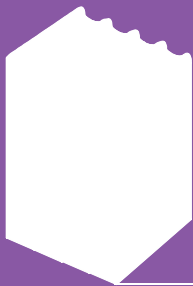


Controls



The following policy and guidelines are to aid A/E firms, in-house engineers and planners, construction management firms, and anyone else involved in the design, procurement, or installation of control and monitoring systems at the NIH.

F.1 Heating, Ventilation, and Air-Conditioning (HVAC) Controls

F.1.1 Distributive Digital Control (DDC) for HVAC Systems

New or renovated control work related to HVAC systems within NIH buildings shall be DDC for all logic. Hardware devices may be electric, electronic, or pneumatic based on the application.

The A/E shall comply with the Direct Digital Control Specification written by Dr. Farhad Memarzadeh, P.E., NIH and define on Contract documents complete sequences of control for all HVAC systems. Control diagrams shall be utilized to graphically indicate the systems, show the location of control devices, and define the setpoints for control elements.

Legends for control symbols and abbreviations should be included on all control diagrams.

The sequence of operations shall be included as a part of the control diagrams and in the project specifications.

F.1.2 DDC Control and Monitoring Capabilities for HVAC Systems

Monitoring Capabilities:

100% outdoor air units:

- Fan status - supply and exhaust
- Preheat discharge temperature
- Cooling coil discharge temperature
- Reheat coil discharge temperature
- Duct humidity
- Exhaust humidity
- Air flow in L/s (supply and exhaust)



- Downstream static pressure
- Differential pressure across all filters
- Motor current on single leg
- Outdoor air temperature (one per building)
- Outdoor air damper end switch
- Freezestat status
- Coil circulating pump status/alarm
- High static pressure
- Smoke detector alarm
- Smoke/isolation damper end switch
- High humidity

Recirculating AHUs:

- Fan status, supply and return
- Mixed and return air temperature
- Cooling-coil discharge temperature
- Preheat-coil discharge temperature
- Building static pressure
- Return-air humidity
- Discharge humidity
- Airflow in L/s (supply and return)
- Downstream static pressure
- Differential pressure across all filters
- Motor current on single leg
- Freezestat status
- Coil circulating pump status/alarm
- High static pressure alarm
- Smoke detector
- Smoke/isolation damper end switch
- High-humidity alarm

HVAC pumps:

- Pump status (on/off/alarm)
- Differential pressure and pressure ranges.
- Fault status of variable-frequency drives (VFDs)
- Motor current on a single leg

Heat exchangers:

- Water supply and return temperature
- Pump status



Control capabilities: DDC outputs:

AHUs:

- Fan on/off control
- Preheat loop with sensor in preheat discharge
- Cooling coil loop with sensor
- Reheat coil loop with sensor
- Vortex damper (by duct static pressure)
- Mixed air dampers
- VSDs (by duct static pressure)
- Humidifier valve or panel

Large pumps/motors:

- Automatic on/off control with lead/lag via DDC panel
- DDC output to variable speed drives
- Pump sequencing: Alternate weekly every Wednesday morning (via DDC panel)

Heat exchangers:

- Hot water discharge temperature reset based on outdoor temperature
- Pump sequencing via DDC panel

Building system functions to be monitored:

- Primary chilled water supply and return temperature, flow and operating differential pressure
- Steam flow
- Main condensate return temperature and receiver level
- Electric meters: kilowatts, kilovolt amperes, power factor or peak demand, voltage, and amperage (average or highest phase)
- Temperature and humidity alarms in environmental rooms
- Domestic cold water pressure
- Refrigerant monitors
- Domestic hot water temperature
- Building waste pH Level
- Sump and sewage pump high-level alarms
- ATC compressor status and tank pressure
- Medical/lab air compressor pressure and dewpoint
- Medical/lab vacuum pump pressure
- Network protector



- Tie breaker
- Fuel oil tank level and leak monitors alarms
- Gas storage alarm
- Propane alarm
- Liquid sensors (electric vaults/rooms)
- Oxygen and nitrous oxide pressure and alarms
- Building static pressure

Water system functions to be monitored:

- Pump status by differential pressure switch and optional current sensor
- Supply and return temperature
- Lead/lag program-automatic
- Differential pressure (output to VFD or differential valve)
- System flow

Other areas to be monitored:

- Animal rooms: temperature, humidity, air-change rate, and lighting on/off/status
- Computer rooms: temperature and humidity
- Critical health care and lab spaces: temperature and humidity

F.1.3 Definition of a Stand-Alone Control Unit (SCU) and Modular Building Controller (MBC)

The DDC system is comprised of field-installed microcomputer based panels, also referred to as SCUs. The term "DDC panel" refers to both SCU and MBC microcomputers. There are also some earlier RBC panels which reside on the same network as the SCU or the MBC.

These microcomputers can operate as an independent stand-alone controller and do not require a central computer. Variables such as temperature, humidity, and pressures are measured electronically and controlled through application software programs which reside in the SCU or the MBC. Individual pneumatic or electronic output loops control valves, dampers, or other devices maintain a programmed setpoint.



All MBC controllers shall have hand-off-auto (HOA) switches with monitoring of the hand position. This is typical for digital out modules.

F.1.4 Networking Capabilities

SCUs or MBCs can operate independently or in a local network with other SCU/MBC panels. When in a network, these panels communicate in a token-passing arrangement. All panels are continuously listening on the trunk, while only the panel that has the token can poll the other panels for point information. When the SCU or MBC is done requesting point information, the token is passed to the next panel on the network, and the process repeats itself. This means that points do not have to reside in the same cabinet that is doing the polling because they share the point information across the network. It also means the SCU or MBC application programs can operate either in a single panel or over a network of panels.

An example of an SCU/MBC network is shown in Diagram No. 1.

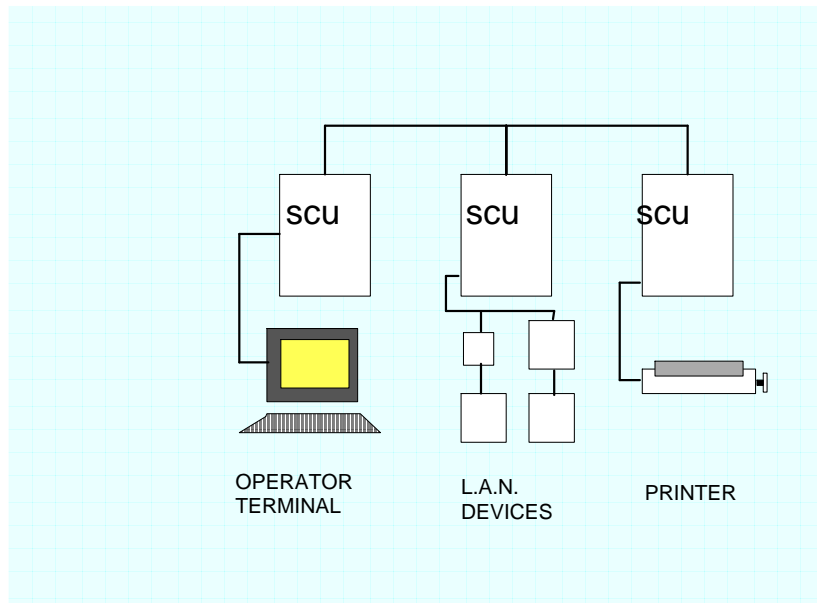


Diagram No. 1
An SCU/MBC network.



Although a central computer is not needed for control, it is needed for SCU/MBC program backup, central monitoring, data processing, and graphical man/machine interface.

An example of the SCU/MBC network connected to a central computer is shown in Diagram No. 2.

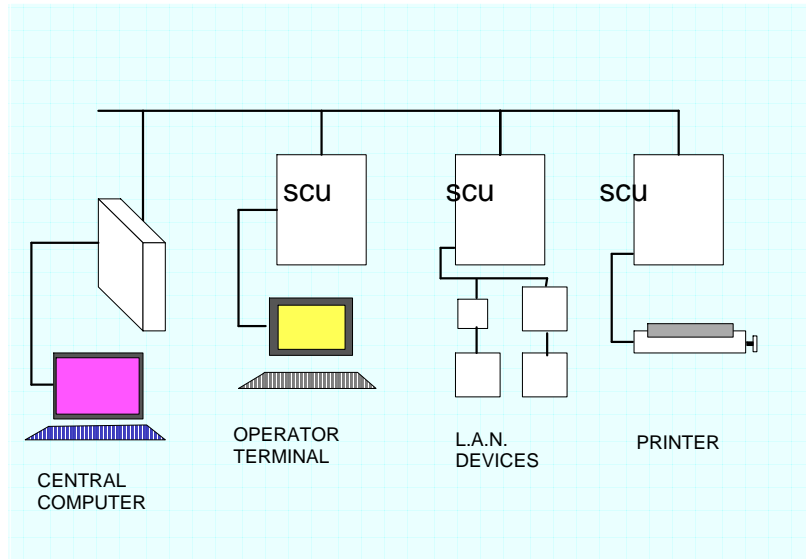


Diagram No. 2
An SCU/MBC network connected to a central computer.

F.1.5 DDC Network at the NIH

The Maintenance Sections (North, South, and Clinical Center) each have their own central computer.

Clinical Center DDC System: The Clinical Center, which is composed of 280,000 m² of floor space, has both a Landis & Gyr and an old Johnson JC-80 nondistributive system. Both systems communicate via trunk lines to central computers in Building 10, Room B1N-108, in the Maintenance office. The JC-80, while still in use, should be replaced with a modern distributive system with the latest software. Currently expansions are being made to the Landis & Gyr system.

In the past years a DDC communication network for the Landis & Gyr system was established in the Clinical Center. The



communication network consists of eight trunk lines, installed in conduit, connecting a multichannel minicomputer to all the SCUs in the field. Over 60 SCUs and MBCs reside on this network and are all located in Mechanical rooms.

A diagram of the location for SCUs and the Central Computer (located in Room B1N-111) in the Clinical Center is available upon request.

North Buildings DDC System: The North Buildings have a PC-based central computer located in Building 31, North Maintenance Engineering Office. The central computer is connected via hard-wire and leased-line connections to all buildings North of South Drive, including the Twinbrook, Poolesville, and Park Buildings .

A diagram of the location for SCUs and the PC-based central computer in the North Buildings is available upon request.

Poolesville DDC System: In addition, the central computer in Building 31 is connected, via leased telephone line, to the PC-based computer console located in Poolesville Farm. This console provides for central monitoring within the Poolesville area.

A diagram of the location for the SCUs and the PC-based computer console on the Poolesville Farm is available upon request.

South Buildings DDC System: The South Buildings have a multichannel minicomputer located in Building 37, South Maintenance Engineering Office. The central computer communicates, via leased telephone lines and underground trunk lines, to all buildings South of South Drive.

A diagram of the location for SCUs and the central computer for the South Buildings is available upon request.

F.1.6 Location of SCUs and MBCs

In the interest of the designers who will be expanding this system, Tables No. 1-5 define the locations of DDC equipment by building and room.



