

POWERCORP

Intelligent Power Systems

WIND/DIESEL WORKSHOP

Operational Experience

**J. Zimmermann
Powercorp Pty Ltd**

AGENDA

1. Company Introduction
2. Products Overview
3. Operation Maningrida Multiple Diesel
4. Operation Denham Wind/Diesel

Where is Powercorp?



What have We in Common?

Northern Territory

Remote Areas

Alaska

Darwin

Sister Cities

Anchorage

Subtropical/Desert

Extreme Climates

Arctic

Crocodiles

Friendly Wildlife

Bears



Anchorage 2002



Powercorp Pty Ltd, JZ

POWERCORP

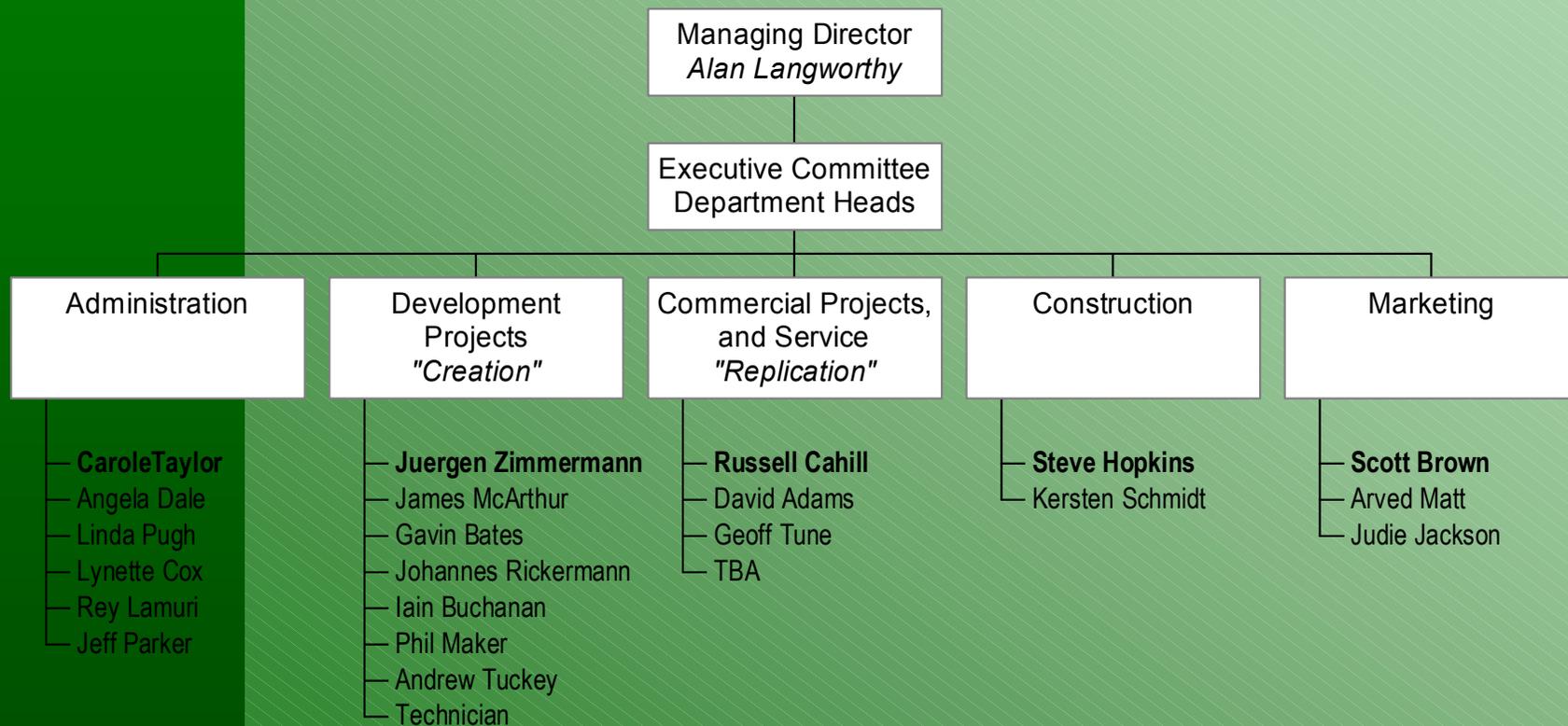
- Medium sized high-tech company
- Specialising in Software and Control Systems for Power Station Automation
- More than 12 years of direct Experience in Utility Applications
- 40 Systems in the N.T. for PowerWater, Malaysia, WA
- Specialists in Wind/Diesel Systems – Denham Test Site



The Team



Management Structure



Associates

Enercon GmbH
Germany

Japan
KBK

IPS Technology
Sdn Bhd (IPST)

Malaysia

PT Kaltimex Energi
Indonesia

PowerWater
NT

Western Power
Corporation

Australian Co-
operative Research
Centre

Vektec Electronics
Ltd

New Zealand

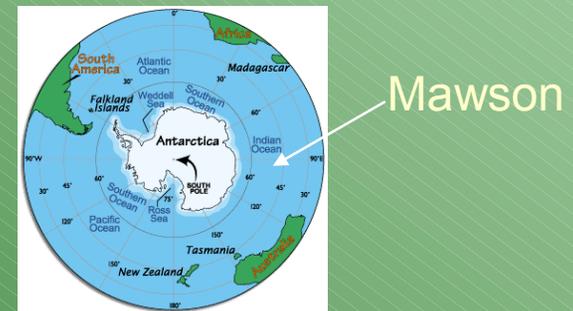
Wireless Energy
Chile

Key Capabilities

- Power Station Automation
 - Specialising in retrofitting
- Wind/Diesel System Design and Construction
- Wind Farm Design and Construction
- Wind/Diesel Modelling
- Power Electronics Solutions



