



# Recommissioning – Mechanical and Electrical System Optimisation

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# Outline

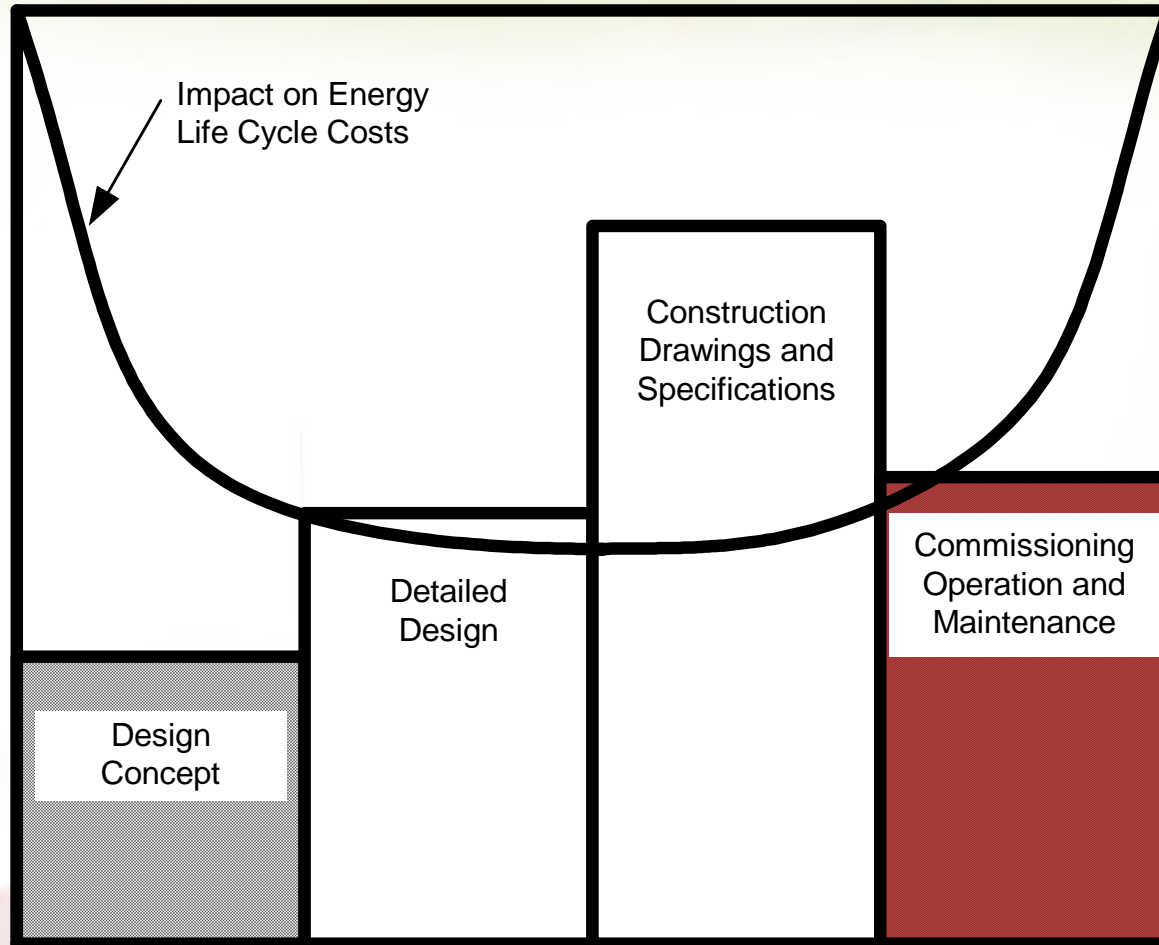
- ◆ Building operation
- ◆ What is recommissioning
- ◆ Why recommissioning
- ◆ Recommissioning process
- ◆ An Example of recommissioning
- ◆ Obstacles to overcome
- ◆ Next steps