Table No. 1
Number of DDC equipment by Building

Network	SCU	MBC	RCU	MPU/ DPU	Unitary	TEC	PC	Mini- Comp
Poolesville	16	8	0	5	1	54	4	
North	42	3	0	15	1	31	10	
Twinbrook	7	2	0	2	0	40	1	
Bldg. 10	55	5	0	21	10	115	4	1
South	38	57	9	10	5	287	9	1
Total	158	75	9	53	17	527	28	2

Table No. 2
NIH Clinical Center DDC Network

SCU No.	LAN Device	Flr.	Area	Room	Feed Panel
001	101-DPU	B1	10A-M.R.	10A-B1-05	
	201-TEC	B1	10A-M.R.		
	202-TEC	B1		B106	
	203-TEC	B1		B108	
	204-TEC	B1		B109	
002	SCU	2	10A-T.C.	10A-241	928A-10
	101-TEC	2		208	
	102-TEC	2		210	
	103-TEC	2		211	
	104-TEC	2		212	
	105-TEC	2		213	
	106-TEC	2		214	
	107-TEC	2		215	
	108-TEC	2		216	
	109-TEC	2		217	
	201-DPU	2	10A-T.C.	10A-241	928A-10
	202-DPU	2	10A-T.C.	10A-241	928A-10
003	SCU	2	10A-T.C.	10A-241	928A-10



	101-TEC	2		218	
	102-TEC	2		220	
	103-TEC	2		225	
	104-TEC	2		226	
	105-TEC	2		227	
	106-TEC	2		228	
	107-TEC	2		231	
	108-TEC	2		232	
	109-TEC	2		235	
	110-TEC	2		236	
	111-TEC	2		238	
	301-DPU	2	10A-T.C.	10A-241	928A-13
004	SCU	3	10A-T.C.	10A-340	928A-13
	101-TEC	3		308	
	102-TEC	3		310	
	103-TEC	3		311	
	104-TEC	3		312	
	105-TEC	3		313	
	106-TEC	3		314	
	107-TEC	3		315	
	108-TEC	3		316	
	109-TEC	3		317	
	201-DPU	3	10A-T.C.	10A-340	928A-13
005	SCU	3	10A-T.C.	10A-340	928A-13
	101-TEC	3		318	
	102-TEC	3		320	
	103-TEC	3		325	
	104-TEC	3		326	
	105-TEC	3		327	
	106-TEC	3		328	
	107-TEC	3		331	
	108-TEC	3		332	
	109-TEC	3		334	
	110-TEC	3		335	



	111-TEC	3		336	
	112-TEC	3		337	
	113-TEC	3		338	
	201-DPU	3	10A-T.C.	10A-340	928A-13
006	SCU	4	10A-T.C.	10A-441	928A-18
	101-TEC	4		408	
	102-TEC	4		410	
	103-TEC	4		411	
	104-TEC	4		412	
	105-TEC	4		413	
	106-TEC	4		414	
	107-TEC	4		415	
	108-TEC	4		416	
	109-TEC	4		417	
	110-TEC	4		428	
	201-DPU	4	10A-T.C.	10A-441	928A-18
007	SCU	4	10A-T.C.	10A-441	928A-18
	101-DPU	4	10A-T.C.	10A-441	
	201-TEC	4		418	
	202-TEC	4		420	
	203-TEC	4		425	
	204-TEC	4		426	
	205-TEC	4		427	
	206-TEC	4		431	
	207-TEC	4		432	
	208-TEC	4		434	
	209-TEC	4		435	
	210-TEC	4		436	
	211-TEC	4		437	
	212-TEC	4		438	
	301-DPU	4	10A-T.C.	10A-441	928A-18
008	EMPTY SCU	B1	NMR-M.R.		
009	SCU	B1	NMR-M.R.	B1D159	LSEC-1
010	SCU	B1	NMR-M.R.	B1D159	LSEC-1



011	RPT SCU	??	??		
099	INSIGHT PC	1	WEST GROUP	IN319	
101	SCU	3	TRANSF. M.R.	PENT	L3A
102	SCU	3	TRANSF. M.R.	PENT	L3A
103	SCU	3	TRANSF. M.R.	PENT	L3A
104	EMPTY SCU				
105	SCU	B3	CYCLTRN C.R.	B3-C-311	LEM-4555A-124
106	SCU	B2	CYCLTRN C.R.	B2-C-305	B2L1-455A-123
	101-DPU	B2	CYCLTRN C.R.	B2-C-305	
107	SCU	B2	CYCLTRN C.R.	B2-C-305	B2L1-455A-123
	101-DPU	B2	CYCLTRN C.R.	B2-C-305	
108	SCU	3	CYCLTRN P.H.	N. PENT	MPL2
109	SCU	B2	ACRF M.R.	B2-C-203	B2EL-4
110	EMPTY SCU	B1	ACRF M.R.	B1-C-106	B2EL-2
111	EMPTY SCU	B1	ACRF M.R.	B1-C-242	B1L-6(4554A-29)
112	EMPTY SCU	3	ACRF M.R.	W. PENT	MPEL-1
113	MBC	3	T. WING AHU7	W. PENT	
114	MBC	2	S. WING (OR1-9)	9C127	
	100-TEC	2	S. WING	2C576	
	101-TEC	2	S.WING	2C613	
115	RBC	1	T. WING (MRI)	1C705	
	101-TEC	1	T. WING (MRI)	1C705B	
	102-TEC	1	T. WING (MRI)	1C705A	
116	RBC	P3	S. WING	UPS ROOM	
117	MBC	3	CYCLTRN P.H.	NORTH P.H.	
198	INSIGHT PC	B1	ACRF	B1C228	
201	SCU	14	ACRF M.R.	14-ACRF	14L1(4557A13)
	101-UC	12	ASC127	12C127	
	102-UC	11	Q. WING	11C127	
	103-UC	4	Q. WING	4C127	
	104-UC	3	Q. WING	3C127	
	105-TEC	4	Q. WING	4C127A	



	106-TEC	4	Q.WING	4C127C	
	107-TEC	4	Q. WING	4C127E	
	108-TEC	3	Q. WING	3C127	
	109-TEC	3	Q. WING	3C127B	
202	SCU	5	UTIL. SHAFT	5C129	
	101-TEC	5	Q. WING	5C127C	
	102-TEC	5	Q.WING	5C127B	
	103-TEC	5	Q. WING	5C127B1	
	201-TEC	7	Q. WING	7C127	
	202-TEC	9	Q. WING	9C127	
	203-TEC	9	Q. WING	9C127	
	204-TEC	9	Q. WING	9C127	
	205-UC	7	Q. WING	7C127	
203	SCU	6	Q. WING UTIL SHAFT	6C127	
	101-TEC	6	Q. WING	6C127B	
	102-TEC	6	Q. WING	6C127C	
	103-TEC	6	Q. WING	6C127D	
	104-TEC	6	Q. WING	6C127E	
	105-TEC	6	Q. WING	6C127F	
	106-TEC	6	Q. WING	6C127A	
	107-UC	6	Q. WING	6C127	
204	LCU	B2		B2N217	
205	RBC	10	Q. WING	10C138	
206		14			
298??	INSIGHT PC	B1	ACRF	B1C228	
300	LCU	??			
301	EMPTY SCU	B2	EAST M.R.	B2N115	
302	EMPTY SCU	B2	EAST M.R.	B207	1261A51
303	SCU	B1	EAST M.R.	B1N201	EK-2
304	SCU	B1	EAST M.R.	B1N232	1260A-183
305	EMPTY SCU	6	EAST M.R.	6B33A	C6L(1260 A-108)
306	SCU	12	D. WING	12N119A	1264A4-2
	101-DPU	12	D. WING	12N-119A	
307	SCU	12	D. WING	12B-119A	1264A4-2



	101-MPU	12	D. WING	12N-119A	
308	SCU	14	EAST M.R.	14S200	A(1264A-79)
	101-TEC	14	EAST M.R.	AH23	
	102-TEC	14	EAST M.R.	EF24	
	103-TEC	14	EAST M.R.	EF46	
309	SCU	B2	EAST M.R.	B2B36	
310	SCU	15	MEZZANINE	M229	
	101-TEC	15	MEZZANINE	AH25	
	102-TEC	15	MEZZANINE	AHE	
311	SCU	14	EAST M.R.	S200	
	101-TEC	14	EAST M.R.	AH8	
	102-TEC	14	EAST M.R.	EF47	
	103-TEC	14	EAST M.R.	EF48	
	104-MPU	14	EAST M.R.	14S200	
312	SCU	14	EAST M.R.	S200	
	101-TEC	14	EAST M.R.	AH24	
	102-TEC	14	EAST M.R.	EF45	
313	EMPTY SCU	14	EAST M.R.	S200	
314	SCU	6	MECH C. WING	6B33A	
315	SCU	6	MECH C. WING	6B33A	
316	SCU	6	MECH C. WING	6B33A	
317	SCU	12	MECH B. WING	12B-19A	
318	SCU	12	MECH B. WING	12B-19A	
	101-MPU	12		12B-19A	
319	SCU	12	MECH D. WING	12B-119A	
399	INSIGHT PC	12	EAST GROUP	12N250	
400	??				
401	EMPTY SCU	B1	WEST M.R.	B1C29	1261A-20
402	SCU	B1	WEST M.R.	B1N304	1261A-119
403	SCU	6	WEST M.R.	6D43	1261A-116
	101-UC	6	6N322		
404	SCU	12	J. WING	12N305	1261A-133
	101-TEC			EF-62	
405	MBC	12	J. WING	12N305	1261A-133



406	SCU	14	F. WING	14S264	
	101-DPU				
407	EMPTY SCU	B2	WEST M.R.	B2L205	DP(3465A-04)
408	SCU	4	WEST M.R.	10A-441	928A-17
	101-TEC	4		106	
	102-TEC	4		112	
	103-TEC	4		113	
	104-TEC	4			
409	SCU	15	F. WING		
410	EMPTY SCU	14	F. WING	14S264	
411	SCU	12	H. WING	12D20	
412	SCU	12	H. WING	12D20	
	101-MPU	12		12D20	
413	SCU	12	H. WING	12D20	
	101-MPU	12	H. WING	12D20	
414	SCU	14	F. WING	14S264	
	101-TEC	14	F. WING	AH29	
	102-TEC	14	F. WING	EF29	
	103-MPU	14	F. WING	14S264	
415	SCU	2	BONE MARROW		
	101-DPU	2	BONE MARROW	NURS' STA	
	301-TEC	2	BONE MARROW	25239	
	302-TEC	2	BONE MARROW	25241	
	303-TEC	2	BONE MARROW	25243	
	304-TEC	2	BONE MARROW	25245	
	305-TEC	2	BONE MARROW	25247	
	306-TEC	2	BONE MARROW	25249	
	307-TEC	2	BONE MARROW	25251	
	308-TEC	2	BONE MARROW	25253A	
	309-TEC	2	BONE MARROW	25253	
	310-TEC	2	BONE MARROW	25255	
	311-TEC	2	BONE MARROW	25255A	
	312-TEC	2	BONE MARROW	25257A	
416	SCU	2	2ND FLOOR		



417	SCU	14	F. WING	14S253	
	101-TEC	14	F. WING	AH9	
418	102-MPU	14	F. WING	14S264	
419	SCU	14	F. WING	14S254	
	SCU	14	F. WING	EF-57	
	100-TEC			CORR G2CV2A	
	101-TEC			CORR G2CV2B	
	102-TEC			CORR G3CV2A	
	103-TEC			CORR G3CV2B	
	104-TEC			CORR G4CV2A	
	105-TEC			CORR G4CV2B	
	107-TEC			CORR G5CV2A	
	108-TEC			CORR G5CV2B	
	201-TEC		F. WING	ELEV MER	
	309-TEC		F. WING	AH31	
490	INSIGHT PC	1	WEST GROUP	1N319	
601	SCU	3	A. WING M.R.	3N100-A	
	101-UC	3	A. WING M.R.	3N100-A	
602	SCU	7	A. WING M.R.	7 P.H.	
	101-UC	7	A. WING M.R.	7 P.H.	
603	SCU	7	A. WING M.R.	7 P.H.	
604	SCU	7	A. WING M.R.	7 P.H.	
698	INSIGHT PC	12	EAT GROUP	12N250	
701	EMPTY SCU	B4	R. ONC. M.R.	B4 M.R.	CCMS MON SYS

**Table No. 3
NIH North Building DDC Network**

SCU No.	LAN Device	Flr.	Area	Room	Feed Panel
101	SCU		8		
102	SCU		8		
	101-MPU		8		
103	SCU		8		