Projects



Training and Testing Facilities



Power Systems
Test Site



Power Electronics
Engineering Facility

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Control Systems
Engineering Facility

Training and Testing Facilities



Power Systems
Test Site



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Power Electronics
Engineering Facility

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Control Systems
Engineering Facility

Control and SCADA Systems

1. MICROLINK

Low cost Automation and SCADA system for small isolated Diesel Power Stations

2. CITIPOWER

Distributed Generation Power Management System for Standby Diesel/Gas power plant

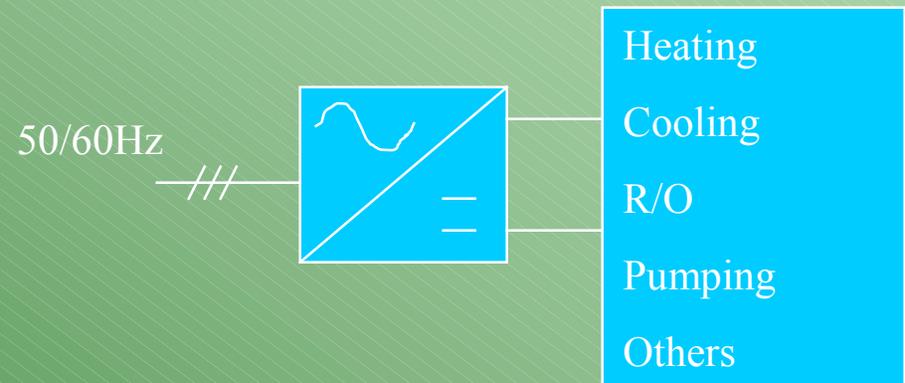
3. IPS – Intelligent Power System

Automation and SCADA system for medium/large size isolated Diesel, Gas, Wind/Diesel or Wind/Gas Power Stations.

Power Electronics Solutions

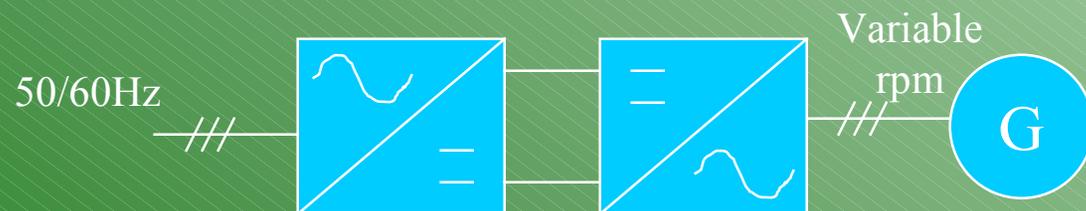
1. DGI

Dynamic Grid Interface to Provide Spinning Reserve



2. WTG

Variable Speed WTG Power Conversion System



Key Elements for High Penetration



Central Station Automation
Intelligent Power System



Controllable WTG
Power Output limit or Start/Stop



Provision of Spinning Reserve
Dynamic Grid Interface to connect
variable loads to power system



Controllable Loads
Demand Managed Devices to maximise
use of available wind

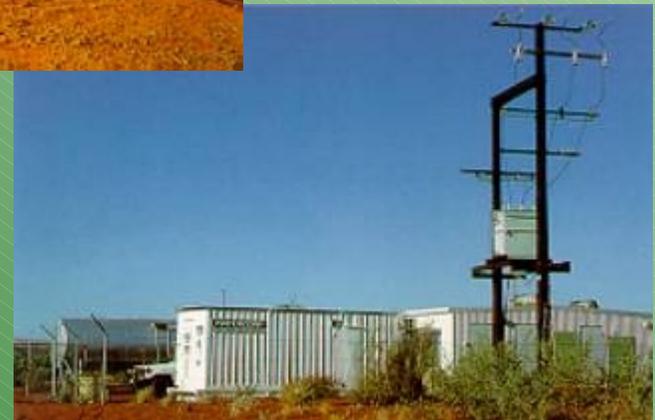
Operating Experience



40 IPS Multiple Diesel Systems



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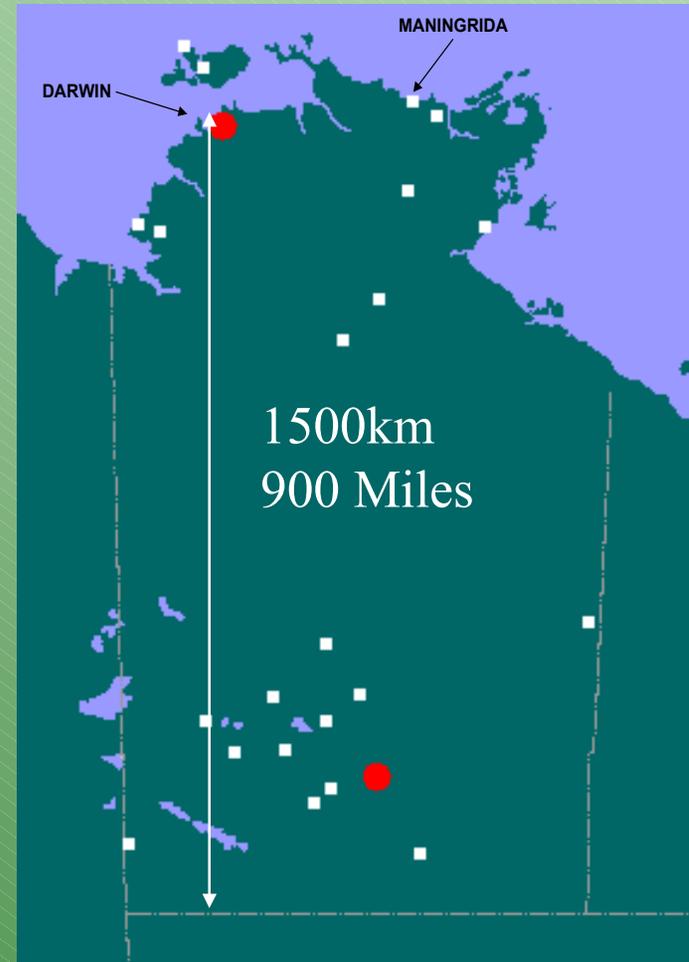


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Maningrida – SNAPSHOT



- 2 hours flight by light aircraft from Darwin.
- Cut off in the wet season.
- Maximum demand 1MW.
- Population 800 people.
- Semiskilled operators.



