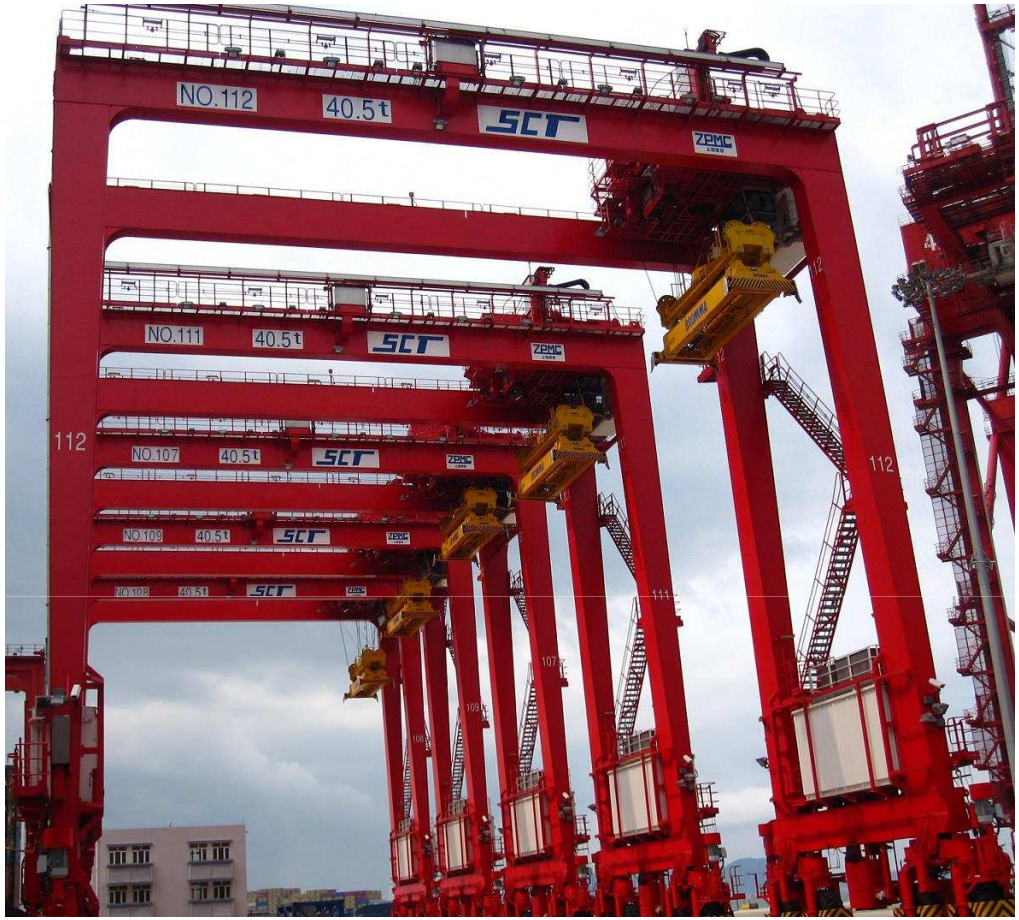

Portek International Ltd. (at booth C66)

Kam Hybrid System – probably the most Flexible & Cost effective "Green" solution available for RTGC

TOC – Europe
9 Jun 2010

Hamilton Ho
Portek North Asia Ltd. – Hong Kong

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KNOWLEDGE & SOLUTIONS IN PORT BUSINESS

CONTENTS -

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1. PROBLEMS ENCOUNTERED BY THE CONVENTIONAL RTGC

1.Oversized engine -

RTGC is powered by diesel generator set whose size is dictated by the hoist motor. The hoist requires the highest amount of electrical power during the lifting of a container. Although the lifting acceleration period only lasts only a few seconds, the genset capacity must be big enough to support the peak power demand.

