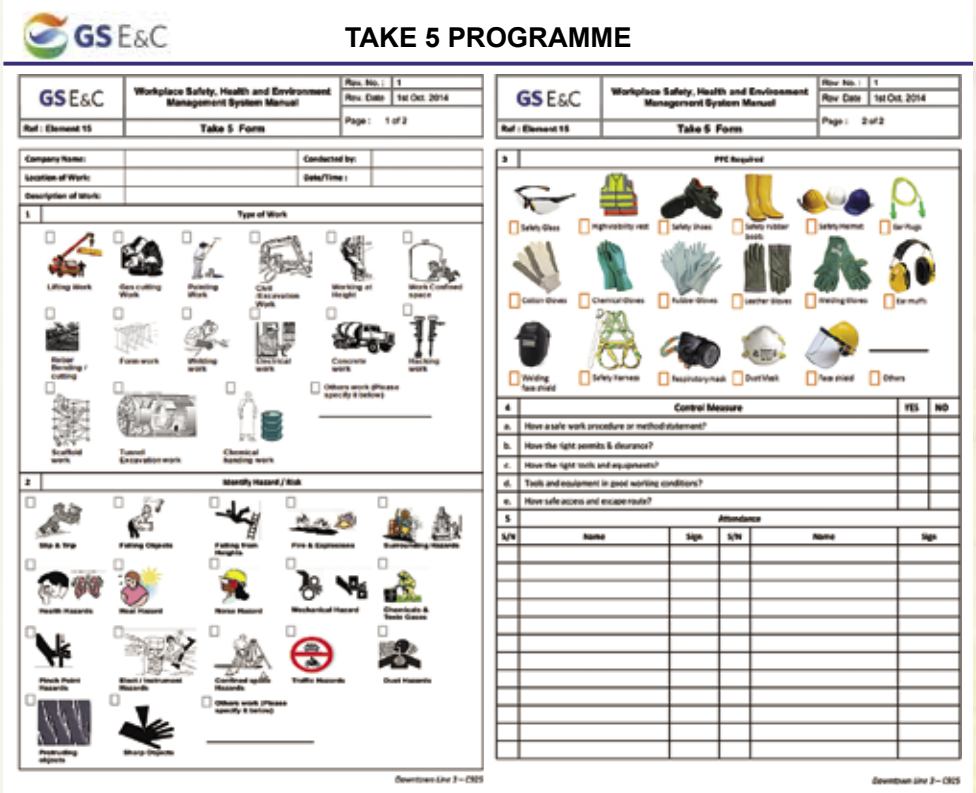

Figure 5: Take 5 form that is used in GS E&C sites

CONCLUSION

A skilled workforce is among the most important attributes that GS E&C looks for in all its projects. As a result of these company-wide efforts to enhance the level of workplace safety & health, GS E&C will continue to concentrate on advanced safety management and site-oriented safety management to ultimately achieve our target of 'Zero Accident'.

Mohammad Hafiiz
Senior Workplace Safety & Health Officer
GS E&C (C925)

KTC's Approach Towards a Skilled and Productive Workforce

INTRODUCTION

KTC Civil Engineering & Construction Pte Ltd (KTC) is very honoured and privileged to be the finalists of the LTA Annual Safety Award Convention (ASAC) for 3 consecutive years. This year emerging as a joint champion had truly showed our commitment and improvement as an organisation.

KTC is the flagship company of the KTC Group. We provide multidiscipline construction services for civil engineering and infrastructure projects. Our corporate philosophy is to uphold a culture of continuous improvement to meet the highest expectations of our clients by enhancing our engineering skills to stay ahead of the competition by exploring and keeping abreast of new technologies and techniques.

At KTC, we treasure our people and uphold the following set of seven Core Values that serve as the guiding pillars of our organisation that reflect the spirit of our company: Safety, Integrity, Ownership, People-Centric, Professionalism, Quality, and Teamwork.