104	SCU		8		
105	SCU		6		
106	SCU		6		
107	SCU		6		
	101-DPU		6		
108	SCU		6B		
	101-DPU		6B		
	102-MPU		6B		
	103-MPU		6B		
109	SCU		6B		
	100-TEC		6B	B1B007	
	101-TEC		6B	B1B009	
	102-TEC		6B	B1B013	
	103-TEC		6B	B1B017	
	104-TEC		6B	B1B021	
	105-TEC		6B	B1B029	
	106-TEC		6B	B1B031	
	201-UC		6B		
	202-DPU		6B		
110	SCU		6b		
	100-TEC		6B	B1B033	
	200-TEC		6B	B1B012	
	202-TEC		6B	B1B018	
	203-TEC		6B	B1B020	
	204-TEC		6B	B1B022	
	205-TEC		6B	B1B026	
	206-TEC		6B	B1B028	
	207-TEC		6B	B1B030	
	208-TEC		6B	B1B033	
	301-DPU		6B		
111	SCU		6B		
	100-TEC		6B	B1B109	
	101-TEC		6B	B1B115	
	102-TEC		6B	B1B116	



	103-TEC		6B	B1B117	
	104-TEC		6B	B1B118	
	201-TEC		6B	B2B014	
	202-MPU		6B		
112	SCU		6B		
113	SCU		6B		
114	LCU		6B	RPT WRITER	
115	RBC		15K		
121	SCU		21	PENTHOUSE	
	101-DPU		21		
	102-DPU		21		
	201-UC		21		
	301-UC		21		
	302-DPU		21		
	303-DPU		21		
122	MBC	PH	1		
131	SCU	PH-A	31		
132	SCU	PH-A	31		
	101-DPU	PH-A	31		
133	SCU	B1A2 1	31		
134	SCU	CAF PH	31		
135	SCU	PH B	31		
	101-DPU	PH B	31		
136	SCU	PH B	31		
137	SCU	PH B	31		
139	SCU	B2B1 0	31		
140	SCU	B4C	31		
141	SCU		4		
142	SCU		4		
143	SCU		4		
144	SCU		4		
	101-DPU		4		
145	SCU		4		



	101-DPU		4		
146	SCU	B4	31	B4C MER	
147	SCU	B4	31	B4C MER	
148	SCU	B4	31	B4C MER	
149	MBC	PH C	31		
150	SCU	B1	1		
151	SCU	B3	5		
152	SCU	B3	5		
153	SCU	B3	5		
154	SCU	B2	5		
155	SCU	4	5		
162	SCU	B1	CHILDREN'S INN		FAC-5561A-2
	101-TEC	B1	CHILDREN'S INN		FAC-5561A-2
171	SCU		7		
	101-TEC		7	1	
	102-TEC		7	27	
	103-TEC		7	21	
	104-TEC		7	29	
	105-TEC		7	23	
	106-TEC		7	33	
	107-TEC		7	25	
	108-TEC		7	31	
182	SCU		82		
	101-DPU		82		
191	SCU		9		
193	INSIGHT PC	B2	6B	JIM RICE	
194	INSIGHT PC	B1	31-6B PB		
195	INSIGHT PC	B3	5	B301	
196	INSIGHT PC	B3	4	B317	
197	INSIGHT PC	3	8	3A13	
198	INSIGHT PC	B4	31	B4C	
199	INSIGHT PC	B1	31 MAIN		
201	SCU	1	TWINBROOK	36	



	101-MPU	1	TWINBROOK	36	
	301-TEC	1	TWINBROOK	CORR "D"	
	302-TEC	1	TWINBROOK	22	
	303-TEC	1	TWINBROOK	62	
	304-TEC	1	TWINBROOK	33	
	305-TEC	1	TWINBROOK	35	
	306-TEC	1	TWINBROOK	34	
	307-TEC	1	TWINBROOK	36	
202	SCU	1	TWINBROOK	52	
	301-TEC	1	TWINBROOK	50	
	302-TEC	1	TWINBROOK	CORR "G"	
	303-TEC	1	TWINBROOK	44	
	304-TEC	1	TWINBROOK	46	
	305-TEC	1	TWINBROOK	CORR "F"	
	306-TEC	1	TWINBROOK	CORR "F"	
	307-TEC	1	TWINBROOK	45	
	308-TEC	1	TWINBROOK	61	
203	SCU	1	PARK BLDG		
204	SCU	2	TWINBROOK		
	101-DPU	2	TWINBROOK		
205	SCU	1	TWINBROOK	AHU6 MER	
	301-TEC	2	TWINBROOK	107	
	302-TEC	2	TWINBROOK	108N	
	303-TEC	2	TWINBROOK	109	
	304-TEC	2	TWINBROOK	112	
	305-TEC	2	TWINBROOK	114N	
	306-TEC	2	TWINBROOK	115	
	307-TEC	2	TWINBROOK	119	
	308-TEC	2	TWINBROOK	118	
	309-TEC	2	TWINBROOK	120	
	310-TEC	2	TWINBROOK	121	
	311-TEC	2	TWINBROOK	124	
	312-TEC	2	TWINBROOK	123	
	313-TEC	2	TWINBROOK	129	



	314-TEC	2	TWINBROOK	128	
	315-TEC	2	TWINBROOK	137A	
	316-TEC	2	TWINBROOK	137B	
	317-TEC	2	TWINBROOK	103N	
	318-TEC	2	TWINBROOK	149	
	319-TEC	2	TWINBROOK	150	
	320-TEC	2	TWINBROOK	156	
	321-TEC	2	TWINBROOK	157	
	322-TEC	2	TWINBROOK	144	
	323-TEC	2	TWINBROOK	143	
	324-TEC	2	TWINBROOK	139A	
	325-TEC	2	TWINBROOK	139	
206	SCU	1	TWINBROOK	52	
207	MBC	2	TWINBROOK	110	
208	SCU	2	TWINBROOK	CORR "L"	
209	MBC	1	TWINBROOK	53	
210	MBC	3	KEY WEST		
211	MBC	1	5 RESEARCH CT		
	100-TEC	1	5 RESEARCH CT	101	
	101-TEC	1	5 RESEARCH CT	102	
	102-TEC	1	5 RESEARCH CT	103	
	103-TEC	1	5 RESEARCH CT	104	
	104-TEC	1	5 RESEARCH CT	105	
	105-TEC	1	5 RESEARCH CT	CORR B-2	
	106-TEC	1	5 RESEARCH CT	CORR B-3	
	107-TEC	1	5 RESEARCH CT	CORR B-4	
	108-TEC	1	5 RESEARCH CT	163	
	109-TEC	1	5 RESEARCH CT	176	
	110-TEC	1	5 RESEARCH CT	175	
	111-TEC	1	5 RESEARCH CT	174	
	112-TEC	1	5 RESEARCH CT	173	
	113-TEC	1	5 RESEARCH CT	172	
	114-TEC	1	5 RESEARCH CT	178A	
	115-TEC	1	5 RESEARCH CT	178	



	116-TEC	1	5 RESEARCH CT	179	
	117-TEC	1	5 RESEARCH CT	CORR D-3	
	118-TEC	1	5 RESEARCH CT	CORR D-3.5	
	119-TEC	1	5 RESEARCH CT	181	
	120-TEC	1	5 RESEARCH CT	180	
	121-TEC	1	5 RESEARCH CT	178B	
	122-TEC	1	5 RESEARCH CT	169	
	123-TEC	1	5 RESEARCH CT	170	
	124-TEC	1	5 RESEARCH CT	171	
	125-TEC	1	5 RESEARCH CT	175	
	126-TEC	1	5 RESEARCH CT	175	
	127-TEC	1	5 RESEARCH CT	176	
	128-TEC	1	5 RESEARCH CT	176	
	200-TEC	1	5 RESEARCH CT	182	
	201-TEC	1	5 RESEARCH CT	167	
	202-TEC	1	5 RESEARCH CT	CORR D-5	
	203-TEC	1	5 RESEARCH CT	165	
	204-TEC	1	5 RESEARCH CT	166a	
	205-TEC	1	5 RESEARCH CT	166	
	206-TEC	1	5 RESEARCH CT	CORR E-7	
	207-TEC	1	5 RESEARCH CT	145	
	208-TEC	1	5 RESEARCH CT	144	
	209-TEC	1	5 RESEARCH CT	154	
	210-TEC	1	5 RESEARCH CT	155	
	211-TEC	1	5 RESEARCH CT	156	
	212-TEC	1	5 RESEARCH CT	160	
	213-TEC	1	5 RESEARCH CT	CORR 168	
	214-TEC	1	5 RESEARCH CT	CORR B-7	
	215-TEC	1	5 RESEARCH CT	106	
	216-TEC	1	5 RESEARCH CT	106	
	217-TEC	1	5 RESEARCH CT	157	
	218-TEC	1	5 RESEARCH CT	154A	
	219-TEC	1	5 RESEARCH CT	CORR C-8	
	220-TEC	1	5 RESEARCH CT	153	



	221-TEC	1	5 RESEARCH CT	119	
	222-TEC	1	5 RESEARCH CT	109	
	223-TEC	1	5 RESEARCH CT	110	
	224-TEC	1	5 RESEARCH CT	CORR A-8	
	225-TEC	1	5 RESEARCH CT	151	
	226-TEC	1	5 RESEARCH CT		
	227-TEC	1	5 RESEARCH CT	148	
	228-TEC	1	5 RESEARCH CT	150	
	229-TEC	1	5 RESEARCH CT	149	
	230-TEC	1	5 RESEARCH CT	142	
	231-TEC	1	5 RESEARCH CT	183	
	300-TEC	1	5 RESEARCH CT	138	
	301-TEC	1	5 RESEARCH CT	131	
	302-TEC	1	5 RESEARCH CT	139	
	303-TEC	1	5 RESEARCH CT	132	
	304-TEC	1	5 RESEARCH CT	CORR 139	
	305-TEC	1	5 RESEARCH CT	133	
	306-TEC	1	5 RESEARCH CT	135	
	307-TEC	1	5 RESEARCH CT	CORR 139	
	308-TEC	1	5 RESEARCH CT	136	
	309-TEC	1	5 RESEARCH CT	CORR 152	
	310-TEC	1	5 RESEARCH CT	112	
	311-TEC	1	5 RESEARCH CT	116	
	312-TEC	1	5 RESEARCH CT	CORR 113	
	313-TEC	1	5 RESEARCH CT	114	
	314-TEC	1	5 RESEARCH CT	117	
	315-TEC	1	5 RESEARCH CT	CORR 152	
	316-TEC	1	5 RESEARCH CT	CORR 152	
	317-TEC	1	5 RESEARCH CT	134	
	318-TEC	1	5 RESEARCH CT	121	
	319-TEC	1	5 RESEARCH CT	CORR 127	
	320-TEC	1	5 RESEARCH CT	122	
	321-TEC	1	5 RESEARCH CT	124	
	322-TEC	1	5 RESEARCH CT	CORR 127	



