



412th Test Wing



War-Winning Capabilities ... On Time, On Cost

How to Do More with Less



U.S. AIR FORCE

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412 CEG/CENPL
10 May 2017**

Approved for public release; distribution is unlimited.
412TW-PA-17213

Integrity - Service - Excellence



412th Test Wing



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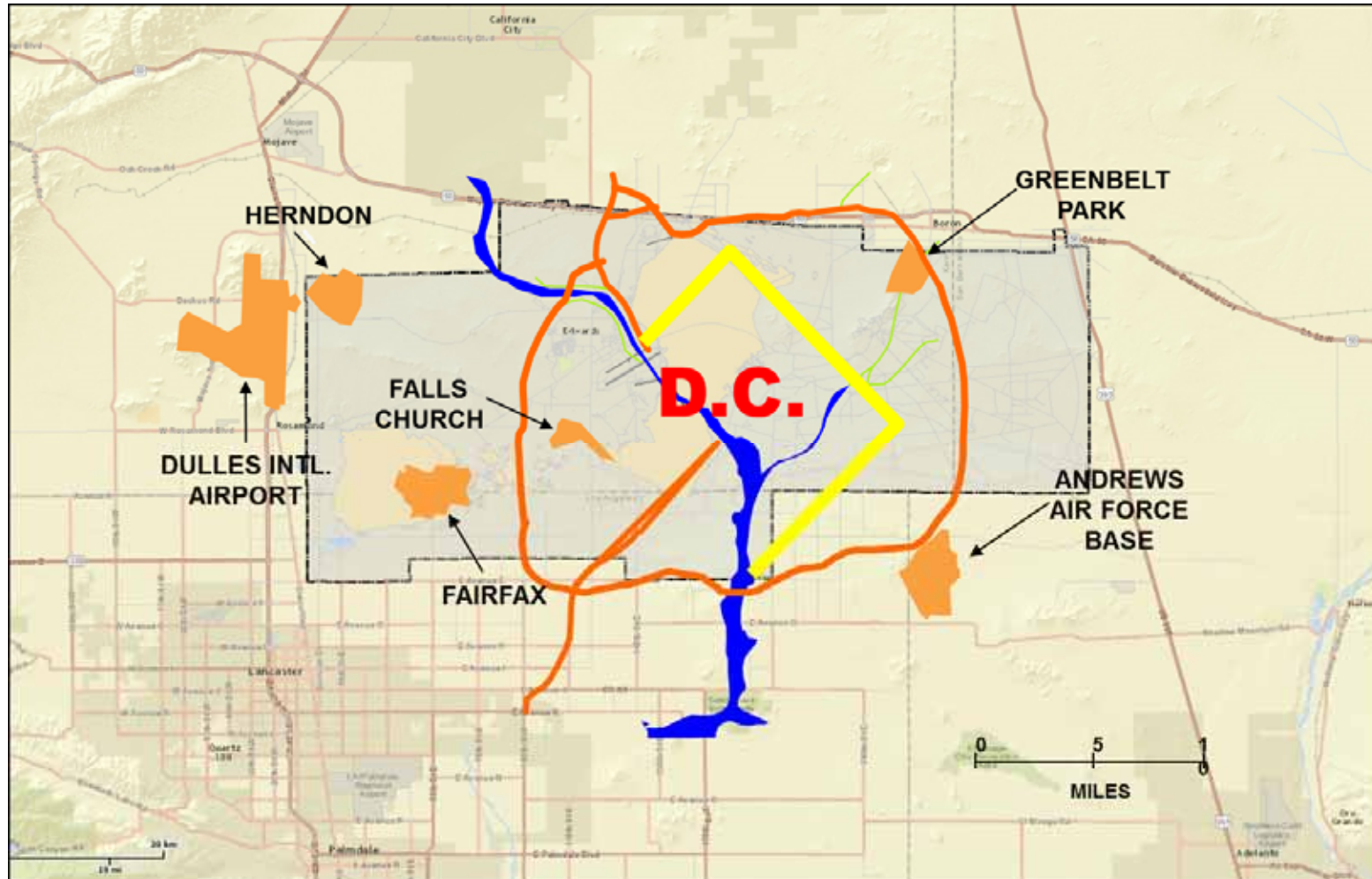
- **412th Test Wing Mission Statement:**
 - **Test and Evaluate Weapons Systems to Ensure War-Winning Combat Capabilities**
- **Challenges**
 - **Infrastructure 70+ years**
 - **Budget Constraints**
 - **Workforce**
- **Test Programs**
 - **KC-46**
 - **F-35**
 - **F-22**
 - **B-2**
 - **Next Generation Trainer X**



Edwards AFB



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Span of Operations



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In A Word...