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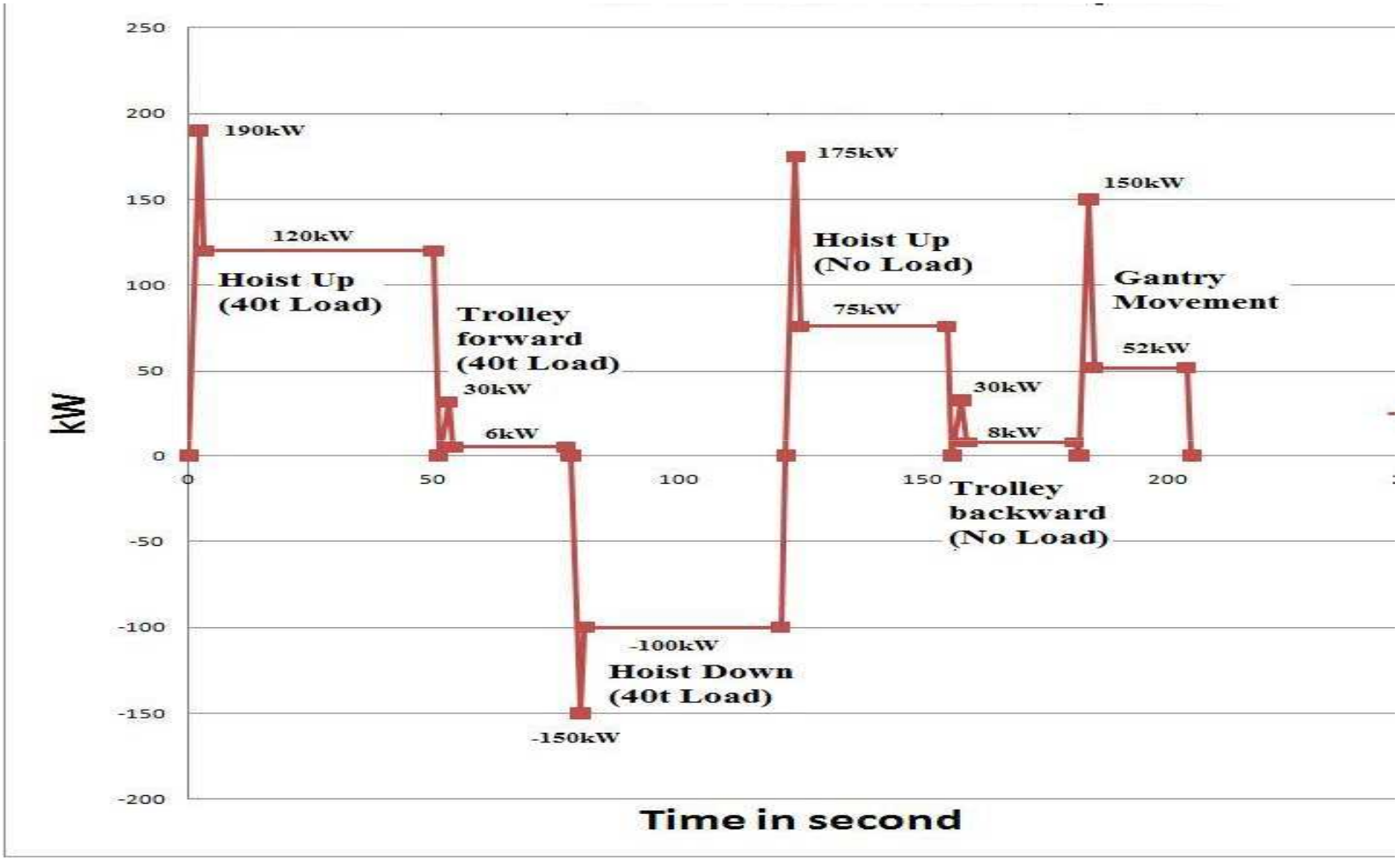
1. PROBLEMS ENCOUNTERED BY THE CONVENTIONAL RTGC

Power output (KW)



RTGC power consumption table (as reference)

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1. PROBLEMS ENCOUNTERED BY THE CONVENTIONAL RTGC

2.RTGC idling –

During crane idling, engine running at its full speed is for supplying power to **Aux. load only** such as air-con, communication system or flood lights

3.Fixed engine running speed -

Since the electricity produced must stay at a fixed frequency - **50 Hz or 60 Hz**, the engine must run at a fixed constant speed either **at 1500 rpm or 1800 rpm**, no matter what the actual power demand is.

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1. PROBLEMS ENCOUNTERED BY THE CONVENTIONAL RTGC

4.Wasted regenerative braking energy –

During hoisting down, the hoist motor works as a generator to create regenerative braking energy. This unused energy is dissipated as heat by the resistors.

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1. PROBLEMS ENCOUNTERED BY THE CONVENTIONAL RTGC

- High fuel consumption average of ~16 to 25 liters/hr.
- High oil price and it is Unpredictable
- High Cost in larger size Genset service cost (~USD 20k / year)
- Environmental – Carbon emission causes air pollution & Noise emission

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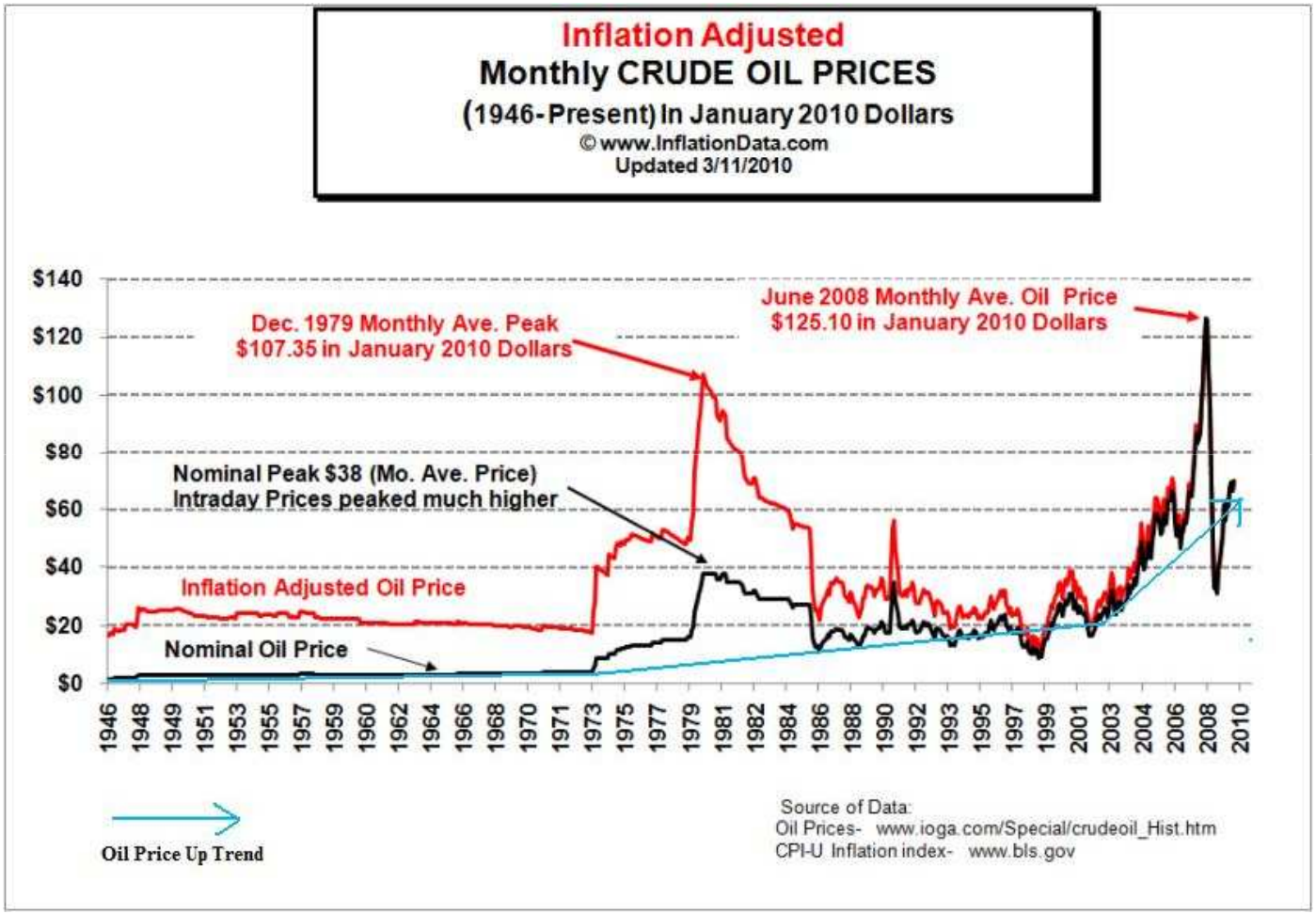
1. PROBLEMS ENCOUNTERED BY THE CONVENTIONAL RTGC



