



Implementation of AFDDR and Advanced Diagnostics in Lower Mainland Health Care Facilities

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Presentation Outline

- ✓ Introduce to LMFM Facilities Energy Usage, Control Systems Inventory
- ✓ History of AFDDR Development and LMFM Roadmap
- ✓ Review of current projects underway and analysis of typical faults found at VGH.
- ✓ Discussion of Critical Environment Monitoring and Reporting
- ✓ Benefits of AFDDR for LMFM
- ✓ Recommendation for Implementing AFDDR in LM Health Care



VGH Heather Pavilion 1948



St. Paul's Hospital 1928



Royal Columbian Hospital 1871

Some Definitions

1. AFDD&R: Automated Fault Detection, Diagnosis and Reporting
2. LMFM: Lower Mainland Facilities Management – Consolidated 4 coastal regions in 2010.



VGH Heather Pavilion 1948



St. Paul's Hospital 1928



Royal Columbian Hospital 1871

Energy Consumption and Cost LMF

(Fiscal Year 2013/14)

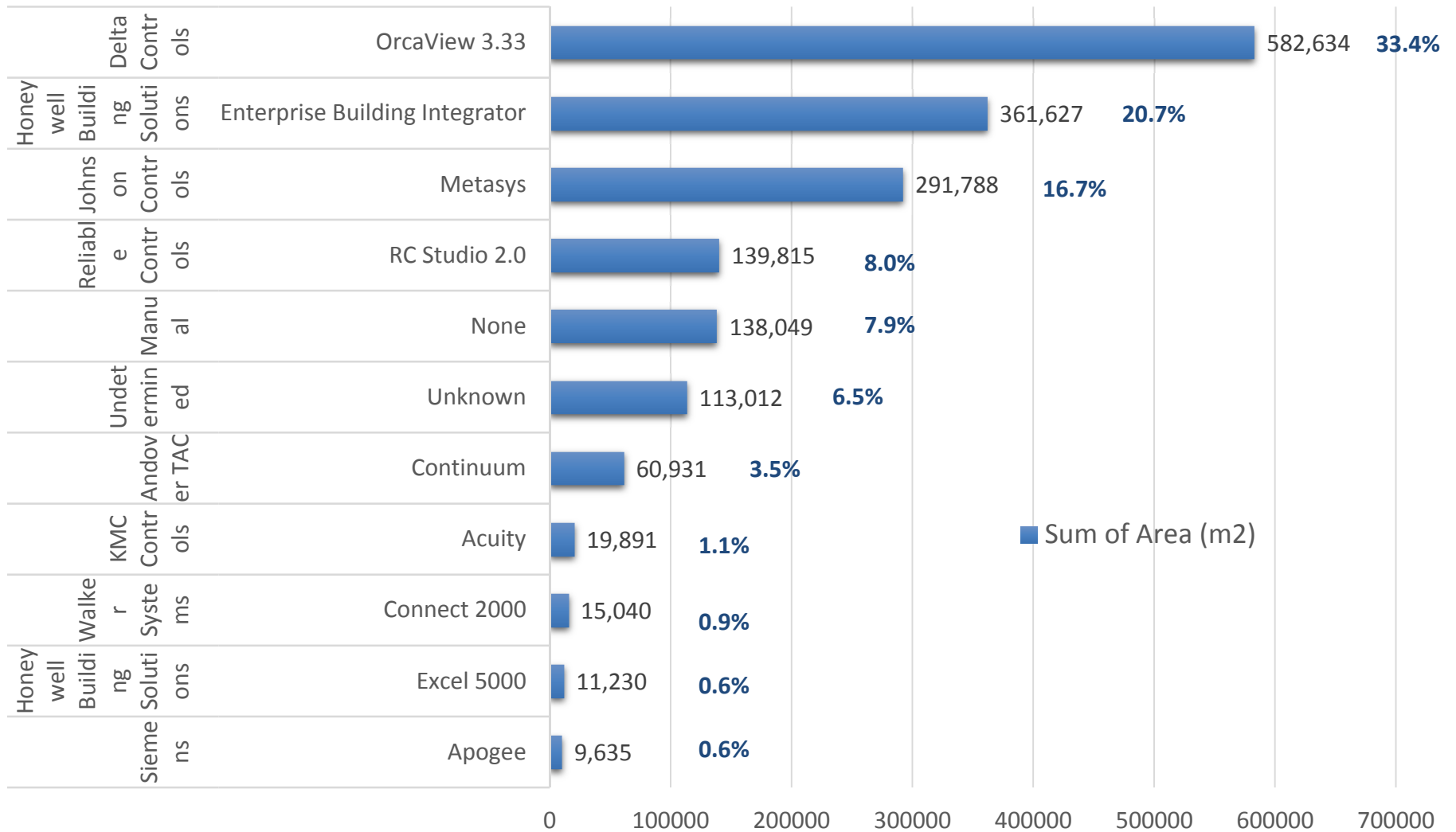
Site		Electrical Usage			Steam and Fuel Usage			Total		
Name	Area (m ²)	Use (MWh)	Cost (\$)	BEPI (kWh/m ²)	Use (GJ)	Cost (\$)	BEPI (kWh/m ²)	Cost (\$)	BEPI (kWh/m ²)	BECI (\$/m ²)
Fraser Health	603,954	123,372	\$9,542,000	175	698,000	\$6,117,000	290	\$15,660,000	465	\$24.42
Provincial Health	248,004	65,313	\$4,873,000	208	288,000	\$2,308,000	195	\$7,149,000	375	\$27.12
Providence Health	166,360	30,985	\$2,268,000	143	154,000	\$2,090,000	245	\$4,355,000	361	\$20.51
Vancouver Coastal Health	664,075	118,473	\$8,635,000	139	776,000	\$7,061,000	212	\$15,669,000	347	\$20.09
Grand Total	1,682,393	338,142	\$25,318,000	161	1,917,000	\$17,576,000	236	\$42,832,000	386	\$22.4