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- 717 Buildings
- 7.19M Sq Ft Building Space
- 19 Runways
- 7.8 Miles of Paved Runways
- 46 Miles of Lakebed Runways
- 13.8M Sq Ft Ramp Space
- 64 Square Miles of Lakebeds
- 216 Miles of Paved Roads
- 414 Miles of Unpaved Roads



In A Word...



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- 130 Miles of Gas Lines
- 27 Electrical Substations
- 5 Switch Stations
- 580 Miles of Electrical Lines
- 254 Miles of Water Lines
- 13M Gallons of Potable Water Storage (25 Tanks)
- 94 Miles of Wastewater Lines
- 3.6M Gallons of Petroleum, Oil and Lubricants Storage

Small Number of Fish Responsible for a Very Large Pond – CEG Steps up to challenge Each and Every Day to Support the Mission!!



Constrained Resources



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- **Insufficient Annual Budget ~\$60M**
 - **Maintenance / Repair**
 - **Lack of Funds for Replacement of Infrastructure**
 - **Aging / Antiquated Infrastructure**
 - **1940's (+70 years)**
- **Shortage in Manpower**
 - **Fewer Craftsmen/Technicians**
- **Increasing Utility Costs (Water, Electrical)**
 - **Conservation**
 - **Implemented Energy Savings**
 - **Xeriscape Landscaping**



Proactive vs Reactive



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- **Think Harder – Outside the Box**
 - **Creative Ways to Handle Shortfall**
 - **Manpower**
 - **Energy Conservation Measures (Energy Savings)**
 - **Support Test & Evaluation Mission**
 - **Provide Reliable Utilities**
- **Energy Management Control System (EMCS) and Supervisory Control and Data Acquisition (SCADA)**
 - **HVAC (EMCS)**
 - **~70 Facilities, Key and High Energy Use, Save Energy When We Don't Realize We're Saving (Cost Savings)**
 - **SCADA**
 - **Tanks and Electrical System**



EMCS/SCADA Controls Overview ***What They Have In Common***



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- **At Equipment Level the Main Controller (PLC) Operates the system**
 - **PLC Controller (Main Brain)**
- **Consolidated EMCS/SCADA Room**
 - **Located in Civil Engineering (Public Works)**
 - **Computers in the EMCS/SCADA Room are the Tools**
 - **All Controllers on EMCS and SCADA Work Independently from EMCS/SCADA Room**
 - **Server Stores Data Points**
- **Does What You Tell It To Do. No More, No Less**
- **Perform Maintenance When We Need To, Not Necessarily Every Month (Periodic Maintenance)**



Energy Management Control System (EMCS)



- **Facility Level Controls**
 - **Heating, Ventilation and Air Conditioning (HVAC)**
 - **Lighting**
- **Augment Manpower**
 - **Remote Troubleshoot**
 - **Does not Replace Technicians**
- **Energy Conservation**
 - **Adjust Temperatures**
- **Automation**
 - **Provide Reliable Utilities**



EMCS - HVAC



412TW

Apr 18, 2017 12:52 PM

[Dashboard](#)
[Reports](#)
[Schedule](#)
[Printout](#)

EDWARDS AIR FORCE BASE

ENERGY MANAGEMENT & CONTROL SYSTEM

Main Base

1 (540)	1488 (527)	1828 (538)
185 (543)	1488 (582)	1838 (516)
151 (507)	1481 (182)	1826(282)
369 (569)	1458 (631)	1844 (587)
710	1688 (677)	1878 (557)
720	1635 (589)	1874 (561)
1119 (567)	1642 (184)	1881 (565)
1982 (57)	1643 (185)	2268 (687)
1278 (546)	1737 (754)	2289 (718)
1268 (88)	1886 (311)	2417 (552)
1298 (632)	1888 (512)	2427 (596)
1488 (528)	1816 (UC)	2424 (519)
1483 (583)	1815 (521)	

AFRL

Ice Ice Baby

Main Base

	2678 (667)	2958 (183)
2488 (631)	2758 (181)	4221
2453 (577)	2888 (678)	4271 (186)
2458 (696)	2818 (139)	4365 (884)
2468 (683)	2868 (633)	5218 (648)
2467 (654)	2888(688)	5513 (755)
2462 (691)	3088 (583)	5525 (188)
2464 (694)	3788 (563)	5688 (634)
2588 (657)	3735 (574)	5681 (373)
Comms(638)	3818 (595)	6457 (815)
2688 (524)	3925 (58-11)	6458 (815)
2688 (667)	3948 (55-7)	7287 (691)
2663 (667)	3948 (794)	7271 (288)

