

香港空調及冷凍商會有限公司 THE HONG KONG AIR CONDITIONING AND REFRIGERATION ASSOCIATION LIMITED

SUMMER 2015 Newsletter 會員通訊





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Dave Chan President

Stepping into the first half of 2015, our construction industry is still busy but the shortage of skilled labour and technicians are still affecting us. The snapshot manpower survey conducted by FEMC showed that there was a shortage of 16% in the E&M industry. The good news is that the TSS scheme is able to



attract more new blood to join our industry with 21% more student intake in 2014/15 than the year before. In addition, CIC has a plan to improve the current CCTS(E&M) scheme to attract more new entrants and launch a new pilot scheme to train up more skilled workers. We have provided feedback to fine tune the systems and procedures and our goal is to have a user-friendly system for easy implementation.

In addition, ACRA is the active member and supporter of the E&M trade promotion group headed by EMSD. We just held a Career Expo 2015 in Kwai Chung IVE in March which had attracted many secondary school students to visit. We will continue our effort in 2015 to organize more activities and events to promote our E&M industry and to attract more new blood to join.

The Construction Workers Registration (Amendment) Bill was passed by the Legislative Council in December, 2014. The Amendment Ordinance has become operational since 1 April 2015. The stage 1 implementation which will cover new construction and major addition, alternation and improvement works, will commence from 1 April 2017, will require designated works to be carried out only by registered workers for the designated trades, also known as "designated workers for designated skills. To cope with this Ordinance, a one-off Senior Workers Registration Arrangement has been made to allow senior workers to register as skilled workers for the work trades they are experienced in. So, all members are encouraged to ensure our subcontractors are aware of the requirements and encourage and help their workers to register.

The average daily wages of workers as published by C&SD has great impact to the contract price fluctuation in public work contracts. As such, we have been looking into various ways to improve the data integrity. A workshop was conducted earlier this year to share the experience and brainstorm measures to improve the submission mechanism. One of the proposals is to split the AC Mechanic into air side, water side and AC electrician and BS Maintenance Mechanic into individual trades. Our objective is to improve the GF527 submission mechanism so that the data published can more accurately reflect the actual wages.

Training is our key focus this year. Our training committees have been busy in organizing various training to our members. Early this year, we have jointly organized a training seminar together with ASHRAE HK Chapter on ASHRAE Standards 189.1 and 90.1 – Green Building Efficiency. After Easter Holiday, we have conducted another three lectures in the Joint Professional Training Course on Building Service engineering, jointly organized by FEMC & its constituent associations. Later this year, we will jointly work with ASHRAE/BSOMES /CIBSE/HKIE to organize a "Joint Comprehensive Certificate Course on HVAC&R System in Buildings". Our goals are to train up our young engineers with more practical skills and knowledge on air-conditioning and energy efficiency.

The Building Energy Code will be reviewed at 3-yearly intervals. The first review is now being conducted by EMSD and ACRA representatives are sitting in the working groups to provide our professional advices on improving the energy efficiency of air-conditioning installations.

Finally, I wish to thank all our council and committee members for their hard work. Their dedication and commitment are crucial to the success of ACRA.



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New Energy Saving Initiatives: What opportunities are open for us ?

Energy Saving Plan For 2015~2025+

The Environment Bureau has released the first-ever energy saving blueprint for Hong Kong in May 2015. The Energy Saving Plan for the Built Environment 2015~2025+, which sets a new target of reducing Hong Kong's energy intensity by 40% by 2025 using 2005 as the base. It replaces the old target of reducing it by 45% by 2035, which was adopted at the 2011 Asia-Pacific Economic Cooperation (APEC) forum. Energy intensity refers to the quantity of energy needed to produce one unit of gross domestic product (GDP). To translate the new target into actual energy reduction, it would mean cutting consumption by 6 % of the total energy consumed in 2012.



End-uses of electricity in Hong Kong, 2012'

Total

155,0791

Energy Use in HK

Of the energy consumed in 2012, the commercial sector accounted for the largest share (42%), followed by the transport sector (32%), residential sector (21%) and industrial sector (5%). In Hong Kong, more than half (54%) of our total annual energy use is in the form of electricity consumption, with buildings consuming about 90% of the city's electricity use.

Hong Kong consumed 43,078 million kWh of electricity in 2012. Air-conditioning accounts for 30%, lighting 13%, office equipment 8% and cooking 8% respectively of the total electricity end-uses. So, air-conditioning is the largest electricity end-use in Hong Kong.

Government manages about 8000 buildings and facilities and is one of the largest users of electricity in Hong Kong consuming more than 6% of total electricity

consumption. In the residential sector, Government is also the biggest landlord and developer. Currently, 45% of total energy use in residential buildings is consumed by public housing. So, it is important for the Government to take the leading role in achieving higher energy efficiency and standards.



Going Forward

Hong Kong has laid a good foundation on achieving better energy saving in buildings. Since the 1990s, the Government has made considerable efforts in collaboration with building professionals to promote green building and buildings' energy efficiency. The Government will continue to engage different professional bodies such as HK Green Building Council to push green building transformation in both new constructions and existing buildings retrofitting. The Government will also launch city-wide campaign to encourage people to save energy on daily basis.

Tighten Regulatory Tools

On the legislation side, the Government will tighten the regulatory tools including the Building Energy Codes (BEC) and Mandatory Energy Efficiency Labelling Scheme (MEELS). For the BEC under the Building Energy Efficiency Ordinance (BEEO), it will be reviewed once every three years with the first review to start in 2015 by making reference to the latest technological development, international standards and public aspirations. In the air-conditioning part, the energy efficiency requirements for major air-conditioning equipment such as chillers, unitary air-conditioners and cooling towers will be reviewed and tightened. For the energy grading standards under MEELS, EMSD has tightened the grading standards for room air-conditioners, refrigerators and washing machines last year. Furthermore, EMSD will extend the coverage of MEELS to more appliances. These efforts would save significant amount of energy and lower the overall energy intensity.

Government Taking the Lead Going Green

In 2015, the Government has adopted a new target of reducing another 5% energy consumption for government buildings from 2015-2020 using 2013-14 as the base. On 1 April 2015, the Development Bureau together with Environment Bureau has issued a new Circular to define the new Green Building Performance Framework for new and existing government buildings. Some of the new initiatives include:-

- All new government buildings with construction floor area (CFA) of more than 5,000 m2 should aim to outperform BEC by the following percentages:
 - office, recreational and community > 10%
 - Cultural, schools, educational, hospital and health facilities > 5%
 - All others > 3%
- All new government buildings with CFA less than 5,000 m2 should also aim to outperform BEC by at least 3%
- All new government buildings shall incorporate energy efficient features where appropriate. Typical energy efficient features include, but not limited to, building energy management system, energy efficient air-conditioning system, etc.
- Energy monitoring shall be installed for each piece of equipment > 50kw or sub-main distribution > 100A (3-phase 380V)
- At least 1% of electricity consumption shall be provided by renewable energy
- All existing government buildings undergoing major retrofitting should aim to achieve energy performance in line with the requirements for new government buildings







New Energy Saving Initiatives:

What opportunities are open for us ?