	323-TEC	1	5 RESEARCH CT	125	
	324-TEC	1	5 RESEARCH CT	126	
	325-TEC	1	5 RESEARCH CT	128	
	326-TEC	1	5 RESEARCH CT	130	
	327-TEC	1	5 RESEARCH CT	129	
	328-TEC	1	5 RESEARCH CT	140	
212	MBC	BSM T	KEY WEST		
	101-UC	1	KEY WEST	ANML RMS	
213	MBC	1	5 RESEARCH CT	FLR 1 MER	
	101-DPU	1	5 RESEARCH CT	CHLR 1	
	102-DPU	1	5 RESEARCH CT	CHLR 2	
	103-DPU	1	5 RESEARCH CT	CHLR 3	
214	MBC	2	5 RESEARCH CT	FLR 2 MER	
215	MBC	2	5 RESEARCH CT	FLR 2 MER	
	100-TEC	2	5 RESEARCH CT	CORR C-1	
	101-TEC	2	5 RESEARCH CT	204	
	102-TEC	2	5 RESEARCH CT	202	
	103-TEC	2	5 RESEARCH CT	205	
	104-TEC	2	5 RESEARCH CT	205	
	105-TEC	2	5 RESEARCH CT	206	
	106-TEC	2	5 RESEARCH CT	CORR C-2.5	
	107-TEC	2	5 RESEARCH CT	208	
	108-TEC	2	5 RESEARCH CT	CORR C-4	
	109-TEC	2	5 RESEARCH CT	CORR C-4.5	
	110-TEC	2	5 RESEARCH CT	211	
	111-TEC	2	5 RESEARCH CT	210A	
	112-TEC	2	5 RESEARCH CT	210	
	113-TEC	2	5 RESEARCH CT	214	
	114-TEC	2	5 RESEARCH CT	279	
	115-TEC	2	5 RESEARCH CT	283	
	116-TEC	2	5 RESEARCH CT	280	
	117-TEC	2	5 RESEARCH CT	282	
	118-TEC	2	5 RESEARCH CT	278	
	119-TEC	2	5 RESEARCH CT	277	



	120-TEC	2	5 RESEARCH CT	277	
	121-TEC	2	5 RESEARCH CT	276	
	122-TEC	2	5 RESEARCH CT	275	
	200-TEC	2	5 RESEARCH CT	214	
	201-TEC	2	5 RESEARCH CT	218	
	202-TEC	2	5 RESEARCH CT	218	
	203-TEC	2	5 RESEARCH CT	222	
	204-TEC	2	5 RESEARCH CT	223	
	205-TEC	2	5 RESEARCH CT	226	
	206-TEC	2	5 RESEARCH CT	224	
	207-TEC	2	5 RESEARCH CT	227	
	208-TEC	2	5 RESEARCH CT	215	
	209-TEC	2	5 RESEARCH CT	213	
	210-TEC	2	5 RESEARCH CT	CORR C-6	
	211-TEC	2	5 RESEARCH CT	218	
	212-TEC	2	5 RESEARCH CT	CORR C-7	
	213-TEC	2	5 RESEARCH CT	219	
	214-TEC	2	5 RESEARCH CT	220	
	215-TEC	2	5 RESEARCH CT	CORR C-8.5	
	216-TEC	2	5 RESEARCH CT	274	
	217-TEC	2	5 RESEARCH CT	273	
	218-TEC	2	5 RESEARCH CT	CORR D-6	
	219-TEC	2	5 RESEARCH CT	270	
	220-TEC	2	5 RESEARCH CT	272	
	221-TEC	2	5 RESEARCH CT	284	
	222-TEC	2	5 RESEARCH CT	263	
	223-TEC	2	5 RESEARCH CT	268	
	224-TEC	2	5 RESEARCH CT	CORR E-8	
	225-TEC	2	5 RESEARCH CT	260	
	226-TEC	2	5 RESEARCH CT	267	
	227-TEC	2	5 RESEARCH CT	259	
	228-TEC	2	5 RESEARCH CT	CORR E-9	
	300-TEC	2	5 RESEARCH CT	226	
	301-TEC	2	5 RESEARCH CT	232	



	302-TEC	2	5 RESEARCH CT	229	
	303-TEC	2	5 RESEARCH CT	231	
	304-TEC	2	5 RESEARCH CT	238	
	305-TEC	2	5 RESEARCH CT	228	
	306-TEC	2	5 RESEARCH CT	230	
	307-TEC	2	5 RESEARCH CT	242	
	308-TEC	2	5 RESEARCH CT	CORR C-9.5	
	309-TEC	2	5 RESEARCH CT	266	
	310-TEC	2	5 RESEARCH CT	CORR C10.5	
	311-TEC	2	5 RESEARCH CT	265	
	312-TEC	2	5 RESEARCH CT	247	
	313-TEC	2	5 RESEARCH CT	243A	
	314-TEC	2	5 RESEARCH CT	249	
	315-TEC	2	5 RESEARCH CT	266A	
	316-TEC	2	5 RESEARCH CT	264	
	317-TEC	2	5 RESEARCH CT	259	
	318-TEC	2	5 RESEARCH CT	259	
	319-TEC	2	5 RESEARCH CT	255	
	320-TEC	2	5 RESEARCH CT	256	
	321-TEC	2	5 RESEARCH CT	CORR E10.5	
	322-TEC	2	5 RESEARCH CT	257	
	323-TEC	2	5 RESEARCH CT	250	
	324-TEC	2	5 RESEARCH CT	251	
	325-TEC	2	5 RESEARCH CT	251	
	326 - TEC	2	5 RESEARCH CT	250	
	327 - TEC	2	5 RESEARCH CT	252	
	328 - TEC	2	5 RESEARCH CT	250	
	329 - TEC	2	5 RESEARCH CT	253	
	330 - TEC	2	5 RESEARCH CT	MER FCU	
299	INSIGHT PC	1	KEY WEST		
298	INSIGHT PC	1	TWINBROOK		



**Table No. 4
NIH Poolesville DDC Network**

SCU No.	LAN Device	Flr.	Area	Room	Feed Panel
001	SCU	BSMT	110A		
002	SCU	BSMT	110A.		
003	SCU		101	CONTROL	
	101-DPU		101	CONTROL	
004	SCU		101	CONTROL	
	101-DPU		101	CONTROL	
	102-DPU		101	CONTROL	
005	SCU	PH	103		
	101-TEC	PH	103	341	
	102-TEC	PH	103	343	
	103-TEC	PH	103	345	
	104-TEC	PH	103	347	
	105-TEC	PH	103	349	
	106-TEC	PH	103	351	
	107-TEC	PH	103	353	
	108-TEC	PH	103	355	
006	SCU	PH	103		
	101-TEC	PH	103	327	
	102-TEC	PH	103	325	
	103-TEC	PH	103	329	
	104-TEC	PH	103	331	
	105-TEC	PH	103	333	
	106-TEC	PH	103	335	
	107-TEC	PH	103	337	
	108-TEC	PH	103	339	
007	SCU	PH	103		
	101-MPU	PH	103		
	201-TEC	PH	103	313	
	202-TEC	PH	103	315	
	203-TEC	PH	103	317	



	204-TEC	PH	103	319	
	205-TEC	PH	103	321	
008	SCU	PH	103		
	101-TEC	PH	103	213	
	102-TEC	PH	103	215	
	103-TEC	PH	103	217	
	104-TEC	PH	103	219	
	105-TEC	PH	103	221	
	106-TEC	PH	103	223	
	107-TEC	PH	103	225	
	108-TEC	PH	103	227	
	109-TEC	PH	103	229	
	110-TEC	PH	103	241	
	111-TEC	PH	103	231	
	112-TEC	PH	103	233	
	113-TEC	PH	103	235	
	114-TEC	PH	103	237	
	115-TEC	PH	103	239	
009	SCU	PH	103		
	101-UC	PH	103 AHU-1		
	201-TEC	PH	103	216	
	202-TEC	PH	103	218	
	203-TEC	PH	103	220	
	204-TEC	PH	103	222	
	205-TEC	PH	103	224	
	206-TEC	PH	103	226	
	207-TEC	PH	103	228	
	208-TEC	PH	103	230	
	209-TEC	PH	103	232	
	210-TEC	PH	103	234	
	211-TEC	PH	103	236	
	212-TEC	PH	103	238	
	213-TEC	PH	103	240	
	214-TEC	PH	103	242	



010	SCU		102		
011	SCU		102		
	101-MPU		102		
012	SCU		102		
013	SCU		112		
014	SCU		T-18		
015	SCU		127		
	101-TEC		127		
	102-TEC		128		
	103-TEC		127		
016	SCU		T-1		
017	LCU	PH	103		
020	MBC		102		
021	MBC		104		
022	MBC		103		
023	MBC		100		
024	MBC		132		
025	MBC		102		
026	MBC		102		
027	MBC		102		
095	INSIGHT PC		SEWAGE PLANT		
096	INSIGHT PC		100		
097	INSIGHT PC		110A		
098	INSIGHT		101-CNTRL PLANT		

**Table No. 5
NIH South Building DDC Network**

SCU No.	LAN Device	Flr.	Area	Room	Feed Panel
301	RCU	B2	49	MER	
302	RCU	B1	49		
303	RCU	B1	49		
304	MBC	2	49		
305	RCU	3	49		



306	RCU	4	49		
307	RCU	5	49		
308	RCU	6	49		
309	RCU	P.H.	49	MER	
310	SCU	B2	49	MER	
	101-DPU		49		
311	SCU	B2	49	MER	
	101-DPU		49		
312	SCU	B2	49	MER	
313	RCU	B2	49	MER	
314	MBC	B2	49	MER	
315	SCU	B1	49		
316	SCU	1	49		
	100-TEC	1		1D75	
	101-TEC	1	49	1D75	
	102-TEC	1	49	1D71	
	103-TEC	1	49	1D71	
	104-TEC	1	49	1D67	
	105-TEC	1	49	1D67	
	106-TEC	1	49	1D63	
	107-TEC	1	49	1D63	
	108-TEC	1	49	1D59	
	109-TEC	1	49	1D59	
	110-TEC	1	49	1D55	
	111-TEC	1	49	1D55	
	112-TEC	1	49	1D51	928A-13
	113-TEC	1	49	1D51	928A-13
	114-TEC	1	49	1D47	
	115-TEC	1	49	1D47	
	116-TEC	1	49	1D43	
	117-TEC	1	49	1D43	
	118-TEC	1	49	1D39	
	119-TEC	1	49	1D39	
	120-TEC	1	49	1D35	



	121-TEC	1	49	1D35	
	122-TEC	1	49	1D31	
	123-TEC	1	49	1D31	
	124-TEC	1	49	1D27	
	125-TEC	1	49	1D27	
	126-TEC	1	49	1D23	
	127-TEC	1	49	1D23	
	128-TEC	1	49	1D19	
	129-TEC	1	49	1D19	
317	SCU	2	49		
318	SCU	3	49		
319	MBC	B2	49	MER	
320	SCU	PH	49	MER	
	101-DPU		49		
323	MBC	PH	30		
	101-TEC	PH	30		
	102-TEC	PH	30		
	103-TEC	PH	30		
	104-TEC	PH	30		
	105-TEC	PH	30		
	106-TEC	PH	30		
	107-TEC	PH	30		
	108-TEC	PH	30		
	109-TEC	PH	30		
	110-TEC	PH	30		
	111-TEC	PH	30		
	112-TEC	PH	30		
	113-TEC	PH	30		
	114-TEC	PH	30		
	115-TEC	PH	30		
	116-TEC	PH	30		
	117-TEC	PH	30		
	118-TEC	PH	30		
	201-TEC	PH	30		



	202-TEC	PH	30		
	203-TEC	PH	30		
	204-TEC	PH	30		
	205-TEC	PH	30		
	206-TEC	PH	30		
	207-TEC	PH	30		
	208-TEC	PH	30		
	209-TEC	PH	30		
	210-TEC	PH	30		
	211-TEC	PH	30		
	212-TEC	PH	30		
	213-TEC	PH	30		
324	MBC	SB	30		
325	MBC	SB	30		
326	MBC	SB	30		
335	MBC	1	30	MER102	
336	MBC	2	30	MER200	
337	SCU	5	30		
	100-TEC	5	30	500	
	101-TEC	5	30	503	
	102-TEC	5	30	504	
	103-TEC	5	30	505	
	104-TEC	5	30	506	
	105-TEC	5	30	507	
	106-TEC	5	30	508	
	107-TEC	5	30	509	
	108-TEC	5	30	510	
	109-TEC	5	30	511	
	130-TEC	5	30	SOU CORR	
	131-TEC	5	30	SOU CORR	
398	INSIGHT PC	002	30	MER200	
401	SCU		29A		
402	SCU	3	29A		
407	MBC	SB	29		