Figure 1: ASAC 2015 joint champions

MAINTAINING A SAFE WORKING ENVIRONMENT

We believe that all workplace-related hazards and injuries can and must be avoided. It is our responsibility to care for the well-being of our people. This is actualised by complying with safety regulations, swiftly rectifying any unsafe practices through the gathering of feedback, conducting regular safety-training workshops to educate our workforce with the requisite safety knowledge, organising safety campaigns, and coordinating mandatory daily briefings to inculcate a strong safety culture in our organisation.

Figure 2: Safety campaigns at the project site

As a result, our ability to sustain a cleaned safety record over the years is a testimony of our pledge to strive for zero accident at all of our worksites through a rigorous safety plan. We also have a committed safety team that is on the ground at all times, making sure that the safety standards are being upheld and maintained.

Figure 3: Our management and the safety team

With the unwavering support from our management and dedicated team surveying the ground, we formed a very robust safety system that oversees all of our worksites, making sure that all safety standards are fulfilled and maintained.

CREATING A SKILLED AND PRODUCTIVE WORKFORCE

In addition to instilling a strong work ethic in our people and recognising their contributions, we ensure that our workforce develops essential competencies and skills through internally and externally conducted training programmes.

Furthermore, in response to the Government's recent initiative to raise construction productivity, we have been on a constant look-out to discover reliable and advanced technologies.

Figure 4: Workers completing their in-house training modules

Through this, we embarked on a series of initiatives and pilot projects such as the Electronic Earthwork Recording System (EERS) and Building Information Modelling (BIM) to enhance quality workmanship and boost the efficiency of our workforce.

Initiatives as such give opportunities to the workforce to get exposed and trained in various ways, bringing them into a higher level at work.

In terms of productivity, with the aid of these advance systems and technologies, we are able to accomplish more in a shorter period of time.

ELECTRONIC EARTHWORK RECORDING SYSTEM (EERS)

EERS is an online truckload monitoring system that prevents vehicular overloading and minimises human intervention, which reduces the exposure of workers to unnecessary risk generated by surrounding vehicles.

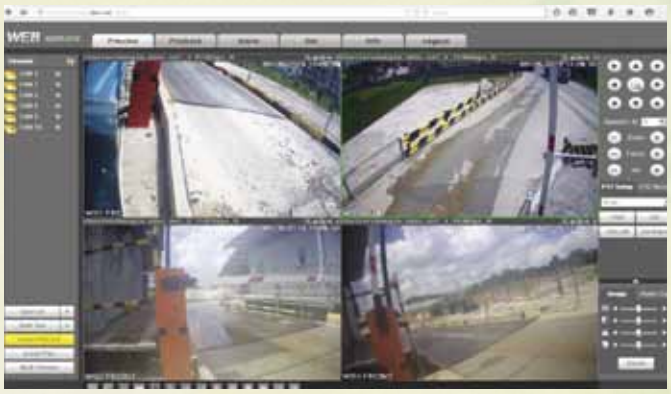

Figure 5: Images captured by CCTV of the EERS

The EERS accurately records the weight and vehicle number of an empty truck as the truck approaches the worksite. The weight of the truck is measured again at the exit after soil has been loaded onto the truck and the laden weight is computed and archived into a database.

This process requires trained workers in the control room to monitor and ensure that the EERS perform its tasks smoothly. CCTVs are installed so that every vehicular movement can be monitored clearly in the control room by the worker (Figure 5).

Figure 6: Truck Scale control system

Figure 7: Workers are not exposed to vehicular movements

BUILDING INFORMATION MODELLING (BIM)

The BIM software is an advanced knowledge-based resource centre. In this system, information can be shared with regards to the digital representation of the physical and functional characteristics of a facility (Figure 8).

Through this software, our team can detect any potential clashes between the services and structures to raise the productivity of the tasks-at-hand.