Opportunities in the Industry

Currently, Hong Kong has 42,000 existing building stock with majority of them are over 20 years old. These buildings were normally designed and equipped with systems and equipment not meeting today's energy efficiency standards. With the

technological advancement, there will be more innovative technologies and products coming out from the market. Together with the progressive tightening of BEC, the demand for energy retrofitting and upgrading work will increase. Some of the opportunities include:-

- Energy audit and report
- Equipment replacement with more efficient products (eg. VSD chillers and pu
- Energy retrofitting with better system design
- Re-commissioning to ensure buildings perform to their design standards
- Intelligent metering of energy data
- Integration of energy and operation data into a single IT platform
- Energy management reporting software





It creates a big market for energy efficient products, intelligent building systems and energy services retrofitting works. We foresee the energy services market will continue to grow in Hong Kong.



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People Interview with Mr. Albert Lee

香港空調及冷凍商會有限公司 The Hong Kong Air Conditioning and Refrigeration Association Limited

安利機械工程有限公司 李鼎強先生

我們很榮幸能邀請到安利機械工程有限公司李鼎強先生(Mr. Albert Lee),人稱「拔哥」,接受是次訪問。在整個訪問過程中,我們深切感受到拔哥的友善,和藹可親及成功人士的正面態度。



入行經過

60年代,拔哥於中學畢業後就出來社會工作,最初是從電腦廠技術員開始,之後獲得獎學金進修電子課程。當時 拔哥住在大坑道,跟在長沙灣的公司有一段距離,但他不怕辛苦。每日需要上午六時起床,坐巴士往灣仔碼頭, 再坐船到佐敦轉乘廠車上班,早上八時半準時到達公司,由於每天要長途跋涉上班,三個月後拔哥體重大減。當 時拔哥的親大哥是一所教會的牧師,碰巧有一教友知道開利冷氣正聘請員工,拔哥又曾修讀電子課程,認為可以 一試。當時負責面試的就是熊翰章博士(Dr. George Hung),George喜歡拔哥的陽光型性格,覺得他很合適,所 以就安排拔哥見老闆黃宣平先生,最後就受聘於開利冷氣公司。剛開始時拔哥是跟George學習怎樣做銷售的工 作,George亦教了拔哥很多有關冷氣和工程的知識,所以George可以說是拔哥的師父。拔哥越做越有興趣,除 銷售外更兼顧安裝工程。從工地視察、呈意見書、計算報價到找判頭開工等一連串的工作都需要兼顧,令他對公 司的運作加深了認識,對他日後自己開公司的幫助很大。

拔哥不斷進修,通過自學及上堂,對冷氣及公司管理的認識更上一層樓。雖然工作已經上了軌道,但二十出頭的 拔哥對將來沒有什麼打算,心裡有點迷茫,只是本著隨遇而安的輕鬆心情去探索未來,這也是在那個年頭一般年 青人的心態。

從打工到創業之路的經過

因老闆在社會上地位高,人面廣,當時在開利做銷售很容易,每日生意不斷,十分輕鬆,大部分香港的私人市場 冷氣工程當時都是由開利奪得。70年代末,美國開利廠要求香港代理只專注銷售工作,老闆黃宣平先生年紀又漸 老,便把有關生意轉讓給有馬來西亞背景的Sime Darby,部份在開利工作多年的同事都因此轉到Sime Darby工 作。當時Sime Darby的辦公室是在銅鑼灣的温莎大廈,佔地甚廣。

後期工程的發展沒有預期理想,加上當時有一位同事極力建議拔哥嘗試自己開公司做老闆,所以拔哥便決心與 一位開利的前合作伙伴自立門戶,創立了安利機械工程有限公司。拔哥負責接生意,他的伙伴負責工程安裝的 部分,生意做得有聲有色,拔哥把最初賺到的錢用來投資位於荃灣的物業,亦把這物業作為辦公室用途。憑著個 人的努力工作、不怕辛苦,生意慢慢擴充起來。後期因Sime Darby改組,Sime Darby亦將香港開利的經營權售 回美國開利廠。之前從開利轉職到Sime Darby的舊同事又重新回歸到香港開利工作。拔哥因以前工作關係,當時 向開利取貨可以有60日數期,加上工程可以預支上期,而當時的判頭是完工後或按工程進度才需要付款,在現金 充裕下,拔哥就投資物業,隨著地產升值,拔哥亦進入小康時期。在80年代初期,公司亦隨著發展需要而搬進現 時荔枝角的辦事處。



在拔哥的冷氣工程生涯中,有一位客戶對他幫助很大,由1969年當他還在開利工作時就開始服務這客戶,這客戶是香港的一名隱形富豪。當拔哥在開利工作初期,George就委派拔哥負責這個於山頂有物業的客戶,這客戶對拔哥十分滿意,亦很倚賴他。每當這客戶有新物業發展,一定會找拔哥負責冷氣工程的部分,這種關係一直延續到現在。

雖然業務發展順利,拔哥亦曾於90年代初考慮把公司結束。事緣有一個工人出身的員工,升到管理層後,卻出賣 了公司,拔哥很失望,就萌生了結束公司的想法。幸好當時有一位同事,為人誠懇及有幹勁、並有自己一套管理 的哲學,對拔哥説安利的生意做得很好,每年都有賺錢,不應該只為了一個出賣公司的員工而把公司結束,他承 諾拔哥幫他全盤看守公司,希望拔哥改變主意。從此,安利事無大小都交由他接管,亦為公司的一個轉捩點。

對工作及管理的心得 - 無為而為, 跟員工一起分享成果

拔哥最欣賞施永青先生的無為而為,他認為越多目標只會給自己帶來更多迷茫,他以此為自己做人宗旨,所以過 去的幾十年都過得非常愉快。他從沒有給員工定下生意目標,任由他們自己發輝,他從不當面責罵員工,只會從 旁勸導。

很多的員工都於安利工作了很多年,部分更達三十年以上。拔哥認為公司老闆的治理概念對公司的管理很重要, 他覺得大部份人往往喜歡控制別人,如果老闆希望做到上下一心,就必須要學會放手,融入同事中,一起為同一 個目標進發。他認為每位員工都各有自己的天賦才能及潛質,應該容忍同事在工作上出錯,好好引導才是,使員 工可以發揮得更好;另外老闆不應該只往錢看,錢是員工辛辛苦苦地為公司賺回來的,公司沒有他們就沒有現在 的成果,他們是有權合理地分享公司利潤,能與員工一起分享成果,才能使員工建立歸屬感及動力,留住他們繼 續為公司奮鬥。拔哥認為成功的要訣離不開人脈、經驗、公司口碑、個人誠信及處事作風,讓員工了解公司運作 並給予員工應有的權力使員工有滿足感。當員工做得安心及開心時,自然會主動投入工作,公司才可以得到最大 的益處。





Ready Electrical Metal Work Ltd. was incorporated in July 1992. Since the company has built up a renowned brand name for low voltage switchboard manufacturer in both Mainland China and Hong Kong. The factory in Dangguan (東莞) together with the Hong Kong office, offer a comprehensive service of high quality switchgear systems and electrical panels for various application in diversified construction industry.

Ready employs over 200 staff to handle professional and technical work. The product range includes Low Voltage Cubicle Switchboards, Motor Control Centre and Motor Control Panel. High reliability, professional technical support and after-sale services are the main advantage of Ready's products.

Ready is fully aware of the importance of quality and has undertaken to test every detail of its design in accordance with the latest edition of BSEN 61439-1 & 2. Furthermore, we have been successfully pass the Type-Test and certificated by the Association of Short-Circuit Testing Authorities (ASTA)

Ready L. V. Switchboard also pass the type test in accordance with the requirement of Mainland China Power Supply Authority on December 1996. We award "CCC" certification and are accredited by Mainland China Government on 2003 as well.

