Harris County, Texas

Extra Low Energy LED
DC Cabinet System
Alternative Energy System
DETERMING FACTORS TO MOVE TOWARD LOW VOLTAGE SYSTEM

Hurricane Experience
Repairs to most locations were done, but....
Many locations had no power restored for two weeks in some instances.

Lower power consumption at signalized locations.
5.5 Amps at 48VDC equals 264 Watts total load.

Requirements to work around voltages > 50 Volts*
  Qualifications
  Coordination of efforts
  PPE

*The NEC and UL define a low-voltage system in different terms and applications; defining low-voltage as non-ripple DC voltage of less than 50V.
Reduced loads made consideration for alternative/renewable power sources more cost effective and useful.

Sources Considered:

- SOLAR
- WIND
- BATTERY
- FUEL CELL
- COMBINATIONS
Major Building Blocks

Direct Current (DC) Traffic Signal System

1. DC Traffic Signal & Control Assembly

2. DC Service Assembly
   - Uninterrupted Power System  -> Battery Banks
   - Alternative Energy System  -> Solar Panel Array
     -> Wind Energy
     -> Fuel Cell
DC Traffic Signal & Control Assembly
24VDC to 48VDC Power Supply
120VAC to 24VDC Power Supply/Charger
Wireless Modem
Solar Charge Controller
CNG Fuel Cells
Normal cabinet with PDA, Output Files (125 VAC)

Extra Low Power Assembly
METHANOL SUPPLIED

Solar Panel
Solar Panel

24V Battery Bank

48VDC Module (DC-DC)

24VDC Module (AC-DC)

Circuit Sense & Protection Panel

Methanol Fuel Cell Module

Methanol Tank #1
Methanol Tank #2

LED Cabinet Lighting

Fiber Termination

2070L Traffic Controller Unit
24V Source

Document Tray Equipment Shelf

Auxiliary Display Unit

DC High-density Output Assembly

48V DC-DC Power Supply Assembly (12-24DC)

Field Output Terminations (Signal Displays)

Field Input Terminations (Detection)

ITS 340 Cabinet

Grid Power Pedestal

120VAC
Direct Current (DC)
Traffic Signal & Control Assembly
ITS V1 SIGNAL INTERFACES

6-14 PACK REAR PANEL

SWITCHPACKS

SIGNS FACE

SIU

CONTROLLER

CMU

BUS 3

AMU
Existing Equipment Needs – AC Power

- Controller
- SIUs
- Detectors / DC Isolators / AC Isolators
- Communications Equipment
  - Rugged Comm Switch
  - Camera
  - Video Encoder
  - Digi
- Field Outputs
- Flash Bus
- Cabinet Support Equipment
  - Ventilation
  - Lighting
  - Police Panel
  - Service Outlets
DC Cabinet Power Requirements

- 48V Power Supply for ATC 2070
- DC Load Module
- 48V DC Cabinet Monitor CMU
- Communications Equipment
- Flash Bus
- Lighting & Ventilation
DC Power Needs – 12 /24V Equipment

• Detectors / DC Isolators
• Communications Equipment
  – Rugged Comm
  – Video Encoder
DC Power Needs – 48 V Equipment

- DC Load Module Field Outputs
- Flash Bus
- Fan and Light Assembly
AC Power Needs?

- 120 VAC Service Outlets
  - PTZ Camera & Control
  - Laptops
  - Drills & Small Tools
  - Etc
Overall DC Rack Equipment

- Conflict Monitor Unit (CMU)
- HD Flasher Unit
- Technician/Police Switches
- Vehicle Phase Load Switches (8phs)
- Serial Interface Unit (SIU)
- 2x Pedestrian (4) and 2x Overlap (4) Load Switches
DC SERVICE PANEL
DC Conflict Monitor Display Unit
Integrated DC Field Panel (Flash Transfer & Output)
Initial DC Signal Cabinet Rack Layout

Front View

Rear View
Final Design was much more compact and even provided more modularity.
Direct Current (DC) Service Assembly System
DC Service Assembly

- Power Conversion for 48 VDC
- Provides equipment operating power while simultaneous battery charging capability
- Temperature compensating charging
- Remote status monitoring and reporting (SNMP capable)
- Accepts any AC voltage/frequency combinations
- Alarms – Built-in LCD Display and Dry Contact control
Hold-Up Power Budget

• Worst Case Power Budget
  – 12 VDC at 2.5 Amps
  – 24 VDC at 5.0 Amps
  – 48 VDC at 5.0 Amps

• Total of 420 – 450 Watts
Back-Up Operation Power Budget

- RNO (Reduced Normal Operation)
  - 300 Watts
- ARF (All-Red Flashing Operation)
  - 150 Watts
UPS System

• Dual Banks of 4 – 12 VDC (100+ A.h.) Rated Batteries.
• The batteries charged by a combination of Solar/Wind/Fuel Cell Energy and AC power.
• Alternative Energy Source(s) Charging has Priority when AC Power is not available.
Underground Battery Storage Units
Previous battery issues have been resolved with better technologies.