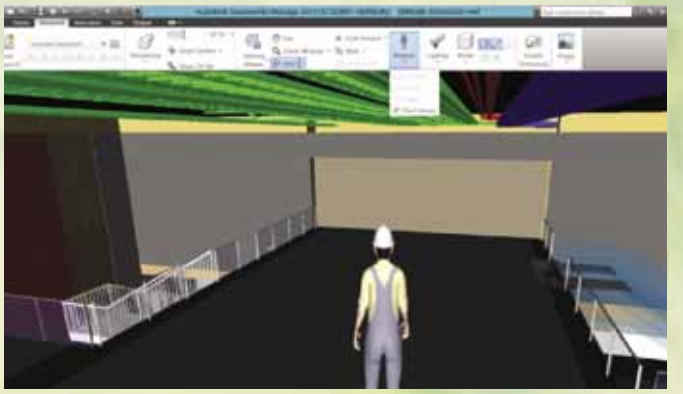

Figure 8: Animated walkthroughs in the BIM software help production teams understand and visualise the building services easily

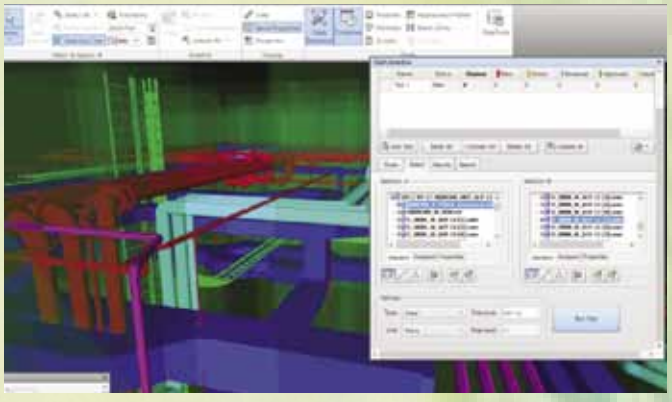

Figure 9: BIM produces detailed crash analysis report

MOVING FORWARD

Safety will always remain as the top priority of KTC. It is regarded as a long-term investment and it is an integral part of the factors that raise the productivity at work.

KTC will continue to look into technologies and methodologies which are safer and more efficient. At the same time, maintaining a skilled and productive workforce through continuous trainings and upgrading.

Rick Hong
Safety Manager
KTC Civil Engineering & Construction Pte Ltd (C925A)

INTRODUCTION

Water is a strategic resource to Singapore. The water discharged from construction sites into controlled watercourses, such as public drains, will eventually flow to our reservoirs where we tap our drinking water. Hence, PUB and NEA are concerned about the quality of the construction wastewater that was being discharged into the watercourse as foam and visible coloured discharge were observed in the public drains. Such foaming and colouration indicate the presence of contaminants which may degrade the quality of our water resources.

Figure 1: Foam entering into public drain

According to NEA, wastewater contaminated with chemicals, diesel, cement, etc. will be regarded as trade effluent. It could potentially pollute the watercourse if it is being discharged without meeting the regulated quality.

Wastewater management has not been well understood by the construction industry and it has often been confused to be part of Earth Control Measures (ECM). In fact, ECM only provides guidelines for managing soil erosions, containment and treatment of silty discharges due to the impact of rainwater, and it is not meant for the treatment of wastewater. In order to address such gap and enhance the wastewater management system on construction site, LTA has consulted members from NEA, PUB, wastewater management industry and our contractors. This article provides an understanding of the legislative requirements related to trade effluent discharge, the different sources of contamination and ways of managing wastewater generated by construction activities.

LEGISLATIVE REQUIREMENTS

Under the Sewerage and Drainage Act, wastewater generated from construction activities is regarded as “trade effluent” and trade effluent is defined as:

“Any liquid, including particles of matter and other substances in suspension in the liquid, which is the outflow from any trade, business or manufacture or of any works of engineering or building construction.”

There are two regulations that govern the management and discharge of trade effluent. These regulations are applicable depending on the discharge point:

- **Environmental Protection and Management (Trade Effluent) Regulations** – for discharge into watercourse
- **Sewerage and Drainage (Trade Effluent) Regulations** – for discharge into the public sewerage system

Under the regulations, it is stipulated that the quality of the discharge shall adhere to the allowable discharge limits as shown in Figure 2.