CLIMATEC

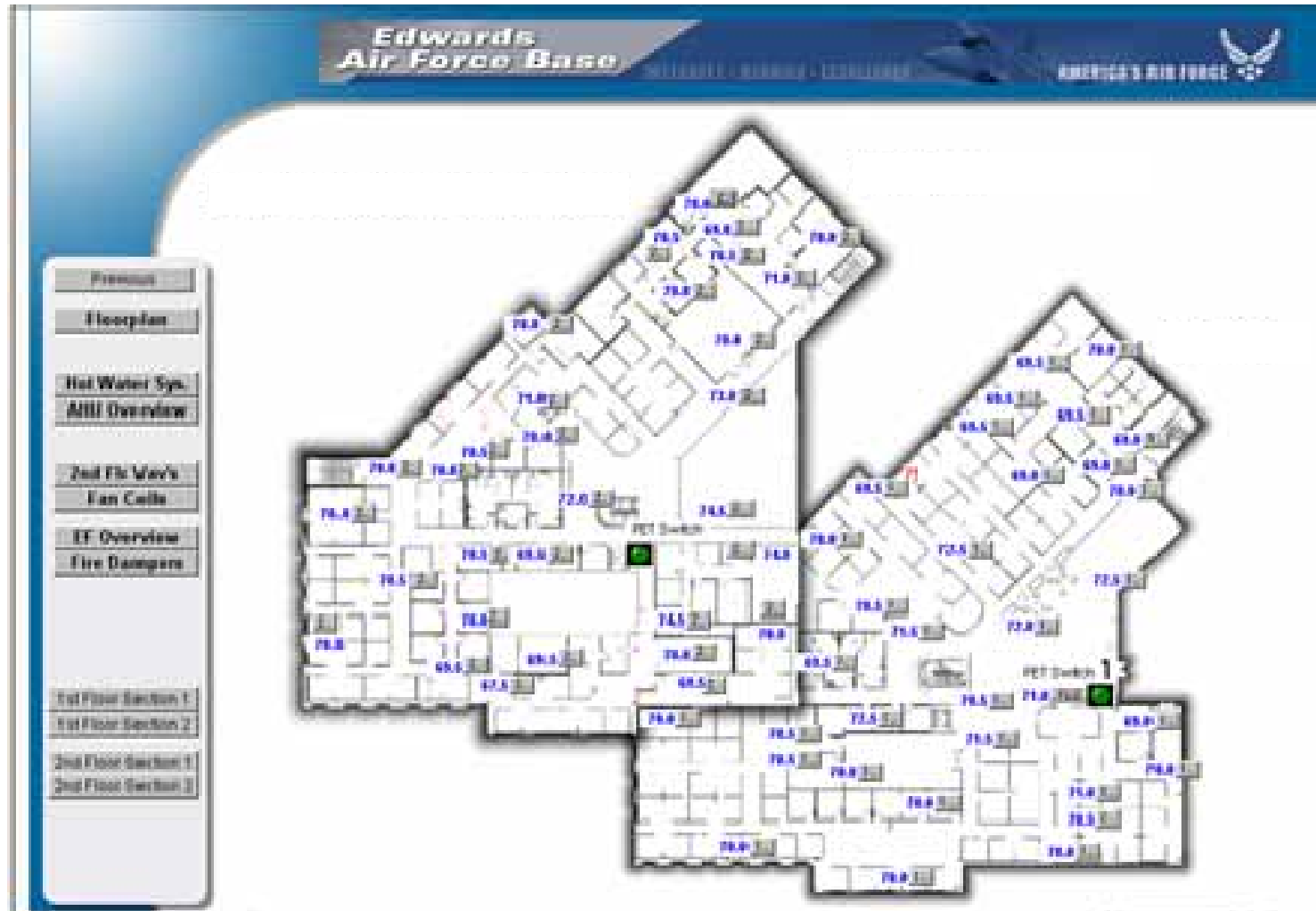


Administrative Building – HVAC



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Real time temperatures broken down by specific HVAC units.
Provides sight picture of current heating/cooling





Variable Air Volume



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Real time temperatures broken down by specific HVAC units.

Provides sight picture of current heating/cooling

This allows our craftsmen to immediately diagnose a problem in the field

Note:
Discharge temp,
system
occupancy and
airflow.