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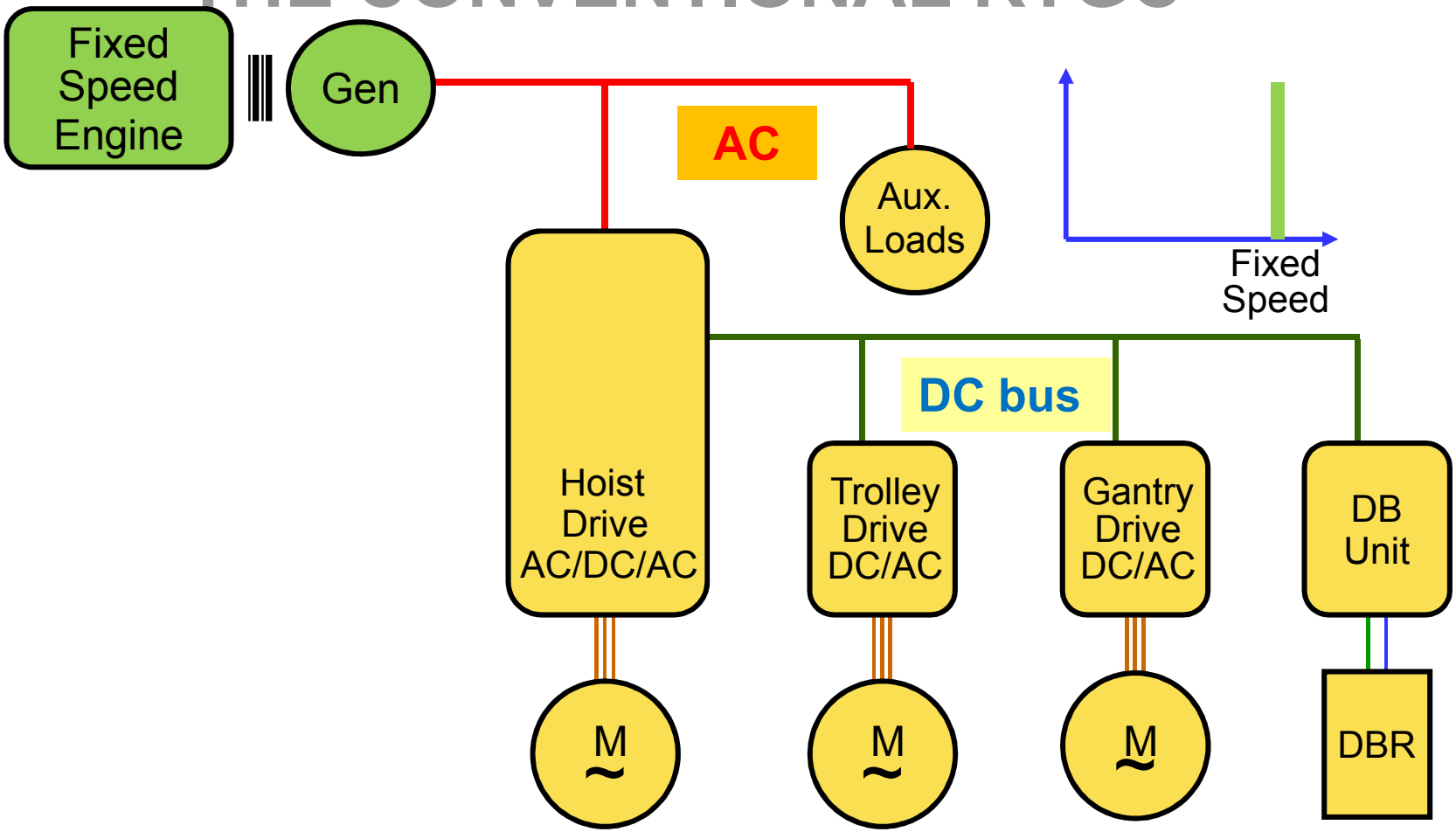
1. PROBLEMS ENCOUNTERED BY THE CONVENTIONAL RTGC



