Fermilab

$\bar{p}$ Note #394

UTILITY MONITORING FOR THE ANTIPROTON SOURCE

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The purpose of the utility portion of the FIRUS system is to alert humans in the main control room, at Phillips farm, and in building 10 control room when either environmental conditions are unhealthy for antiproton source devices, or electrical or mechanical equipment is malfunctioning. When first envisioned, the FIRUS system consisted of the following equipment:

(1) 2 FIRUS mini-computers (wall mounted, 1 fire, 1 utility)
(2) emergency power supply (also wall mounted)
(3) coax hardline communication cable
(4) junction boxes
(5) contact points and analog transducers
(6) three-pair 18 gage shielded cable
(7) silent printer

Each mini can monitor 16 contact points or 15 analog points or a combination of contact and analog points. Each contact point can be more than one physical point if the points are wired in series. An alarm then indicates any one of a group of points has opened.

The following devices/quantities are proposed to be monitored by the utility portion of the FIRUS system:

(1) sump pumps
(2) LCW (Low Conductivity Water)
(3) auxiliary generator
(4) service building temperatures
(5) stub room/tunnel temperature
(6) stub room/tunnel humidity

After the number of quantities to be monitored (see table I) was determined, it was found that two or three minis would be required, or a FIRUS crate could be used. A FIRUS crate is an "old beam transfer crate" with 25 slots which hold cards to either monitor 16 contact points or 15 analog points. The space requirement for the crate system is about half a relay rack. The emergency power supply could remain wall mounted, or it could be rack mounted with the firus crate. Conversations with Al Franck and Rich Mahler concerning availability, expandability, cabling, and cost indicate that the FIRUS crate is the preperable option for the antiproton source.

Two contact sets per sump pump would be used. The first opens when a controlling float reaches a high water position, and the second opens upon loss of 120 VAC power to the pump.

The LCW cooling system for the rings enclosure will be derived from new equipment in the Central utility building (CUB). One transducer for water pressure and one transducer for water temperature will located just downstream of the 1000gpm, 150psi pump in CUB. The LCW cooling system for the antiproton target hall and pretarget enclosure will be extended from the main ring LCW system at service building F-23. Since the main ring LCW system is already monitored by FIRUS, no additional monitoring is necessary, as is true of the hot water (HTW) and chilled water (CHW) systems used for heating and airconditioning.

The auxiliary power generator (to be located outside service building 50) has a panel (to be located inside service building 50) with 8 monitors of contacts. A FIRUS contact will be wired such that if any one of these 8 monitors trips, the FIRUS contact will open, indicating trouble with the auxiliary power system.

Service building temperatures are proposed to be monitored with either one to three distributed contacts that open upon a high temperature limit and one contact that opens upon a low temperature limit or two distributed analog temperature sensors with FIRUS software set limits. The service buildings are heated and airconditioned, so temperature monitoring provides a check on the correct operation of the air handling units. The high temperature limit will insure a healthy environment for the electronic equipment, and the low temperature limit will protect water pipes from freezing in winter.

An analog temperature sensor with FIRUS software set limits is proposed for the stub rooms. Human access to the antiproton rings enclosure will be prohibited if a beam is present. Remote monitoring of environmental temperature allows an operator to comfortably assess any long term danger to electronic equipment and decide if and when an access should be preformed to investigate a high temperature indication. Also, during bakeout of the accumulator, access to the rings enclosure will be possible, but not comfortable. The high temperature limit for electronics is higher when the electronics are not operating, and the flexibility of a analog temperature sensor would be very useful.

The rings enclosure is heated and indirectly airconditioned by service building forced air ventilation. The possibility of electrical equipment damage due to condensation exists in the summer when warm, humid air could be cooled in the nearly constant temperature, below ground rings enclosure. An analog humidity sensor, with a FIRUS software set limit is proposed in sselected stubrooms to provide a check on the ventilation system.

Because of the limited access to the rings enclosure, the selection of temperature and humidity transducers to be located there should emphasize high reliability and no periodic maintenance or calibration.

Following is a list of monitor points (table I) and a list of sensor hardware (table II).

