

COPY

PHILADELPHIA ELECTRIC COMPANY
NUCLEAR GROUP HEADQUARTERS
955-65 CHESTERBROOK BLVD.
WAYNE, PA 19087-5691
(215) 640-6000

10 CFR 30.34

NUCLEAR ENGINEERING & SERVICES DEPARTMENT

June 13, 1991

Docket No. 030-30512

License No. 37-06752-08

U.S. Nuclear Regulatory Commission
Region I
Nuclear Material Section B
475 Allendale Road
King of Prussia, PA 19406

Subject: Philadelphia Electric Company
Application for Amendment to Byproduct
Material License No. 37-06752-08

Gentlemen:

Enclosed is an original and one copy of an application for amendment to Philadelphia Electric Company's (PECo's) Byproduct Material License No. 37-06752-08. This amendment application is being submitted in accordance with 10 CFR 30.34, and in accordance with 10 CFR 30.6.

PECo requests that the byproduct material license issued for the possession, storage, and use of a sealed Cesium-137 source, for a thermoluminescent dosimetry (TLD) irradiator, be amended to allow specified PECo personnel to remove and reinstall the sealed source in the irradiator. As currently stipulated in the byproduct material license under License Condition No. 14: "The licensee shall not perform repairs or alterations of the irradiator involving removal of shielding or access to the licensed material. Removal, replacement, and disposal of sealed sources in the irradiator shall be performed by a person specifically licensed by the Commission or an Agreement State to perform such services."

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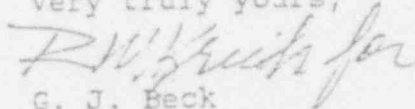
In order to facilitate access to critical components of the irradiator during preventive and/or corrective maintenance, the lead castle containing the Cesium-137 source must be removed. The contractor designated to perform the scheduled maintenance on the irradiator is not specifically licensed by the NRC to remove or reinstall the licensed source. Therefore, we are requesting that the byproduct material license be amended to permit the following PECO personnel to remove and reinstall the sealed source as necessary to accommodate maintenance activities.

The attached information provides the names and qualifications of those PECO individuals that we request be permitted to remove and reinstall the licensed material. Information concerning radiation protection efforts during removal, storage, and installation of the source are included in the attachment. In addition, some supportive information is provided on an NRC Form 313, "Application for Material License," and is part of the attachment.

In addition, pursuant to the requirements of 10 CFR 170, we have enclosed the filing fee in amount of \$200.00 for processing this license amendment application.

If you have any questions, or require additional information, please do not hesitate to contact us.

Very truly yours,



G. J. Beck
Manager
Licensing Section
Nuclear Engineering and Services

Enclosure
Attachment

cc: U.S. Nuclear Regulatory Commission, Document Control Desk
(w/ attachment)

bcc: R. N. Charles - 51A-1	(w/ attachment)
R. J. Scholz - 51A-3	"
J. R. McFadden - VFC	"
D. M. O'Connell - VFC	"
M. M. Wager - VFC	"
S. T. Hammann - S8-2	"
R. M. Krich - 52A-5	"
Correspondence Control Desk	"
DAC	"

ATTACHMENT

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Individuals for Which Authorization is Requested to Remove and to Reinstall Licensed Material

Name of Individuals

- o John R. McFadden
- o Deborah M. O'Connell (name changed, previously Deborah M. Rombold)

Individual's Training and Education

- o John R. McFadden

Education

- 1967-1968, M.S. Radiation Health, Temple University, Philadelphia, PA.
- 1968-1971, PhD Bionucleonics, Purdue University, West Lafayette, IN.

Training

- Principles and fundamentals of radiation protection and good safety practices related to the use of radioactive materials.
- Radioactivity measurements, use of radiation detection and measuring instruments, and monitoring techniques.
- Mathematics and calculations basic to the use and measurement of radioactivity.
- Biological effects of radiation.