Water Costs LMFM

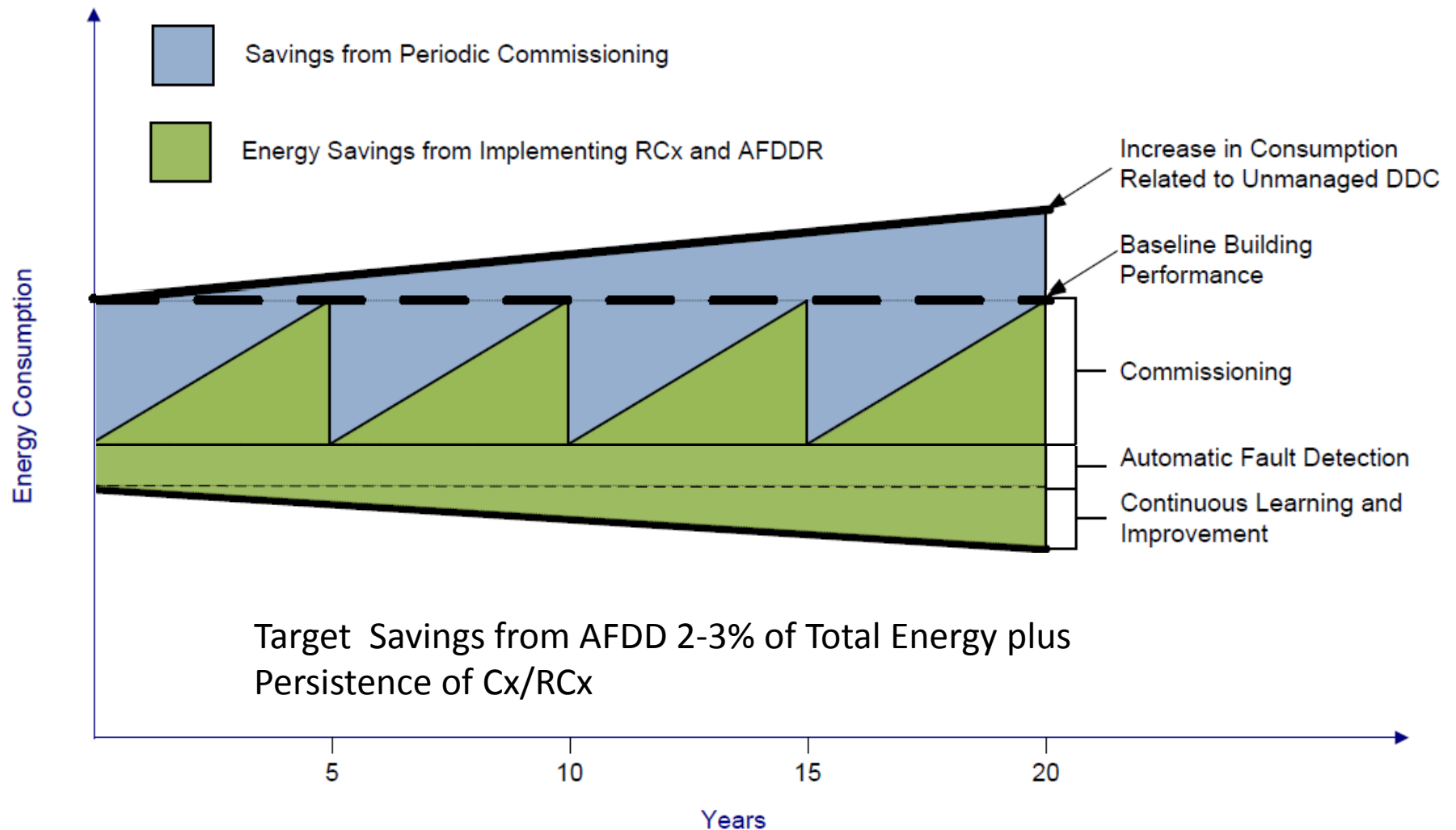
(Fiscal Year 2013/14)

Site Name	Total Floor Area (ft ²)	Sum of Cost (\$)	BWCI (\$/ft ² /yr)
Fraser Health	5,410,515	\$1,688,843	\$0.30
Provincial Health	2,269,586	\$546,291	\$0.19
Providence Health	1,755,526	\$519,610	\$0.33
Vancouver Coastal Health	7,152,870	\$2,012,426	\$0.32
Grand Total	16,588,497	\$4,767,170	\$0.31