The screenshot displays a BMS interface for Edwards Air Force Base. At the top, it shows 'Edwards Air Force Base' and 'AMERICA'S AIR FORCE'. The main display area is titled 'MM-50' and 'MM-2-00' with a timestamp of 'Apr 18, 2017 11:30 AM'. A central 3D model of an HVAC unit is shown with a blue arrow pointing to its discharge. Surrounding the model are several data panels:

- Occupancy Schedule:** Shows 'Occupied' (checked), 'Planned' (checked), 'Cooling' (checked), and 'Heating' (checked). The 'Schedule' is set to 'Afterhours TI...' and the 'Afterhours TI...' value is '0.0'.
- Discharge Temp:** Shows a value of '57.7'.
- Hg Valve Position:** Shows a value of '0%'.
- Temperature Setpoints:**
 - 72.5 °F: Space Temp
 - 72: Occupied Setpoint
 - 80 °F: Limit Maximum Set
 - 60: Minimum Set Limit
 - 2.0: Heating Offset
 - 1.0: Cooling Offset
 - 55: Unoccupied Hg Setp
 - 55: Unoccupied Cg Setp
 - 0%: Heating Signal
 - 100%: Cooling Signal
- Airflow Data:**
 - 300: Max Airflow (cfm)
 - 130: Min Airflow (cfm)
 - 130: Return Airflow (cfm)
 - 200cfm: Desired Airflow
 - 340cfm: Current Airflow
 - 30% Open: Est. Damper Position

On the left side of the interface, there are 'Previous' and 'Test' buttons. The bottom of the interface shows a 'MM-50' label.



Air Handling Unit



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Real time temperatures broken down by specific HVAC units

Provides sight picture of current heating/cooling

This allows our craftsmen to immediately diagnose a problem in the field

Note: Discharge temp, system occupancy and airflow

Edwards Air Force Base AMERICA'S AIR FORCE

Air Handler for VAV 401-417

Operating Mode

- Occupied
- Unoccupied/Afterhours/Reset
- Disable Unit Alarm Prio.
- Supply Fan On (Fan Status)
- Return Fan On (Fan Status)

Handling Coeffs of

- 1 Return Air Humidity Setpt
- 20 RA Hum. H/Limit
- 10 Min. RA Hum. Limit
- Humidifier Valve 0 % Open

Supply Pressure Control

- 1.25" Setpt Pressure
- 1.40 Manual/Status SP
- 1.20 Auto-Reset SP H/Limit
- 0.90 Auto-Reset SP Lo Limit
- 100% High-Speed Make Air
- 0.0 Min. Fan Offset (%)
- 200 Min. Supply Fan Speed

Supply Temperature Control

- 55.0 Current Setpoint
- 55.5 Manual/Status SP
- 75.0 Auto-Reset SP H/Limit
- 60.0 Auto-Reset SP Lo Limit
- 100% High-Cooling Signal
- 52.0 Min. Supply Fan SP

Miscellaneous

- 11120 Supply Fan Hours
- Cg. Valve Choice
- 100 Cg. In/Choke Value
- 110 Cg. Fan Speed

Discharge

- 0% Room Position
- 100 Room Min. Posn.
- 100 Room Speed
- 100 Lockout - H/Limit
- 50 Mixed Air Lockout
- Locked Out

Return Air
75.5
18.1 %rh

Supply Air
55.4
14.8 %rh

Cooling Valve
0 % Open

0% Supply Fan Speed
0% Return Fan Speed



Thermal Energy Storage (TES) Ice Plant (Chiller Mode)