ALLOWABLE LIMITS FOR TRADE EFFLUENT DISCHARGED INTO A PUBLIC SEWER/WATERCOURSE/CONTROLLED WATERCOURSE

	Items Of Analysis	Public Sewer	Watercourse	Controlled Watercourse
		Units in milligram per litre or otherwise stated		
1	Temperature of discharge	45°C	45°C	45°C
2	Colour	-	7 Lovibond Units	7 Lovibond Units
3	pH Value	6 - 9	6 - 9	6 - 9
4	BOD (5 days at 20°C)	400	50	20
5	COD	600	100	60
6	Total Suspended Solids	400	50	30
7	Total Dissolved Solids	3000	—	1000
8	Chloride (as chloride ion)	1000	—	250
9	Sulphate (as SO_4)	1000	—	200
10	Sulphide (as sulphur)	1	0.2	0.2
11	Cyanide (as CN)	2	0.1	0.1
12	Detergents (linear alkylate sulphonate as methylene blue active substances)	30	15	5
13	Grease and Oil	-	10	1
	Grease and Oil (Hydrocarbon)	60	10	-
	Grease and Oil (Non-hydrocarbon)	100	-	-
14	Arsenic	5	0.1	0.01
15	Barium	10	2	1
16	Tin	10	—	5
17	Iron (as Fe)	50	10	1
18	Beryllium	5	—	0.5
19	Boron	5	5	0.5
20	Manganese	10	5	0.5
21	Phenolic Compounds (expressed as phenol)	0.5	0.2	Nil
22	*Cadmium	1	0.1	0.003
23	*Chromium (trivalent and hexavalent)	5	1	0.05
24	*Copper	5	0.1	0.1
25	*Lead	5	0.1	0.1
26	*Mercury	0.5	0.05	0.001
27	*Nickel	10	1	0.1
28	*Selenium	10	0.5	0.01
29	*Silver	5	0.1	0.1
30	*Zinc	10	1	0.5
31	*Metals in Total	10	1	0.5
32	Chlorine (Free)	-	1	1
33	Phosphate (as PO_4)	-	5	2
34	Calcium (as Ca)	-	—	150
35	Magnesium (as Mg)	-	—	150
36	Nitrate (NO_3)	-	-	20

Figure 2: Allowable limits for trade effluent discharge[1]

Although ECM treatment plants or filter press machines are currently adopted on site for treating of slurry or wastewater to effectively remove suspended solids, other soluble substances however, could still be present in the wastewater. Other regulated parameters, such as pH value, Chemical Oxygen Demand (COD), Total Dissolved Solids (TDS) etc, need to be addressed to meet the allowable limits before discharging into sewers. Without adequate treatment and proper monitoring, the watercourse could be polluted unknowingly by the trade effluent discharge.

IDENTIFICATION OF WASTEWATER SOURCES

During the course of construction and tunnelling works, cement, diesel, hydraulic oil, lubricant, polymers, soil conditioner, etc. are heavily used and they could contaminate the water within the construction site if there is no proper planning and control measures in place. It is essential to identify the sources of wastewater first so as to make provision to manage them downstream. The following are some examples of wastewater sources found in LTA construction sites:

1. Source: http://www.nea.gov.sg/anti-pollution-radiation-protection/water-pollution-control/allowable-limits

Tunnelling Wastewater

- Washout from washing of the invert of the tunnel during construction
- Washout from cutter head intervention
- Outflow of residual water from pipe extensions in tunnel
- Spillage of muck from conveyor belt and muck car

Other Construction Wastewater

- Polymers, ground conditioners and dye used for construction activities
- Processed water from diaphragm wall, bored piling, micropiling, pipe-jacking
- Concrete washout water
- Spillage of hydraulic oil, diesel, excess grouting material, etc

Figure 3: Hydraulic oil spillage at cutter head

MANAGEMENT OF WASTEWATER

Similar to the hierarchy of waste management system, elimination and reduction of wastewater generation should be considered first. This can be achieved by choosing non-toxic soil conditioners and products, providing secondary containment for chemical drums to prevent contact with water, as well as reducing unnecessary use of water for washing of tunnel length.