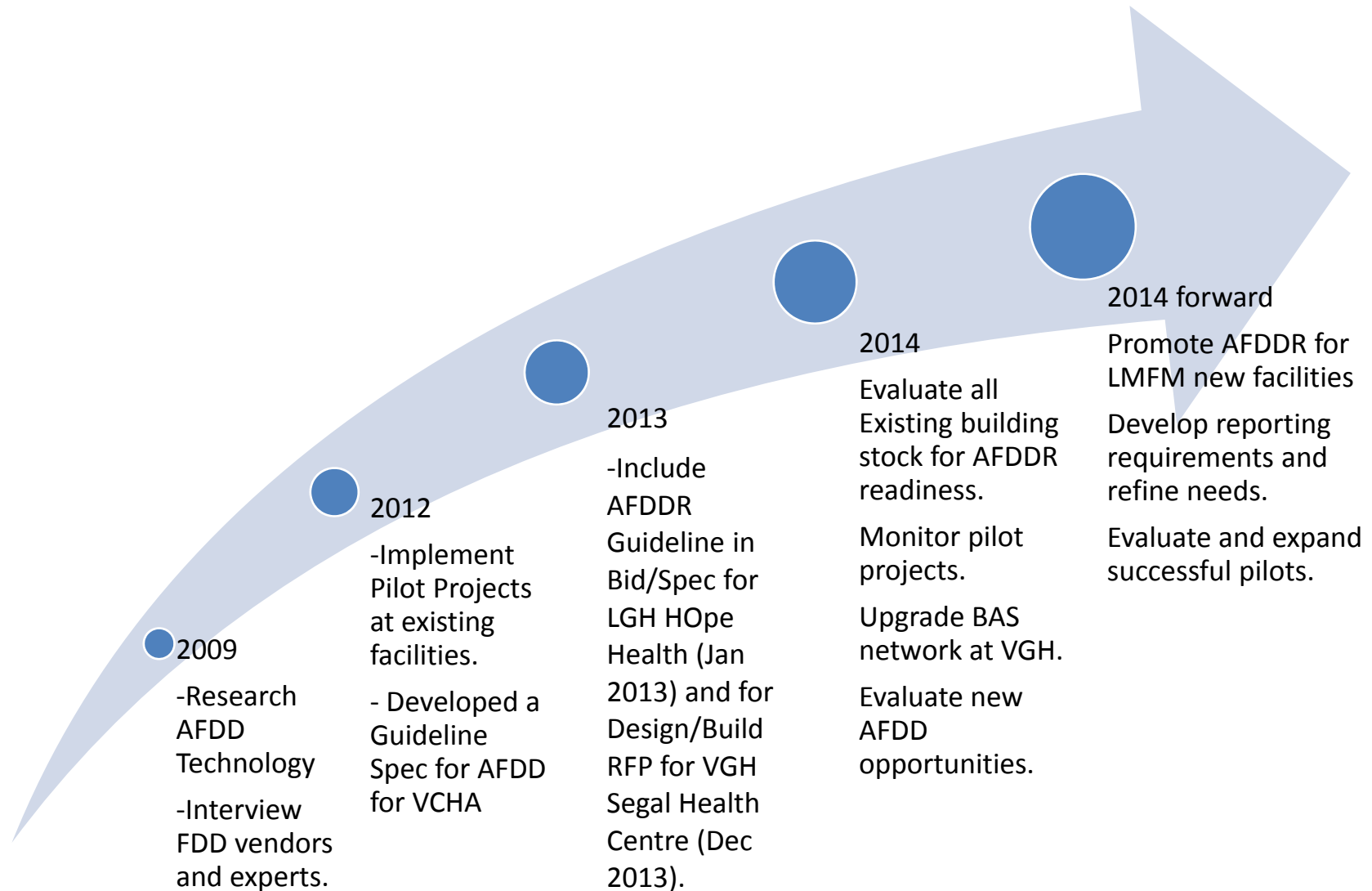
Breakdown of Control Systems by Building Area



A combination of commissioning and AFDDR is the most effective way of achieving and maintaining energy savings



Simplified AFDDR Roadmap for LMFM



Current FDD Pilot Projects in LMFM

1. VCHA Vancouver General Hospital

- Jim Pattison Pavilion South Tower
- AFDD System & BAS Network Upgrade



2. VCHA Lions Gate Hospital

- HOpe Health Centre
- Substantial Completion



3. FHA Mission Memorial Hospital

- Mission Memorial Health
- Installed March 2013



4. VCHA Vancouver General Hospital

- Joseph & Rosalie Segal Family Health Centre
- Design in Progress



5. VCHA Saint Mary's Hospital

- Saint Mary's Expansion



Vancouver General Hospital – Jim Pattison South Tower



- Area: 70,800 m² (Tower only 35,000 m²)
- DDC Type: Delta Controls – ORCAview R3.33 V2 and V3
- FDD Software: DABO v2.3
- FDD Installed: 2013
- I/O Points Monitored: 4100
- Number of Systems and Zones: 1240
- Monitoring Frequency: 10 minutes
- Fault Analysis: Hourly
- Data Collection Method: ODBC
- Data Storage: On site