# Building operation



Construction Expenditures %



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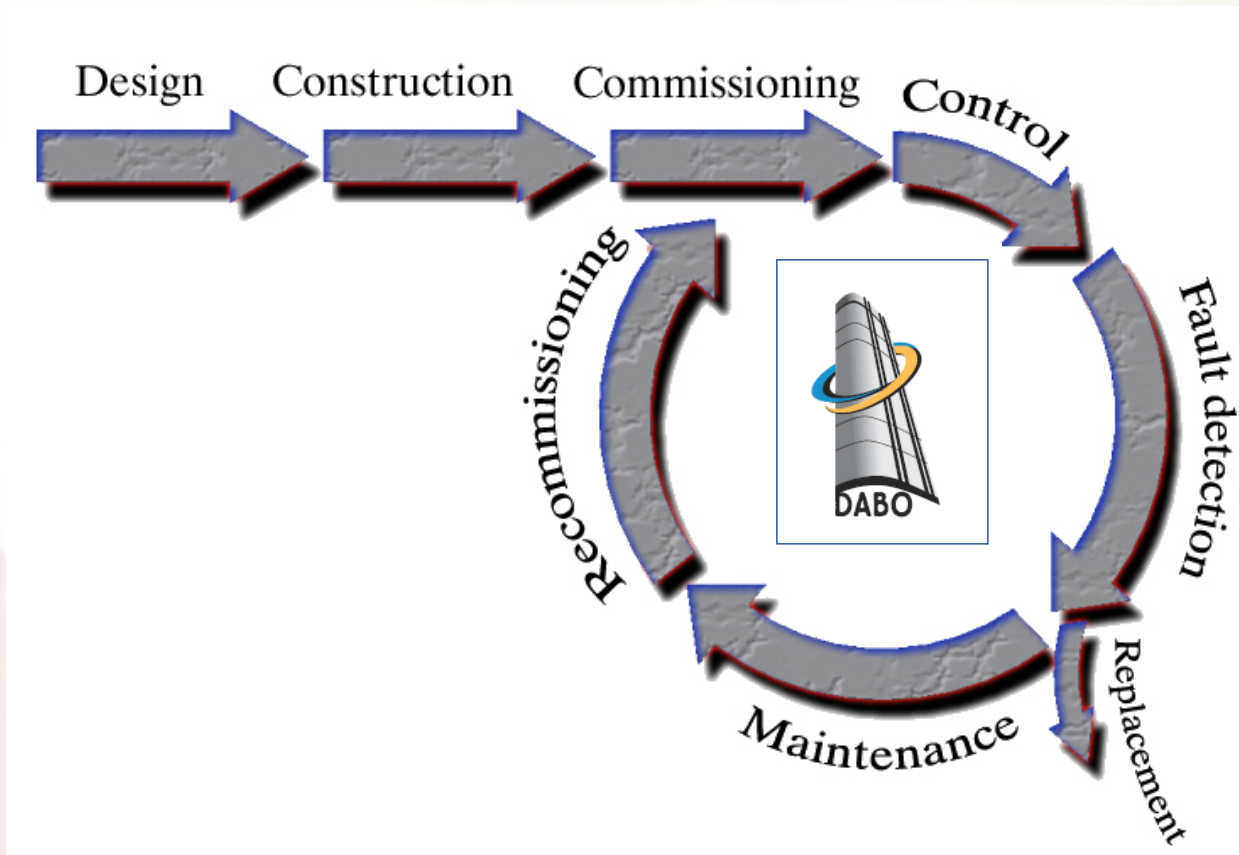
# Recommissioning



- ◆ Optimisation of the operation
- ◆ Systems not equipment
- ◆ No capital expenses (No equipment replacement)
- ◆ Paybacks of 2 years or less
- ◆ Persistence of benefits maintained using DABO (Diagnostic Agent for Building Operators)