Usual RTGC fitted with AC drives - Configuration

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2. CONCEPT OF KAM HYBRID

a) KAM Hybrid System is a POWER SUPPLY System

It is designed based on the Engine's point of view

By using variable engine speed - It controls the engine to run at its Most Optimum Level in terms both fuel consumption and power output in connection with Energy Storage to achieve fuel saving

1) PRIMARY ENERGY SOURCE - To meet the RTGC actual power requirements against different operation modes such as M/H up with different loadings, T/T movement, G/T movement and during Idling rather than having the engine to run always at a Fixed High Speed eg. 1500 / 1800 rpm

2) SECONARY ENERGY SOURCE -To use Super Capacitor as an Energy Storage Means to store the braking energy and these stored energy will be released when needed eg. starts up of M/H up and G/T travels

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2. CONCEPT OF KAM HYBRID

Operating mode –

During Idling – ~800 rpm

Trolley travel only – ~800 rpm

Gantry travel only – ~800 rpm

Hoisting up with empty spreader – ~800 rpm

Hoisting up with 30T container (during acceleration) – ~1450 rpm

RTGC - Engine running speed after installation of the Kam hybrid system

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2. CONCEPT OF KAM HYBRID

b) Benefits offered by KAM Hybrid –

Energy Storage Means - (braking energy to be saved in :)

1)Super capacitors (Proven solution – fuel saving of ~50%) OR

2) LiFePO4 battery (under testing – fuel saving of ~60%)

Less Carbon emission, Less noise emission and Less maintenance required by the genset as the engine rating is smaller than the original one and is running at a lower speed

No need to interface with the crane PLC / drive system

The normal M/H, T/T and G/T operating speed can be maintained

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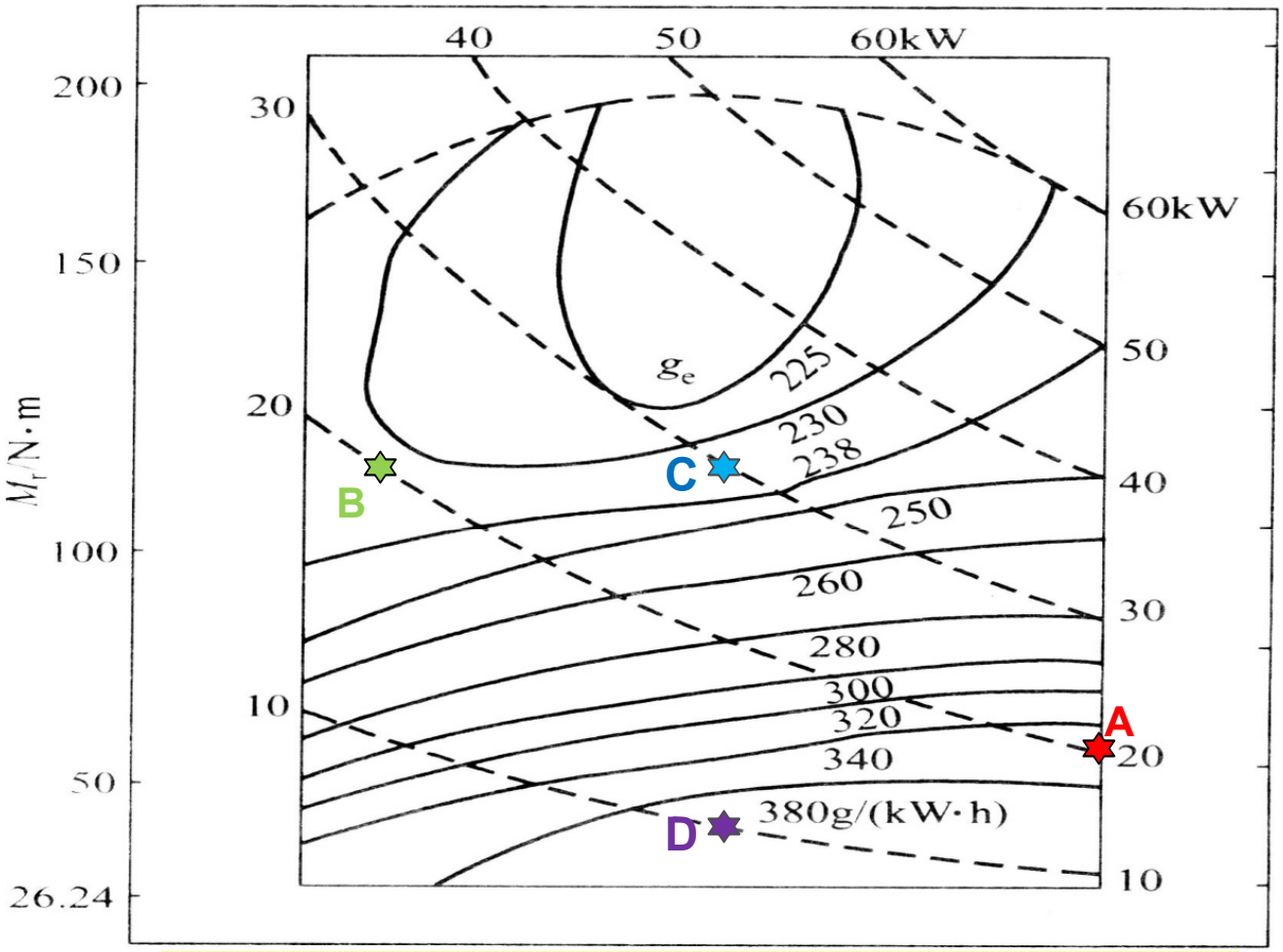
2. CONCEPT OF KAM HYBRID