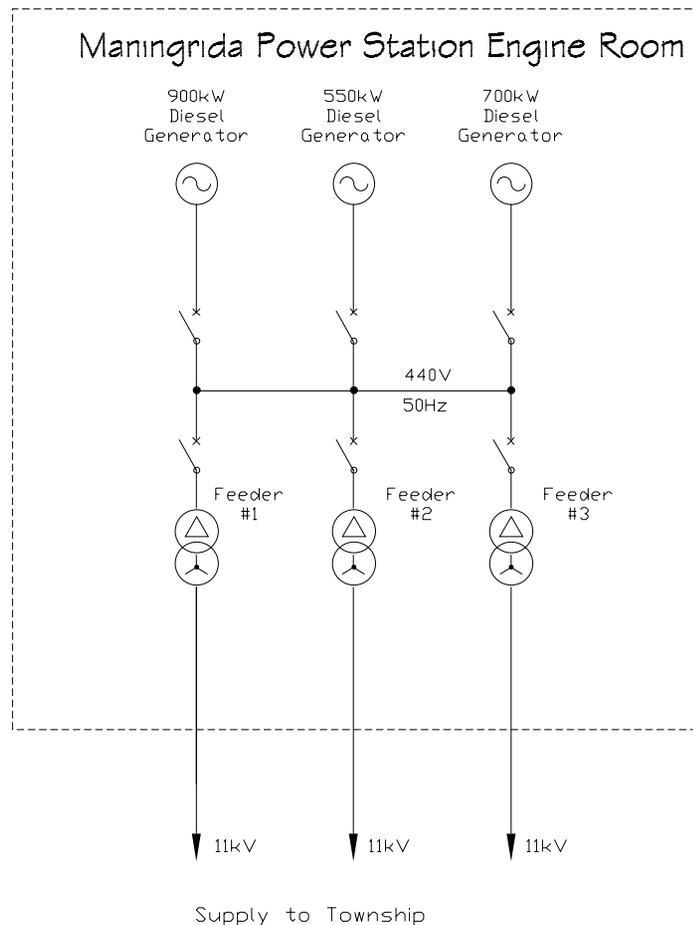
IPS Multiple Diesel in Australia



Maningrida Power System



MANINGRIDA MULTIPLE DIESEL POWER SYSTEM



Maningrida – PROBLEMS

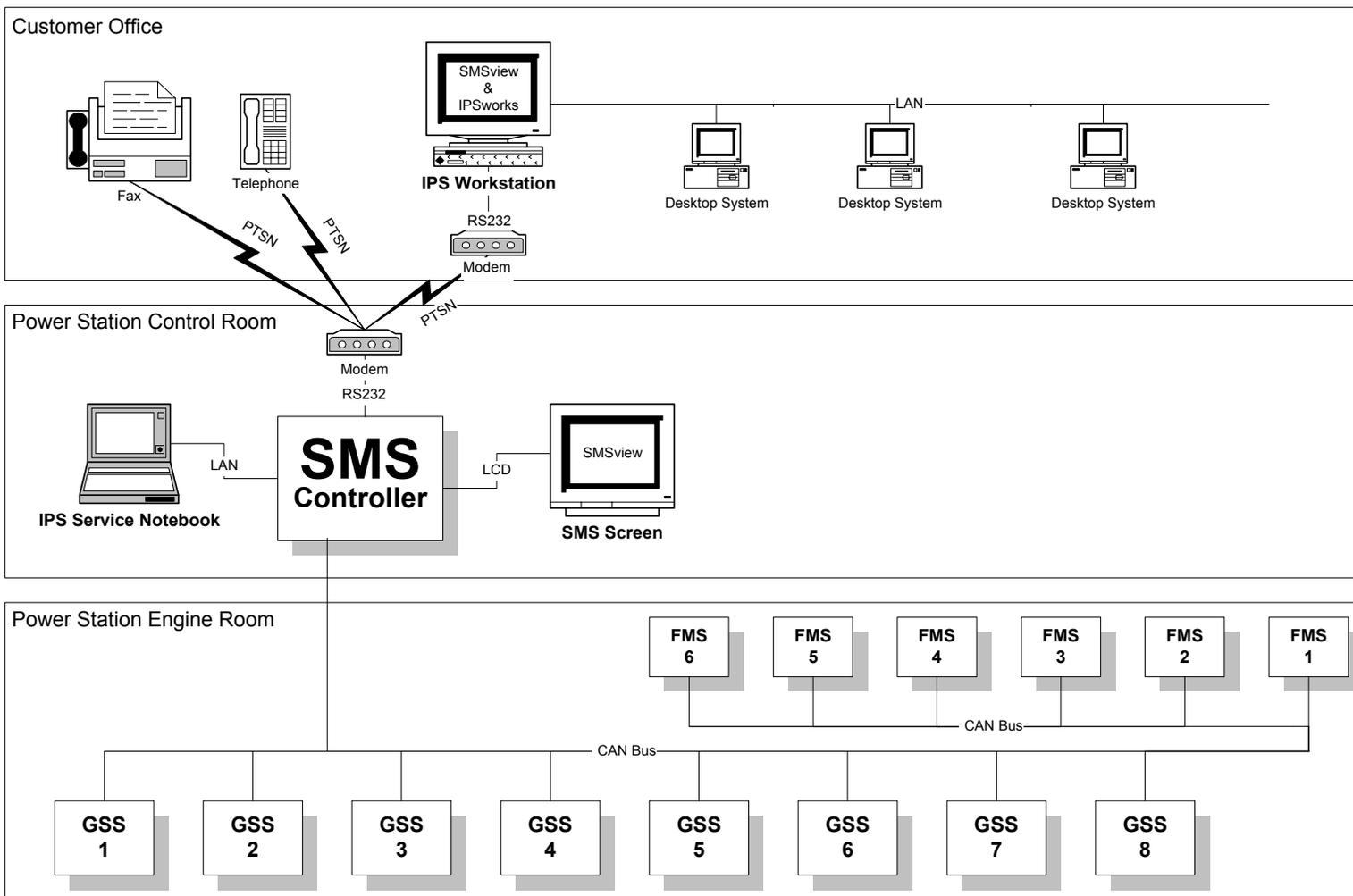


- No historical data logging.
- Manual synchronisation leading to alternator damage.
- Lack of scheduled servicing.
- Poor load-sharing and VAr sharing.
- Poor load factor – 60%.
- Poor fuel efficiency – 0.33 litres/kWh.