VCHA - Lions Gate Hospital – HOpe Centre



- Area: 9,000 m² (without parkade)
- DDC Type: Johnson Controls – Metasys
- FDD Software: Johnson Controls - Panoptix
- FDD Installed: 2014 (Final Commissioning Phase)
- I/O Points: 398
- Number of Systems: 28

panoptix[™]
BY JOHNSON CONTROLS

Mission Memorial Hospital – Pilot Project



- Area: 9,023 m²
- DDC Type: Reliable Controls – RC Studio 2.0
- FDD Software: SCIEnergy – EnergyScape DM (Diagnostics and Monitoring) Database
- FDD Installed: 2013
- I/O Points: 315
- Number of Systems: 13 (47 pieces of equipment)



VCHA – VGH Joseph & Rosalie Segal Family Health Centre



- Area: TBD (100 private patient rooms)
- DDC Type: **Delta Controls Orcaview R3.33**
- FDD: Future Installation as part of Design Build Project
- I/O Points:
- Number of Systems Monitored: ??
- FDD Software: **Coppertree Analytics**

Vancouver General Hospital

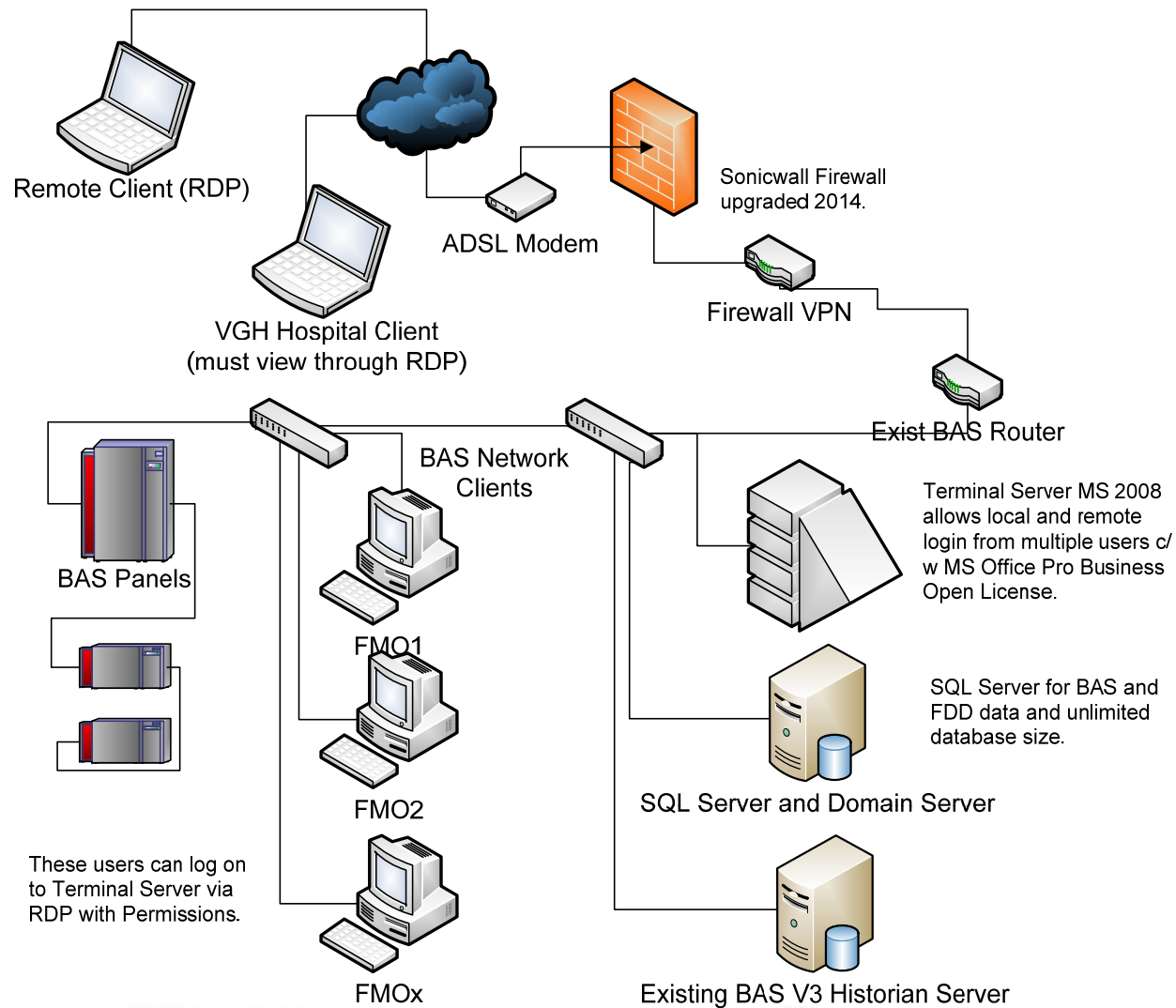
– Jim Pattison Pavilion South Acute Care Tower