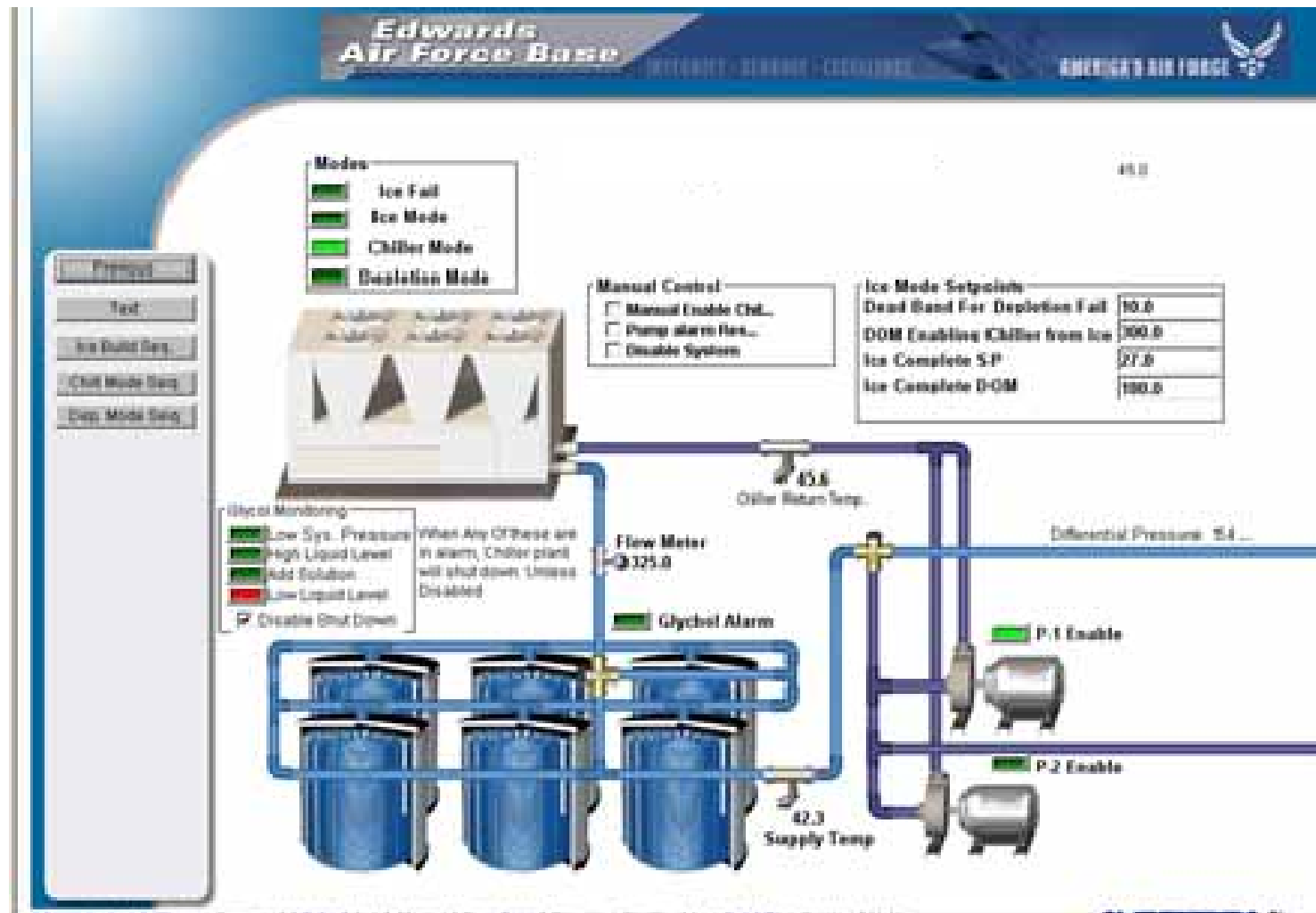


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Provides real time readout of TES

Color coded for ease of diagnostics