- o Deborah M. O'Connell

Education

- 1977-1981, B.S. Radiological Technology, Thomas Jefferson University, Philadelphia, PA.

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Training

- Principles and fundamentals of radiation protection and good safety practices related to the use of radioactive materials
- Radioactivity measurements, use of radiation detection and measuring instruments, and monitoring techniques.
- Mathematics and calculations basic to the use and measurement of radioactivity.
- Biological effects of radiation.

Individuals Close Familiarity With/Actual Experience in Irradiator Use

o John R. McFadden

<u>Type of Irradiator</u>	<u>Dates</u>	<u>Location</u>
Dry Storage/Gamma Irradiator for survey meter calibration.	1967-1986	Temple University Philadelphia, PA
	1968-1971	Purdue University West Lafayette, IN
Dry Storage/Gamma Irradiator for studies of radiation effects on biological/chemical materials.	1968-1971	Purdue University West Lafayette, IN
Medical diagnostic X-ray machines.	1972	Philadelphia Health Department

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<u>Type of Irradiator</u>	<u>Dates</u>	<u>Location</u>
Medical diagnostic X-ray machines and medical therapeutic X-ray (0.25 and 4.0 MeV) and Co-60 machines. Manipulation using tongs, etc. of unshielded therapy sources (mCi quantities of Ra-226, Cs-137, P-32, and I-131).	1972-1974	Nuclear Radiation Consultants New Haven, CT
Dry Storage/Gamma Irradiators for survey meter calibration and studies of radiation on electronic systems. Manipulation using tongs, etc., of unshielded sources (mCi to 10 Ci quantities of Co-57, Co-60, Cs-137, Se-75, and Ta-182).	1974-1984	General Electric Co. Philadelphia, PA
WE 2001 Series TLD Irradiator with 2 Ci Cs-137 source for irradiation and/or calibration of thermoluminescent dosimeters (TLDs). Observation of and assistance to authorized service representative in 1) assembly and disassembly of lead castle, 2) installation and removal of source cylinder into lead castle, and 3) installation and removal of source capsule into source cylinder.	1988-1991	Philadelphia Electric Co. Philadelphia and Wayne, PA

ATTACHMENT

o Deborah M. O'Connell

<u>Type of Irradiator</u>	<u>Dates</u>	<u>Location</u>
Medical diagnostic X-ray machines.	1979	Thomas Jefferson University Philadelphia, PA
Dry Storage/Cs-137 Irradiators for survey meters, self-reading dosimeters, and thermoluminescent dosimetry badge calibrations.	1980-1988	Peach Bottom Atomic Power Station and Limerick Generating Station, Delta and Sanatoga, PA, respectively
WE 2001 Series TLD Irradiator with 2 Ci Cs 137 source for irradiation and/or calibration of thermoluminescent dosimeters. Observation of and assistance to authorized service representative in 1) assembly and disassembly of lead castle, 2) installation and removal of source cylinder into lead castle, and 3) installation and removal of source capsule into source cylinder	1988-1991	Philadelphia Electric Co. Philadelphia and Wayne, PA

Description of Source Removal and Reinstallation Process

The 2 curie Cesium-137 source is installed in a source cylinder which is secured in a lead shield (castle). The shield is a right circular cylinder that is 16 centimeters in diameter and 20 centimeters high. The source cylinder/shield assembly is secured in the irradiation chamber of the cabinet. The removal and reinstallation of the source cylinder/shield

ATTACHMENT

assembly will be performed in accordance with the directions specified in the manufacturer's operating manual. A copy of this manual was submitted with our original byproduct materials license application for the TLD irradiator on March 24, 1988.

Prior to removing the source, a dry run will be performed in the vicinity of the irradiator in which a dummy source capsule will be handled with a remote-handling tool (approximately 1 meter long) and placed in a Department of Transportation (DOT) approved shipping container. This shipping container has been previously used for shipping the Cesium-137 source. Following satisfactory completion of the dry run, the actual radiation source will be removed in the same method as that conducted during the dry run. In addition, a dry run will be performed prior to reinstalling the radiation source.