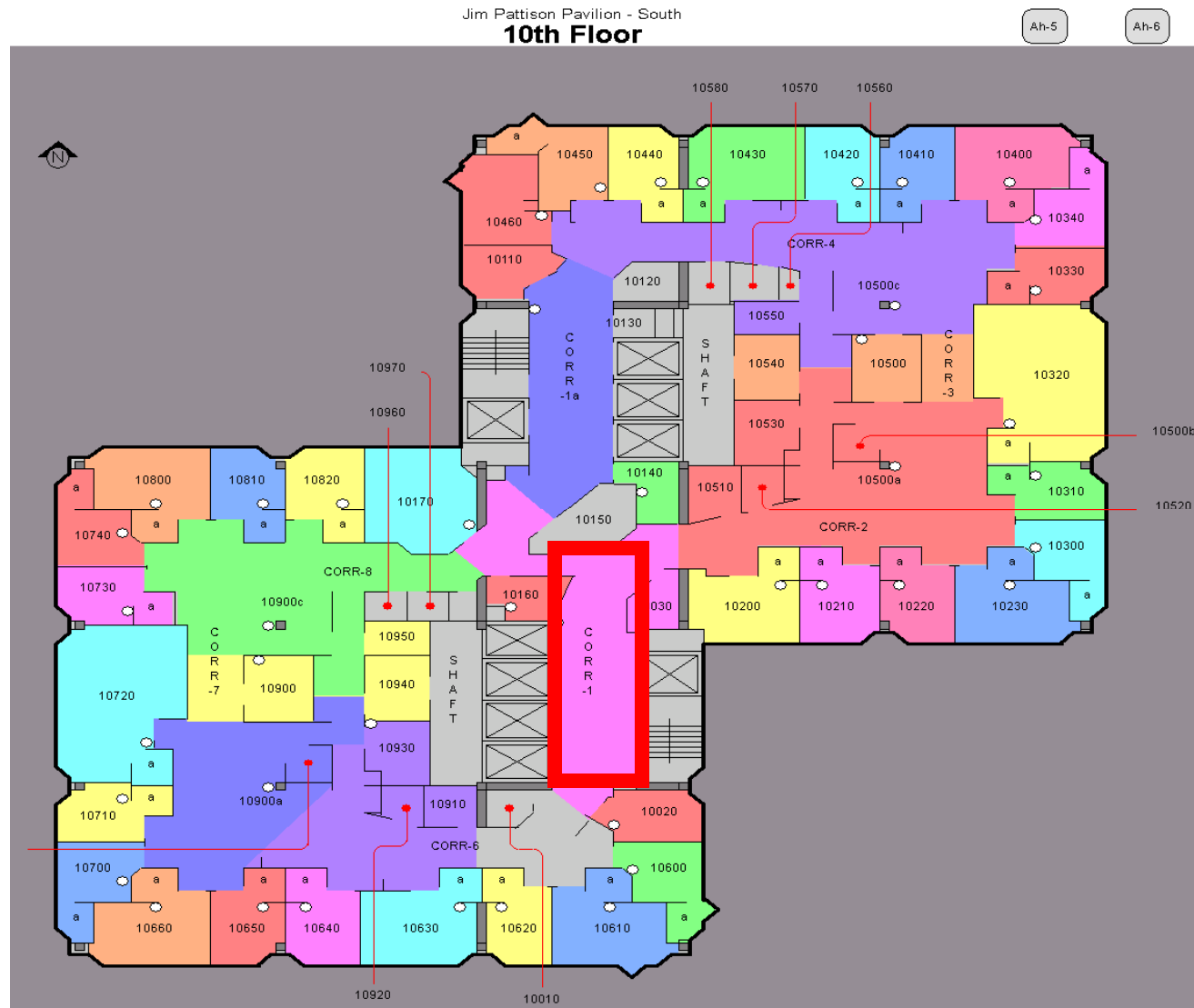
Systems with FDD Installed	Quantity
Fan Coils Telecommunication Rooms	12
Fan Coils Electrical Rooms	12
Isolation Exhaust Fan System (3 fans)	1
Main Air handling Units with Exhaust (AHU5 and AHU6)	2
Heat Recovery Systems serving tower	2
Chillers Serving Tower and pumps	2
Heat Exchangers and Pumps serving tower	6
VAV Boxes (Supply and Exhaust)	725
Control Zones (Rooms with Thermostats)	480
Total	1242

- All air flows, amperages, capacities from balance reports entered into FDD database for analysis.
- Control Zones Include 80 Isolation Rooms.