# Recommissioning – Integral part of intelligent building operation



# Why recommissioning – Government perspective



- ◆ Prolong equipment life
- ◆ Improved indoor environmental quality → improvements in productivity
  - 0.25% increase in productivity → \$432M
- ◆ 5% to 30% reductions in energy consumption
- ◆ Lowering of greenhouse gas emissions
  - 4.4Mt CO<sub>2</sub> equivalent with operating cost savings estimated at \$776M



# Why recommissioning – User perspective

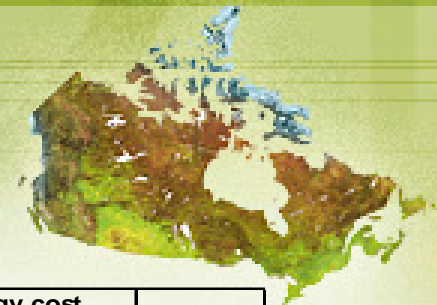


Determining Factors in the Decision to Retro-commission a Building			
Scale 1 to 7: 7 indicates greater importance			
United States		Canada	
<u>Factor</u>	<u>Rate</u>	<u>Factor</u>	<u>Rate</u>
Minimizing Operatng Costs	6.2	Assure System Reliability	6.0
Assure System Reliability	6.0	Demonstrate Code Compliance	6.0
Save Energy	5.9	Mnimize Operating Costs	5.8
Demonstrate Code Compliance	5.9	Save Energy	5.6
Maximize Occupant Safety	5.7	Maximize Occupant Safety	5.6
Minimize Liability	5.6	Minimize Liability	5.6
Assure Occupant Comfort	5.5	Assure Occupant Comfort	5.3
Owner Requirement	5.0	Owner Requirement	5.3
Other	N/A	Other	N/A

NEMI Retro-commissioning Existing Building Inventory



# Why recommissioning – Owner/operator perspective



Building name of location; type	Area (ft <sup>2</sup> )	Ending Date	Pre-comm. Energy Cost (\$/ft <sup>2</sup> /yr)	Commissioning cost		Energy cost savings		Simple payback (years)
				Total \$	\$/ft <sup>2</sup>	\$/yr	% of total cost	
Oregon; office	278,000	1995	1.25	12,745	0.05	8,145	2.3	1.6
Citizen's Plaza, Tennessee; Office	250,000	1995	1.81	23,967	0.1	42,045	9.3	0.6
Colorado; retail	122,000	1995	0.88	11,310	0.09	13,779	12.8	0.8
Massachusetts; retail	107,000	1995	2.4	12,801	0.12	8,042	3.1	1.6
High-tech research facility	44,000	1984	4.35	14,000	0.32	59,540	31.3	0.2
203 N. Lasalle St.; office	623,000	1995	1.28 <sup>b</sup>	80,000	0.3	150,000 <sup>c</sup>	18.8	0.5
Capitol Buidng; computer facilities/office	282,499	1996	1.63	24,000	0.08	88,812	19.2	0.3
S.F. Austin Building & CP; computer facilities/office	470,000	1993	1.24	28,000	0.06	30,385	5.2	0.9
John H. Reagan Building; computer facilities/office	169,756	1996	1.56	24,000	0.14	50,680	19.2	5
Archives Building; library	120,000	1996	0.37	24,000	0.2	9,867	22.5	2.4
Starr Building; office	99,000	1995	2.16	20,000	0.2	48,000 <sup>e</sup>	22.5	0.4
Capitol Extension; computer facilities/office	592,781	1996	0.84	28,000	0.05	89,758	18	0.3
School of Public Health; medical institution	233,738	1994	1.62	24,000	0.1	63,502	16.8	0.4
Medical School Building; medical institution	887,187	1994	3.16	28,000	0.03	879,101	31.4	0