The individual performing the removal and reinstallation will wear wholebody radiation dosimetry badge, a wholebody self-reading dosimeter, and extremity TLD dosimeters. Radiation surveys will be performed and appropriate posting established in accordance with the requirements of 10 CFR 20. Previous removal/reinstallation operations performed by NRC licensed individuals have resulted in exposures equal to or less than 50 mrem wholebody and/or extremity to the individual.

After the source has been removed and placed in the DOT shipping container temporarily, the source will be constantly attended or kept in a locked room. The source will be reinstalled to its fully shielded configuration in the irradiator on the same day that source is removed after the necessary maintenance work is completed.

NRC FORM 313
 (1-84)
 10 CFR 30.32, 33, 34,
 35 and 40

U.S. NUCLEAR REGULATORY COMMISSION
 APPROVED BY OMR
 3150120
 Rev. 5-2-87

APPLICATION FOR MATERIAL LICENSE

INSTRUCTIONS: SEE THE APPROPRIATE LICENSE APPLICATION GUIDE FOR DETAILED INSTRUCTIONS FOR COMPLETING APPLICATION. SEND TWO COPIES OF THE ENTIRE COMPLETED APPLICATION TO THE NRC OFFICE SPECIFIED BELOW.

FEDERAL AGENCIES FILE APPLICATIONS WITH:

U.S. NUCLEAR REGULATORY COMMISSION
 DIVISION OF FUEL CYCLE AND MATERIAL SAFETY, AMSS
 WASHINGTON, DC 20545

ALL OTHER PERSONS FILE APPLICATIONS AS FOLLOWS, IF YOU ARE LOCATED IN:

CONNECTICUT, DELAWARE, DISTRICT OF COLUMBIA, MAINE, MARYLAND, MASSACHUSETTS, NEW JERSEY, NEW YORK, PENNSYLVANIA, RHODE ISLAND, OR VERMONT, SEND APPLICATIONS TO:

U.S. NUCLEAR REGULATORY COMMISSION, REGION I
 NUCLEAR MATERIAL SECTION 8
 631 PARK AVENUE
 KING OF PRUSSIA, PA 19406

ALABAMA, FLORIDA, GEORGIA, KENTUCKY, MISSISSIPPI, NORTH CAROLINA, PUERTO RICO, SOUTH CAROLINA, TENNESSEE, VIRGINIA, VIRGIN ISLANDS, OR WEST VIRGINIA, SEND APPLICATIONS TO:

U.S. NUCLEAR REGULATORY COMMISSION, REGION II
 MATERIAL RADIATION PROTECTION SECTION
 101 MARIETTA STREET, SUITE 2900
 ATLANTA, GA 30303

IF YOU ARE LOCATED IN:

ILLINOIS, INDIANA, IOWA, MICHIGAN, MINNESOTA, MISSOURI, OHIO, OR WISCONSIN, SEND APPLICATIONS TO:

U.S. NUCLEAR REGULATORY COMMISSION REGION III
 MATERIALS LICENSING SECTION
 700 ROOSEVELT ROAD
 GLEN ELLY, IL 60137

ARKANSAS, COLORADO, IDAHO, KANSAS, LOUISIANA, MONTANA, NEBRASKA, NEW MEXICO, NORTH DAKOTA, OKLAHOMA, SOUTH DAKOTA, TEXAS, UTAH, OR WYOMING, SEND APPLICATIONS TO:

U.S. NUCLEAR REGULATORY COMMISSION REGION IV
 MATERIAL RADIATION PROTECTION SECTION
 811 WYMAN PLAZA DRIVE, SUITE 1000
 ARLINGTON, TX 76011