408	MBC	SB	29		
409	MBC	SB	29		
410	MBC	SB	29		
411	MBC	SB	29		
412	SCU	PH	29		
	100-TEC	PH	29		
	101-TEC	PH	29		
	102-TEC	PH	29		
	103-TEC	PH	29		
	104-TEC	PH	29		
	105-TEC	PH	29		
	106-TEC	PH	29		
	107-TEC	PH	29		
	108-TEC	PH	29		
	109-TEC	PH	29		
	110-TEC	PH	29		
	111-TEC	PH	29		
	112-TEC	PH	29		
	113-TEC	PH	29		
	114-TEC	PH	29		
	115-TEC	PH	29		
	116-TEC	PH	29		
	200-TEC	PH	29		
	201-TEC	PH	29		
	202-TEC	PH	29		
	203-TEC	PH	29		
	204-TEC	PH	29		
	205-TEC	PH	29		
	206-TEC	PH	29		
	207-TEC	PH	29		
	208-TEC	PH	29		
	209-TEC	PH	29		
	210-TEC	PH	29		
	211-TEC	PH	29		



	212-TEC	PH	29		
	213-TEC	PH	29		
413	SCU	SB	29A		
	101-TEC	1	29A		
	102-TEC	1	29A		
	103-TEC	1	29A		
	104-TEC	1	29A		
	105-TEC	1	29A		
	106-TEC	1	29A		
	107-TEC	1	29A		
	108-TEC	1	29A		
	109-TEC	1	29A		
414	MBC	SB	29A		
415	MBC	B2	29B		
416	MBC	B2	29B		
417	MBC	B2	29B		
418	MBC	B2	29B		
419	MBC	B2	29B		
420	MBC	B2	29B		
421	MBC	B2	29B		
422	SCU	SB	29A	B-10	
498	INSIGHT PC	SB	29A	B-10	
504	SCU		13		
523	MBC	BSMT	12A		
524	RBC	PH	12		
525	MBC	1	12B	MER	
526	RBC	1	16		
598	INSIGHT PC	B1	12B	MER	
601	MBC	1	45	FIRE CTL	
602	MBC	P2	45		
603	MBC	P2	45		
604	MBC	P2	45		
605	MBC	P2	45		
606	MBC	P2	45		



607	MBC	PH	45		
698	INSIGHT PC	P1	45		

F.1.7 Requirements for Specific Control Loops

HOA Switches for Motors shall be provided: (fireman's override):
 All AHU supply fans, return fans, and exhaust fans shall be started and stopped by an HOA switch located where it is readily accessible to the Fire Department in the event of an emergency.

Freeze Protection: All AHUs shall have a two-pole freezestat with manual reset. The freezestat shall trip when the setting drops below 6°C. The freezestat shall have two sets of contacts. One set shall be hard wired to the motor starter, and the dry set of contacts shall be connected as a digital in to the DDC panel. When the freezestat trips, the supply fan shall stop, the preheat, chilled water, and air-handler reheat valves shall open fully, and the freezestat point will be placed in alarm status. The freezestat located at eye level on the air handler shall have a manual reset button which is required to restart the air-handler fan and return the digital in point to the normal status.

Relative Humidity (RH) Control: The DDC panel shall modulate the steam humidifier valve to maintain RH in the workspace. One electronic humidity transmitter is required per humidifier. The transmitter shall be located in the workspace or in the exhaust duct. RH shall be monitored at the control processing unit. A humidity reset program shall be provided.

In order to prevent condensation in the supply duct, an electronic high-limit humidity sensor shall via the DDC panel override the signal to the humidifier valve when the duct humidity rises above 90% RH. The high-limit sensor shall be located a minimum distance of 3 m downstream of the humidifier.

Variable-Frequency Drives: VFDs shall not be installed on HVAC equipment. Further guidelines are required before this decision is reversed. The concern is that VFDs may cause harmonic or line distortions which will affect the research community.

Existing VFDs that are being replaced shall be installed with



individual electrical bypass capability. The VFD shall automatically bypass during a fault condition and shall attempt an automatic restart at least three times. The bypass shall operate in three modes (Automatically Bypass) Auto-Bypass shall be used for critical equipment.

Automatic: In the automatic mode, the VFD receives a signal from the DDC panel to modulate the VFD.

Manual: In the manual mode, the VFD receives a signal from a manually adjusted potentiometer to modulate the VFD.

Bypass: The bypass mode shall be independent of the cabinet. In the bypass mode the VFD is completely bypassed. The VFD display is off, and all components of the VFD are electrically isolated. The frequency output to the motor is 60 with line voltage.

The DDC panel shall monitor and control the following points.

- Analog output to modulate drive in the auto mode
- A digital in to indicate drive failure
- A digital in to indicate if the bypass panel is in the manual or bypass mode
- A digital out to start and stop the motor while in the automatic, bypass, or manual mode

When the motor is for the VFD display shall remain on.

The following is the method for Monitoring Constant Speed Fans, Motors, and Pumps:

Method for monitoring fans that are parallel to each other and share the same plenum: A current transducer shall measure the current in one leg of each motor. High and low limits shall be set to plus or minus 10% of the initial amperage reading, and a programmed time delay shall be included for fan start-up. A high current may represent a locked motor or a phase outage. A low-current alarm may represent a reduction in load, such as slipping belts.

- In addition, a single differential pressure switch is required across each fan.



Method for monitoring pumps connected in parallel: A current transducer is required to measure the amperage in one leg of each motor. High- and low-limit alarms shall set to plus and minus 10% of the field reading, and a programmed time delay shall be included for start-up. A current alarm may represent a locked rotor or a phase outage. A low-current alarm may represent a reduction in load.

In addition, a single differential pressure switch is required across each pump.

F.1.8 Guidelines for Control Systems

Typical control of AHUs serving laboratories and animal facilities shall be constant air volume with modulating vortex damper, 100% outside air.

Sequence of Operation:

HOA switch for motors: All AHU supply fans, return fans, and exhaust fans (EFs) shall be started and stopped from the DDC panel through the AUTO position of the fan starter HOA switch. When the HOA switch is in the HAND position, the DDC panel shall show an alarm condition. When the HOA is in the OFF position, the proof differential pressure switch will show "off" status via the DDC panel.

AHU Start-up: The DDC panel shall start and stop the fans through the motor starter circuit. When R-1 is energized, pneumatic air is provided to the analog out pneumatic points (except to chilled water, AOP) and to the outside air (OA) damper and smoke damper (SM). When the OA and SM dampers are opened as sensed by their limit switches (LS), the fan motor is started. When this occurs, R-2 will energize EP-4, which will allow the vortex damper to open.

Proof of Fan Status: Dedicated differential pressure switches across the supply fan, return fan, and exhaust fan shall prove the "oil" status of each fan. In addition, a current transducer is required to measure the current in one leg of each motor. High- and low-limit alarms of plus or minus 10% of the initial amperage reading



shall be programmed into the DDC panel. A high current may represent a locked motor or a phase outage. A low current alarm may represent a deduction in load such as slipping belts.

Freeze Protection: All AHUs shall have a two pole freezestat with manual reset. One is required for every 3.7 m² of coil surface. The freezestat shall trip when any area of the preheat coil discharge drops below 6°C. The freezestat shall have two sets of contacts. One set shall be hard wired to the motor starter and the other set of dry contacts shall be wired to the DDC panel. When the freezestat trips, the supply fan shall stop, and the preheat, chilled water, and reheat valves shall open fully. The freezestat point in the DDC panel shall be placed in the condition. The freezestat shall have a manual reset which is required to restart the fan, actuate the control air, and return the freezestat point to the normal status.

Relative Humidity Control: The DDC panel shall modulate the humidifier valve to maintain a setpoint of forty (40) percent relative humidity in the work space as sensed by an electronic humidity transmitter located in the main exhaust duct.

High-limit Humidity: An electronic high-limit humidity transmitter located 3 m downstream of the humidifier shall via the DDC panel at the humidity level to 85% RH.

High pressure fan override of System Static Control: Should the static pressure in the ductwork in the vicinity of the fan approach a high setpoint as sensed by a secondary static pressure transmitter, the DDC panel shall place this point in alarm and maintain a designated setpoint in the vicinity of the fan. Should the static exceed the high limit setpoint the DDC panel shall - shut down the fan to prevent duct blowout. (Note: consideration should be given to a hard-wired high limit.)

Smoke Detection: The duct smoke detector on the detection of products of combustion shall stop the supply fan and at the DDC panel.

Vortex Control: Based on static pressure: The DDC panel shall vary the supply fan vortex damper position to maintain a constant



static pressure as sensed by the electronic static pressure transmitter mounted on the supply air ductwork near the end of the longest run. The vortex damper shall gradually ramp up on fan start-up. The sequence will be the same if a plug fan is provided.

Vortex control based on airflow: The DDC panel shall vary the supply fan vortex damper position to maintain a constant airflow rate as sensed by the electronic transmitter located at the airflow measuring station. The vortex damper shall ramp to setpoint on fan start-up.

Discharge temperature control from Preheat, Cooling Coil, and Reheats within the Air Handling Unit, (RTD sensors):

The preheat setpoint shall be based on design conditions. An averaging discharge sensor shall modulate the steam preheat coil valve to maintain design setpoint. Multiple sensors shall be provided for large coils.

The cooling coil shall have an averaging discharge sensor which shall via the DDC panel modulate the chilled water valve to maintain 12°C. Multiple sensors shall be provided for large coils.

Reheat coil within the air handler shall have an averaging discharge sensor which shall via the DDC panel modulate the reheat valve to maintain the programmed setpoint.

Glycol Preheat: The preheat temperature shall be maintained at 10°C as sensed by an averaging discharge sensor which shall via the DDC panel modulate the glycol valve to maintain programmed setpoint.

Exhaust Fan Start-up: The DDC panel shall start and stop the exhaust fan through the motor starter circuit. When R-3 is energized pneumatic air is provided to the exhaust damper. When the end switch makes the fan motor is allowed to start. Relay R-4 energizes EP-5 and allows the vortex damper to open. Exhaust flow must be proven before the associated supply fan starts. (Exhaust Building Only) The supply fan cannot start unless the exhaust is running. If the supply fan fails the exhaust shall continue



to run. During outages and reduced exhaust capacity (emergency power) the fume hood exhaust fans run on maximum flow and the general exhaust run on minimum flow. Note: Verify building pressure control versus window conditions.

Exhaust Fan Operating Point: Static Control - The DDC panel shall vary the exhaust fan vortex damper position to maintain a constant static pressure. The vortex damper shall gradually ramp up to setpoint on fan start-up.

Flow Control: The DDC panel shall compare the supply exhaust flow rates and shall vary the exhaust fan vortex damper position in order to maintain a predetermined flow differential.

Typical Control of AHUs Serving Office Environment: Constant Volume with Dry Bulb Economizer.

Each fan system shall be designed to use up to and including 100% of the fan system capacity for cooling with outdoor air whenever its use will result in lower use of energy than would be required under its normal operation. Exceptions are fan system capacities less than 2360 L/S or 39275 W total cooling capacity. The following sequence serves as a guideline.

Sequence of Operation:

Hand-Off-Auto switch for motors: All AHU supply fans, return fans and all exhaust fans shall be started and stopped by the DDC panel through the AUTO position of the fan starter "Hand-Off-Auto" switch. When the starter switch is not in the "Auto" position the DDC panel shall place the point in the status. (NFPA 90A 4-1, Manual Controls). When the HOA is in the off position the proof differential pressure switch will show "off" status via the DDC panel.

AHU Start-up: The DDC panel shall start and stop the fans through the motor starter circuit. When R-1 is energized pneumatic air is provided to the analog out pneumatic points (except to chilled water AOP) and to the outside air (OA) damper and smoke damper (SM). When the outdoor air damper and smoke dampers are opened as sensed by their limit switches (LS) the fan motor is started. When this occurs R-2 will energize EP-4 which will allow



the vortex damper to open.