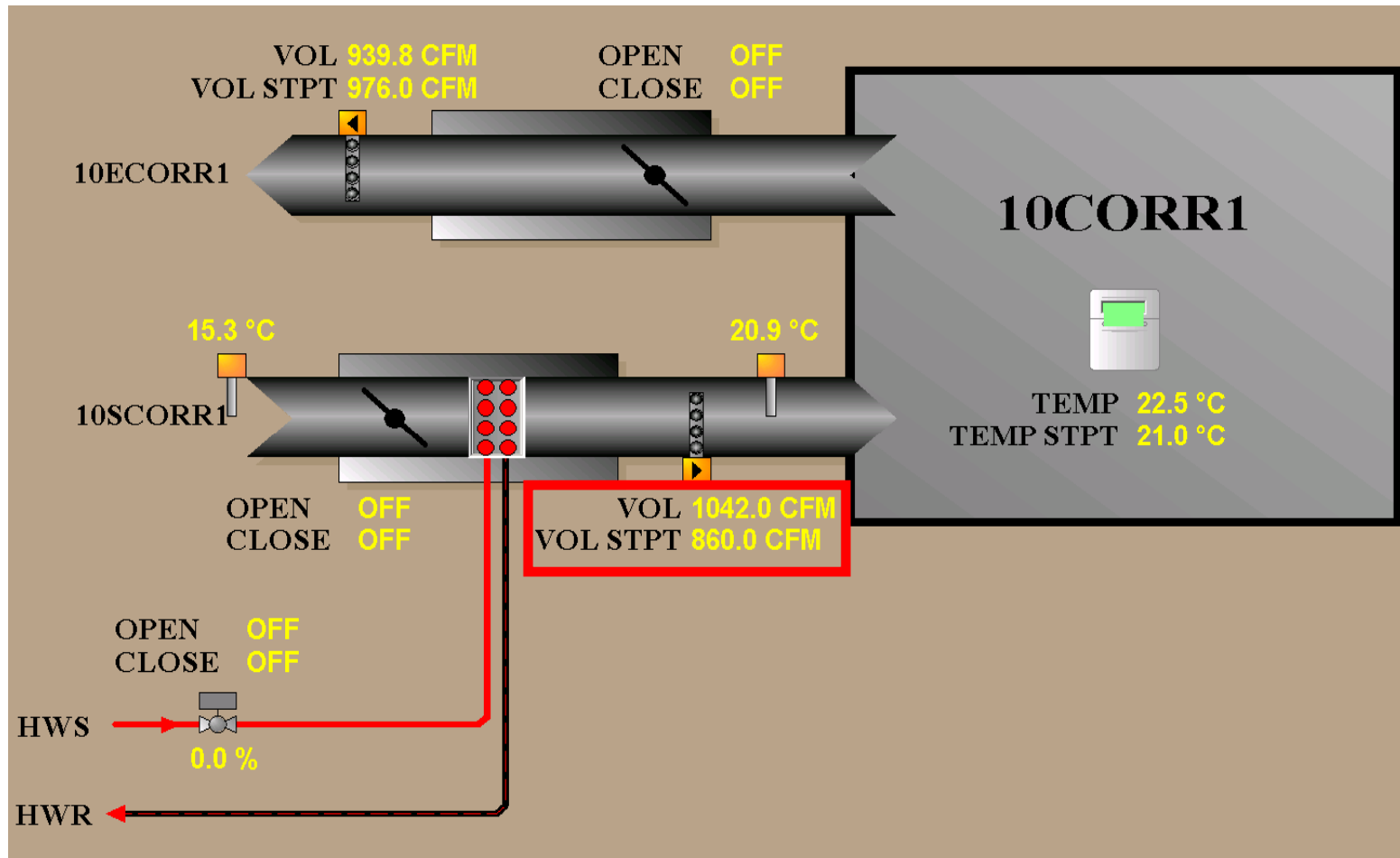
VGH BAS Network Upgraded to Accommodate RCx and FDD in 2013