ALASKA, ARIZONA, CALIFORNIA, HAWAII, NEVADA, OREGON, WASHINGTON, AND U.S. TERRITORIES AND POSSESSIONS IN THE PACIFIC, SEND APPLICATIONS TO:

U.S. NUCLEAR REGULATORY COMMISSION REGION V
 MATERIAL RADIATION PROTECTION SECTION
 1425 MARLA LANE, SUITE 210
 WALNUT CREEK, CA 94598

PERSONS LOCATED IN AGREEMENT STATES SEND APPLICATIONS TO THE U.S. NUCLEAR REGULATORY COMMISSION ONLY IF THEY WISH TO POSSESS AND USE LICENSED MATERIAL IN STATES SUBJECT TO U.S. NUCLEAR REGULATORY COMMISSION JURISDICTION.

1. THIS IS AN APPLICATION FOR (CHECK ONE):

- A. NEW LICENSE
- B. AMENDMENT TO LICENSE NUMBER 37-06752-08
- C. RENEWAL OF LICENSE NUMBER _____

2. NAME AND MAILING ADDRESS OF APPLICANT (Include Zip Code):

Philadelphia Electric Company
 1111 Old Eagle School Road
 Wayne, PA 19087
 Attn: TLD Processing/J. R. McFadden

3. ADDRESS(ES) WHERE LICENSED MATERIAL WILL BE USED OR POSSESSED:

SAME AS ITEM 2 ABOVE.

4. NAME OF PERSON TO BE CONTACTED ABOUT THIS APPLICATION:

J. R. McFadden

TELEPHONE NUMBER

(215) 971-7204

5. ITEM 1 THROUGH 4, ON EX-11, TABLE THE TYPE AND SCOPE OF INFORMATION TO BE PROVIDED IS DESCRIBED IN THE LICENSE APPLICATION GUIDE.

6. RADIOACTIVE MATERIAL

A. ELEMENT AND MASS NUMBER B. CHEMICAL SYMBOL C. PHYSICAL FORM AND STATE D. ACTIVITY (Ci) E. DATE OF RECEIPT

7. PURPOSE(S) FOR WHICH LICENSED MATERIAL WILL BE USED:

8. INDIVIDUAL(S) RESPONSIBLE FOR RADIATION SAFETY PROGRAM AND THEIR TRAINING AND EXPERIENCE:

9. TRAINING FOR INDIVIDUALS WORKING IN OR REQUESTING RESTRICTED AREAS:

10. FACILITIES AND EQUIPMENT:

11. RADIATION SAFETY PROGRAM:

12. WASTE MANAGEMENT:

13. LICENSEE FEE (See 10 CFR 170 and Section 170.31):

FEE CATEGORY: 3E AMOUNT ENCLOSED: \$ 200.00

14. CERTIFICATION: (Must be completed by applicant) THE APPLICANT UNDERSTANDS THAT ALL STATEMENTS AND REPRESENTATIONS MADE IN THIS APPLICATION ARE BINDING UPON THE APPLICANT.

THE APPLICANT AND ANY OFFICIAL EXECUTING THIS CERTIFICATION ON BEHALF OF THE APPLICANT, NAMED IN ITEM 7, CERTIFY THAT THIS APPLICATION IS PREPARED IN CONFORMITY WITH TITLE 10, CODE OF FEDERAL REGULATIONS PARTS 30.32, 33, 34, 35, AND 40 AND THAT ALL INFORMATION CONTAINED HEREIN IS TRUE AND CORRECT TO THE BEST OF THEIR KNOWLEDGE AND BELIEF.

WARNING: 18 U.S.C. SECTION 1001, ACT OF JUNE 25, 1948 (52 STAT. 378) MAKES IT A CRIMINAL OFFENSE TO MAKE A WILLFULLY FALSE STATEMENT OR REPRESENTATION TO ANY DEPARTMENT OR AGENCY OF THE UNITED STATES AS TO ANY MATTER WITHIN ITS JURISDICTION.