Maningrida Solution



Intelligent Power System (IPS) Technology



Typical GSS Control Panel

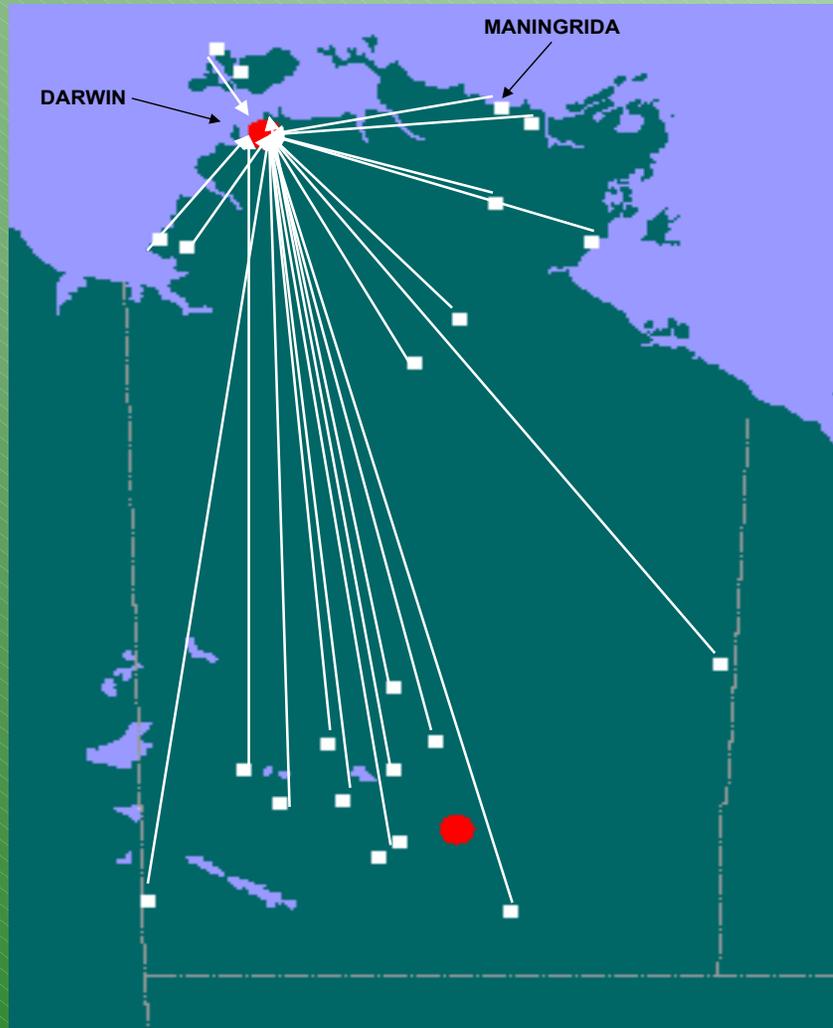


Results: Full Automation

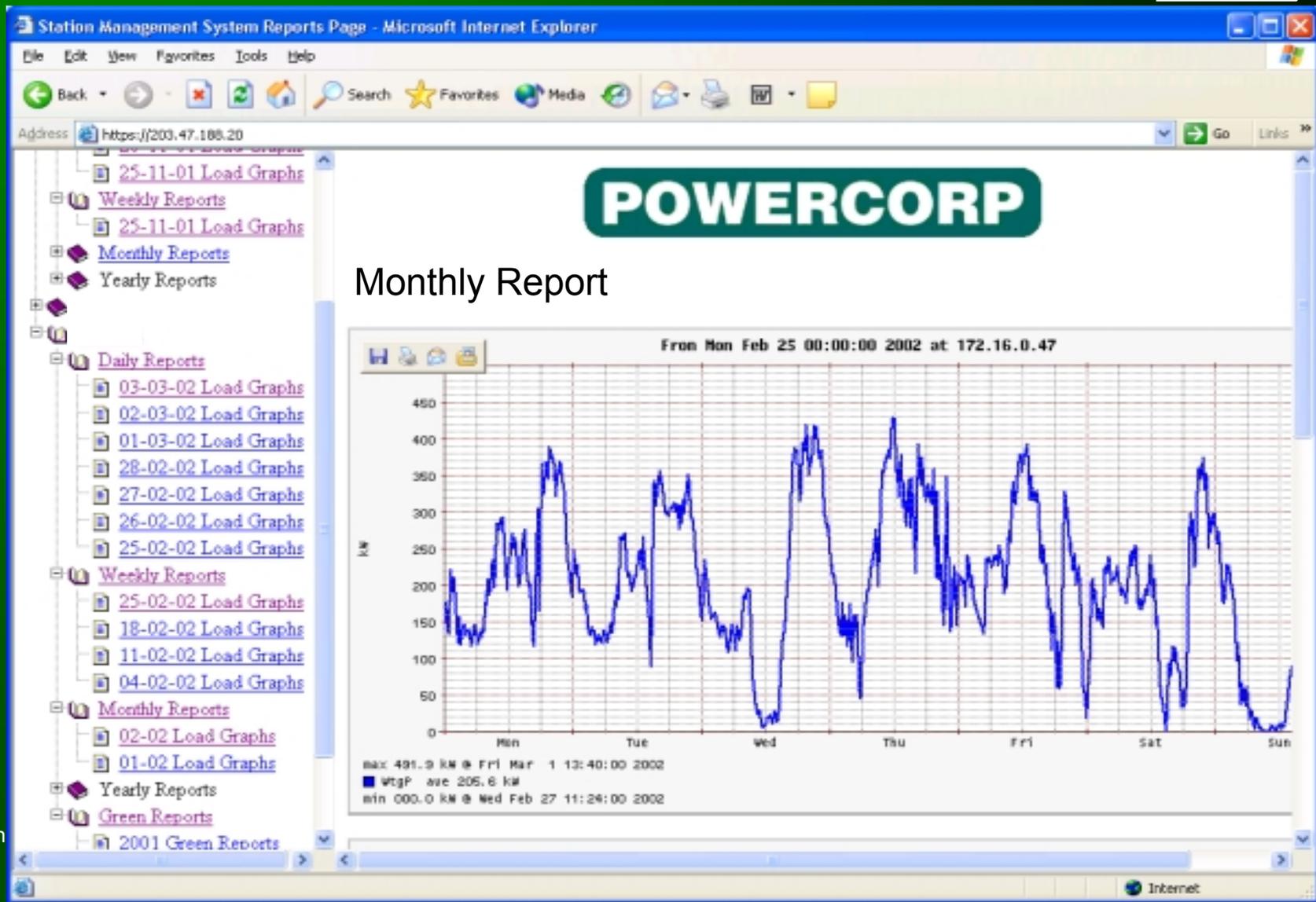


- Data logging 100 msec time intervals.
- Full automatic power station operation.
- Remote monitoring and control.
- Scheduling of genset services with warning messages for service due.
- Improved load factor – 75% - 85%
- Improved fuel efficiency – 0.27 litres/kWh.

Results: Network Integration



Results: Web Reporting



An

IPS Wind/Diesel Denham



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Wind/Diesel High Penetration



Denham Objectives

- Utility Standard Quality of Supply
- Maintain Minimum Diesel Loadings
- Maximise Fuel Savings