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Major Projects References:

- Kwun Tong Public Swimming Pool
- Tuen Mun (NW) Public Swimming Pool
- Tung Chung Public Swimming Pool
- Hang Seng Management College Swimming Pool
- Diocesan Girl School Swimming Pool
- Holiday Inn Express, Wharney Gaungdong Hotel
- Disney's Hollywood Hotel, Cosmopolitan Hotel
- Sham Tseng & Stonecutter Island Sewage Plant
- Ocean Park, Cathay Pacific Airways
- HSBC Data Centre, Shek Mun
- Tsing Yi Sport Centre, Macpherson Indoor Stadium
- Hong Kong Sport Institution, Hong Kong University
- Yuen Long Library, Ko Shan Theatre



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The 2nd phase of "Construction Workers Registration Ordinance"

The 2nd phase of "Construction Workers Registration Ordinance" has taken effect from 1 April 2015 as following key points:

1. Registration by skill - Designated workers for designated skills :



Only registered skilled workers are allowed to carry out designated skill works. Create new skills as necessary to facilitate registration to recognize their skills and raise their status. Skilled workers can carry out construction works of the respective trade divisions personally under the provision of "designated workers for designated skills" to be effective on 1 April 2017.

2. Multiple skills – Higher employability :

Encourage workers to become multi-skilled in order to enhance their employability. Create master skills to recognize status of multi-skilled workers

3. According to industry's practice, work across similar skills : A registered skilled worker of designated skill is allowed to work across similar skills

4. Skilled work under "instruction and supervision" – General workers can take part :

A registered general worker may carry out designated skill work under the "instruction and supervision' of a relevant skill-registered worker.

5. Exempted works – General workers can take part :

Contractors may arrange registered general workers to carry out designated skill out of exempted works e.g. emergency or small scale work.

6. Publicize exemption arrangements – Ensure workers' understanding :

Contractors and sub-contractors shall implement reasonable measures to ensure that workers fully understand the "instruction and supervision" and "exempted

work" arrangement; CIC will issue code of practice to provide guidance on the reasonable measures.

7. One-off registration arrangement for senior workers :

One-off arrangement for senior workers who possess not less than 10 years' relevant working experience to register as Registered Skilled Workers. After the enactment of 2nd phase of the Ordinance, qualified workers who possess not less than 10 years' relevant work experience of specified trade divisions can become registered skilled workers through the Senior Workers Registration Arrangement, without a need of passing trade tests. Application is accepted on or



before 30 September 2016 according to arrangement as indicated on the right.

Trade Division Code	Trade Division Name	Trade Division Code	Trade Division Name	
E314	Refrig. / Air-cond. / Vent. Mechanic (Master)	E305a	Control Panel Assembler	
E314a	Refrig. / Air-cond. / Vent. Mechanic (Air System)	E303	Cable Jointer (Power)	
E314b	E314b Refrig. / Air-cond. / Vent. Mechanic (Electrical Control)		Cable Joiner (Low Voltage) E303a	
			Cable Joiner (Low Voltage)	
E314c	Refrig. / Air-cond. / Vent. Mechanic (Thermal Insulation)	E305b	Electrical Wireman	
E314d Refrig. / Air-cond. / Vent. Mechanic (Unitary System)		E3036	Electronic Equipment Mechanic	
			(Construction Work) (Master)	
E314e	Refrig. / Air-cond. / Vent. Mechanic (Water System)	E323	Building Security System Mechanic	
E306a	Fire Service Electrical Fitter	E324	Communication System Mechanic	
E306b	Fire Service Mechanical Fitter	CE310	Plant and Equipment Mechanic	
			(Construction Work) (Master)	
E311	Overhead Linesman	E310	Mechanical Fitter	

The arrangement is applicable for 105 trade divisions, in which 18 divisions are related to E&M trades as following :

Besides the principle trade division, qualified worker applies for the Senior Workers Registration can also apply for the registration of other E&M division as following table. The applications should be made at the same time.

Principle trade division (already possessed the proof of 10 years' work experience)		Other relevant designated trade division	
E314a	RAV Mechanic (Air System)	E314c	RAV Mechanic (Thermal Insulation)

Qualified worker can also apply for the registration of Registered Skilled Worker of other trade division(s) according to the corresponding requirements of work experience listed in the below table (which are less than the statutory requirement of work experience). The applications should be made at the same time.

Principle trade division (already possessed the proof of 10 years' work experience)	Other relevant designated trade division(s)	Requirement of work experience of other relevant designated trade division(s)
E305a	E314b & E306a	Additional 1 year's work experience proof of RAV Mechanic (Electrical
Control Panel Assembler		Control) and 1 year's work experience proof of Fire Service Electrical Fitter
E314b	E305a & E306a	Additional 0 year's work experience proof of Control Panel Assembler
RAV Mechanic (Electrical Control)		and 1 year's work experience proof of Fire Service Electrical Fitter
E306a	E314b & E305a	Additional 2 years' work experience proof of RAV Mechanic (Electrical
Fire Service Electrical Fitter		Control) and 1 year's work experience proof of Control Panel Assembler
E314c	E314a	Additional 3 years' work experience proof of RAV (Air System)
RAV Mechanic (Thermal Insulation)		
E314d	E314a & E314c	Additional 3 years' work experience proof of RAV Mechanic (Air System)
RAV Mechanic (Unitary System)		and 0 year' work experience certificate of RAV (Thermal Insulation)
E314d	E314c	Additional 1 year's work experience proof of RAV Mechanic
RAV Mechanic (Unitary System)		(Thermal Insulation)
E314e	E314d; E314c & E314a	Additional 0 year's work experience proof of RAV (Unitary System),
RAV Mechanic (Water System)		0 year's work experience proof of RAV Mechanic (Thermal Insulation)
		and additional 2 years' work experience proof of RAV (Air System)

Remark : RAV = Refrigeration / Air Conditioning / Ventilation

Construction Workers should submit a completed "Application Form for Senior Construction Workers Registration" & "Working Experience Certification Form for Application for Senior Construction Workers Registration (Form SWR1)" together with all required documents (originals and copies)in person to any Workers Registration and Renewal Service Point for application. Working experience to be certified by means of 1. Employers; 2. Trade Unions or 3. Statutory Declaration (Oath) with limit to not more than three years.

Being one of Construction-related Trade Associations, ACRA Members can certify their direct employees or contractual relationship of lower layer of sub-contractor in the above application form. The code of ACRA is 212.

Please visit the website of the Construction Workers Registration Authority **http://cwr.hkcic.org/information/ccwro.asp** for details.

Differences Between Oil Free Chiller and VSD Chiller

Introduction

By: Kelvin TANG & K. L. CHAN

With the increasing energy conscious, the application of a Variable Speed Drive (VSD) is pretty common at different kinds of HVAC equipment. VSD plays an important role in optimizing the system efficiency at part load conditions; therefore, it is easily found at the condenser pumps, distribution pumps, condenser fans and even used at the chillers. It is because, in most cases, the E&M consultant will size HVAC equipment to meet the full load requirements with some safety margin in cooling capacity. However, this peak load condition will occur in some occasions only. VSD device can regulate the speed and rotational force of the compressor to meet with the partial load situations for better energy saving. Although there are benefits of using VSD devices at part load conditions, the application of VSD to HVAC equipment was limited in the past because of the huge price difference and limited choices. Until the Oil Free Chiller¹ is widely accepted by the market due to its unique feature of magnetic bearing at the centrifugal compressor with no lubrication oil and the VSD technology becomes maturity. Major chiller manufacturers were driven to develop the VSD chillers to compete with Oil Free Chillers, it is worth to explore in more details by knowing the differences between Oil Free Chiller and VSD Chiller.