Point A –
Speed : 1400 rpm
Power output : 20KW
Fuel con. :
~355g/KW.hr

Point B –
Speed : ~750 rpm
Power output : 20KW
Fuel con. :
~235g/KW.hr

Point C –
Speed : 1050 rpm
Power output : 30KW
Fuel con. :
~234g/KW.hr

Point D –
Speed : 1050 rpm
Power output : 10KW
Fuel con. :
>380g/KW.hr

Engine - Brake specific fuel consumption chart

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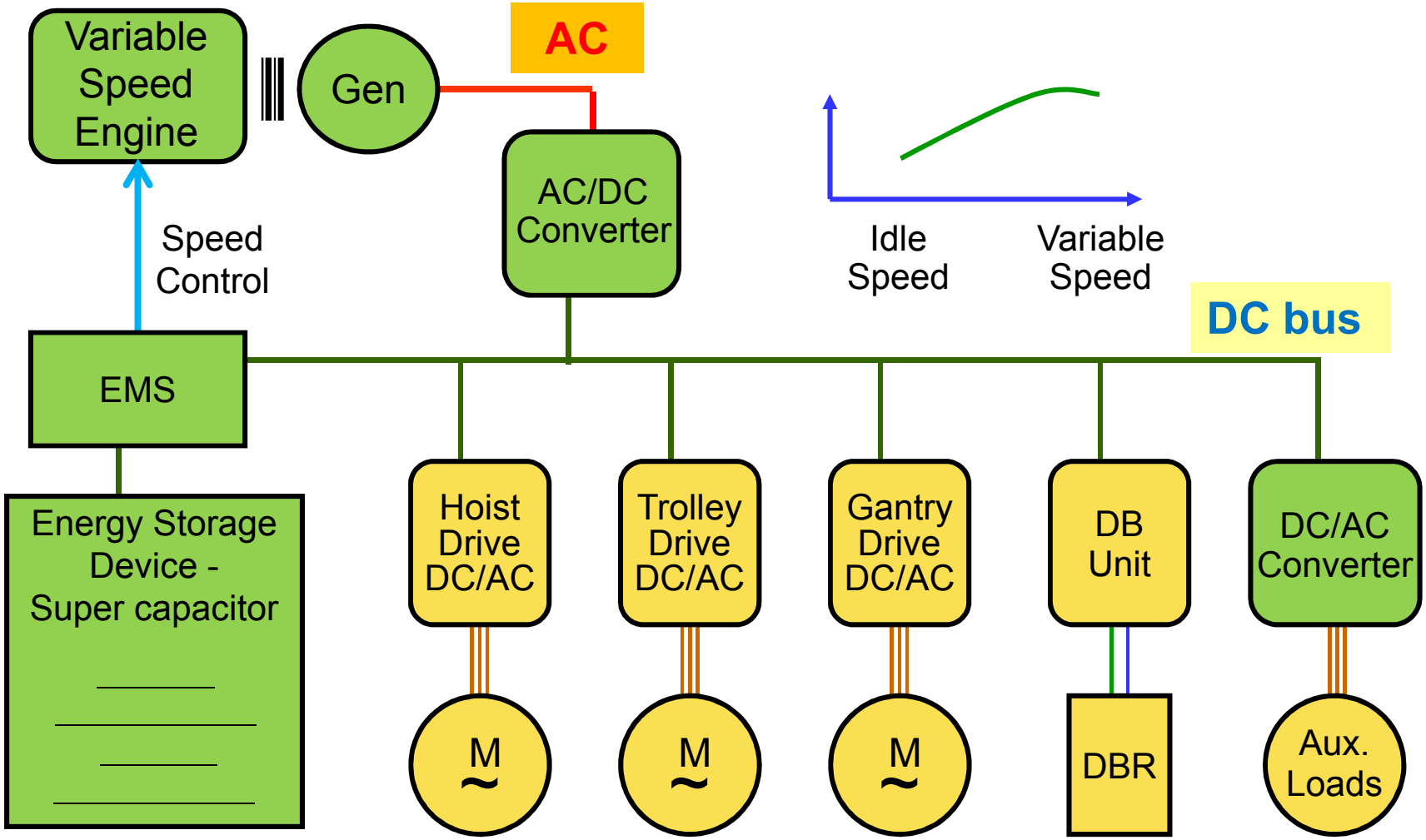
2. CONCEPT OF KAM HYBRID