FIRUS

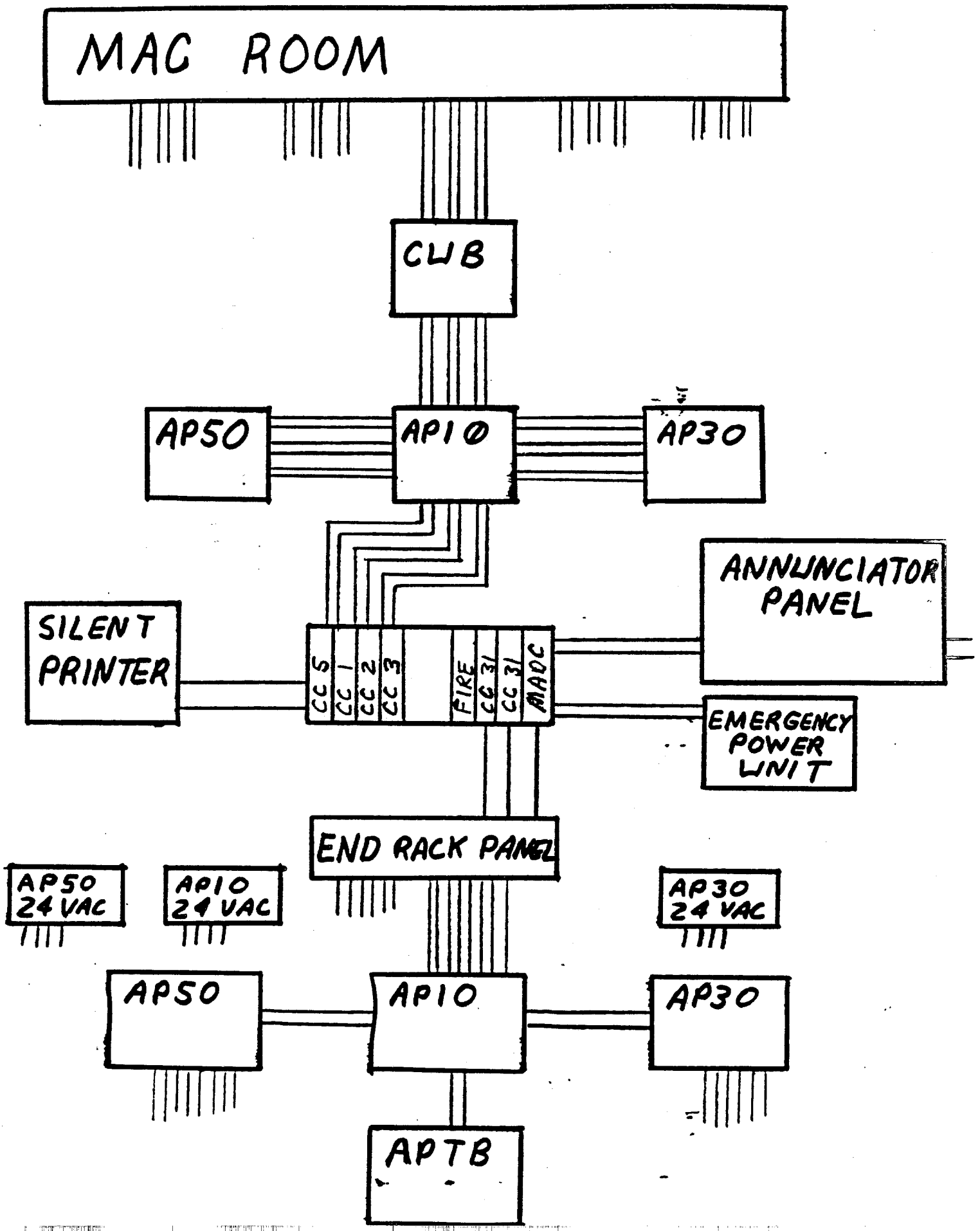
MAC ROOM
CUB
AP50
AP10
AP30
ANNUNCIATOR PANEL
SILENT PRINTER
CC 5
CC 1
CC 2
CC 3
FIRE
CC 31
CC 31
MADC
EMERGENCY POWER UNIT
END RACK PANEL
AP50 24 VAC
AP10 24 VAC
AP30 24 VAC
AP50
AP10
AP30
APTB