Looks just like TES plant, enables technician to easily and quickly respond to problem





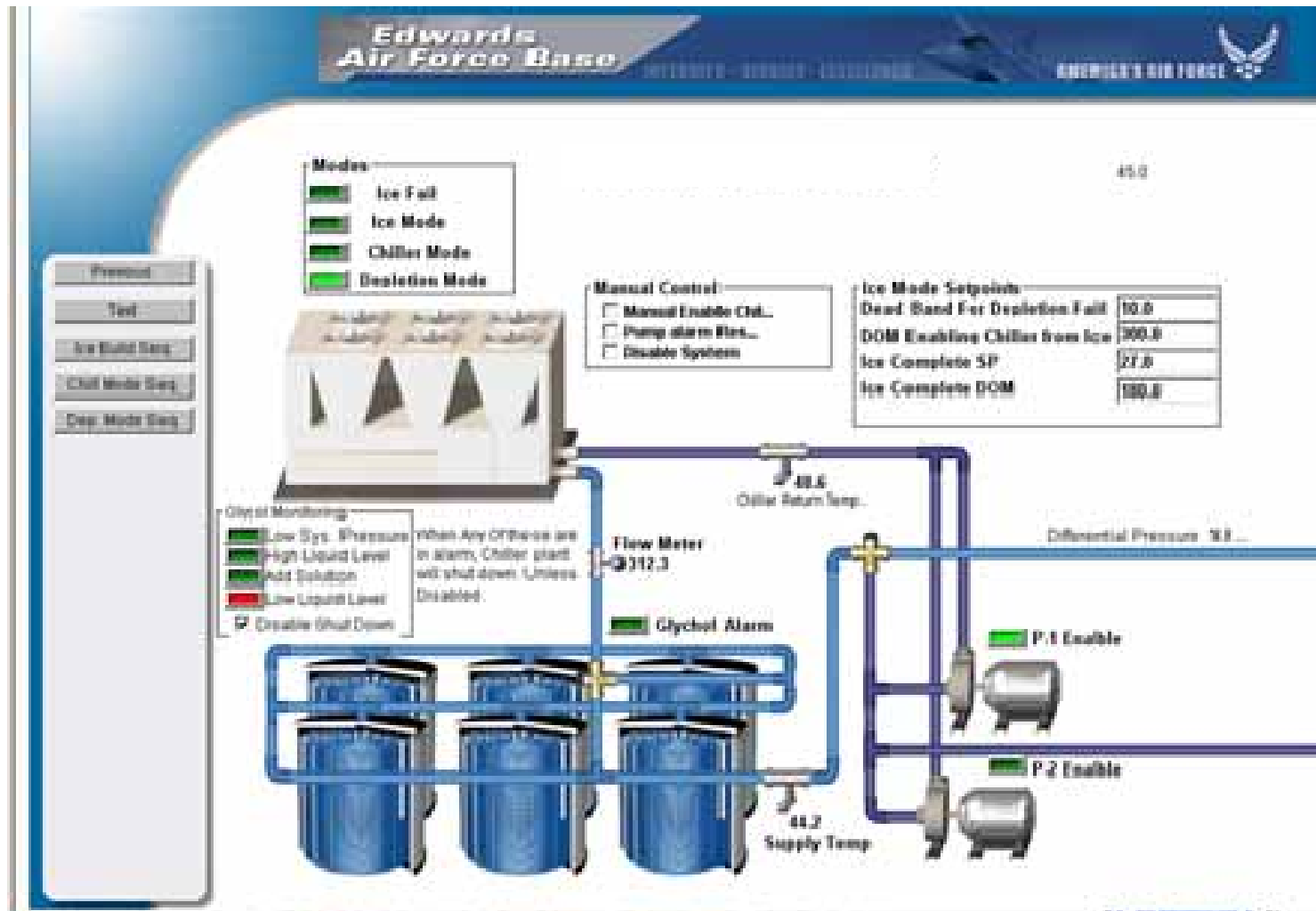
Thermal Energy Storage (TES) Ice Plant (TES Mode)