The facts about the Oil Free Chiller

Nowadays, Oil Free chillers become an icon of energy efficiency. In fact, an Oil Free chiller is also a kind of VSD chiller and using a Centrifugal type compressor with magnetic or ceramic bearing. The full description of an Oil Free Chiller should be Oil Free VSD Centrifugal Chiller with magnetic or ceramic bearing. An Oil Free chiller consists of one to multiple centrifugal compressors, each compressor integrated with a variable speed drive. By adopting the digital controlled electromagnetic coupled with the positioning bearing built-in signal sensors ring, the entire moving assembly, i.e. the rotor shaft and the 2-stage impellers are positioned and levitated into a magnetic field. There is a pair of backup touch down bearings equipped in the compressor designed to protect the rotating shaft when the shaft is falling down due to sudden power failure. Furthermore, the impeller of the Oil Free chiller is relatively small; the rotating speed is extremely high (up to 48,000rpm) in order to maintain the sufficient tangential velocity of the impeller to generate the required pressure head for the compression.

Beyond the screen, VSD is the main feature of an Oil Free chiller giving high value of Integrate Part Load Value (IPLV)² and adverse performance at the full load efficiency. But most of the people did not understand this and always think that oil free or magnetic bearing is the key element to the energy efficiency. It was mentioned by Mr. Roger Richomd-Smith, the President and CEO of Smardt Chiller Group during the interview by the JARN Journal³ last year. "The magnetic bearing without lubricating oil only contributes very low percentage of energy saving to the overall performance of an Oil Free Chiller." Except the difference in features, the operating principle of the Oil Free Chiller is also different from conventional chiller with multiple compressors. Multiple compressors of an Oil Free chiller will be loaded and unloaded at the same time to achieve better part load performance. For conventional chiller with multiple compressors, stack control and compressor rotation will be applied. This makes the life of an Oil Free centrifugal chiller equivalent to conventional screw chiller



even though the expected life of centrifugal compressor is longer than that of the screw compressor. The frequent operation of centrifugal compressor will offset the advantage in expected life between centrifugal and screw compressors. Although the mechanical components will have the similar life span, it is not the same for the electrical components.

In addition, most of the Oil Free chiller manufacturers did not make Oil Free compressors by themselves. They bought Oil Free compressors from a single supplier and there are only few standard models of Oil Free compressors available. When Oil Free compressors break down, the general practice is to replace a new one. The limited models of Oil Free compressors make the replacement of compressors amongst different chiller suppliers simple provided that there are stock of Oil Free compressors and quality service providers available. Without the oil management system including the oil pumps, oil separators, heaters, etc., the risk of breaking down of Oil Free chillers will be lowered. Oil Free compressors may require less maintenance, but the chillers still need routine maintenance service for other electrical components, refrigerant circuits, condenser & chilled water systems and cabinet and related hardware, etc. There are capacitors on the Oil Free compressors which have a lifetime of 5 - 10 years. In few cases, the failure of the capacitors caused the replacement of the whole compressor.



Air-Cooled VSD Screw Chiller





Air-Cooled Oil free VSD Centrifugal Chiller

Water-Cooled Oil free VSD Centrifugal Chiller

The facts about the VSD Screw Chiller

The VSD chillers that we discussed here focus on VSD screw chillers because they always directly compete with Oil Free chillers. In the past, screw chillers did not equip with VSD device because the VSD technology and price were not popular. The most important thing is they do not think it is necessary. The part and full load performance of a screw chiller are better than that of a reciprocating chiller. Screw chiller uses sliding valve and conventional operating principle. Compared with reciprocating chillers, it gives a pretty good part load performance in a chiller with multiple compressors at low load conditions.

The general acceptance of Oil Free chillers dilutes the market share of conventional screw chillers in the range of 100 to 400 Tons. It drives the development of VSD screw chillers to the market. After few years' R&D, most of the screw chiller manufacturers can now supply VSD screw chillers to the market. The part load performance of VSD screw chiller can close to or even equal to that of an Oil Free chiller. It provides more choices to the consultants and clients on chiller selection if they focus on part load efficiency.

VSD screw chiller is equipped with a semi-hermetic, direct-drive, 3000 rpm, rotary compressors that includes a VSD device, capacity control slide valve, oil sump heater, and differential pressure refrigerant oil flow system. Four pressure-lubricated rolling element bearing groups support the rotary assembly. Motor is suction gas-cooled, hermetically sealed, two-pole squirrel cage induction motor or Permanent Magnet Motor which has been used by some manufacturers.

In conventional chillers with lubrication oil, oil analysis is part of the preventive maintenance to find out the hidden problems of the chiller. It makes the services company to rectify the hidden defects before the system breaks down. It allows the facility managers and owners to make good plan for the maintenance work without disturbance to their normal daily operation. Many service companies will advise the client to replace the oil annually. In fact, the oil provides aging record or hints of hidden problem to the operator; it should not be regularly replaced until major problem is identified.

Recommendation

As an owner or the facility manager, saving energy helps to reduce the operating cost (less payment on the electricity bill). Therefore, they focus on the performance of the chiller plant or chillers. If we talk about performance of chillers, we always use coefficient of performance (COP) to make the comparison. It is the most meaningful and direct way to compare the efficiency of chiller. The chiller manufactures provide the COP value in accordance with certain criteria, such as the AHRI standard. In addition, another term of IPLV/NPLV is also used in the industry; it is a value for the part load efficiency that was also developed by the AHRI at the specified chiller water IN/OUT temperature at different part load conditions. No matter whether an Oil Free chiller or a VSD chiller is used, both types of chillers can achieve the high IPLV/NPLV at part load conditions. With oil or no oil, which one is better? There are different views. For energy efficiency, the end result is more important. The consultants should specify high COP and IPLV/NPLV in the tender requirements to achieve better energy performance!

Reference: 1. ACRA Newsletter Summer Issue 2008: Oil Free Centrifugal Chiller

- 2. http://ashrae-cfl.org/2010/03/understanding-iplvnplv/
- 3. JARN Journal : Published on 25 July 2014, JARN

Disclaimer: All materials published in the "Differences Between Oil Free Chiller and VSD Chiller" do not necessarily reflect the view of The Hong Kong Air Conditioning and Refrigeration Association Ltd (ACRA). ACRA & author will not be responsible or liable for any costs, damages and any issues whatsoever arising out of the information in this article.





Oil Free Chiller

Heat Pipe

FSV / FS MULIT

Ventilating Fan & Filter

Integrated AHU ITPAC, Chiller & FCU



S&P Coil Products Limited is a UK based specialist manufacturer and supplier of heating and cooling equipment to the public and private sector. Set up in 1979, the business now operates globally, manufacturing in Leicester, UK over 30 years and Middle East over 10 years. To fulfill the market needs in Asia Pacific Region.

C recently established a manufacturing plant in China to provide the professional and high erformance product in the region.