Proof of fan status: Dedicated differential pressure switches across the supply fan, return fan and exhaust fan shall prove the "on" status of each fan. In addition, a current transducer is required to measure the current in one leg of each motor. High-and-low limit alarms of plus or minus 100% of the initial amperage reading shall be programmed into the DDC panel. A high-current alarm may represent a locked motor or a phase outage. A low-current alarm may represent a deduction in load such as slipping belts.

Freeze protection: All AHUs shall have a two-pole freezestat with manual reset. One is required for every 3.7 m² of coil surface. The freezestat shall trip when any area of the preheat coil discharge drops below 6°C. The freezestat shall have two sets of contacts. One set shall be hard wired to the motor starter, and the other set of dry contacts shall be wired to the DDC panel. When the freezestat trips, the supply fan shall stop, and the preheat, chilled water, and reheat valves shall open fully. The freezestat point in the DDC panel shall be placed in the alarm condition. The freezestat shall have a manual reset which is required to restart the fan, actuate the control air, and return the freezestat point to the normal status.

RH Control: The DDC panel shall modulate the humidifier valve to maintain a setpoint of 40% RH in the working space as sensed by an electronic humidity transmitter located in the main exhaust duct.

High-Limit Humidity: An electronic high-limit humidity transmitter located 3 m downstream of the humidifier shall via the DDC panel, limit the humidity level to 85% RH.

High-Pressure Fan Override of System Static Control: Should the static pressure in the ductwork in the vicinity of the fan approach a high setpoint as sensed by a secondary static pressure transmitter, the DDC panel shall place this point in and maintain a designated setpoint in the vicinity of the fan. Should the static exceed the high-limit setpoint, the DDC panel shall shut down the fan to prevent duct blowout. (Note: consideration should be given to a hard-wired high limit.)



Smoke Detection: The duct smoke detector on the detection of products of combustion shall stop the supply fan and at the DDC panel.

Minimum Outside Air Volume Control- The DDC panel shall modulate the outside air dampers to maintain a predetermined outside air flow rate as sensed by a single point velocity sensor.

Dry Bulb Economizer Control: The DDC panel shall maintain a programmed mixed air temperature when the outdoor air is below 18 °C (program adjustable). One outdoor air sensor is required per building. When the outdoor air is above 18 °C the outdoor air, return air and relief air dampers will go to a minimum set position.

Discharge Temperature Control From Preheat, Cooling Coil, and Reheats within the AHU (RTD sensors): The preheat setpoint shall be based on design conditions. An averaging discharge sensor shall modulate the steam preheat coil valve to maintain the design setpoint. Multiple sensors shall be provided for large coils.

The cooling coil shall have an averaging discharge sensor which shall via the DDC panel modulate the chilled water valve to maintain 12°C. Multiple sensors shall be provided for large coils.

The reheat coil within the air handler shall have an averaging discharge sensor which shall via the DDC panel modulate the reheat valve to maintain the programmed setpoint. Reheat valves shall be normally closed.

Glycol Preheat: The preheat temperature shall be maintained at 10°C as sensed by an averaging discharge sensor which shall via the DDC panel modulate the glycol valve to maintain the programmed setpoint.

Exhaust Fan Start-Up: The DDC panel shall start and stop the EF through the motor starter circuit. When R-3 is energized, pneumatic air is provided to the exhaust damper. When the end switch makes the fan motor is allowed to start. Relay R-4 energizes EP-5 and allows the vortex damper to open.



F.1.9 HVAC Conventional Control Systems

Legends for control symbols and abbreviations should be included on all control diagrams.

The sequence of operations shall be included on the control diagrams and in the specifications.

Symbol identification shall be shown on drawings.

The point list (NIH Standard Specification) shall be shown on the drawings.

Valve selection criteria shall be shown on the drawings. Pressure drops, maximum differential, and constant volume ratings shall also be shown.

Valve specifications shall be by standard of quality shown in the specification section.

The damper actuator selection shall show the actuator sizing, torque rating, and minimum number of actuators per damper section.

Control submittals shall be AutoCad "Fast Look" standard.



F.2 Animal Holding Areas (AHAs)

F.2.1 Capabilities of the DDC Systems

Monitoring Capabilities:

- Room humidity
- Air changes
- Space temperature
- Room pressurization
- Differential pressure switches across high-efficiency particulate air (HEPA) filters
- Status of Lights

Control Capabilities:

- Temperature
- Humidity
- Lights
- Air changes

Control Devices:

- Terminal equipment controllers (TECs)
- Modular building controller

F.2.2 Room Humidity

General: The DDC is capable of controlling and monitoring humidity. Humidity is generally controlled on a zone-by-zone basis. A zone may consist of an entire floor or an entire building. In existing facilities humidity is rarely controlled on an individual room basis. Humidity monitoring for an individual AHA is required. Only in special cases, where definite program requirements exist, such as in areas that may house animals that are sensitive to humidity levels, are humidity sensors an option. Restrictions are necessary for the following reasons.

Maintenance Intensive: Humidity sensors require a higher degree of maintenance in comparison to temperature sensors. Industrial class capacitance-type humidity sensors are required for durability and repeatability. Care should be taken in sensor locations so that any effect by dirt and moisture is kept to a minimum.



Variation in Humidity: AHAs within the same zone will not exceed a variance of 20% under usual conditions.

Control Operation: From a control standpoint, no more than one humidity sensor is required. Humidifiers are located on the discharge side of the AHU and may serve an entire building or zone. For control purposes, only one room humidity transmitter is required per humidifier (located in the AHA or the exhaust duct.)

Location: The ideal place to locate the zone or room humidity sensor is on the wall near the exhaust air duct. However, if the walls are washed down, then the exhaust duct outside the space is preferable. Good access should be provided. Humidity sensors should not be placed in the supply duct unless they function as a high limit.

Accuracy of Humidity Control: During the winter the DDC system with a high-accuracy sensor can maintain plus or minus 2%. Humidity levels in other areas supplied by the same humidifier can vary by as much as 10% depending on the humidity loads of the individual areas. Consideration should be given to individual booster humidifiers with their own DDC control loop. During the summer, spring, and fall the humidifiers are valved off or controlled off. Dehumidification is required in the summer, spring, and fall. This occurs when outside air passes through the cooling coil. In the summer the AHU will maintain less than 65% RH in the AHAs. In summary, conditions should be above or below the 30-70% RH range under normal conditions.

F.2.3 Air Changes

Control of Air Changes in High-Pressure Systems: Constant volume boxes can be installed in high-pressure systems to control supply and exhaust flow rates. The DDC system (TECs) can also control modulating dampers in the supply and exhaust to maintain flow rates.

Control of Air Changes in Existing Low-Pressure Systems: In most instances involving existing facilities the DDC system cannot control the airflow rate into individual rooms without major modifications to the duct system (i.e. without major modulating



dampers at the duct branches and without changing the design of the ventilation system to increase the static pressure). For existing systems the flow rate into individual rooms is normally maintained by manual adjustments to balancing dampers. In most cases the DDC system can provide monitoring for information purposes.

Monitoring Air Changes in High-Pressure Systems: The DDC system can monitor the total pressure and static pressure ports on the constant volume boxes to calculate velocity pressure, which can be converted to L/s and, if need be, multiplied by a correction factor to reflect the traverse readings taken in the field.

Monitoring Air Changes in Existing Low-Pressure Systems: The DDC system can readily monitor air changes using velocity probes. These probes should be mounted on the supply duct rather than the exhaust.

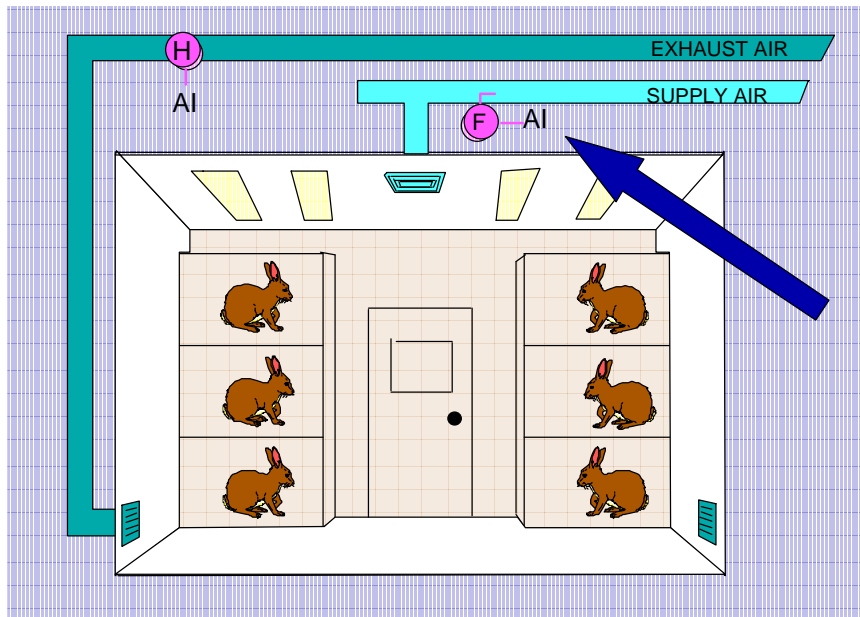


Diagram No. 3

The reasons are as follows: The probes are very sensitive to dust



particles and produce false readings when dirty. Since the prefilters on the supply side are generally 95% efficient, the probes require less maintenance when installed in the supply duct.

Generally, the exhaust ducts are less accessible and branch out to two areas of each animal room for good air distribution. On the other hand, each holding room generally has one supply duct.

Converting Velocity Pressure (VP) to Air Changes per hour (CPH): The velocity of the airflow in the duct (VEL) is equal to a constant time the square root of the velocity pressure.

$$\text{VEL(m/s)} = 4005 \times \text{the square root of VP}$$

The air changes per hour (cph) in the AHA is equal to the average velocity (VEL_{ex}) times the area of the exhaust duct times 3600 seconds per hour divided by the volume of the room.

$$\text{cph} = \frac{\text{VEL}_{\text{ex}} \times \text{Area} \times 3600 \text{ s/hr}}{\text{Room Volume}}$$

However, since the measurements are taken from the supply duct and not the exhaust, this measurement is multiplied by a factor (between 1.1 and 1.17) based on actual field conditions, making the cph equal to the (velocity of the supply air) (area of the supply duct) (1.15) (3600) divided by the (volume of the room)

$$\text{cph} = \frac{(1.15) \times (\text{VEL}_{\text{sa}}) \times (\text{AREA}) \times 3600 \text{ s/hr}}{\text{Room Volume}}$$

F.2.4 Room Pressurization

Control of High-Pressure Systems: The status of room pressurization (positive or negative) is controlled when the flow rates are controlled at the supply and exhaust boxes, usually with a TEC which will control the modulating dampers on the supply and exhaust boxes. The TEC also provides the monitoring required per the point standards.

Control of Room Pressurization in Existing High-Pressure



Systems: In most instances involving existing facilities the DDC system cannot control the pressurization of individual rooms without major modifications to the duct system (i.e., without installing modulating dampers at the duct branches, and without changing the design of the ventilation system to increase the static pressure). For existing systems the pressurization into individual rooms is normally maintained by manual adjustments to balancing dampers. In most cases the DDC system can provide monitoring for information purposes.

Monitoring Room Pressurization in High-Pressure Systems: The status of room pressurization (positive or negative) can be monitored indirectly by monitoring the flow rates into the room. The DDC system can monitor the total pressure and static pressure ports on the constant volume boxes and calculate VP, which can be converted to flow rates (L/s) and, if need be, multiplied by a correction factor to reflect traverse readings taken in the field.