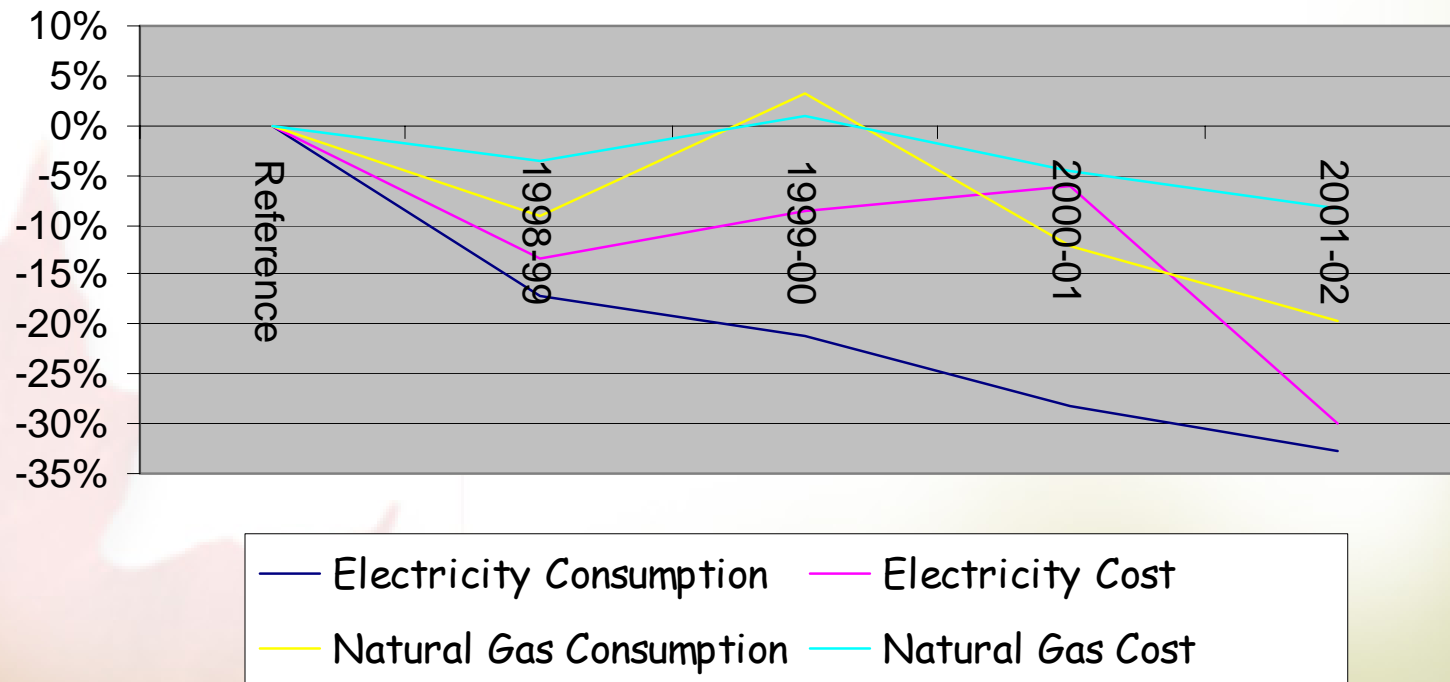




# Why recommissioning – Our Director's perspective



## CETC-Vareennes Impact of Improved Operation Consumption & Cost



# Recommissioning process



- ◆ Planning phase
- ◆ Investigation phase
- ◆ Implementation phase
- ◆ Project hand-off phase



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# Recommissioning process



## ◆ Planning phase

- Define project objectives
- Choose the team
- Review building documentation and energy bills
- Develop Commissioning plan



# Recommissioning process



## ◆ Investigation phase



- Site assessment
- Install DABO
- Develop and carry out diagnostic tests and system monitoring
- Analyse monitoring results
- Develop list of deficiencies
- Select the most cost effective opportunities



# Recommissioning process



## ◆ Implementation phase

- Implement improvements identified in investigation phase
- Retest and re-monitor to confirm the results
- Verify, if necessary, the improvements carried out during the investigation phase
- Review the energy consumption reduction estimates