Provides real time readout of TES

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Lighting



- **Lighting Automation**
 - **Programmed to Turn Off a Percentage of Lights When Facility is Unoccupied (After-Hours and Weekends)**
 - **Motion Detectors in Hallways, Offices**
 - **Emergency Lighting Maintained for Safety Purposes**
- **Other Cost Savings**
 - **Facility Lighting Upgraded to LED**
 - **Interior & Exterior**
 - **3 Phases; Annual Savings for 62 Buildings = \$996,436**
 - **Projects 35% Complete**
 - **Micro-Turbines (Future)**
 - **Evaporative Pre-Coolers (Future)**



Supervisory Control and Data Acquisition (SCADA)



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- **Distribution Level Controls**
 - **Water**
 - **Power**
- **Augment Manpower**
 - **Remote Troubleshoot, Remote Operate**
- **Energy Conservation**
 - **Monitor/Adjust Tank Levels, Power Consumption**
- **Automation**
 - **Provide Reliable Utilities**
 - **Records Data Points, Historical Analysis**



Electric Overview - Power

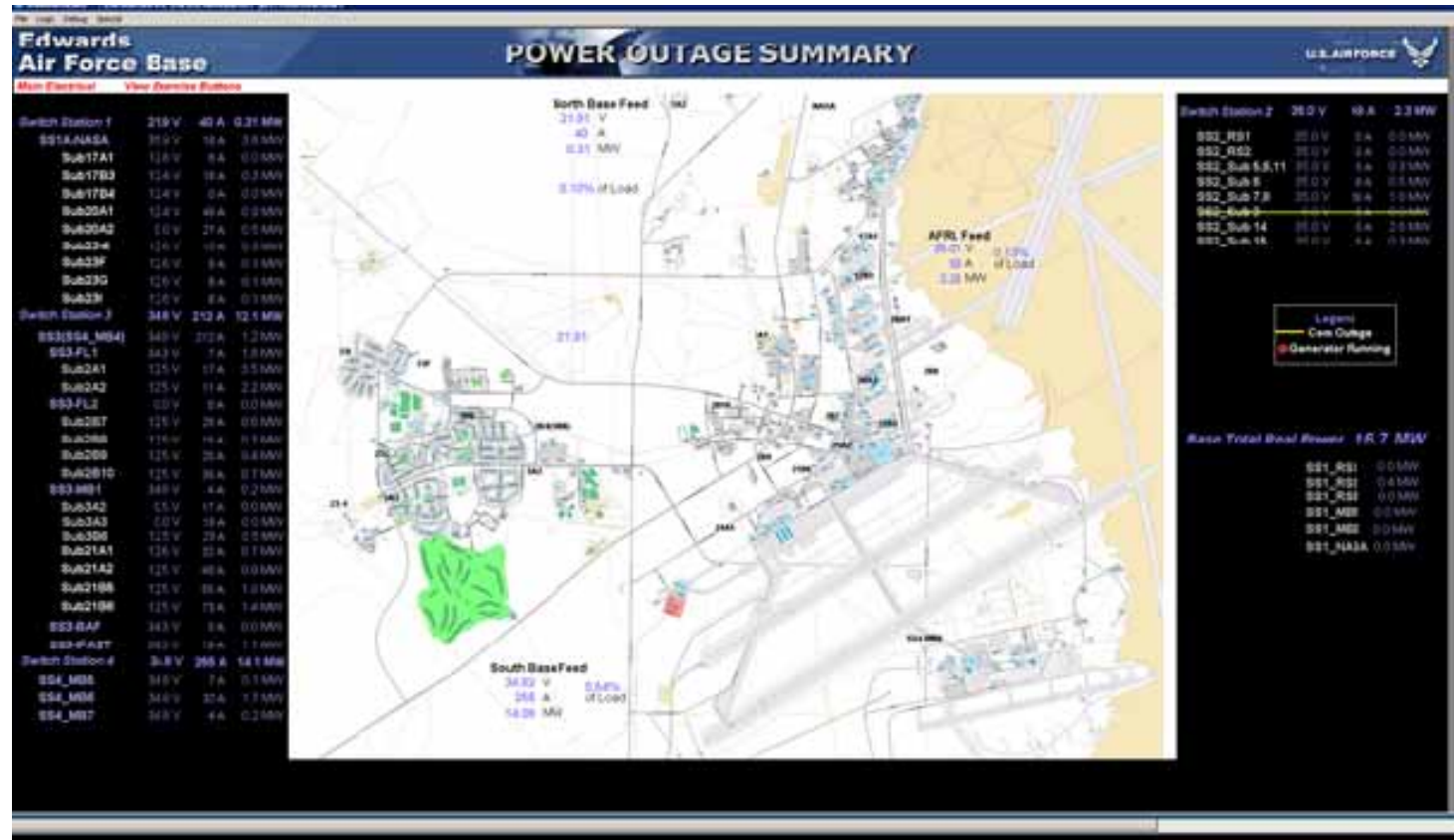


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Provides real time readout of Power Outage across cantonment area of installation