Monitoring Where Room Pressurization Is Not Automatically Controlled: At existing facilities the individual room pressurization is normally maintained by manually adjusting balancing dampers. Even though the pressurization is not automatically controlled, the DDC system is capable of monitoring room pressurization. The researcher should have a justifiable reason for centrally monitoring room pressurization. A good justification is to provide alarm capabilities for areas where airborne contamination is a major threat to human life or to the research program. This information could be logged into a software program such as Report Writer. Central monitoring of room pressurization should be restricted to AHAs where room pressurization is critical.

The earlier method for monitoring room pressurization is the use of a differential pressure switch. The switch has two ports. One port is open to the corridor, and the other is open to the room. The differential switch will indicate if the room is positive or negative in relation to the corridor.

Airflow Monitors: In cases where more than one exhaust branch exists per room, the use of airflow monitors in the supply and



exhaust ducts is not acceptable for the following reasons.

VP transmitters do not have enough resolution to accurately detect the differences between the supply and exhaust VPs.

The costs are considerably higher than differential pressure switches.

Other acceptable alternatives: In AHAs where pressurization is not a critical factor but some indication is required by the researcher, the use of a differential pressure gauge at each AHA is acceptable. The differential gauge would normally be mounted near the entrance to the animal room and would not be connected to the DDC system. These gauges are analog readout and measure the actual differential pressure between the room and corridor.

The later systems utilize a room pressurization monitor with digital readout. The monitor is connected to the DDC network and is capable of reading both positive and negative pressures. This information is passed over the DDC network for positive or negative mode determination.

F.2.5 Space Temperature

Temperature should be monitored by the DDC system. Sensors should be located in the exhaust air leaving the AHA after the last duct takeoff in order to get a true reading of all the air leaving the space. The temperature sensor should have an access door.



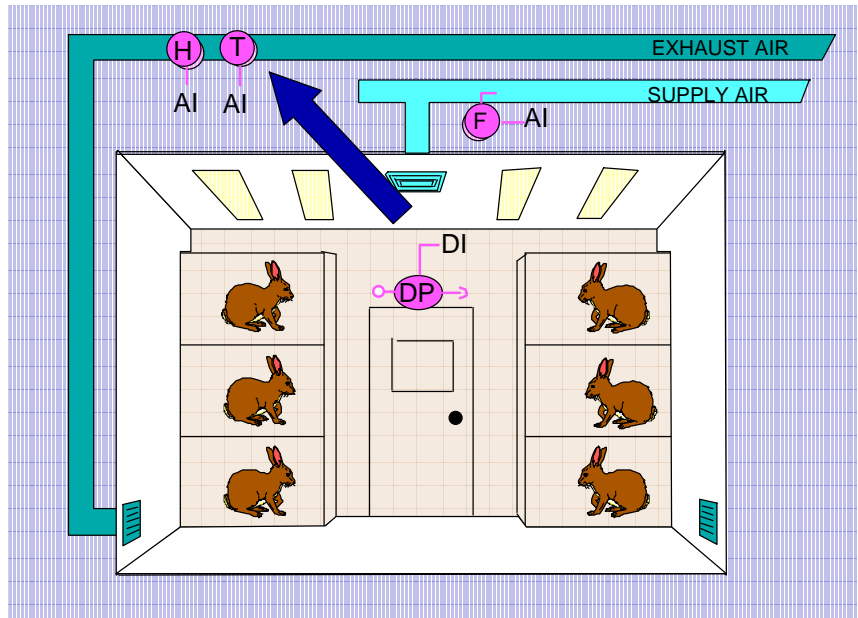


Diagram No. 4

New designs or renovations to AHAs shall include DDC temperature control (TECs). If the DDC system controls the room temperature, alarm limits can be set at plus or minus 17°C of setpoint. Typically, AHAs have individual hot water reheat coils controlled by the TEC (analog-out-electronic).

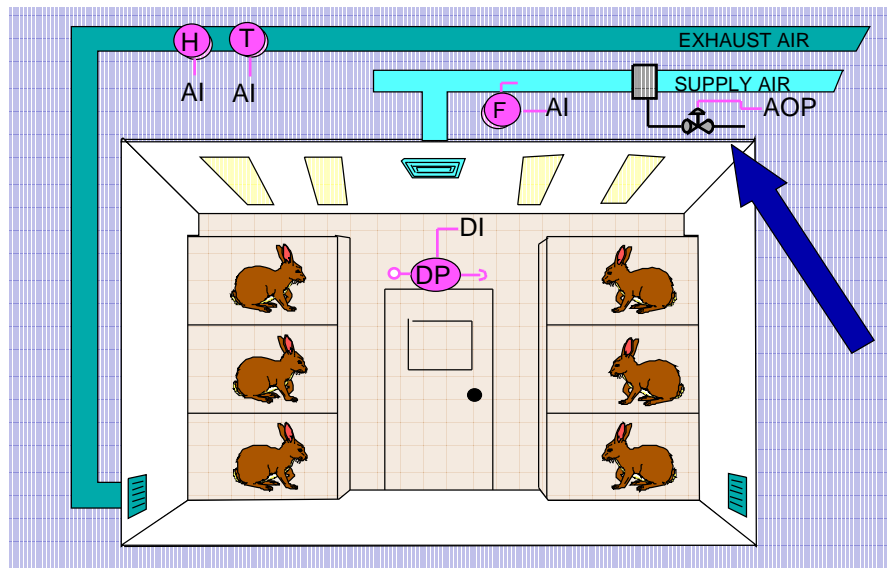


Diagram No. 5



F.2.6 Lights

General: The DDC system shall monitor and control the lights. Standard multilevel lighting designs are explained below.

One Level of Lighting: The TEC controls the lighting in the AHAs on a room-by-room basis. Each room will have a manual timer which will be used by the veterinarians to override the TEC to turn the lights on during the night.

The lights shall retain their last known command when:

- The TEC fails.
- The TEC is turned off.
- A power blip occurs.
- Sequence: via terminal controller.
- Lights ON: TEC turns lights on.
- Lights OFF: TEC turns lights off.
- Timer Override of TEC: Lights ON.
- Timer Monitor: Status to tell TEC if switch is on.
- Lights Monitor: Photocell status (or current switch).

Two Levels of Lighting: In some AHAs a lower level of light is required during normal day operation. The veterinarians need to have the capability to increase the level of lighting when they walk into the room.

The TEC controls the low level of light in the AHAs on a room-by-room basis. The manual timer will override the TEC command to increase the lighting level during day operation or to turn on both sets of lights during night operation.

The lights shall retain its last known command when

- The TEC fails.
- The TEC is turned off.
- A power blip occurs.

Sequence:

- Lights ON: The TEC turns on lower lighting level.
- Lights OFF: The TEC turns off lower lighting level.
- Timer Override TEC: Turns on additional lights
- Timer Monitor: Status to TEC to tell lights are on.



- Lights Monitor: Photocell status of lights.

Note: All levels of lighting are monitored by a watertight, resistance-type photocell or a current transducer switch.

F.2.7 Reports

General: Local reports can be generated from the DDC network. Each DDC panel (SCU or MBC) has the capability to support a printer to generate these reports, known as "Multitrend Reports." They are printed out on a scheduled basis. In addition, trending can be generated in color, graphic form at the main workstation.

Also available is a software package called Report Writer, which can obtain data from the DDC panels in, for example, AHAs and put them in a easy-to-read report form on a PC.



F.3 Elevator Controls

F.3.1 Swift 5000

All new elevator installations and upgrades to existing elevators shall be equipped with the Swift 5000 solid-state, microprocessor-based controller, as manufactured by Computerized Elevator Control Corp. With the exception of the New York City area, these controllers are available to all elevator installers and, as such, do not constitute a sole source. At the present time, the NIH has installed 31 of these controllers and is in the process of installing 10 more. The Maintenance Engineering Branch, NIH Division of Engineering Services, has a program of upgrading all of the older elevators throughout the campus and will use the Swift 5000 controller exclusively.

F.3.2 DC-SCR Drives

All new elevator installations and upgrades to existing elevators shall be equipped with DC silicone-controlled rectifier (SCR) drives in lieu of motor-generator sets. Either the GE DC 300 or the Lewis-Allis Sabor SCR drive for elevator hoist motors is acceptable. Both of the above drives are available on the open market and do not constitute a sole source.

F.3.3 Installed Swift 5000 and SCR Drives

<u>Building</u>	<u>Elevator #</u>	<u>Location</u>
1	1&2	P.H. Mach Rm.
4	1&2	P.H. Mach. Rm.
5	1&2	P.H. Mach. Rm.
8	1 (W/O Drive)	Bsmt. Mach. Rm
8A	1 (W/O Drive)	Bsmt. Mach. Rm.
10	5 (W/O Drive)	Mn. Bnk. Mch. Rm.
10	8,9,15&16	E&W P.H. Mch. Rms.
10(ACRF)	29	15th Flr. Mach. Rm.
10(ACRF)	30-32	15th Flr. Mach. Rm.(N)
13	1-4	N&S P.H. Mach. Rms.
30	1&2	P.H. Mach. Rm.
31C	15	P.H. Mach. Rm.



36	1,2 & 3 (W/O Drive)	P.H. Mach. Rm. (N)
37	1,2 & 3 (W/O Drive)	P.H. Mach. Rm. (S)
49	1-7	P.H. Mach. Rms.
10A-Wing	11 & 12	P.H.Mach.Rms.
29	3	P.H. Mach. Rm.
49	8	P. H. Mach. Rm.



F.4 Power Plant Controls

F.4.1 DDC Systems in the Chilled Water Plant

In the Power Plant the Landis & Gyr DDC system monitors the chilled water variables and does not provide any control functions. The SCUs in Building 11 and 34 monitor temperature, flow rates, and pressures, and compute the energy usage and efficiencies of the chillers, as well as the performances of the chilled water pumps.

A diagram for the location of SCUs for the chilled water plant is available upon request.

The new chillers, which consist of Chillers 15, 16, and 17, have an Andover-based DDC system known as FAX 4000.

F.4.2 DDC Requirements for the Future Chilled Water Plant

NIH Specific Requirement: Future DDC panels shall have peer-to-peer communication with the existing DDC panels controlling Chillers 15, 16, and 17. This can be accomplished via a "gateway" so that information now on the existing network can be passed along via the gateway to the Landis & Gyr system.



F.5 Laboratory Equipment Alarm Monitoring

F.5.1 Description of the Current System

The NIH Division of Engineering Services, and specifically the Maintenance Engineering Branch, is responsible for responding to freezer, cold room, and warm room temperature alarms. Temperature switches, mounted within the environment of the equipment, will send a signal (typically a normally closed set of contacts will open) to a local zone panel when the temperature rises above a predetermined setpoint. An indicator light will illuminate at the local zone panel, and a signal will be sent to a central panel located within the building. An indicator light will illuminate at the central panel, and a signal will be sent to the Power Plant. The shift personnel at the Power Plant will then notify the responsible Shift Leader of the alarm. The Shift Leader will walk to the building where the alarm was generated and locate the alarm by following the indicator lights. Each freezer should have a list of names with work and home telephone numbers to call when temperature cannot be restored.

The alarm signal from the temperature switch to the local panel and to the central panel is transferred through a hard-wired connection. Line voltages can be as high as 70 V. The alarm signal from the central panel to the Power Plant is transferred via leased lines. There are no modems involved.

F.5.2 Disadvantages of the Current System

There are many encumbrances related to the design of the current system. The following is a short list of the disadvantages of the using a hard-wired-relay system as opposed to using microcomputer-based technology:

The switch sensors typically do not have built-in delays, which means they trip often when freezers are kept open too long and for other transient events.

The system is plagued by nuisances which are frequent enough that people waste a lot of time tracking them.



The nuisance alarms are related to the extraordinary amount of wire and wiring connections required to make this system fully operational.

The Power Plant has no way of knowing which input is affected or what the current reading is.

The system will not keep hard records of readings and alarm conditions.