# Recommissioning process



## ◆ Project Hand-off Phase

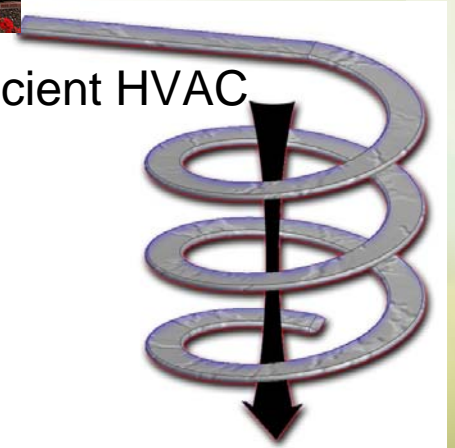
- Prepare and present final report
- Ensure that the use of DABO is well understood by the operators so as to maintain the recommissioning benefits



# Recommissioning example



- ◆ Two identical buildings
  - EESB
  - ETB : Low-E windows; T-8 lighting system; energy efficient HVAC system; LED exit lights
- ◆ ...2 years later: Surprise!
  - Complaints skyrocketed in ETB
  - AND 32% more energy consumed
- ◆ Correction of problems: manual setting; simultaneous heating and cooling
- ◆ Result: comfort related complaints dropped; energy consumption reduced