Controllable WTG

Power Output limit or Start/Stop

Central Station Automation
Intelligent Power System

Denham Power System

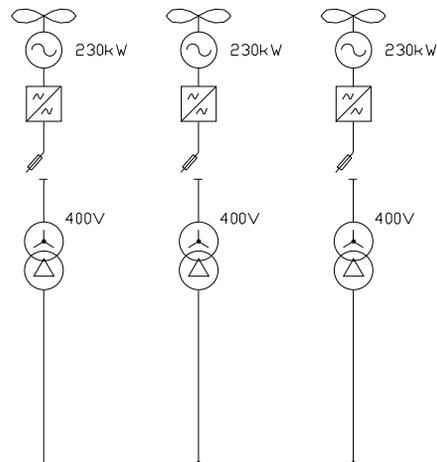


DENHAM WIND / DIESEL POWER SYSTEM

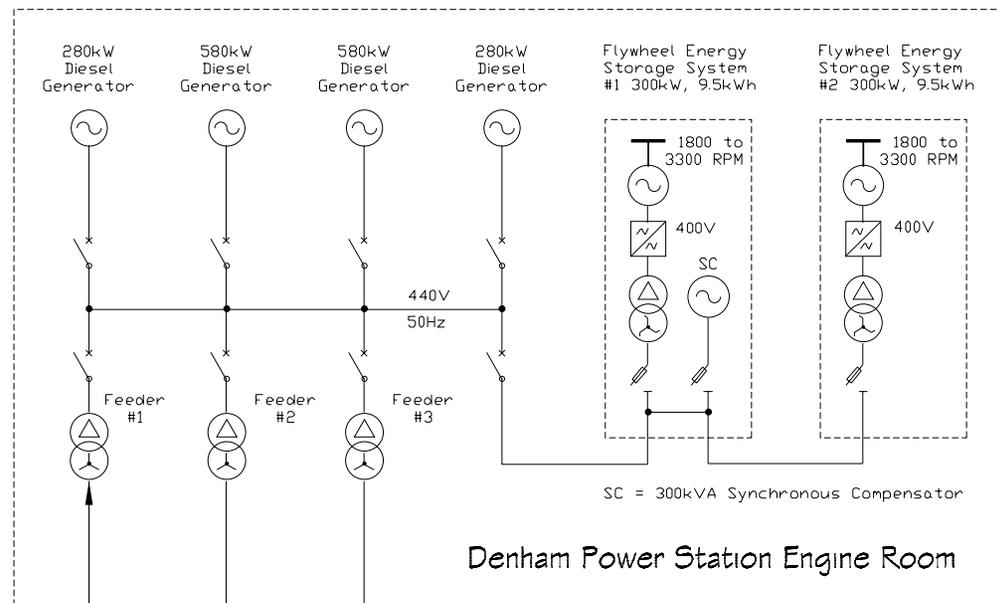
Phase 2

Denham Wind Farm

3 x ENERCON E-30 Windturbines



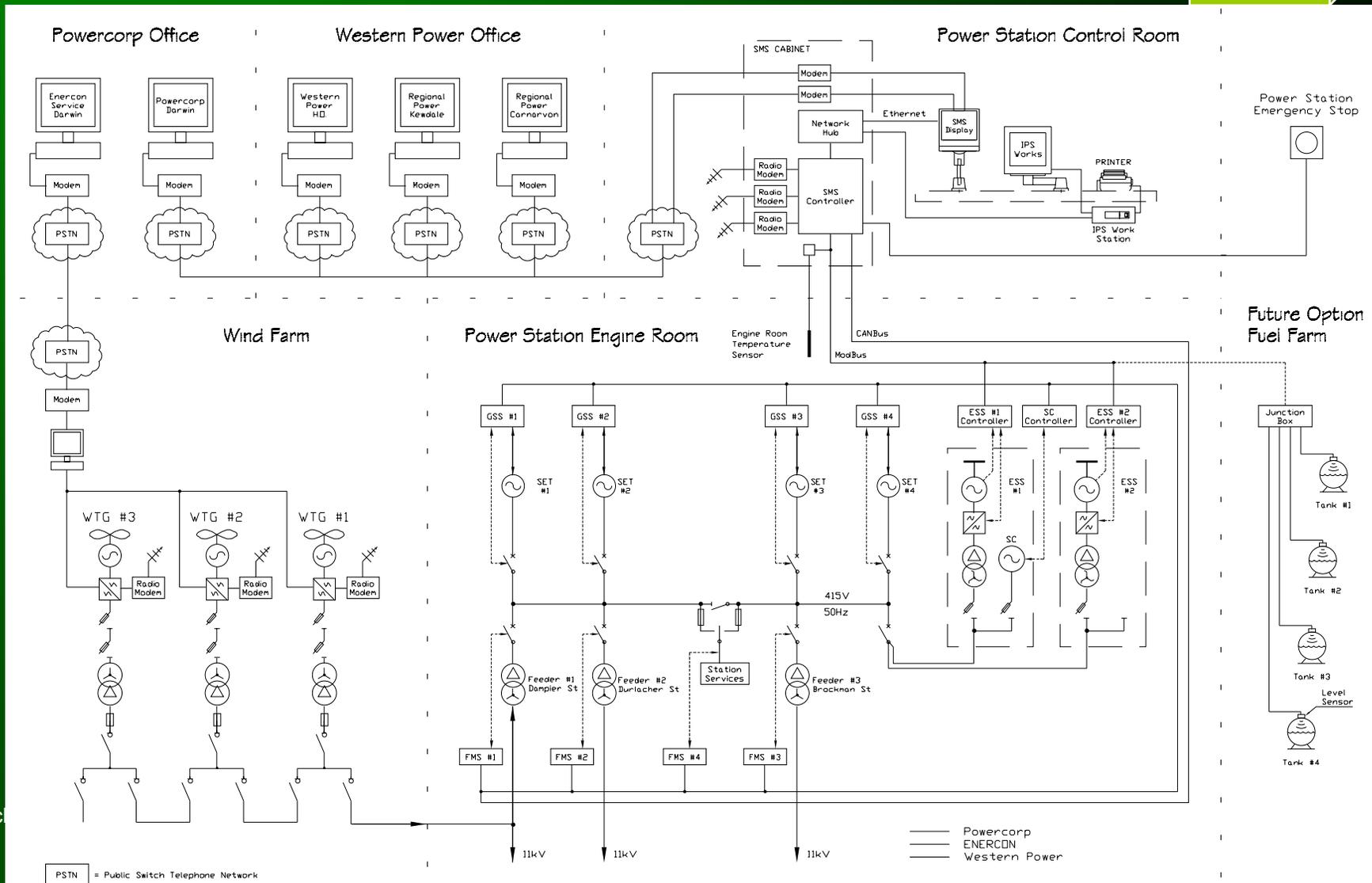
11kV Underground Cable Within Windfarm



Denham Power Station Engine Room

Supply to Denham Township

Denham IPS Control System



And

Denham IPS Installation



Denham IPS Engine Hall



Denham IPS Control Room



2 Diesel Low Wind: 16% Penetration

WTG
IPS

Main DenhamWindDiesel 13:58:08 9/17/2002 POWERCORP

GSS # 1 GSS # 2 GSS # 3 GSS # 4 GSS # 5 ESS #1 ESS #2

147 kW 302 kW
0.52 lf 0.52 lf
0.75 ind 0.75 ind

280 580 580 280

A F A F A A M M M

WTG #1 WTG #2 WTG #3

37 kW 45 kW 32 kW
0.95 ind 0.95 ind 0.95 ind

Network Info	Station Info	Windfarm	Genset Config	Feeder Info	ESS Info
Gensets	Actual kW 456 kW	Setpoint kW 450 kW	Upper Configuration <input type="checkbox"/> <input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	Maximum Capacity 1160 kW	Maximum Capacity 860 kW
ESS	0 kW	0 kW	Selected Configuration <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	Maximum Capacity 580 kW	
Windfarm	114 kW	99 kW	Lower Configuration <input type="checkbox"/> <input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	Switch Down Timer 00:00 mm:ss	Config Setpoint 591 kW
Network Total	570 kW				
Wind Penetration	20.1 %				

Devices
Reports
Station Trends
Logon
Parameters
Start
No VF Alm

2 Diesel High Wind: 30% Penetration

WTG
IPS

Main DenhamWindDiesel 11:03:21 9/17/2002 POWERCORP

GSS # 1 GSS # 2 GSS # 3 GSS # 4 GSS # 5 ESS # 1 ESS # 2

112 kW 231 kW
0.40 lf 0.40 lf
0.72 ind 0.73 ind

280 580 580 280

A F A F A A

COMM S.C.