As the ECM treatment facilities cannot treat trade effluent, wastewater shall not be mixed with silty surface runoff and not directed into the ECM treatment facilities. Instead, the wastewater should be contained separately and either disposed via licensed waste collector or treated in-situ with a separate wastewater treatment system.

Figure 4: Separate containment of tunnelling wastewater at the bottom of the launch shaft

If the contractor proposed in-situ treatment to treat wastewater, they should engage wastewater treatment solution providers to advise the treatment system design and capacity based on the inflow quality and outflow discharge requirements.

In order to ensure compliance to the permitted quality of the trade effluent allowed to be discharged, the contractor shall send samples of the trade effluent for laboratory analysis on a quarterly basis to monitor the quality of the outflow.

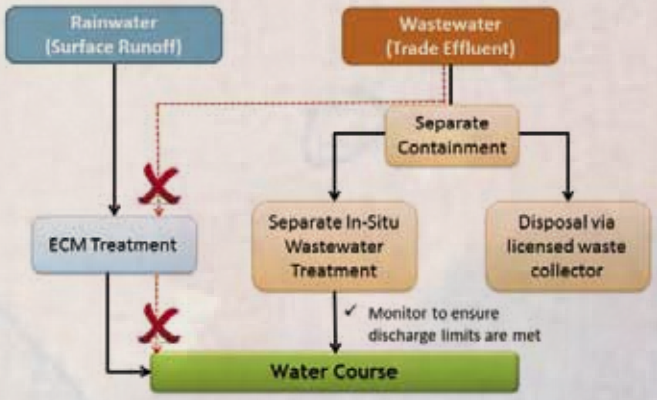

Figure 5: Overall flowchart of wastewater management

Last but not least, all these practices shall be documented inside the waste management plan, under wastewater management section. This portion shall include the activities and sources that generate wastewater, list of chemicals used on site, procedures for handling, disposing or treating of wastewater and a contigency plan in the event of wastewater spillages into drains.

ADDITIONAL INFORMATION ON GROUNDWATER

Groundwater ingress are common in our sites, and in certain areas, the amount of groundwater ingress can be substantial. Depending on the location, the groundwater can contain heavy metals and high salinity that may exceed the permissible trade effluent discharge limits. While NEA does not classify naturally occuring groundwater to be trade effluent, such water may impair the water treatment plants of PUB which supplies potable water for Singapore. Hence, LTA projects have also put in a lot of control measures to reduce as much groundwater ingress as possible.

CONCLUSION

Wastewater generated from our construction activities, if not controlled and treated properly, will eventually end up in our waterways and reservoirs which form part of our drinking water system. LTA ensures proper management of wastewater so as to build our projects in an environmentally responsible manner to safeguard our precious water resource.

Teng Wei Ling
Deputy Environmental Manager
Safety Division

Safety Considerations of the Detrainment Door for SPLRT 2 Train-car Operation

INTRODUCTION

The Sengkang Punggol Light Rail Transit (SPLRT) system is located in the north-east region of Singapore. Opened in 2003, it is the second LRT line which connects the residents of Sengkang and Punggol with the North-East Line.

Since the SPLRT system started its operations, its ridership has been steadily increasing over the years. As Sengkang and Punggol towns continue to expand its township, this trend will continue.

INCREASING SYSTEM CAPACITY AND 2 TRAIN-CAR OPERATION

To meet future demands, in 2012 a decision was made to increase the capacity of the SPLRT line. 16 of the 41 existing single train-cars will be modified to allow coupling for 2 train-car operations. 16 additional new cars will also be procured, bringing the fleet size to a total of 57 train-cars, a 40% increase as compared to the current fleet size of 41 single train-cars.

With the modification, the SPLRT system will be able to accomodate both the single train-car and the 2 train-car operations.