WATER HEAT PIPE

Improving IAQ and Energy Saving



Green and eco-Friendly Zero refrigerant Zero ODP and GWP Zero cross contamination More LEED or BEAM points Reduced running cost High latent heat of vaporisation High thermal conductivity High heat recovery rate Reduced depths and airside pressure drop

HEAT PIPES for Heat Recovery

Up to 70% heat energy in exhaust fan section be recovered

HEAT PIPES for Humidification

Raising 50 to 100% dehumidification



Latest Job References

- Chimelong Ocean Kingdom Penguin Exhibit
- Hong Kong Baptist Hospital
- Hong Kong Tsuen Wan Adventist Hospital (OT Block)
- Hung Hom Grand Hyatt Hotel
- Macau Kiang Wu Hospital

- New World Centre
- Shanghai Disneyland
- Singapore Ng Teng Fong Hospital
- Tin Shui Wai Hospital



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sales@saiver-welaire.com.hk Email:





(SAIVEZ) Integrated AHU ITPAC, Chiller & FCU





Heat Pipe

Panasonic FSV / FS MULIT



MTR Chiller Plant Replacement Works for Central Refrigeration Plant

By: Billy Kwan

Project Name	: MTR Chiller Plant Replacement Works for Central Refrigeration Plant	
Member's Role in the Project	t : Replacement of Central Refrigeration Plant located inside	
	the Cheung Sha Wan Station	
Completion Year	: 2014	
Member/Company Name	: Shinryo (Hong Kong) Limited	



Background

The Central Refrigeration Plant (CRP) provides chilled water system to provide services for 5 stations including Mei Foo Station, Lai Chi Kwok Station, Cheung Sha Wan Station, Sham Shui Po Station and Princes Edward Station via the tunnel at Tsuen Wan Line since May 1982.

The previous chiller plant has been operated for about 30 years while one of the water cooled chiller was malfunction in 2010 which could not be repaired due to spare parts obsolescence.

Work Locations

Located at Cheung Sha Wan Station, there are 3 main working areas:

1) **Central Chiller Plant Room** with approx. 900m² which is located on the Concourse Level below the Ground Floor.

The following 2 areas are both located on the Platform Level below the concourse:

- 2) **3.3kV Motor Control Center Room** with the size of approx. 112m²,
- 3) Track Access Lobby Room with the size of approx. 70m²

Major Equipment	Details	
Water-Cooled Chiller	900 RT per chiller	6 nos.
	Total Cooling Capacity 5400 RT	
Chilled Water Pump	75kW, Water Flow Rate 56.8 l/s per pump	7 nos.
AHU	Total Air Flow Rate 3.92 m³/s	1 no.
Rolling Shutter in Track Access Lobby Room	4 hours Fire Rated Protection Vertical Rolling Shutter	1 no.
	Width 5130m x Height 3250m	
3.3kV Chiller Starter	Starter Panel Modification	6 nos.
Frequency Inverter for Chilled Water Pump	75kW Frequency Inverter with Harmonic Filter	7 nos.



Features and Highlights

All of the new equipment installed complies with the updated Code of Practice for Energy Efficiency of Building Services Installation such as the new chiller COP (Coefficient of Performance) and additional frequency inverter drive for chilled water pump. The Main Energy Saving Features are indicated as follows:

- 1) 2-Stage Centrifugal Pumps rated at 75kW are installed for its best performance under low flow (56 l/s) and high head (720kPa) operating condition, to replace the original 110kW Horizontal Split Case Pumps.
- 2) After equipping with the Variable Speed Drive (VSD) to each of the 7 Chilled Water Pumps, only 12kW pumping power was required under a single chiller operating condition as measured onsite.
- 3) The installed new Water-Cooled Chillers' Non-Integrated Part Load Values [NPLV to ARI 550/590] is 7.02kW/kW which is enhanced compared with the old chillers installed in 1979 resulting better energy saving.



Chiller shipment to Hong Kong Container Terminal.



Chillers were disassembled at tempoary storage area at Hong Kong.



Chiller components were delivered to Kowloon Bay Depot and placed on MTR wagon ready for delivery to CRP at night time.



Unloaded the chiller components in Track Access Lobby room.



Reassemble chiller at CRP



When completion of chiller reassembly, pipework and electrical work would be started installation.

Challenges

Due to the operation of the railway services, all of the work should not affect the daily operation of the chiller plant. Nonetheless, the chiller plant must be shut down for major replacement works in the winter season from early December and resume to normal operation before the end of March annually throughout the construction period.

For all time except the winter season, at least 4 nos. of chillers must be maintained to provide service of the air conditioning system for the 5 stations and therefore one to one chiller replacement was required to fulfill the requirement.

Another challenge for this project was that there was no additional space for chiller storage at CRP. In this case, the old chiller is required to be removed beforehand so that there would be sufficient space for the new chiller to be delivered.



Before

After

Moreover, all major equipment and materials to Track Access Lobby Room could only be delivered by MTR wagon through the railway tunnel during non-traffic hours from 01:30am to 04:00am daily. Due to height limitation in the railway tunnel, the chiller had to be disassembled before loading to the wagon.

中國制冷展2015

踏入4月,通風、節能、冷氣和冷凍業界的從業員都 雀躍起來,因為一年一度的中國制冷展即將舉行。 今年中國制冷展移施回到上海展覽館舉行,主題為 "合作共贏,同擴藍天"。為了支持中國制冷學會和 探索最新產品資訊,香港空調及冷凍商會、建同香 港能源工程師學會、美國供暖制冷及空調工程師學 會香港分會和香港註冊通風系統承建商協會共同組 織了一個36人的代表團出席這次盛會。

4月7日早上,代表團由陳志雄會長、佘達志上屆會 長、劉自威副會長、梁栢泉司庫、陳家龍前會長、 葉啟賢前會長、理事老少達、理事莫達成帶領下, 從香港國際機場出發,於是日下午到達上海浦東國 際機場。團隊代表在酒店辦理登記手續後,馬上出 席了由大會安排的國際組織招待晚宴。

4月8日早上,四會代表出席了中國制冷展的開幕典 禮及論壇,隨後便跟代表團會合,在進場參觀前來 一張大合照留念。然後大家就各自自由參觀,直到 下午參觀完畢,大家都滿載而歸。晚上,代表團亦 應大會邀請,出席了中國制冷展的開幕晚宴。舊雨 新知,高朋滿座,大家享受了一個愉快的晚上。

4月9日早上,代表團安排了參觀位於上海金山區的 埃弗斯閥門製造有限公司。下午便馬不停蹄參觀了 上海ABB電機有限公司及Heatex Heat Wheel公司。 平常大家對閥門,電機和Heat Wheel的應用已經十 分熟悉,但很少有機會親眼看到它的生產及測試過 程。參觀完畢後,大家對相關產品的認識又更上一 層樓了。

4月10日早上,在出機場前,順路參觀了位於外高橋 保税區的依安派特風機(上海)有限公司,它的業務 範圍包括生產及銷售風機和電機。代表團於是日下 午安全返抵香港國際機場,旅程完滿結束。













Annual Dinner 2014

The 53rd Anniversary Dinner took place at JW Marriott Hotel on 24th November 2014 and it was a huge success. The event brought together more than 600 ACRA members and professionals across fields of HVAC engineering, building services, government scene and academia.

Mr Chan Fan, JP, Director of EMSD, as our guest-of-honor, was invited to join the most important event of ACRA in the year. The evening was packed with highlights including lucky draw and the wonderful singing performance by Ms Aster Fong.



Mr Dave Chan, President of ACRA, gave an opening remark to start off the event.

Mr Chan Fan, JP, Director of EMSD of HKSAR, gave an inspiring speech at the event.





Council members gave a toast and wished all good luck and health in 2015!