TABLE I

ANTIPROTON UTILITY MONITORING POINTS

TYPE, C = RELAY CONTACT, A = ANALOG

POINT	NAME	LOCATION	DESCRIPTION	TYPE
1-1	SP-1	AP10 TUNNEL	SUMP PUMP PIT HIGH WATER	C
1-2	SP-1	AP10 TUNNEL	SUMP PUMP PIT LOSS 120 VAC	C
1-1	SP-2	AP10 TUNNEL	" "	C
1-2	SP-2	AP10 TUNNEL	" "	C
1-3	SP-3	AP30 TUNNEL	" "	C
1-4	SP-3	"		C
1-3	SP-4	"	" "	C
1-4	SP-4	"		C
1-5	SP-5	AP50 TUNNEL	" "	C
1-5	SP-5	"		C
1-6	SP-6	"	" "	C
1-6	SP-6	"		C
2018-12	SP-7	BSE ENCLOSURE	" "	C
2018-13	SP-7	"		C
2018-12	SP-8	"	" "	C
2018-13	SP-8	"		C
2018-12	SP-9	"	" "	C
2018-13	SP-9	"		C
1-7	SP-10	TRANSPORT ENCLOSURE	" "	C
1-8	SP-10	" "		C
1-9	SP-11	TARGET STATION	" "	C
1-10	SP-11	"		C
1-9	SP-12	"	" "	C
1-10	SP-12	"		C
1-11	SP-13	PRETARGET ENCLOSURE	" "	C
1-12	SP-13	" "		C
1521-7	LCW-T	CWB	95° LCW TEMPERATURE	A
1521-8	LCW-P	CWB	95° LCW PRESSURE	A
1-13	AUX-PW	AP50	AUXILIARY GENERATOR STATUS	C

TABLE I

POINT	NAME	LOCATION	DESCRIPTION	TYPE
2-1	AP10-T1	AP10 - A11	AIR TEMPERATURE LIMITS	C
2-2	AP10-T2	AP10 - A14	" " "	C
2-3	AP10-T3	AP10 - A17	" " "	C
2-4	AP30-T1	AP30 - A31	" " "	C
2-5	AP30-T2	AP30 - A34	" " "	C
2-6	AP30-T3	AP30 - A37	" " "	C
2-7	AP50-T1	AP50 - A51	" " "	C
2-8	AP50-T2	AP50 - A54	" " "	C
2-9	AP50-T3	AP50 - A57	" " "	C
2-10	APTB-T1	APTB - B1	" " "	C
2-11	APTB-T2	APTB - B6	" " "	C
2-12	F23-T	F23	" " "	C
2-13	F27-T	F27	" " "	C
3-1	T-T6	A60 TUNNEL	AIR TEMPERATURE LIMITS	A
3-2	T-T1A	A10 STUB	AIR TEMPERATURE LIMITS	A
3-3	T-H1	A10 STUB	AIR HUMIDITY	A
3-4	T-T1B	D10 STUB	AIR TEMPERATURE LIMITS	A
3-5	T-T2	A20 TUNNEL	AIR TEMPERATURE LIMITS	A
3-6	T-T3	A30 STUB	AIR TEMPERATURE LIMITS	A
3-7	T-H3	A30 STUB	AIR HUMIDITY	A
3-8	T-T4	A40 STUB	AIR TEMPERATURE LIMITS	A
3-9	T-T5	A50 STUB	AIR TEMPERATURE LIMITS	A
3-10	T-H5	A50 STUB	AIR HUMIDITY	A

TABLE II FIRWS SENSOR HARDWARE

ITEM	SUPPLIER	MODEL	REQUIRES PW SUP	UNIT COST	QUANTITY	COST
RELAY CONTACTS (SUMP PUMPS & AUX GEN)	POTTER BRUMFIELD	KAP11AG	NO	$15	27	405
TEMP LIMIT SWITCH (DUAL LIMITS)	UNITED ELECTRIC CONTROLS	C54A	NO	$63	13	819
LCW PRESSURE	CONSOLIDATED	415630	28±4 VDC	$500	1	500
LCW TEMPERATURE	ROCHESTER	SC-1374	28±4 VDC	$500	1	500
ANALOG TEMPERATURE	MAMAC SYSTEMS	TE-210	24 VAC	$85	7	595
ANALOG HUMIDITY	MAMAC SYSTEMS	HW-222	24 VAC	$505	3	1515
JUNCTION BOXES	?	?	NO	$50	4	200
24 VAC TRANSFORMER	STOCK ITEM	1165-0250	—	$5.76	3	18
3-CONDUCTOR CABLE	STOCK ITEM	1170-0680	—	$.19/ft	1260'	240
18 GAGE 3-PAIR CABLE	STOCK ITEM	1170-0100	—	$.32/ft	7350'	2352
19-PAIR TRUNK CABLE	?	?	—	$1.25 ft	3071'	3839

TOTAL $10,983

APPENDIX A

CABLE LENGTH CALCULATION

THREE TYPES OF CABLE ARE USED IN THE UTILITY MONITORING SYSTEM, MULTI-CONDUCTOR TRUNK CABLE FOR LONG CABLE RUNS BETWEEN BUILDINGS, 3-PAIR CABLE FOR SHORT CABLE RUNS, AND 3-CONDUCTOR CABLE FOR 24 VAC. 3-CONDUCTOR AND 3-PAIR CABLE ARE FERMILAB STOCK ITEMS, WHILE THE MULTICONDUCTOR CABLE MUST BE ORDERED. DESCRIPTIONS FOLLOW:

MULTICONDUCTOR

19 TWISTED PAIR, INDIVIDUALLY SHIELDED, 18 GAGE, STRANDED, WITH VINYL JACKET OR EQUAL. ≈ $1.25/FOOT

3-PAIR

FT .32
1170-0100 CABLE, AUDIO AND DATA, 3 PAIR INDIVIDUALLY SHIELDED, CHROME VINYL W/ ORANGE STRIPED JACKET, CONSOLIDATED WIRE NO.5353 OR EQUAL, 18 GAGE, 16X30 STRAND.
03

3-CONDUCTOR

FT .19
1170-0680 CABLE, G.P. MULTICONDUCTOR-CONTROL, TINNED COPPER BRAIDED SHIELDING PVC PRIMARY INSULATION AND JACKET, AWG 16, 3 CONDUCTOR.
03

FROM	#PAIR AVAIL	#PAIR USED	#CABLE	DIST	TO	TOTAL RUN
AP10 JUNCTION BOX	19	10	1	700'	AP30 JUNCTION BOX	700'
AP10 JUNCTION BOX	19	8	1	700'	AP50 JUNCTION BOX	700'
AP10 JUNCTION BOX	19	8	1	1525'	APTB JUNCTION BOX	1525'
SP-1	3	2	1	250'	SP-2	250'
SP-2	3	2	1	165'	FIRWS CRATE	165'
SP-4	3	2	1	250'	SP-3	250'
SP-3	3	2	1	165'	AP30 J-BOX	165'
SP-5	3	2	1	250'	SP-6	250'
SP-6	3	2	1	165'	A50 J-BOX	165'
SP-7	3	2	1	15'	SP-8	15'
SP-8	3	2	1	15'	SP-9	15'
SP-9	3	2	1	500'	MIM 2018-12	500'
SP-10	3	2	1	455'	AP30 J-BOX	455'
SP-12	3	2	1	15'	SP-11	15'
SP-11	3	2	1	220'	APTB J-BOX	220'
SP-13	3	2	1	540'	APTB J-BOX	540'
LCW TEMP	3	2	1	400'	MIMI 1521-7	400'
LCW PRES	3	2	1	400'	MIMI 1521-8	400'
AUX-PW	3	1	1	120'	AP50 J-BOX	120'

FROM	#PAIR AVIAL	#PAIR USED	#CABLE	DIST	TO	TOTAL RUN
AP10-T1	3	1	1	135'	FIRWS CRATE	135'
AP10-T2	3	1	1	15'	FIRWS CRATE	15'
AP10-T3	3	1	1	135'	FIRWS CRATE	135'
AP30-T1	3	1	1	120'	AP30 J-BOX	120'
AP30-T2	3	1	1	5'	AP30 J-BOX	5'
AP30-T3	3	1	1	120'	AP30 J-BOX	120'
AP50-T1	3	1	1	120'	AP50 J-BOX	120'
AP50-T2	3	1	1	5'	AP50 J-BOX	5'
AP50-T3	3	1	1	120'	AP50 J-BOX	120'
APTB-T1	3	1	1	120'	APTB J-BOX	120'
APTB-T2	3	1	1	5'	APTB J-BOX	5'
F23-T	3	1	1	290'	APTB J-BOX	290'
F27-T	3	1	1	360'	APTB J-BOX	360'

FROM	#PAIR AVAIL	#PAIR USED	#CABLE	DIST	TO	TOTAL RUN
A60 TUNNEL	3	1	1	335'	FIRWS CRATE	355'
A10 STUB	3	2	1	95'	FIRWS CRATE	95'
D10 STUB	3	1	1	185'	FIRWS CRATE	185'
A20 TUNNEL	3	1	1	355'	FIRWS CRATE	355'
A30 STUB	3	2	1	140'	AP30 J-BOX	140'
A40 STUB	3	1	1	315'	AP30 J-BOX	315'
A50 STUB	3	2	1	100'	AP50 J-BOX	100'
A60 TUNNEL	3 COND.		1	290'	AP10 STUB	290'
A10 STUB	3 COND.		1	95'	AP10 24 VAC	95'
D10 STUB	3 COND.		1	90'	A10 STUB	90'
A20 TUNNEL	3 COND.		1	170'	A10 STUB	170'
A30 STUB	3 COND.		1	140'	AP30 24 VAC	140'
A40 STUB	3 COND.		1	315'	AP30 24 VAC	315'
A50 STUB	3 COND.		1	100'	AP50 24 VAC	100'

19-PAIR CABLE = 2925' + 5% = 3071'

3-PAIR CABLE = 7000' + 5% = 7350'

3-COND. CABLE = 1200' + 5% = 1260'