Color coded for ease of diagnostics

Enables technician to easily and quickly respond to problem



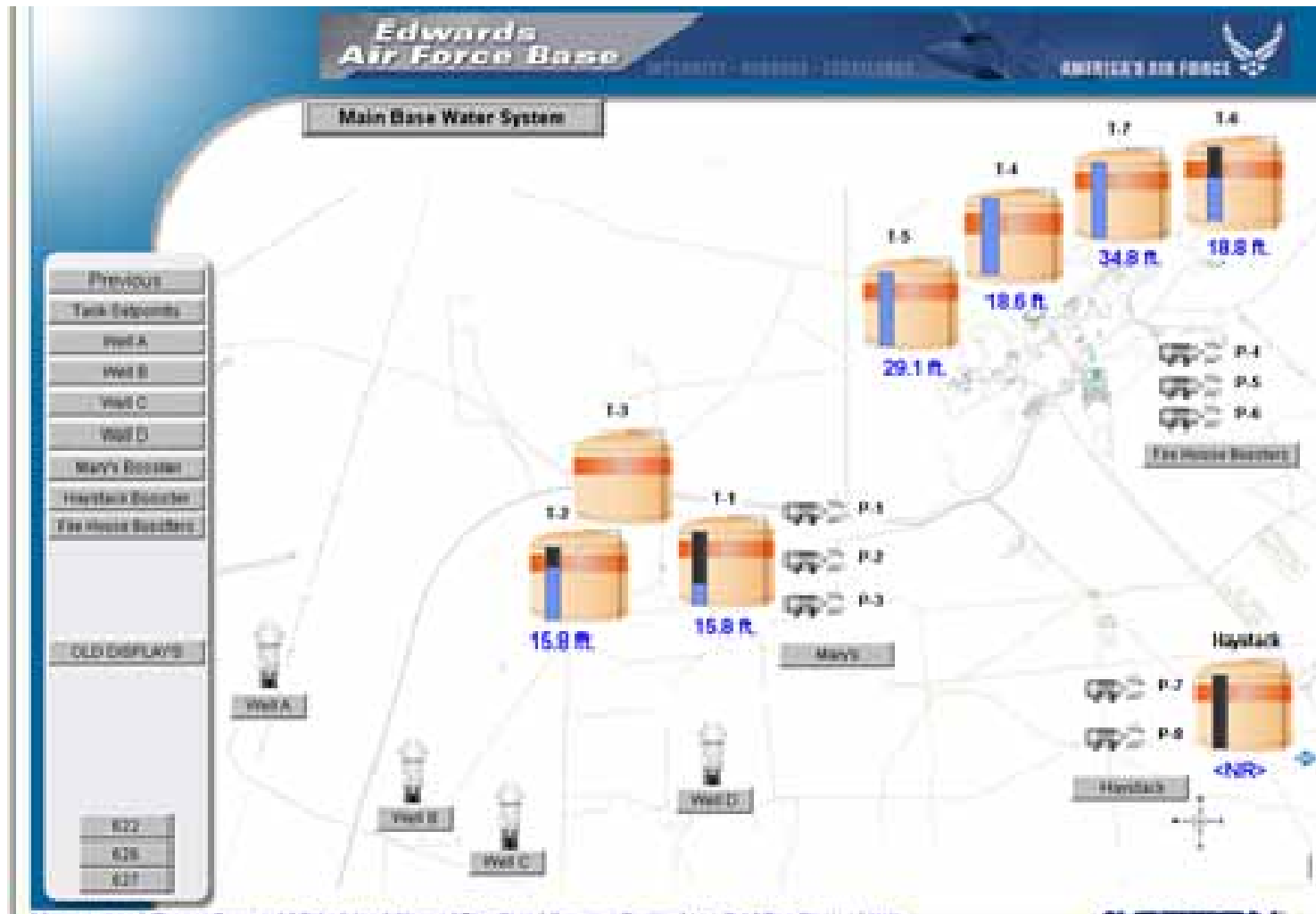


Water System



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- Shows status of all water tanks
- Provides real time readout of tank
- Color coded for ease of diagnostics
- Enables technician to easily and quickly respond to problem





Water System – Well



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Provides real time readout

Color coded for ease of diagnostics

Looks just like well

Enables technician to easily and quickly respond to problem

Can be manually controlled by SCADA

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Well B

Previous

Pump Disable

Commands and Status

- Pump Cmd ●
- Pump Status ●
- Pump HOA In Auto ●
- Pump HOA In Manual ●
- Pump Discharge Pressure Status ●
- Bearing Flow Switch Status ●
- Bearing Water Solenoid Enabled ●

Alarms

- Pump Alarm ●
- Runtime Alarm ●
- Audible Alarm Cmd ●
- Pump Hi Pressure Alarm ●
- Pump Lo Pressure Alarm ●
- Pump Alarm Res...

Sensors

- Pump Discharge Pressure 35.5 Psi
- Water Flow -0.6 GPMs
- Water Level -40.6

Set Points

- Pump Delay Start Time 1 Min
- Pump Hi Pressure Stpt 1000.0 Psi
- Pump Lo Pressure Stpt 0.0 Psi
- Runtime Alarm Stpt 2000 Hrs

Pump Control

Auto Manual

Run Position: 1.0

Minutes Run Today: 0

Minutes Run Yesterday: 78

Day before yesterday: 0

3 days ago: 0

4 days ago: 85

Run Log

HOURS 3495.3



Technologies Used



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- **Electrical – High Voltage**
 - **Micro Processor Based Protective Relays (Computerized)**
 - **Modeling Software “Easy Power”**
 - **Uninterrupted Power Supply (UPS)**
 - **Small Size (Desktop) to Facilities**
 - **Examples**
 - **Electrical Coordination allows**
 - **Smaller Breakers Open First**
 - **Larger Breakers Open Last**
 - **Allows Technicians to Quickly Identify and Isolate**
 - **Better Control**
 - **Faster Reaction Times**



Builder and Facilities Managers



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- **A Relatively New System Initiated by the Air Force**
 - **All Infrastructure Systems in Data Base**
 - **Roofs, Structures**
 - **Roads, Runways**
 - **Supporting Equipment (HVAC – Boilers, Chillers, Power Lines, Tanks, etc.**
 - **Empowered Facility Managers to Initiate Facility Related Problems Which are Entered into Database and Managed at Shop Support Level**
 - **Secondary Source of Problem Notification to CEG**



Continue Planning the Future



- **The 412 TW Plans to Do More of the Same**
 - **Must Maintain Controls Systems**
 - **Computers, Controls, Programs**
 - **Must Maintain Aging Mechanical Systems**
 - **If You Cannot Connect Controls to Mechanical System, the EMCS and SCADA will not Work (Cannot Control Junk!)**
 - **Continually Optimize Current Systems**
 - **Be Innovative, and Ask What Can We Do to Get More Out of the Facility**



Questions



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