1. Kam Hybrid AC drive RTG - System Configuration

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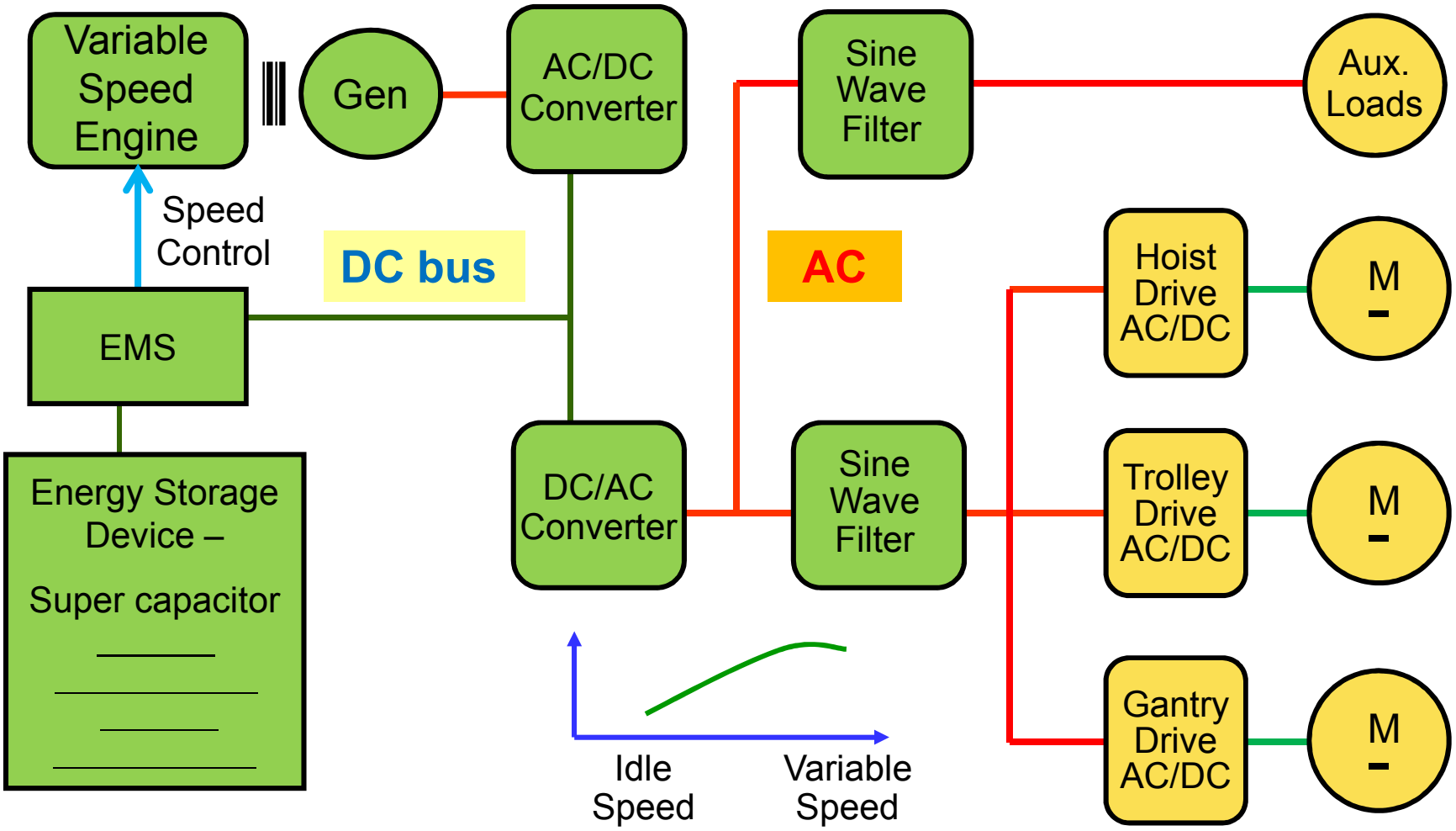
2. CONCEPT OF KAM HYBRID



2. Kam Hybrid DC drive RTG - System Configuration

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3. APPLICATION

- **Retrofit on Existing RTGC**
  (Both AC & DC drive systems of any brands are possible)

- **Installation on brand new RTGC**

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4. JOB REFERENCE

1st unit of Kam Hybrid – (Retrofit project)

On an Existing ZPMC 1 over 5 RTGC

(equipped with Fuji SX-PLC and VG7-drive)

Nansha container terminal no. 2, Guangzhou, PRC (since Aug 08)

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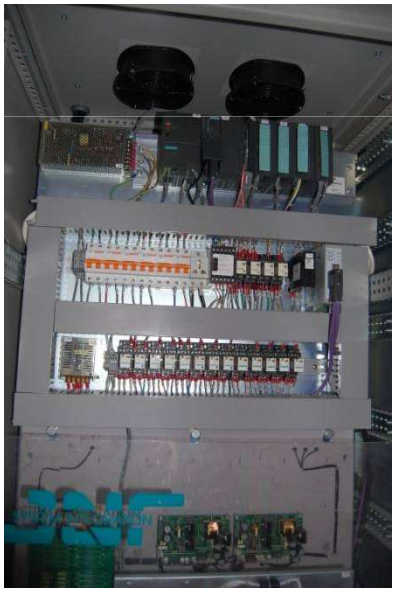
4. JOB REFERENCE

2nd & 3rd unit of Kam Hybrid – (New RTGC)

On New ZPMC 1 over 6 RTGC – start operation in 2010

(equipped with Yaskawa PLC and Varispeed 7 drive)

Shekou Container Terminal (SCT), Shenzhen,



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5. EQUIPMENT LIST

Item	Equipment	Specification
1	Engine	1 x Cummins QSM 11 with 298KW
2	Generator	1 x Stamford with 280KW
3	Energy Storage Device (For Super capacitor solution)	17 sets x Maxwell Super capacitor - 48V, 3.23MJ
4	AC / DC converter	1 x 220 KW converter
5	DC / AC converter (For DC-RTGC only)	1 x 500 KW converter
6	Sine wave filter (For DC-RTGC only)	1 x ~1000KVA for MC & Drives and 1 x ~200KVA for Auxiliary power
7	Energy Management System (EMS)	1 set
8	Engine Room	1 x standard one with ZPMC spec.