M M M

A A A

3 # 2 # 1 WTG # 1 WTG # 2 WTG # 3

166 kW 136 kW 37 kW 65 kW 63 kW 64 kW
0.85 ind 0.86 ind 0.28 ind 0.95 ind 0.95 ind 0.95 ind

Network Info	Station Info	Windfarm	Genset Config	Feeder Info	ESS Info
Gensets	Actual kW 343 kW	Setpoint kW 344 kW	Upper Configuration <input type="checkbox"/> F <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	Maximum Capacity 1160 kW	
ESS	0 kW	0 kW	Selected Configuration F F <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	Maximum Capacity 860 kW	
Windfarm	196 kW	200 kW	Lower Configuration <input type="checkbox"/> F <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	Maximum Capacity 580 kW	
Network Total	539 kW		Switch Down Timer 00:00 mm:ss	Config Setpoint 600 kW	
Wind Penetration		36.3 %			

Devices
Reports
Station Trends
Logon
Parameters
Start
No VF Alm

30/08/2002 11:57:43 - G5.077 - GSS 5 VSD 66 Alarm

Generator Configuration Change



Main DenhamWindDiesel 08:41:26 9/20/2002 POWERCORP

GSS # 1 GSS # 2 GSS # 3 GSS # 4 GSS # 5 ESS #1 ESS #2

363 kW
0.63 lf
0.79 ind

280 580 580 280

A F A F A A M M M

A A A A A A

3 # 2 # 1 WTG #1 WTG #2 WTG #3

160 kW 127 kW 73 kW 60 kW 53 kW 57 kW
0.95 ind 0.82 ind 0.45 ind 0.95 ind 0.95 ind 0.95 ind

Network Info Station Info Windfarm Genset Config Feeder Info ESS Info

Windfarm Status 0xffffffff	Wind Speed 7.1 m/s	Upper Configuration [E][E][][][][][]	Maximum Capacity 860 kW
Windfarm Output 184 kW	Windfarm Power Factor 0.95 ind	Selected Configuration [][E][][][][][]	Maximum Capacity 580 kW
Windfarm Setpoint 170 kW		Lower Configuration [E][][][][][][]	Maximum Capacity 280 kW
Windfarm Available 169 kW		Switch Down Timer 00:00 mm:ss	Config Setpoint 556 kW

Devices Reports Station Trends Logon Parameters Start No VF Alm

1 Diesel High Wind: 50% Penetration

WTG
IPS

Gensets | **DenhamWindDiesel** | 08:36:20 9/17/2002 | **POWERCORP**

GSS # 1 GSS # 2 GSS # 3 GSS # 4 GSS # 5 ESS #1 ESS #2

226 kW
0.39 lf
0.77 ind

280 580 580 280

A F A A

COMM S.C.

M M M

A A A

3 # 2 # 1

WTG #1 WTG #2 WTG #3

163 kW 137 kW -74 kW
0.92 ind 0.88 ind 0.97 ind

77 kW 78 kW 77 kW
0.95 ind 0.95 ind 0.95 ind

Network Info	Station Info	Windfarm
Gensets	Actual kW 233 kW	Setpoint kW 232 kW
ESS	0 kW	0 kW
Windfarm	232 kW	234 kW
Network Total	465 kW	
Wind Penetration	50.3 %	

Genset Config	Feeder Info	ESS Info
Upper Configuration <input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	Maximum Capacity 860 kW	Maximum Capacity 860 kW
Selected Configuration <input type="checkbox"/> <input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	Maximum Capacity 580 kW	Maximum Capacity 580 kW
Lower Configuration <input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	Maximum Capacity 280 kW	Maximum Capacity 280 kW
Switch Down Timer 00:00 mm:ss	Config Setpoint 522 kW	

30/08/2002 11:57:43 - G5.077 - GSS 5 VSD 66 Alarm

Generator Screen: 40% Loadfactor



Genset 1 **DenhamWindDiesel** **11:06:01 9/17/2002** **POWERCORP**

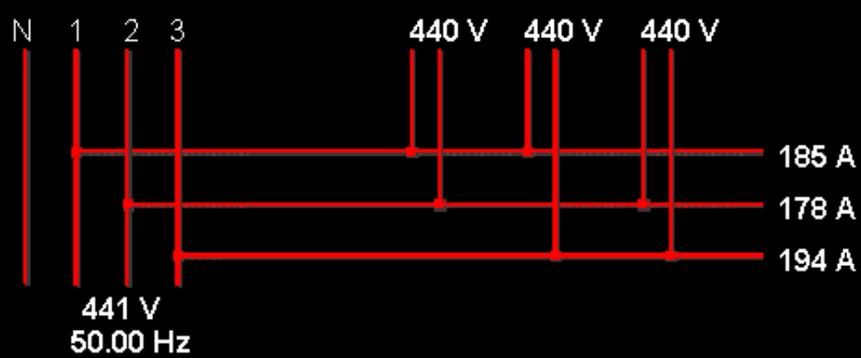
Mode
AUTOMATIC FIRST START

State
RUNNING ON-LINE

112 kW
97 kVAr
0.73 ind
0.40 If



49.93 Hz



Engine Details		Engine Data		Operation Data			
Rated Power Output	280 kW	Total Engine Hours	17499 h	Engine Speed	1499 RPM	Jacket Water Temp Out	74 °C
Derated Power Output	280 kW	Total Energy Produced	2837832 kWh	Oil Temperature	0 °C	Jacket Water Temp In	0 °C
Fuel Economy	0.00 l/kWh	Engine Hall Temp	27.7 deg C	Oil Pressure Before Filter	0 kPa	Exhaust Temp Right	390 °C
Next Service Due	349 h	Genset Commissioned		Oil Pressure After Filter	523 kPa	Exhaust Temp Left	0 °C