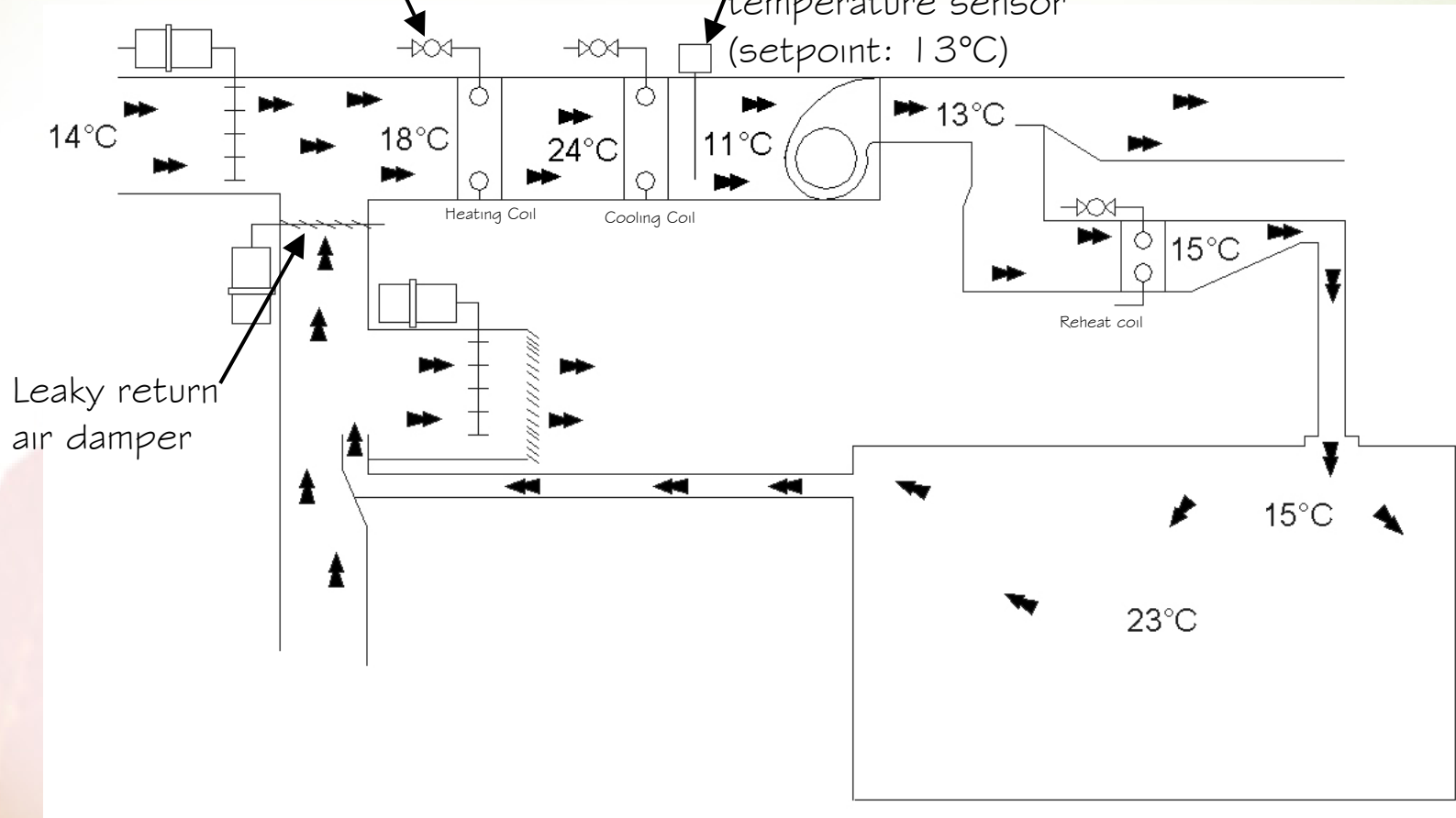


# But how can this be true...?



Leaky heating coil valve

Uncalibrated temperature sensor (setpoint: 13°C)





# Obstacles



- ◆ Few experienced recommissioning providers
- ◆ Recommissioning procedures not known
- ◆ Awareness of building owners/managers
- ◆ Difficulty in quantifying recommissioning benefits, especially those associated with comfort and productivity



# Next Steps



- ◆ Develop the strategy to introduce recommissioning to the building industry
- ◆ Develop Canadian case studies to demonstrate the impact of recommissioning and show its potential to building owners and managers
- ◆ Develop training tools for recommissioning providers and building operators
- ◆ Encourage the provincial and federal governments as well as the utilities to develop a global approach for improving and optimising building operation.



## Incorporating recommissioning in the building's life cycle can have:



- ◆ A significant impact on the occupants' productivity
- ◆ A substantial extension of equipment life
- ◆ An impact on GHG reduction of as much as 4.4 Mt of CO<sub>2</sub> equivalent, and
- ◆ A significant impact on the building operating costs – a payback of less than 2 years