Gel/AGM verses Lead-Acid
Higher amperages in smaller packaging.
Longer Life / Better Manufacturer Warranties

Battery Pods are below grade and are environmentally sealed.

(8) Batteries per “POD”

Because of lower wattage output of methanol fuel cells, two pods were used at that location.
Battery Charging Schematic
Alternative Energy System

Solar Array Panels
Wind Turbines Energy
Fuel Cell
Solar Panels

• 259 Watts Solar Panel (3’ x 6’) with Continuous Output of 1 Amp and 24VDC
• 2-Panel Array produces 48VDC
• 4 to 6 Solar Arrays required per intersection
• Solar Panels to be mounted on AC Service Assemblies
• Solar Array outputs go to the DC Service Assembly
• Goals: smallest panel size and numbers that meet the above requirements
Solar Array Panel
Wind Power

FEATURES:
- Low wind speed operation
- Permanent Magnet Generator Direct Drive - 18 Poles
- Silent operation
- No maintenance
- 5-year warranty
- Self-regulating in high winds

USE:
- Urban
- Suburban
- Rural
- Battery Charging
- Remote Locations
- Emergency Power
- Oil Rigs

Customizable and Interchangeable Graphics Available
**SEAHAWK & SEAHAWK+**

**Vertical Axis Wind Turbines**

- Cage diameter: 78.2 mm (2.5 ft)
- Overall length: 123 mm (4.0 ft)
- Turbine weight: 72 kg (160 lbs)
- Rated power: 500W
- Rated windspeed: 28 mph = 12.5 m/s
- Rated motor speed: 600 rpm
- Start-up windspeed: 1.35 m/s (3.0 mph)
- Cut-in windspeed: 3.6 m/s (8.0 mph)
- Max design windspeed: 54 m/s (120 mph)
- Max power output: 500W
- Turbine input fuse: 60 amps
- Battery Fuse: 90 amps
- Optional photo/kit input fuse: 30 amps
- Dump load fuse: 60 amps

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**SEAHAWK+ Turbine - 1.2 kW**

- Cage diameter: 100.6 mm (3.4 ft)
- Overall length: 182.8 mm (6.0 ft)
- Turbine weight: 81 kg (180 lbs)
- Rated power: 1200W
- Rated windspeed: 28 mph = 12.5 m/s
- Rated motor speed: 900 rpm
- Start-up windspeed: 1.35 m/s (3.0 mph)
- Cut-in windspeed: 3.6 m/s (8.0 mph)
- Max design windspeed: 54 m/s (120 mph)
- Max power output: 1.2kW
- Turbine input fuse: 60 amps
- Battery Fuse: 90 amps
- Optional photo/kit input fuse: 30 amps
- Dump load fuse: 60 amps
# SEAHAWK™ Technical Specifications

**Vertical Axis Wind Turbines**

Interchangeable Custom Graphics Available

## Physical Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
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</thead>
<tbody>
<tr>
<td>Cage Diameter</td>
<td>76.2mm / 2.5ft.</td>
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<tr>
<td>Overall Length</td>
<td>120mm / 4.0 ft.</td>
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<tr>
<td>Turbine Weight</td>
<td>72 kg / 160 lbs.</td>
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## Performance

<table>
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<tr>
<th>Parameter</th>
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<tbody>
<tr>
<td>Rated Power</td>
<td>500W</td>
</tr>
<tr>
<td>Rated Windspeed</td>
<td>12.5 m/s (28 mph)</td>
</tr>
<tr>
<td>Rated Rotor Speed</td>
<td>608 RPM</td>
</tr>
<tr>
<td>Start-up Windspeed</td>
<td>1.35 m/s (3 mph)</td>
</tr>
<tr>
<td>Cut-in Windspeed</td>
<td>3.6 m/s (8 mph)</td>
</tr>
<tr>
<td>Max Windspeed</td>
<td>54 m/s (120 mph)</td>
</tr>
<tr>
<td>Max Power Output</td>
<td>600W</td>
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</table>

## Electrical

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
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<tbody>
<tr>
<td>Turbine Input Fuse</td>
<td>60A</td>
</tr>
<tr>
<td>Battery Fuse</td>
<td>90A</td>
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<tr>
<td>Photovoltaic Input Fuse</td>
<td>30A</td>
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<tr>
<td>Dump Load Fuse</td>
<td>60A</td>
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</tbody>
</table>
FUEL CELL ALTERNATIVE POWER

ULTRA 250 WATT  ACCUMETERICS 500 WATT  EFOY 90 WATT

FUEL NATURAL PROPANE  NATURAL GAS  METHANOL
CNG Fuel Cells (250Watt Each)
Lessons Learned

• Design Changed through continued Private/Public knowledge exchange
• No major failure to date.
• Ran for nearly three weeks with no AC Power, Methanol Tanks emptied!
• Will provide relay closure/fault relay with fiber connectivity completion.
• Possible on site strobe light with sign notification as back up.
• With new ATC devices, possible combination of equipment to singular cabinet.
Contact Info

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Thanks to the following people:

Ron Johnson, Mike Taylor - Intelight
Andrew Mao, P. E. – TxDOT
Andrew Wrigley, P.E. – Shell