The wonderful duet performance of Ms Aster Fong and Mr Dave Chan, President of ACRA, highlighted the evening.





More than 600 guests and friends from HVAC field joined the event.



Joyful Dinner 耆英萬歲晚宴

This is the 5th consecutive year that ACRA Caring Committee and Open Door Ministries (開心社區服務) jointly organized Joyful Dinner. It was successfully held on 6th December 2014. Over 50 volunteers from the 2 organizations attended the dinner to celebrate Winter Solstice Festival with 200 elderlies in Lam Tin. Other than great food, the volunteers also arranged a few entertainment performances for love and fun. Mr Dave Chan, President of ACRA, said 'This is the 5th consecutive year we join hands with Open Door Ministry to help and serve. ACRA will assure the continuous support in the future as a way of contribution to the community.' Special thanks again to our members who sponsored the dinner and gifts.



Mr Raymond Synn, Chairman of ACRA Caring Committee, presented the souvenir to company members to thank for their sponsorships.



Wonderful singing performance by the volunteers.



Smiles and laughter are the best reward to us

Mr Dave Chan, President of ACRA, presented gifts to the elderlies.



Technical Visit to Shunde

ACRA successfully organized a 2-day technical visit to Shunde on 16th-17th January 2015. Members were impressed by the design and manufacturing of

high quality HVAC equipment components at Hangji Industries Group 恆基實業, Guangdong Meizhi Compressor 廣東美芝製冷設備 and Cold Magic Air-conditioning Equipment 高美 空調設備. 24 professionals from the field of HVAC joined this visit.



Revision Course of Training for Workers in Handling HFC & Blended Type Refrigerants for Architectural Services Department Contracts

On 31st January 2015, ACRA organized a training course to registered workers who successfully completed the courses previously held for workers for handling HFC

and blended type refrigerants for ArchSD projects. In this revision course, an update on current refrigerant development and refreshment on training materials were conducted. We received overwhelming response and had 61 technicians attended.





Bill Cheung, Chairman of Training Committee, presented to the guest speaker, Mr KT Cheuk, Senior Contract Manager of Trane Service Hong Kong

2015 Spring Dinner

As the kick-off event for the year of Horse, ACRA Spring Dinner was held successfully on 13th March 2015. Thanks to the support of all members and key players in the industry, we were happy to have more than 270 guests joining this event. The dinner was filled with fun, laughter and fine wine. Hope to see you all again next year!



Mr Dave Chan, President of ACRA, and council member gave a toast

All sets their sights on the champion of beer competition!

機電業博覽 — 生涯好規劃

「機電業博覽-生涯好規劃」已於2015年3月6-7日在職業訓練局葵涌大樓完滿舉行。各大政府部門、公共機構和商 會透過展覧及生涯好規劃專題講座,提供機電業入職及進修的最新資訊。作為暖通空調行業的一分子,ACRA亦 設有展覧攤位,向年青人介紹更多有關我們行業的資訊,為他們升學或就業選擇提供参考。



ACRA 會長陳志雄先生與一眾嘉賓主持活動揭幕禮



我們會員也熱心向學生們講解暖通空調 行業的入行途徑

Joint Technical Seminar – Green Building and Energy Efficiency



Bill Cheung, Chairman of Training committee and representatives of ASHRAE Hong Kong Chapter presented a souvenir to Dr. Hui

More than 60 professionals attended

Co-organized by ACRA and ASHRAE Hong Kong Chapter, the 'ASHRAE Standards 189.1 and 90.1 : Green Building and Energy Efficiency' Seminar was successfully held on 24th March 2015. We are honored to have Dr. Sam C M Hui, Lecturer of the Department of Mechanical Engineering, The University of Hong Kong, as the guest speaker of seminar to introduce the ASHRAE Standards 189.1 and 90.1, which are the



key references in the world on green building and energy efficiency, and explain their major requirements and characteristics. Relationship of these standards to green building assessment and building energy codes were also discussed.

Memory of Derek Leung



商會理事會委員梁鎮華先生於於二零一五年二月十三日不幸病逝,本會深感痛惜及難過。梁鎮華先生一貫熱心 商會事務,為業界爭取利益,不遺餘力,貢獻良多。梁鎮華先生曾積極推動會務發展,很多商會的會員公司都 是經梁先生的介紹而加入商會的,他對新會員公司及後輩一向加倍照顧,盡顯他鐵漢柔情的一面。每年商會籌 辦的關懷社區活動、賽馬之夜、春茗聯歡晚會及週年晚會都由他參與统籌而順利進行,他的離逝對本會確是一 大損失。

Dave Chan

理事會委員 梁鎮華先生

今年二月十二日中午接到Derek來電提示當天下午商會與消防局的通風協調會議,並交托向與 會主席報告因病而未能出席,隨後再接到由WhatsApp傳來此訊息:「溫馨提示:今日下午2:30 FSD VILG Meeting,如你去代我通知我不能來了因請咗病假」,這就是Derek離開我們一天前 的最後通訊,他在患病期間仍然堅持對工作和事情的認真和誠懇態度,在此可見一斑。

Derek在商會服務超過十年,在他領導下之會員小組,由接任初期的一百個左右會員增長至現 在的一百五十多個會員數目,這正是他的投入及其在會務共同領導達致的成果。商會每年最重 要與業界和會員聯系溝通的週年晚宴和春茗,Derek由籌備工作以至宴會當天都絲毫不苟、兼 前顧後,使到整個團隊及節目流程上更加緊密和流暢,令活動更加盡善盡美。Derek在商會其 他活動上也付上不少創意和心思,如邀請新加入的會員到商會會議作入會介紹、在春茗加插會 員歌唱比賽、Horse Racing Night的馬場大亨比賽、在長者千歲宴當中愛心獻唱等等,這些都 使活動氣氛更加高漲。



什麼是快樂!這是Derek今年一月五日WhatsApp傳來的節錄文章:「如果有時間,好好陪陪你的孩子,不要拼命去 換什麼大房子,換什麼豪車,和相愛的人在一起,蝸居也溫暖,自行車也快樂!」。二月六日商會每月例會後, 慣常走到樓下謝菲道下午茶,這次只淨下我與Derek兩個,平時很少互相傾談的工作和家庭事情都在話題當中 ,Derek講到家庭生活和兒子能找到自己喜歡的學科進修和發展,其中流露出的滿足和幸福都替他高興。

活在當下不在乎每天追求精彩或要天長地久,但總要活得健康、快樂和有意義,我們珍惜每個參與機會、每個接 觸自己熟悉或許不熟悉的人、每天上天給自己的生活和生命力。Derek我們永遠懷念你,你開心的笑聲、雄厚的 歌聲、燦爛的笑容、認真一絲不苟的態度、對朋友和工作伙伴的關注和親和.......,作為我們正能量的寫照,永 遠埋在我們心深處。

KY IP

回想在Arnhold (安利) 工作時,便與Derek相識,到現在已經差不多有30個年頭。

Derek是一個重義氣、重感情的人,做事盡責,相識滿天下。他經常安排聚會令大家可以聚首一堂,輕鬆一下。 ACRA有今天的凝聚力,Derek可以説是功不可抹。

對於Derek的忽然離去,大家內心一定感到非常難過。兄弟,我們會永遠懷念你!