Figure 1: Section view of SPLRT 2 Train-car

DETRAINMENT FUNCTIONS FOR 2 TRAIN-CAR OPERATION

The ability to detrain passengers in the event of emergencies, breakdowns, or any other incidents is one of the many key safety considerations for railway system.

As the new SPLRT train-cars can either operate as a single train-car or in a 2 train-car configuration (see Figures 2 and 3), the ends of the car used for detrainment would have to cater for both detrainment to guideway and car-to-car detrainment (detrainment via adjacent car for 2 train-car configuration). These requirements posed design challenges for the modification of the existing SPLRT train-cars.

When the SPLRT train-cars are operated as a single train-car, both ends of the vehicle allow for the detrainment of passengers onto the guideway. However, when two single train-cars are coupled to form a 2 train-car configuration, the coupled end must allow for safe access for car-to-car detrainment. As for the uncoupled end, detrainment stairs to guideway are provided (Figure 2).

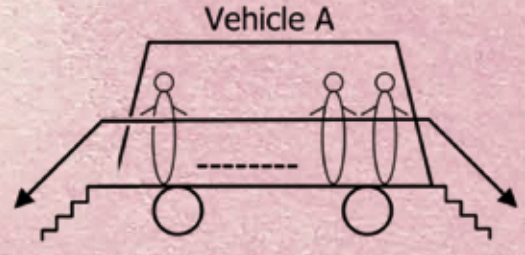

Figure 2: Detrainment direction of SPLRT vehicles with single train-car configuration

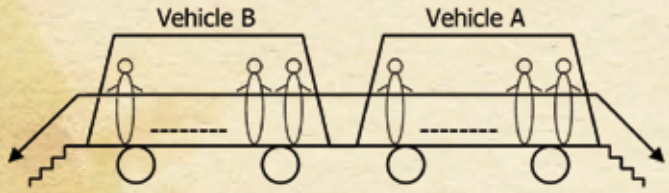

Figure 3: Detrainment direction of SPLRT vehicles with 2 train-car configuration

CHALLENGES FACED AND MITIGATING SOLUTIONS

Challenge 1: Large gap in between 2 train-cars

The gap distance between the 2 train-cars at the coupled end is 713.6mm. This is a concern as it posed risk of passengers falling onto the guideway while evacuating to the adjacent train-car.

Solution: Upper door and lower door (Gangway) Detrainment door system

To mitigate this, an integrated gangway plate is considered for deployment, to serve as the platform to bridge the large gap during car-to-car detrainment. However, for functionality and safety purposes, the final design for the detrainment door system consists of 2 parts; an upper door that swings sideways, and a lower door that deploys automatically to form a gangway (Figure 4). This allows for safe access to the adjacent train-car.

Figure 4: Section view of gangway plates

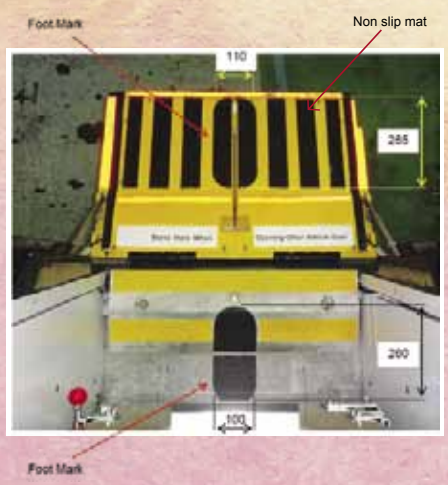

Figure 5: Plan view of gangway plate

The gangway plate is coloured in bright yellow to enhance its visibility during detrainment under low light conditions. Non-slip mats are added to the gangway plate to mitigate slipping hazards (Figure 5).

Challenge 2: Obstruction of detrainment stairs at the coupled end of the 2 train-car

The design of the existing SPLRT train-car is equipped with detrainment stairs at both ends of the vehicle. In a 2 train-car configuration, the detrainment stairs will not be used at the coupled end. One of the proposed solution was to remove the detrainment stairs . However this solution posed an operational constraint as these designated train-cars cannot be used for single train-car operation.