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ZPMC – 1 over 5 RTGC been in operation for ~2 years

Take out the existing engine and generator

New Engine Room with new engine, generator and the EMS

Existing Engine Room

Kam Hybrid – Installation at Nansha terminal II, PRC

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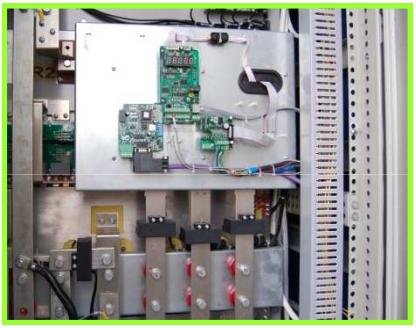
What's inside the new Engine room

Engine – Cummins

(QSM11-C440-Euro3)

Generator – Stamford (HCI4E2)



Energy Management System (EMS)

Energy Storage Device – Super Capacitor~255kg

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6. TEST RESULT

The test below was conducted at Nansha terminal, PRC on 12 Jun, 09

	RTGC – YC 23 (1 over 5 RTGC)	RTGC – YC19 (1 over 5 RTGC)	
Equipped with the Kam Hybrid system	**No**	**Yes**	
Engine type	**Caterpillar CAT 3456 - 456KW**	**Cummins QSM11 - 298KW**	
Generator Type	**Stamford – 540KVA**	**Stamford – 390KVA**	
Main Hoist motor	**150KW**	**150KW**	**unchanged**
Function	**Fuel consumption**	**Fuel consumption**	**Saving**
Idle (for 30 mins.) (Lights OFF, Aux. power ON)	6.12 liters	1.31 liters	**↓79%**
10 moves in a row -			
Empty spreader	8.68 liters	4.58 liters	**↓47%**
15 Tons container	10.08 liters	6.48 liters	**↓36%**
Under 12 months of normal operation	**1.95 liters / move 15.58 liters / hr.**	**1.04 liters /move 8.09 liters / hr.**	**↓47% ↓44%**

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7. PROJECT SCHEDULE

Delivery time –
approx. 3 to 4 months after order confirmation

Installation and Commissioning (for retrofit project) –
~4 weeks (for the 1st unit)
~2 to 3 weeks (for the 2nd unit onwards)

Commissioning (on NEW RTGC) –
~1 to 2 weeks (at the crane's OEM)
~1 week (on site)

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8. CASE STUDY-

Kam Hybrid system cost saving calculation (1) -

a) Amount of diesel consumed per hour -	
No. of moves made in an hour	**12**
Amount of diesel fuel consumed per move	2 L
Amount of diesel fuel consumed per hour	**24 L / hr.**
b) RTGC operation time -	
No. of operation hour in a day	20 hr. / day
No. of operation days in a year	330 days / yr.
No. of operation hours in a year	**6,600 hours / yr.**
c) Amount of diesel consumed in a year -	
Amount of diesel fuel consumed per year	**6,600 x 24 = 158,400 L / yr.**

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8. CASE STUDY-

Kam Hybrid system cost saving calculation (2) -

d) Price of diesel fuel in some European countries -

Price of liter of diesel fuel in Euro Dollars	Euro 1.15-

e-1) Kam Hybrid system (Super capacitor) -

Fuel saving target rate -	45%
Diesel Fuel cost saving after installed of the Kam hybrid on one unit of RTGC in a year -	158,400 L / yr. x Euro 1.15 x 45% = **~Euro 82,000-**

Country -	Unleaded petrol – Euro € per liter	Diesel – Euro € per liter
Belgium	1.46	1.16
France	1.42	1.15
GB	1.32	1.32
Germany	1.42	1.20
Italy	1.36	1.20
The Netherlands	1.57	1.19
Norway	1.54	1.42
Spain	1.16	1.04
Sweden	1.35	1.25
Switzerland	1.17	1.20

Source –
Drive-alive.com
Apr, 2010

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8. CASE STUDY-

Summary – Est. Diesel Fuel saving per RTGC achieved in a year	By applying Super Capacitor
1) Diesel fuel price : (Euro / L) – (At Present Time)	Euro 1.15-
Approx. fuel Saving made per RTGC in a year (Euro €)	~Euro € 82,000-
2) Diesel fuel price increases by 25%:	Euro 1.44-
Approx. fuel Saving made per RTGC in a year (Euro €)	~Euro € 102,600-

EXISTING RTGC – Extra saving would be made from a lower Engine and Generator maintenance cost
eg. smaller gen-set and slower running speed of the engine

NEW RTGC - Initial saving would be made by purchasing a smaller rating of Gen-set

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9. LATEST DEVELOPMENT - 1

1)A New Energy Storage Means (Battery) and Battery Management System (BMS) – (UNDER TESTING)

By using the NEW LiFePO4 battery instead of Super Capacitor to store the braking energy. Target fuel saving rate - ~60%

2) For idling – engine can be completely switched off

Aux. loads (eg. air conditioning, wireless communication, flood lights) will be provided by the LiFePO4 battery during idling

A proven product serving the same functions – Idle Fuel Saver !!!