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师崩過程咨港有限公司 萬聯空調有限公司 聖備貿易有限公司 第一太平戴維斯設備工程有限公司 順興機電工程有限公司 姓建有限公司	2698 3423 2573 4219 2534 1688 2387 2882 2333 1518
师商品程告港有限公司 萬聯空調有限公司 聖備貿易有限公司 「一太平戴維斯設備工程有限公司 順興機電工程有限公司 陸建有限公司 智能空調工程有限公司	2698 3423 2573 4219 2534 1688 2387 2882 2333 1518 2521 9768
隔晶温程香港有限公司 萬聯空調有限公司 工業備貿易有限公司 第一太平戴維斯設備工程有限公司 順興機電工程有限公司 建建有限公司 智能空調工程有限公司 南龍工程有限公司 南龍工程有限公司	2698 3423 2573 4219 2534 1688 2387 2882 2333 1518 2521 9768 2963 7241
振崩温程舎港有限公司 萬聯空調有限公司 工業備貿易有限公司 第一太平戴維斯設備工程有限公司 順興機電工程有限公司 型建有限公司 智能ご調工程有限公司 南龍工程有限公司 「庭星(香港) 冷熱設備右限へ司	2698 3423 2573 4219 2534 1688 2387 2882 2333 1518 2521 9768 2963 7241 6116 7832
「福通裡谷港有限公司」 「福聯空調有限公司」 「第一太平戴維斯設備工程有限公司」 第一太平戴維斯設備工程有限公司」 「興機電工程有限公司」 「登建有限公司」 智能空調工程有限公司」 「南龍工程有限公司」 「香港」/茶設設備有限公司」 「高速(香港)/茶設設備有限公司」	2698 3423 2573 4219 2534 1688 2387 2882 2333 1518 2521 9768 2963 7241 6116 7832
隔崩温程香港有限公司 萬聯空詞有限公司 21年一太平戴維斯設備工程有限公司 順興機電工程有限公司 建建作空調工程有限公司 智能電工程有限公司 智能電工程有限公司 百種龍工程有限公司 恆星 (香港) 冷熱設備有限公司 百 2 (香港) 六熱設備有限公司	2698 3423 2573 4219 2534 1688 2387 2882 2333 1518 2521 9768 2963 7241 6116 7832 2595 1122
师 晶 社 控 港 有限公司 萬聯 空調有限公司 單備貿易有限公司 第一太平戴維斯設備工程有限公司 順興機電工程有限公司 聲建有限公司 智能空工程有限公司 南龍正程有限公司 恆星(香港)冷熱設備有限公司 高達(香港)工程有限公司 力霸水泵機械工程有限公司	2698 3423 2573 4219 2534 1688 2387 2882 2333 1518 2521 9768 2963 7241 6116 7832 2595 1122 2745 3562
师 确 品程 各港 有限公司 萬聯 空調有限公司 聖備貿易有限公司 第一太平戴維斯設備工程有限公司 婚興機電工程有限公司 智能空調工程有限公司 智能空調工程有限公司 南龍工程有限公司 直星(香港) 冷熱設備有限公司 高達(香港) 社 程有限公司 力霸水系機械工程有限公司 」 「澤衛能有限公司	2698 3423 2573 4219 2534 1688 2387 2882 2333 1518 2521 9768 2963 7241 6116 7832 2595 1122 2745 3562 2332 3077
师 确 品 控 答 港 有 限 公 可	2698 3423 2573 4219 2534 1688 2387 2882 2333 1518 2521 9768 2963 7241 6116 7832 2595 1122 2745 3562 2332 3077
□ 「「「」」」 「「」」」 「」」 「」」 「」」 「」」 「」」	2698 3423 2573 4219 2534 1688 2387 2882 2333 1518 2521 9768 2963 7241 6116 7832 2595 1122 2745 3562 2332 3077 2155 9882
隔晶温控香港有限公司 電備設置的有限公司 工業術業系統 範疇空調力 第一太平戴維斯設備工程有限公司 範囲機構取公司 型建能空調工程有限公司 智能電工程有限公司 固定 (香港) 二程程限公司 百 這 (香港) 二程程限公司 百 臺 (香港) 二程程限公司 百 臺 大星程有限公司 5 二程 一 大星程有限公司 5 二 一 二 七 七 七 七 七 七 七 七 七 七 七 七 七	2698 3423 2573 4219 2534 1688 2387 2882 2333 1518 2521 9768 2963 7241 6116 7832 2595 1122 2745 3562 2332 3077 2155 9882 2554 6263
师 确 品 控 不 有限 公 可 瑞 瑞 福祉 福祉 福祉 在 昭本 南 南 南 南 南	2698 3423 2573 4219 2534 1688 2387 2882 2333 1518 2521 9768 2963 7241 6116 7832 2595 1122 2745 3562 2332 3077 2155 9882 2554 6263 2756 3837
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隔晶温控香港有限公司 電船空調有限公司 整備貿易有限公司 第一太平載和新設備工程有限公司 第興機機取公司 如此一次。 如此一次。 如此一次。 如此一次。 第一次。 如此一次。 如一一次。 一一一次。 如一一次。 如一一次。 如一一次。 如一一次。 如一一次。 如一一次。 如一一次。 如一一次。 如一一次。 如一一次。 如一一次。 如一一次。 如一一次。 如一一次。 如一一次。 如一一次。 如一一次。 如一一次 如一一次 如一一次 如一一次 一一》 一一》 一一》 一一》 一一》 一一》 一一》	2698 3423 2573 4219 2534 1688 2387 2882 2333 1518 2521 9768 2963 7241 6116 7832 2595 1122 2745 3562 2332 3077 2155 9882 2554 6263 2756 3837 6325 1197
师 确定控告 港有限公司 電 一 一 一 一 一 一 一 一 一 一 一 一 一 一 一 一 一 一 一	2698 3423 2573 4219 2534 1688 2387 2882 2333 1518 2521 9768 2963 7241 6116 7832 2595 1122 2745 3562 2332 3077 2155 9882 2554 6263 2756 3837 6325 1197 2432 0170
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^{玩崩} 品 和 品 和 品 和 空 和 和 和 和 和 和 和 和 和 和 和 和 和	2698 3423 2573 4219 2534 1688 2387 2882 2333 1518 2963 7241 6116 7832 2595 1122 2745 3562 2332 3077 2155 9882 2554 6263 2756 3837 6325 1197 2432 0170 2757 5539 2861 2261
师 福光学 高大学 化学生 化合金	2698 3423 2573 4219 2534 1688 2387 2882 2333 1518 2521 9768 2963 7241 6116 7832 2595 1122 2745 3562 2332 3077 2155 9882 2554 6263 2756 3837 6325 1197 2432 0170 2757 5539 2861 2261
^{玩品 把} 「 「 「 「 「 」 」 」 二 二 二 二 二 二 二 二 二 二 二 二 二	2698 3423 2573 4219 2534 1688 2387 2882 2333 1518 2521 9768 2963 7241 6116 7832 2595 1122 2595 1122 2595 1122 2745 3562 2332 3077 2155 9882 2554 6263 2756 3837 6325 1197 2432 0170 2757 5539 2861 2261 2556 1001
^{瑞晶} 融空者、 和 " 福 加 空 和 和 四 和 四 和 四 和 和 和 和 和 和 和 和 和 和 和 和 和	2698 3423 2573 4219 2534 1688 2387 2882 2333 1518 2963 7241 6116 7832 2595 1122 2745 3562 2332 3077 2155 9882 2554 6263 2756 3837 6325 1197 2432 0170 2757 5539 2861 2261 2556 1001 2557 8003
^{瑞爾} 福爾 · · · · · · · · · · · · ·	2698 3423 2573 4219 2534 1688 2387 2882 2333 1518 2521 9768 2963 7241 6116 7832 2595 1122 2745 3562 2332 3077 2155 9882 2554 6263 2756 3837 6325 1197 2432 0170 2757 5539 2861 2261 2556 1001 2557 8003 2797 2168
^{瑞晶斑} 亞 「 福山 一 一 一 一 一 一 一 二 一 二 二 二 二 二 二 二 二 二 二 二 二 二	2698 3423 2573 4219 2534 1688 2387 2882 2333 1518 2521 9768 2963 7241 6116 7832 2595 1122 2595 1122 2595 1122 2595 122 2745 3562 2332 3077 2155 9882 2554 6263 2756 3837 6325 1197 2432 0170 2757 5539 2861 2261 2556 1001 2557 8003 2797 2168
^{玩品 新} 「 「 「 「 「 」 」 」 二 二 二 二 二 二 二 二 二 二 二 二 二	2698 3423 2573 4219 2534 1688 2387 2882 2333 1518 2521 9768 2963 7241 6116 7832 2595 1122 2745 3562 2332 3077 2155 9882 2554 6263 2756 3837 6325 1197 2432 0170 2757 5539 2861 2261 2556 1001 2557 8003 2797 2168 2979 4068
^玩 而 爾 「 「 「 「 「 「 「 」 」 」 二 二 二 二 二 二 二 二 二 二 二 二 二	2698 3423 2573 4219 2534 1688 2387 2882 2333 1518 2521 9768 2963 7241 6116 7832 2595 1122 2745 3562 2332 3077 2155 9882 2554 6263 2756 3837 6325 1197 2432 0170 2757 5539 2861 2261 2557 8003 2797 2168 2979 4068 2543 0610
^{瑞爾斯} 福爾 · · · · · · · · · · · · ·	2698 3423 2573 4219 2534 1688 23534 1688 29534 1688 2963 7241 6116 7832 2595 1122 2745 3562 2332 3077 2155 9882 2554 6263 2756 3837 6325 1197 2432 0170 2757 5539 2861 2261 2556 1001 2557 8003 2797 2168 2979 4068 2979 4068 2543 0610 2890 9321
^玩 「 「 「 「 「 「 」 」 二 二 二 二 二 二 二 二 二 二 二 二 二	2698 3423 2573 4219 2534 1688 2387 2882 2333 1518 2521 9768 2963 7241 6116 7832 2595 1122 2745 3562 2332 3077 2155 9882 2554 6263 2756 3837 6325 1197 2432 0170 2757 5539 2861 2261 2556 1001 2557 8003 2797 2168 2979 4068 2543 0610 2890 9321
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^{端晶聯合 「 「 「 「 「 」 」 」 二 二 二 二 二 二 二 二 二 二 二 二 二 }	2698 3423 2573 4219 2534 1688 2337 2882 2333 1518 2963 7241 6116 7832 2595 1122 2745 3562 2332 3077 2155 9882 2554 6263 2756 3837 6325 1197 2432 0170 2757 7539 2861 2261 2556 1001 2557 8003 2797 2168 2979 4068 2543 0610 2890 9321 2329 8268 2792 6331
·····································	2698 3423 2573 4219 2534 1688 2387 2882 2333 1518 2521 9768 2963 7241 6116 7832 2595 1122 2745 3562 2332 3077 2155 9882 2554 6263 2756 3837 6325 1197 2432 0170 2757 5539 2861 2261 2556 1001 2527 8003 2797 2168 2979 4068 2543 0610 2890 9321 2329 8268 2792 6331 2456 0198
^玩 「 「 「 「 「 「 」 」 」 二 二 二 二 二 二 二 二 二 二 二 二 二	2698 3423 2573 4219 2534 1688 2353 1688 2953 1688 2963 7241 6116 7832 2595 1122 2745 3562 2332 3077 2155 9882 2554 6263 2756 3837 6325 1197 2432 0170 2757 5539 2861 2261 2556 1001 2527 8003 2797 2168 2979 4068 2543 0610 2890 9321 2329 8268 2792 6331 2456 0198 2614 2213
^{瑞爾斯} 「 「 「 「 「 「 「 「 「 「 「 「 「	2698 3423 2573 4219 2534 1688 2337 2882 2333 1518 2521 9768 2963 7241 6116 7832 2595 1122 2745 3562 2332 3077 2155 9882 2554 6263 2756 3837 6325 1197 2432 0170 2757 5539 2861 2261 2556 1001 2527 8003 2797 2168 2979 4068 2543 0610 2890 9321 2329 8268 2792 6331 2456 0198 2614 2213
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^{而晶戰} 「「「」」 「」 「」 「」 「」 「」 「」 「」 「」 「」 「」 「」	2698 3423 2573 4219 2534 1688 2353 1688 2953 1688 2963 7241 6116 7832 2595 1122 2745 3562 2332 3077 2155 9882 2554 6263 2756 3837 6325 1197 2432 0170 2757 5539 2861 2261 2556 1001 2557 8003 2797 2168 2979 4068 2979 4068 2543 0610 2890 9321 2329 8268 2792 6331 2456 0198 2614 2213 2572 7110 2362 2186
^玩 · · · · · · · · · · · · · · · · · · ·	2698 3423 2573 4219 2534 1688 2387 2882 2333 1518 2521 9768 2963 7241 6116 7832 2595 1122 2745 3562 2332 3077 2155 9882 2554 6263 2756 3837 6325 1197 2432 0170 2757 5539 2861 2261 2556 1001 2556 1001 2557 003 2797 2168 2979 4068 2543 0610 2890 9321 2329 8268 2792 6331 2456 0198 2614 2213 2572 7110 2362 2186 2795 8286