Solution: Stowage of detrainment stairs

The final design calls for the addition of a rotational device to allow the detrainment stairs to be stowed to the side. This creates a clear passage for access to the gangway during emergencies. The operation of the detrainment stairs for the single train-car or the 2 train-car is now the same.

Figure 6: Detrainment stairs stowed to the side in a train-car

Figure 7: Clear passageway for access to gangway in car-to-car detrainment

Challenge 3: Passenger maybe confused by the different methods of detrainment

Displaying clear and concise signages are an integral part of the detrainment process. Signages should be designed in a manner that its instructions on the use of the detrainment equipment (i.e. deployment of detrainment stairs or gangway plate) are straightforward, and can be easily understood by passengers. With the ability to operate the train-cars in 2 different configurations, attention to visual graphics outlaying its intended message has to be considered in its design.

Solution A: Use of different colour schemes

Colours have long been used as a means for differentiation and identification of different parts / processes. Similarly, for this project, different colours have been used to identify the 2 different detrainment processes (i.e. car-to-car detrainment, or direct evacuation from train-car to guideway).

Knobs / switches are coloured, and signages are also placed at the suitable locations to indicate the steps required for deployment of the detrainment equipments.

Figure 8: Red signage showing instruction for car-to-car evacuation, whereas the yellow signage showing instruction for direct evacuation to guide way

Solution B: Usage of pictures and pictograms

The usage of pictures complement the detrainment instructions. Thus, its intended message can be easily understood by passengers of other nationalities.

Figure 9: Pictures showing coloured knobs and step number sequence for easy identification

Figure 10: Pictograms on detrainment signage

CONCLUSION

The modification works to the SPLRT system, with the train-cars ability to adapt to different configurations, and the complexity of the entire detrainment equipment, posed significant challenges. By embracing the principles and concepts from Design for Safety, foreseable risks thoroughout its operational phrase are identified. Through safety consideration and intervention, risks are thus mitigated by having practical and effective solutions in-built to the SPLRT system. Passenger safety continues to remain our top most priority.

Sum Zhuohao
Senior Project Engineer
Network Renewal (Systems)

EDITORIAL PAGE

CONTRACTORS' SAFETY FORUM 2016

LTA hosted the Contractors' Safety Forum on 15th February 2016 at the HSO Auditorium. It was attended by more than 200 Main Contractors' Senior Management. The safety forum served as an excellent platform for sharing of lessons learnt from recent accidents at our worksites and safe work practices to prevent similar occurrences.

In the opening address delivered by LTA Chief Executive, Mr. Chew Men Leong, he encouraged contractors to take on a proactive stance and improve on their culture of near-miss reporting to prevent future accidents from taking place. It is envisaged that such forums will go a long way, assisting our contractors in maintaining a high-level of safety standards at their worksites.

Five presentations were made during the Safety Forum. The topics presented were:

- Near Miss Incident by LTA Safety Division
- Sharing of good WSH practices: Near Miss Reporting System – The Samsung Way by Samsung C&T Corporation
- Lessons learnt from recent fatal accident by Tiong Seng – Dongah JV (Contract T220)
- Lessons learnt from recent fatal accident by Or Kim Peow Contractors (Contract ER391)
- Lessons learnt from recent dengue outbreak by Cooperativa Muratori & Cementisti - C.M.C Di Ravenna (Contract 926)

Figure 1: LTA Chief Executive, ***Mr. Chew Men Leong***

Figure 2: LTA Deputy Safety & Health Manager, ***Mr. Kenneth Cheong***

Figure 3: Safety Manager from Samsung C&T Corporation, ***Mr. Kelani Bin Mohamed Amin***

Figure 4: Corporate Safety Director from Tiong Seng – Dongah Joint Venture, ***Mr. Andrew Khng***

Figure 5: Project Director from Or Kim Peow Contractors, ***Mr. Allen Yee***

Figure 6: Planning Manager from Cooperativa Muratori & Clementisti – C.M.C Di Ravenna, ***Mr. Alex Puzderliski***

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