Main

Alarms Events

Trends

Logon

Genset Control

Start Priority

Service Done

Reset Alarms

◀ ▶

▲

Anchorage 2002

30/08/2002 11:57:43 - G5.077 - GSS 5 VSD 66 Alarm

WTG Screen: Power Limitation

WTG
IPS

WTG 1 DenhamWindDiesel 11:08:23 9/17/2002 POWERCORP

Mode
AUTOMATIC

State
RUNNING (Online)

52 kW

1 2 3 234 V 234 V 233 V 0.95 ind

50.07 Hz 39.1 RPM

WTG Details		Windfarm Details		WTG Data		Operation Data	
Rated Power Output	250 kW	Total Operating Hours	33521.0 s	Nacelle Position	66 °	Stator Temperature	39 °C
Available Power	222 kW	Total Energy Produced	2102473 kWh	Blade Pitch Angle	13 °	Rotor Temperature	49 °C
Power Limit Setpoint	60 kW	WTG Commissioned		Excitation Current	9 A	Bearing Temperature	25 °C
Wind Speed	13 m/s			Ambient Temperature	22 °C	Battery Temperature	19 °C

30/08/2002 11:57:43 - G5.077 - GSS 5 VSD 66 Alarm

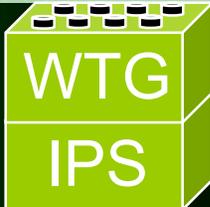
- Main
- Alarms Events
- Trends
- Logon
- WTG Control
- Reset Alarms
- Service Done
- Reset Alarms
- Navigation buttons: Left, Right, Up

Denham Outcomes

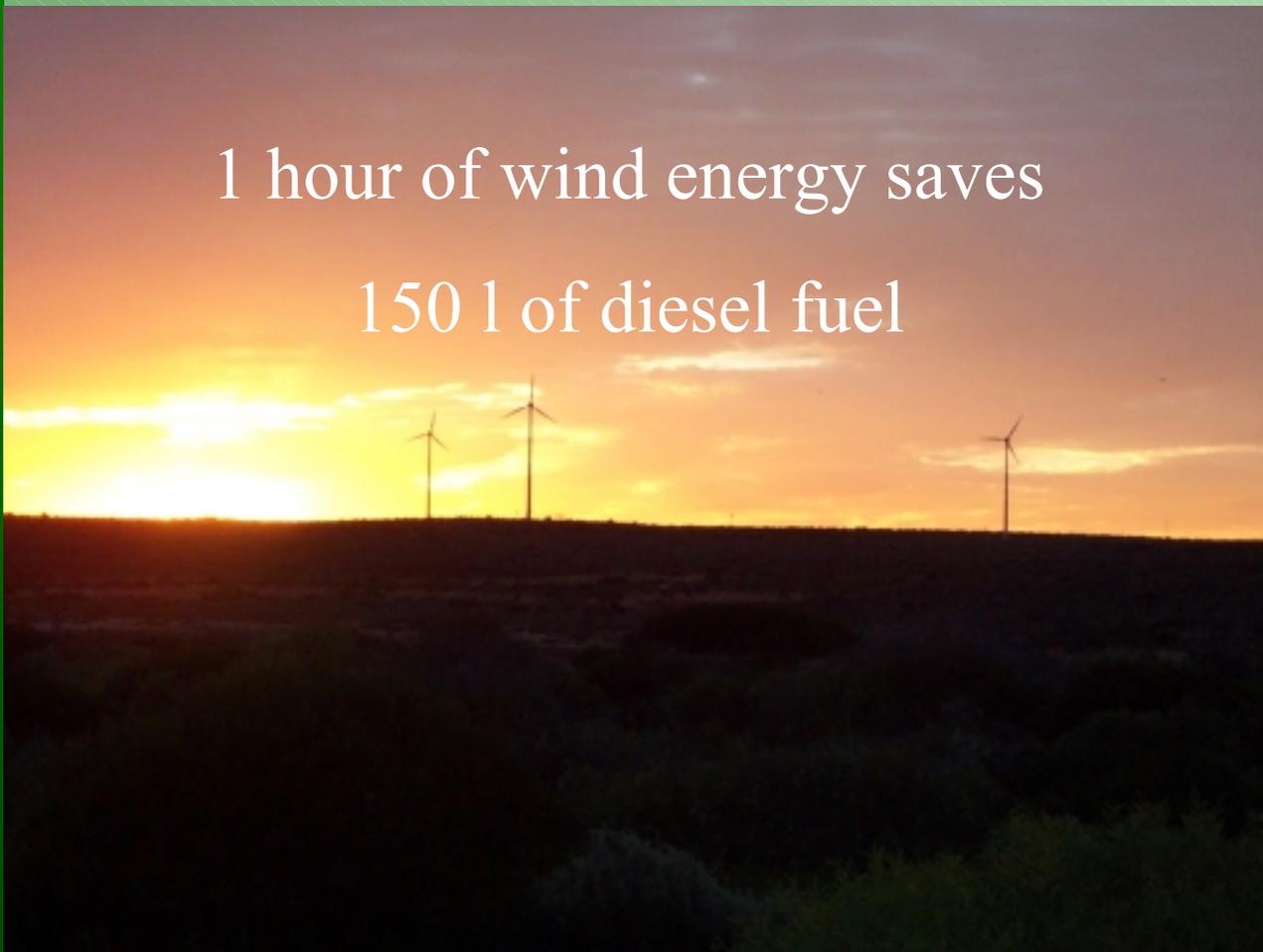


- Full Automation of Power Station
- Installation of three E30 WTG
- 3 years of Operation
- Fuel Savings of 270,000l/year
- Utility Quality of Supply (Isoch 50Hz, 440V)
- Test site for Wind/Diesel Technology

Denham Outcomes



1 hour of wind energy saves
150 l of diesel fuel



Thank You

■

POWERCORP

Intelligent Power Systems

www.pcorp.com.au