Сс	ntact	Number	Website / Email
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	2562	3331	www.evergreen-environmental.com
	2898	7331	www.fareast.com.hk
	2682	7200	fungscww@netvigator.com
	2688	2666	www.gatewayv.com.hk
	2123	0888	www.gtechservices.com.hk
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	2893	3600	getwick@getwick.com
	2459	3038	gotopco@yahoo.com.hk
	2345	2219	general@greattop.com.hk
	2/21	6129	www.hangji.com
	2773	4705	www.hilti.com.hk
	2396	8108	aircond@netvigator.com
	2770	7703	www.hitakinsul.com
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	2687	1755	jyin@jinchat.com
	2695	8872	www.keio.com.hk
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	2967	9639	www.mason-hk.com
司]	2787	5717	www.mesanct.com
	3669	4888	www.mideahk.com
	2866	4575	www.mitsubishi-ryoden.com.nk
	2325	6892	www.newway.com.hk
	2590	8088	info@oxprime.com
	3549	5372	www.pacificsense.com.hk
	2365	0372	stso@peterson.com.hk
	2//02	2110	powers.pts@gmail.com
	2388	8038	www.pvrofoe.com.hk
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	2619	8817	www.yaulee.com
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	2333	1518	singkin@gmail.com
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	2595	1122	www.supermark.com.hk
	2745	3562	www.sppump.com
	2332	3077	www.sustaine.com.hk
	2155	9882	www.targetensol.com
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	6325	1197	www.sinro.com
	2432	0170	www.tomifuji.com.hk
	2757	5539	tom@toms-equipment.com
	2861	2261	www.troxapo.com
	2556	1001	www.ucibb8.com
	2797	2168	www.luenming.com
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