# Questions

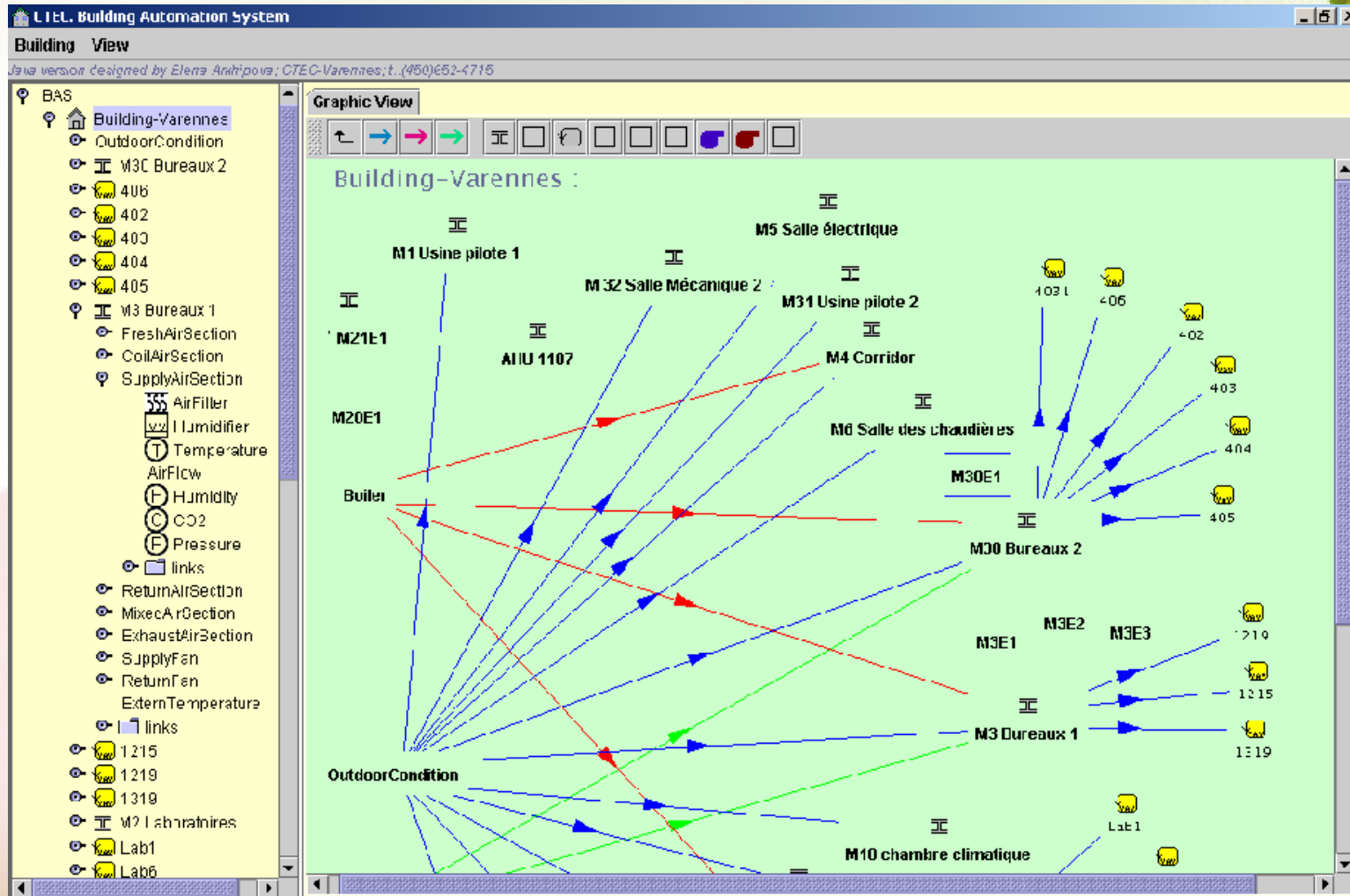


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# DABO Interface



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# DABO - Results - VAV Boxes