F.5.3 Guidelines for Future Laboratory Equipment-Monitoring Systems

General: The environmental monitoring system shall be Landis & Gyr Report Writer Software with its own computer residing on the existing building network. The PC shall be a Pentium 90, with a 1gb hard drive, 16 megabytes of RAM, and a color monitor. A separate tape drive for backup shall be provided. A laser printer shall be provided for hard-copy reporting.

The Report Writer shall look at the building systems and store the information in its data base. From this data base the user shall obtain "plain English" information in graphic form or on hard copy. Room names shall be spelled out as shall actual data. The Report Writer shall trend and archive all data so that this information can be obtained at any time at any location on the network.

F.5.4 Additional Features and Capabilities

Monitoring Frequency: The system shall monitor continuously on either a change-of-value or time input.

Inputs: The system inputs shall be universal.

The system shall be capable of monitoring an infinite number of points.

The system shall provide the option to disable for a preset time. Reenabling shall be operator selected.

Inputs shall have electromagnetic interference, radio frequency



interference, and spike protection built in.

The system shall be capable of printing its user program.

The system shall allow multiple PCs to access the system or building within a system. The personnel gaining access to the system and performing modification's shall be limited by access permission level.



F.6 Monitoring Chilled Water Variables

Currently, the Landis & Gyr System monitors most chilled water variables as it enters the buildings. Variables such as flow rates, temperature, and pressures are monitored, and average and instantaneous data are collected and stored at the DDC panel (MBC or SCU). This data are accessed by the NIH Division of Engineering Services, Maintenance Engineering Branch, by dial-up communication.

F.6.1 Gateways

Gateways shall be provided (firmware and software) to allow the DDC panel to communicate with standard panels provided by the chiller manufacturer, rooftop unit manufacturer, or lighting manufacturer. Open protocol shall be provided by the manufacturer furnishing the equipment.



F.7 Control Devices: Standard of Quality

F.7.1 Sensors and Transmitters

Type 1: Room

- Setpoint: 13°C to 35°C
- Concealed or exposed adjustment
- Output signal: Changing resistance (10,000 ohms)
- Connection: Six-wire cable, RJ-11 plug-in terminal

Type 2: Room

- None
- Range: -7°C to 49°C
- Output: Changing resistance (1,000 ohms)

Outdoor air:

- Range: Minus -40°C to + 116°C
- Output: Changing resistance
- Element: Platinum wire
- Resistance at 0°C: 1,000 ohms

Duct: Single Point:

- Range: Minus- 18°C to +49°C
- Output: Changing resistance
- Element: Platinum wire
- Resistance at 0°C: 1,000 ohms

Duct: Averaging

- Range: 0°C to 49°C
- Output: Changing resistance
- Element: Platinum wire
- Resistance at 0°C: 1,000 ohms

Liquid Immersion:

- Range: -1°C to 116°C
- Output: Changing resistance
- Element: Platinum wire
- Resistance at 0°C: 1,000 ohms
- Insertion well: Stainless steel



Liquid Immersion: (Industrial temperature element and probe with temperature transmitter)

- Single-unit assembly: 100 ohm platinum
- Three- or four-wire ungrounded RTD-type element in a general-purpose stainless steel probe. Probe shall be spring loaded for positive connection between probe tip and thermowell.
- Probe immersion length shall be factory matched and tested for insertion into thermowell. Probe shall have 75 mm extension.
- Output: 4 to 20 mA
- Range: To match the application.

RH Transmitters

- Single unit with separate mounting arrangements for either wall duct or outside. Units shall be intrinsically safe or FM approved and explosion proof where required.
- Range: 0 to 100% RH - Accuracy 0 - 95% RH plus or minus 2%, plus or minus 1% over any 25% of span.
- Operating Temperature: Minus 40°C to +66°C
- Repeatability: Plus or minus .5% RH
- Unit shall be completely washable with splash-protective and dust-resistant housing. Output: Linear 4 to 20 mA DC into 500 ohms at 24 V DC supply. Diode polarity protection.
- Operating temperature: 0°C to 21°C
- Zero and span adjustment: Plus or minus 5% of span

Air Static and Velocity Transmitters:

- Applications: Static pressure or differential static pressure and VP. Ten ranges from 0 to 2.5 up to 0 to 2490 Pa of water. Operating temperature is 18°C to 79°C with zero and span adjustments.
- Power supply: 24 V DC with internal voltage regulator
- Loop output: 4 to 20 mA
- Loop resistance: 800 ohms
- Accuracy: plus or minus 1% of full scale

Differential Pressure Transmitters: Liquid:

- Pressure transmitters shall gauge pressure in the form of a linear 4 to 20 mA signal. All components shall be



- hermetically sealed in a Type 316 stainless steel case.
- Pressure transmitters shall meet the following performance criteria.
 - External span and zero adjustments
 - 0.25% accuracy over the entire span
 - Wetted parts: stainless steel with a silicone fluid-filled diaphragm.
 - Range 0 to 1379 kPa.
 - Input voltage - 12 to 48 V DC.
 - Suppression - 0 to 800/c of full scale.
 - Overranging: within 2,000/c over top of range.
 - Repeatability: plus or minus 0.1% at maximum span
 - Stability: plus or minus 0.25% of upper range for a period of 6 months.

Flow Transmitters: Turbine Wye (Steam and Water):

- The flow transmitter shall be a turbine meter probe designed for pipe insertion via the hot tap method. Transmitters shall measure flow by means of a turbine rotor located in the flow stream which, through a magnetic pickup, creates a signal proportion to flow. The flow transmitter shall have a sliding-type stem passing through two pressure seals to allow for proper positioning of the rotor in the flow stream. A carbon steel isolation valve shall be provided so that the meter can be completely removed from the pipeline without disruption of the medium.
- The flow transmitter shall be supplied with a two-wire preamplifier to produce a 4 to 20 mA output signal.
- Transmitter electronic components shall be contained in an epoxy-cast housing located in a cast aluminum head. The preamplifier head shall have internal, graduated dial settings which shall allow recalibration as the meter is inserted into different pipe sizes.



Performance Criteria:

- Pressure: 1724 kPa at 38°C for chilled water and 249°C for steam
- Seals: Viton O-ring
- Wetted Parts: 316 stainless steel with 17-4 stainless steel body
- Rotor Velocity: Chilled water, 53 m/s, Steam, 0.91 to 152 m/s
- Flow Rangeability: 10 to 1
- Linearity: Plus or minus 1%
- Repeatability: Plus or minus 0.25% at maximum
- Pressure Drop: Unmeasurable
- Input Voltage: 15 to 60 V DC, current limit 30 mA

F.7.2 Chilled Water Valves

Low Pressure:

Double seat- Stainless steel trim sizes 25 mm to 200 mm with ANSI 1725 kPa body. Flow characteristics linear in 50 mm and equal percentage in 65 mm to 200 mm.

Application- Where maximum differential for shutoff does not exceed 175 kPa.

High Pressure:

Class 1035 kPa and 2070 kPa standard-bore flanged ball valve for equal percentage modules service. The body shall be carbon steel. The temperature range shall be 0 to 260°C. Trim shall be stainless steel. The ball shall be 316 stainless steel with PTFE seat.

Actuators shall be spring-return pneumatic with cast iron housing and cover and cast iron piston. Nominal spring torque range shall be 68J to 9500J depending on the actuator selected for the service.

Butterfly valves, on/off and modulating service, shall be ANSI Class 2070 kPa wafer-sphere single-flanged, high performance lug-type butterfly valves in sizes 75 mm to 900 mm. Bodies shall be carbon steel in both two-way and three-way applications.

Actuators shall be spring-return pneumatic as indicated under ball valves.



F.7.3 Steam Service Valves

Type: Bodies, discs, stems, and stuffing boxes designed for ANSI 1725 kPa service

Leakage: Class IV or V

Body: Carbon steel; 65 mm and larger shall be flanged

Trim: Stainless steel

Minimum continuous operating temperature 232°C

Valves shall be modulating pneumatic tight shutoff, cage guided-linear flow

Note: All control valves shall have position indicator.

F.7.4 Dampers: Standard Duty

Type: Low-leakage, extruded aluminum

Frame: 125 mm x 25 mm 6063T5 extruded aluminum hat channel with 3.2 mm minimum wall thickness

Blades: 150 mm wide, 6063T5 heavy-gauge extruded aluminum with blade-edge seals and jamb seals. Temperature range on seals: minus 46 to plus 121°C. Maximum size 1500 mm wide x 1800 mm high (one actuator per section)

F.7.5 Dampers: Heavy Duty for Supply and Exhaust Systems

Frame: 250 mm x 55 mm, 1.9 mm steel channel

Blades: Opposed blade configuration, 16 mm steel triple V-groove, 125 mm to 200 mm in width

Linkage: side linkage out of airstream

Axles: 20 mm diameter plated steel



Bearings: Stainless steel sleeve pressed into frame

Finish: Mill galvanized

Operating temperature: 149°C

Maximum size: 1200 mm to 2400 mm.

Note: For external static pressures above 2490 Pa a heavy-duty backdraft damper should be considered. (is American Warming BD52)

F.7.6 Smoke Dampers: Ultra-Low Leakage, UL 555S Classified With Factory Mounted and Tested Actuator

Frame: 125 mm by 25 mm 6063T5 aluminum hat channel 3.2 mm in minimum wall thickness

Blades: 150 mm wide airfoil, 6063T5 extruded aluminum, opposed action

Linkage: Concealed in frame

Axles: 15 mm plated steel hex

Seals: Blade edge, silicon rubber designed for 232°C maximum temperature. Jamp seals, flexible metal compression type

F.7.7 Control Tubing

All copper tubing in mechanical equipment rooms shall be hard-drawn Type L copper.

All tubing installed above nonplenum return lift-out ceilings shall be Type FR self-extinguishing polyethylene.

All tubing installed in plenum return ceilings shall be soft copper Type L.



All control tubing installed in vertical chases shall be hard copper. Drip legs on vertical risers and shutoff valves shall be located in an accessible location where main leaves the riser.

All control tubing installed in nonaccessible walls or ceilings shall be soft copper.

All control tubing installed outside shall be jacketed hard copper for single lines and sheathed polyethylene for multiple lines. All lines outdoors shall be heat traced.

All tubing in control panels shall be Type FR polyethylene.

All control air hangers shall be clamp type and shall not be attached to other trades.

All connections shall be sweated fittings.

All air liens shall be installed in straight lines in harmony with building construction. No control lines shall be run exposed in occupied spaces.

F.7.8 Control Wiring

All control wiring in mechanical equipment rooms shall be installed in electrical metal tubing (EMT) with compression fittings.

All control wiring in the Chilled Water Plant shall be installed in EMT or RIGID conduit.

All control wiring installed outdoors or any area subject to moisture shall be installed in rigid conduit.

All control wiring installed in vertical chases shall be installed in EMT with compression fittings.

All control wiring above nonaccessible ceilings shall be installed in EMT with compression fittings.



All control wiring installed above accessible ceiling spaces which are not laboratories or AHAs shall be plenum type, not installed in conduit.

Similar control functions shall have a similar wire color.

Wire shall be unspliced from the DDC panel to the sensor.

All terminations shall be on terminal strips.

Color code all raceways and junction boxes with color directed by Design Engineering Group.

Control wiring shall not be routed in the same raceway as power wiring.

F.7.9 Air Compressors

Air compressors shall be single, high pressure, electric motor driven oil cooled, consisting of a positive displacement rotary screw compressor with a separate vertical ASME receiver. Provide a service valve between the compressor and the tank.

The compressor shall be factory packaged and shall include the compressor, electric motor, lubrication system, regulation and control system and refrigerated air dryer.

The compressor shall be complete with required pressure switches, gauges, filters, belt guards, combination starter with run time indicators, and control panel.

Tank size will be per project requirements based on a 33% run time.

An automatic drain shall be piped to the nearest building drain.

An automatic alternator/starter package on duplex units shall provide equal run time for each compressor.