Examination of a Typical VAV System and Fault

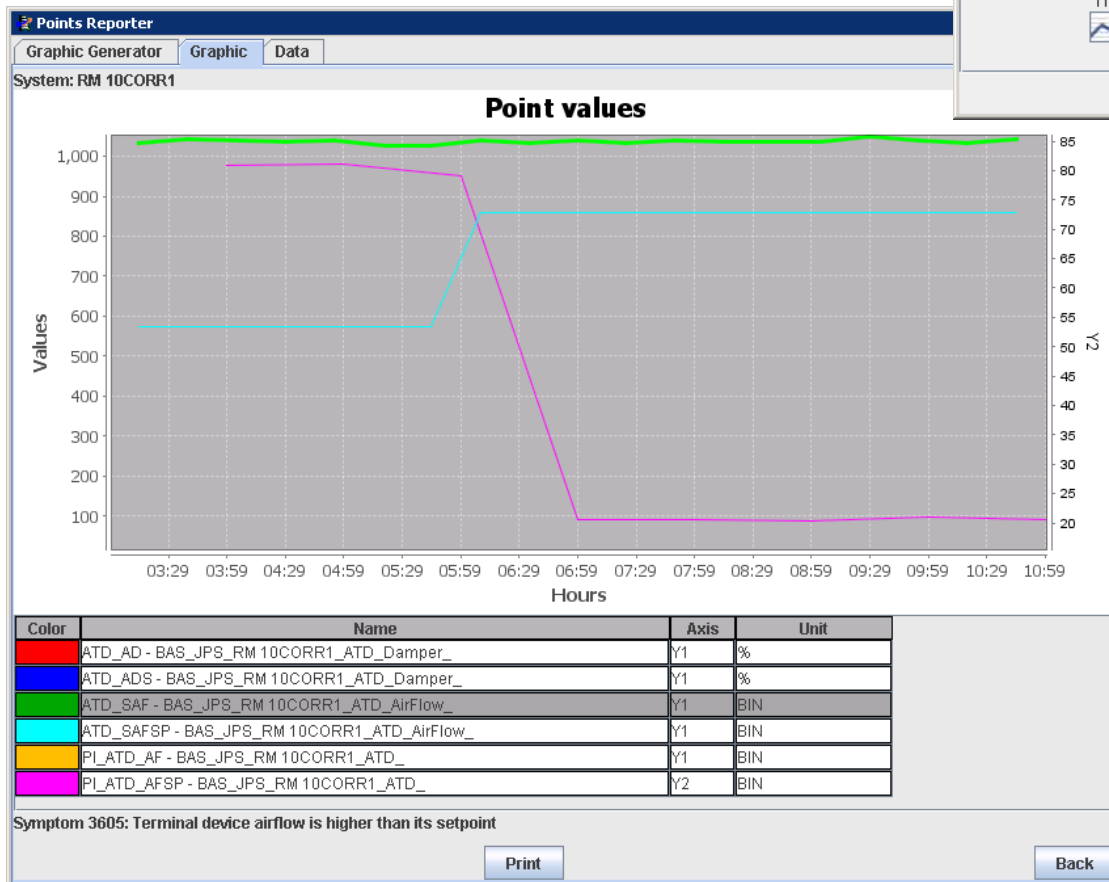


Examination of a Typical VAV System and Fault



FDD 1 Fault: Terminal Device Cold Side Damper Failure

Screens from FDD Software



Possible failures details

RM 10CORR1_ATD - 2014-01-10 at 7h

Failure 313: Terminal device cold side damper failure

Mode: Undetermined

Suggested Action: Check actuator command input signal value (CO, I/P, scale range, positioner, feed back signal), check damper actuator and linkage integrity; Point in manual?

Impact: Lack of ventilation or cooling capacity in the room or control zone. Thermal discomfort and/or poor air quality.

Symptom 3605: Terminal device airflow is higher than its setpoint

Print

$$PI_AFSP = \frac{|Air\ Flow - Air\ Flow\ Setpoint|}{Air\ Flow\ Setpoint}$$

$$PI_AFSP_1 = \frac{|1040 - 580|}{580} = 79\%$$

$$PI_AFSP_2 = \frac{|1040 - 860|}{860} = 21\%$$

$$PI_AF = \frac{Air\ Flow}{Air\ Flow\ Setpoint}$$

PI: Performance Index

Typical DABO VAV (ATD) Hourly Failures Detected

Symptom ID	Description	Number of Occurrences	Impact on Energy Use
3501	Terminal device supply air temperature sensor out of normal scale range	7	Increase or Decrease
3525	Simultaneous heating and cooling at the Terminal device	8	Increase
3605	Terminal device airflow is higher than its setpoint	4	Increase
3608	Terminal device airflow is lower than its setpoint	6	Decrease
3614	Terminal device supply temperature higher than AHU supply temperature while Terminal device is not heating	15	Increase
	Total	40	