Graphic View M30 Bureaux 2 FDD report VAV Faults AHU FDD report

System:  Floor:  Orientation:  Date: 02 / 07 / 2003 ... Details

Name	System	Floor	Orientati...		Averages for each hour of the day																							
					0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19				
405	M30 Bur...	1		T	22,7	22,7	22,6	22,5	22,5	22,3	22,2	21,2	21,1	22,6	24,0	23,3	22,0	22,7	22,7	22,5	22,3	22,4	23,6	24,0				
				SP	22,0	22,0	22,0	22,0	22,0	22,0	22,0	23,0	23,0	23,0	23,0	23,0	23,0	23,0	23,0	23,0	22,5	22,0	22,0	22,0	22,0			
1215	M3 Bure...	1	P-W	T	23,8	23,8	23,8	23,8	23,8	23,8	23,4	22,7	22,0	21,9	21,9	22,0	22,3	22,3	22,4	22,3	22,3	22,4	23,5	24,0				
				SP	22,0	22,0	22,0	22,0	22,0	22,0	22,0	22,0	22,0	22,0	22,0	22,0	22,0	22,0	22,0	22,0	22,0	22,0	22,0	22,0	22,0			
1219	M3 Bure...	1	P-W	T	22,7	22,7	22,7	22,7	22,7	22,7	21,1	20,6	20,8	21,0	21,3	21,1	21,3	21,1	20,9	20,9	21,2	22,3	24,0					
				SP	21,0	21,0	21,0	21,0	21,0	21,0	21,0	21,0	21,0	21,0	21,0	21,0	21,0	21,0	21,0	21,0	21,0	21,0	21,0	21,0	21,0			
1319	M3 Bure...	1	P-E	T	23,6	23,6	23,6	23,6	23,4	23,2	23,2	21,7	21,3	22,5	24,3	24,0	24,0	23,9	23,4	23,2	22,8	23,0	24,4	24,0				
				SP	24,0	24,0	24,0	24,0	24,0	24,0	24,0	24,0	24,0	24,0	24,0	24,0	24,0	24,0	23,4	23,0	23,0	23,0	23,0	23,0	23,0			
Lab1	M2 Labo...	1	C	T	23,5	23,5	23,5	23,5	23,5	23,4	23,4	23,2	22,4	22,4	22,3	22,2	22,1	22,2	22,2	22,3	22,3	22,7	23,0					
				SP	22,5	22,5	22,5	22,5	22,5	22,5	22,5	22,5	22,5	22,5	22,5	22,5	22,5	22,5	22,5	22,5	22,5	22,5	22,5	22,5	22,5			
Lab6	M2 Labo...	1	C	T	25,4	25,5	25,5	25,5	25,5	25,5	25,5	25,4	24,6	24,6	24,5	24,2	24,1	24,0	24,0	23,9	23,9	23,9	23,9	24,0				
				SP	23,0	23,0	23,0	23,0	23,0	23,0	23,0	23,0	23,0	23,0	23,0	23,0	23,0	23,0	23,0	23,0	23,0	23,0	23,0	23,0	23,0			
Lab2	M2 Labo...	1	C	T	24,0	24,1	24,1	24,1	24,1	24,1	24,1	24,0	23,3	23,0	22,9	22,9	22,7	22,7	22,6	22,6	22,6	22,6	23,1	23,0				
				SP	24,0	24,0	24,0	24,0	24,0	24,0	24,0	24,0	24,0	24,0	24,0	24,0	24,0	24,0	24,0	24,0	24,0	24,0	24,0	24,0	24,0			
Lab3	M2 Labo...	1	C	T	23,8	23,8	23,8	23,8	23,8	23,8	23,8	23,7	23,0	22,9	22,8	22,6	22,5	22,5	22,6	22,7	22,7	22,7	23,0	23,0				
				SP	22,0	22,0	22,0	22,0	22,0	22,0	22,0	22,0	22,0	22,0	22,0	22,0	22,0	22,0	22,0	22,0	22,0	22,0	22,0	22,0	22,0			

Fault legend

- System not running
- Airflow Setpoint not satisfied
- Temp. Setpoint not satisfied
- Airflow Setpoint unstable
- Airflow unstable
- Normal



# DABO – Results – Air Handling Unit



Graphic View AHU FDD report

M3 Bureaux 1 Date: 03 / 09 / 2003 Details

		Averages for each hour of the day																							
		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20			
Faults detected	0	3	3	3	1	1	1	1	4	3	3	4	3	3	3	2	2	2		4	4	4			
Point in manual	31																								
Sensor limits	32																								
Temperature sensors	Outside	2																							
	Supply	3																							
	Mixed	4																							
	Return	5																							
Humidity sensors	Return	6																							
	Supply	7																							
	Outside	8																							
CO2 sensor	Outside	37																							
	Supply	35																							
	Return	36																							
Pressure sensor	Supply	100																							
	Filter	101																							
Flow measurement	Supply	102																							
	Return	103																							
	Supply	104																							

Modes Legend

- Diagnostic (Red)
- Free Cooling (Green)
- Off (Grey)
- Heating (Yellow)
- Free cooling with/without mechanical cooling (Orange)
- Mechanical cooling (Magenta)



# DABO Installation sites



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