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9. LATEST DEVELOPMENT - 2

3a) A Totally“ Green” crane operation concept -

To install the Kam Hybrid System on the Electrified RTGs

Kam can provide secondary power supply to Electrified RTGs during peak power requirements eg. when hoisting up with a loaded container :

- To bring down the KVA required from the Mains Power supply in each stacking lane, thus to reduce the overall infrastructure cost

-There will be less current required by the conductor bar (Mains) and that means more Electrified RTGs can work in the same stacking lane, thus to reduce disturbance caused to terminal operation

-Save Electricity cost

-To bring back the regenerative power back to the Power supply network

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9. LATEST DEVELOPMENT - 3

3b) A Totally“ Green” crane operation concept -

To install the Kam Hybrid System on the Electrified RTGs

The whole Gen-set can be taken out from the Electrified RTGs

Using battery pack to supply power for running the Electrified RTGs when crossing yard or going back to the RTGC Maintenance area

To keep “power on” equipment eg. Control system, flood lights, air-con. when switching power supply from Mains to the engine and vice versa

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10. CONCLUSION

- Kam Hybrid System is basically a Power Supply System and is a Well-Proven system
- The concept of Kam system is by using of variable engine speed - It controls the engine to run at its Most Optimum Level in terms both fuel consumption and power output in connection with Energy Storage to achieve fuel saving as well as to meet the peak power requirements
- Kam can work incorporate with any DC or AC drive systems and can be applied on both New & Existing RTGC
- Operating Speed of the RTGC can be Maintained
- For Super Capacitor solution – it can achieve a fuel saving of ~50%
- For the new LiFePO4 battery solution, the targeted fuel saving rate is ~60%

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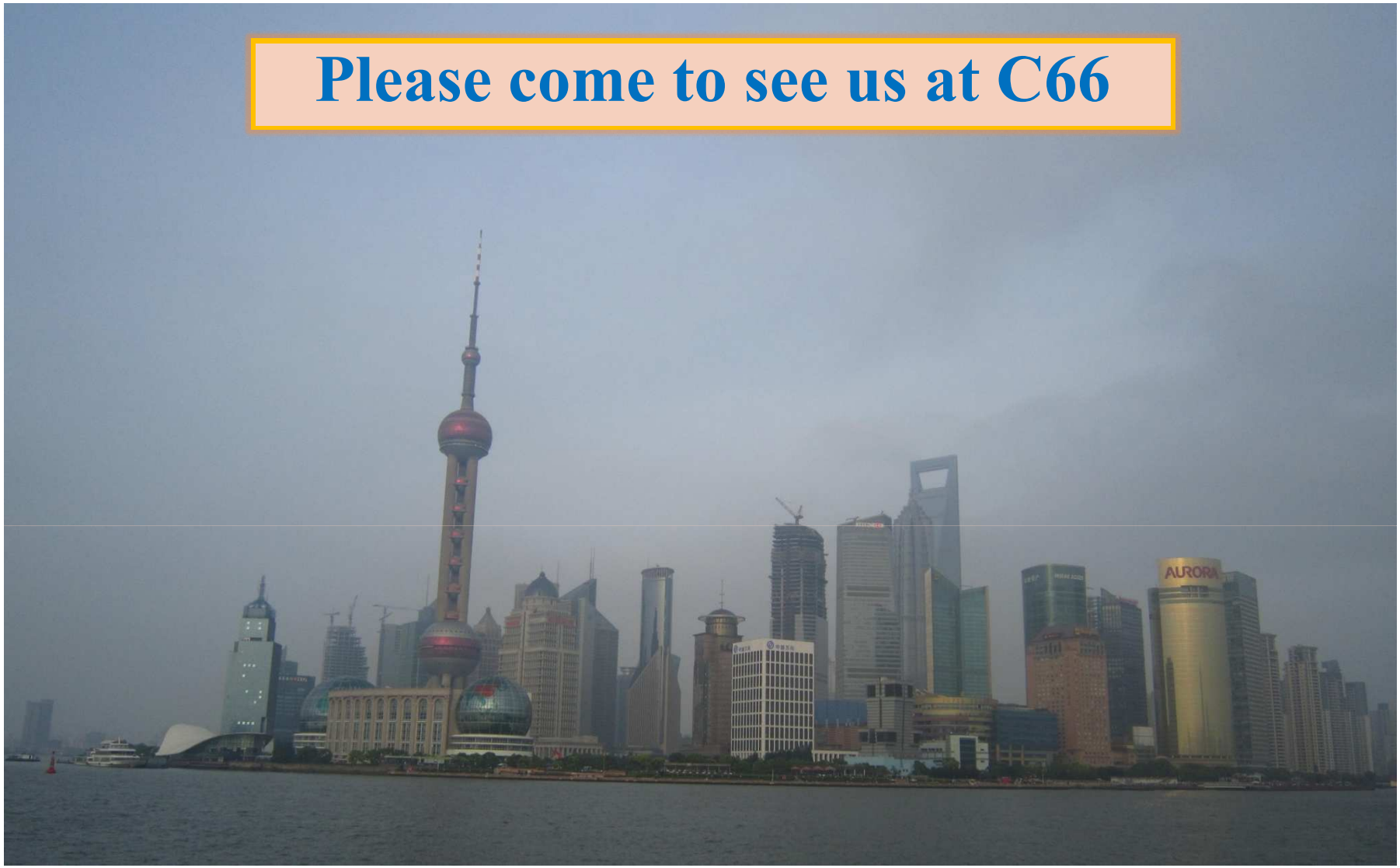

Thank you for your attention !!!

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