Examination of a Major AHU System and Fault

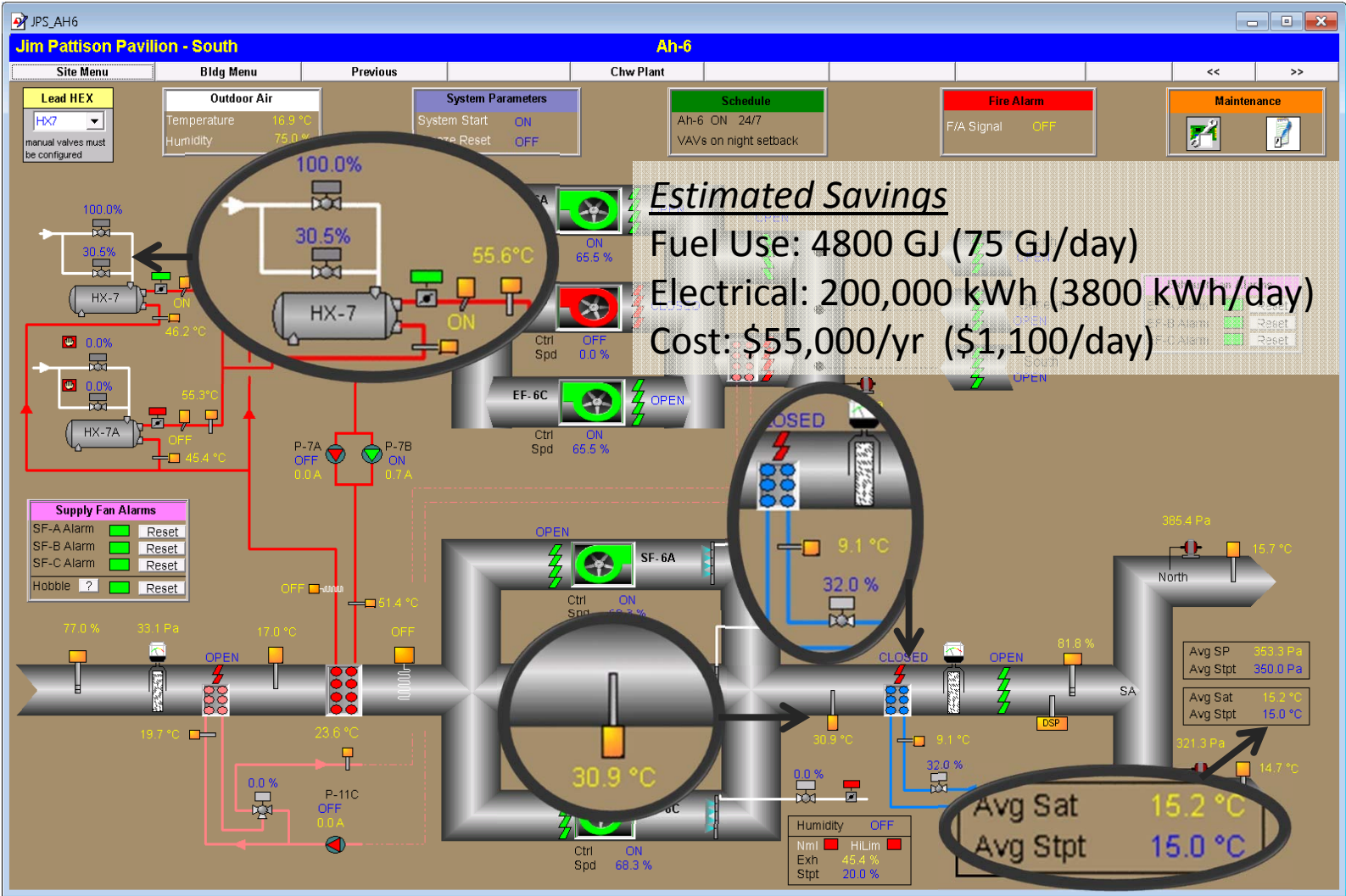


Figure 1: VGH AH6 Simultaneous Heating and Cooling Fault (June 15 2013)

Critical Environment Monitoring - Targets

Area	Minimum OA ACH	Minimum ACH	Relative Pressurization	Temp Min	Temp Max	Relative Humidity Min	Relative Humidity Max
Animal Research and Lab							
Holding area	3	12	Use Specific	20	24	30	60
Surgery	15	20	Use Specific	20	24	30	60
Special Precaution Rooms							
Protective Environment Room	3	12	Positive	22	24	30	60
Airborne Infection Room	3	12	Negative	22	24	30	60
Burn Unit	5	15	Positive	24	30	30	60
Surgery							
Operating Rooms	6	20	Positive	18	23	40	60
Minor Surgical Procedures							
General/Cystoscopy	5	15	Positive	18	22	30	60
Bronchoscopy	5	20	Negative	18	22	30	60
Endoscopy	5	15	Negative	18	22	30	60
Autopsy	3	20	Negative	18	20	30	60
Sterile Processing	3	10	Positive	18	23	30	60

Table 1 Summary - CSA Z317.2-10 Special Requirements for HVAC Systems in Health Care Facilities



Critical Environment Monitoring – Calibration

Location	Parameters to be monitored and/or displayed	Frequency	Monitor sensor location	Monitor readout location	Alarmed (yes/no)	Location of alarm	Calibration frequency
Type I areas							
All operating rooms	Temperature Relative humidity Pressurization	Continuous	Each room and zone	Each room and central location	yes	Local, central	Monthly
Airborne isolation rooms	Temperature Relative humidity Pressurization	Continuous	Each room and zone	Each room and central location	yes	Local, central	Monthly
Protective isolation rooms	Temperature Relative humidity Pressurization	Continuous	Each room and zone	Each room and central location	yes	Local, central	Monthly
Wound intensive care units (burn units)	Temperature Relative humidity Pressurization	Continuous	Each room and zone	Central	yes	Central	Monthly
Diagnostic imaging treatment areas (e.g., angiography)	Temperature Relative humidity Pressurization	Continuous	Each room and zone	Central	yes	Central	Semi-annually
Other patient care areas (Type I)	Temperature Relative humidity	Continuous	Each room and zone	Central	yes	Central	Semi-annually
Type II areas							
General diagnostic imaging	Temperature Relative humidity	Continuous*	Each room and zone	Central	yes	Central	Annually
Sterile processing	Temperature Relative humidity	Continuous*	Room temperature and zone RH	Central	yes	Central	Annually



CSA Z317.2-10 Special Requirements for HVAC Health Care Facilities (Table 5)



Some Advantages of AFDDR for Health Care

- ⓐ Provides a New Approach to Building Operations and Maintenance
- ⓐ Can be a Compliance tool for Critical Environment monitoring and reporting
- ⓐ Enables monitoring of Hundreds of Rooms and Zones continuously
- ⓐ Promotes uniformity in DDC naming and system conventions for HVAC
- ⓐ Keeps Historical Records of Faults and Repairs
- ⓐ Organizes and presents DDC data and trend data automatically – with full featured charting tools
- ⓐ Provides a common platform for Buildings Operators and Managers, Consultants.
- ⓐ AFDD and EMIS (sub metering) work together
- ⓐ Can Track Energy Use and Cost Savings from AFDD

Recommendations – for AFDDR for Health Care

- ❖ Develop AFDD for Critical Hospital Environments
- ❖ Develop and Specify standards for AFDD Rules and Reporting.
- ❖ Bring the cost in-line with realistic savings expectations
- ❖ Standardize on Energy and Soft Savings calculations for AFDD.
- ❖ Monitor/Group multiple smaller sites at central AFDD location and service.
- ❖ Make sure the buildings are AFDD ready – Work towards this.
- ❖ Make it work with enterprise CMMS and work flow
- ❖ Make it easy to use and understand



Saint Mary's Hospital Sechelt



Lions Gate Hospital 1979



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