SIGNATURE—CERTIFYING OFFICER

TYPED/PRINTED NAME

TITLE

DATE

15. ANNUAL \$100,000

16. NUCLEAR ECONOMIC DATA

17. 0-250K	18. \$1M - 1.5M
19. 250K - 500K	20. \$1.5M - 2M
21. 500K - 750K	22. 2M - 2.5M
23. 750K - 1M	24. > \$2.5M

25. NUMBER OF EMPLOYEES (Item 16)

26. NUMBER OF BEDS

27. WOULD YOU BE WILLING TO FURNISH COST INFORMATION (Personnel and materials) ON THE ECONOMIC IMPACT OF CURRENT NRC REGULATIONS OR ANY FUTURE PROPOSED NRC REGULATIONS THAT MAY AFFECT YOUR NRC REGULATORY PERMIT? IF YES, PLEASE COMPLETE SECTION 17 OF FORM NRC-313 (SEE INSTRUCTIONS) FOR NRC USE ONLY.

YES

NO

FOR NRC USE ONLY

TYPE OF FEE	FEE LOG	FEE CATEGORY	COMMENTS	APPROVED BY
AMOUNT RECEIVED	CHECK NUMBER			DATE

PRIVATE ACT STATEMENT ON THE REVERSE

* The information necessary for Item 5 through Item 10 was previously provided as part of the original license application, submitted on March 24, 1988, and is unchanged.

Panasonic

*Attachment B
(cover page)*

TLD IRRADIATOR
WE 2001 SERIES

OPERATING AND SERVICE
MANUAL

PANASONIC INDUSTRIAL COMPANY
2 PANASONIC WAY
SECAUCUS, N.J.
07094

THEORY OF OPERATION

B

(pg. 1 of 2)

The WC 2001 TLD Irradiator is designed to accommodate 10 magazines of 50 dosimeters each (ie 500 dosimeters).

The magazines do not have to be fully loaded with dosimeters and also do not necessarily be loaded in consecutive rack positions.

On pressing the start button on the electronic console the rack motor will drive the rack to the position of the first magazine found in the rack. The feed motor will then feed the magazine through to the lead castle containing the Cs 137 irradiation source.

The dosimeter arm will lift the first dosimeter out of the magazine and place it in front of the source for irradiation. The time of irradiation is preset by the timer in the electronics console.

After the preset period the dosimeter is replaced in the magazine and the next dosimeter is found. This process is continued until all dosimeters in one magazine have been irradiated. The magazine is then returned to the rack and the next magazine continues the process until all racks loaded have been completed.

At the end of the cycle an intermittent alarm is given to advise the operator.

Indicators

The electronics console has two LCD displays marked rack and dosimeter.

a) Rack

This indicates which rack number containing a magazine is being irradiated.

b) Dosimeter

This indicates which dosimeter in the magazine being irradiated

Interlock

a) There is an electronic interlock in the instrument which prevents operation of the instrument under any alarm condition.

Timer

The timer which is located on the right hand side of the top rack can be set for preset irradiation times by means of the thumbwheel switches from 0.1 s to 9990 hrs.

B
(pg. 2. of 21)

OPERATION

LOADING *****

- a) Open door on rack in order to load magazines
- b) Load magazines which are numbered 1-50 with 1 closest to lead castle (ie. the gear teeth on magazine towards the back of the instrument).
- c) After loading make sure that the rack door is closed again to ensure correct operation of the instrument.

ALARMS *****

There are five continuous alarms indicating faults and one intermittent alarm indicating completion. All alarms can be silenced by pressing the "stop" button on the electronic console.

Note: If the "stop" button is not pressed the machine will not start.

Type of alarms:

a) "Source position"

This alarm will occur if the "start" button is pressed to commence irradiation and the source is not in the correct position for irradiation and the LED will light.

Turn handle until it presses against the limit switch on the lead castle and the LED on the electronic console will turn off. The alarm can be silenced by pressing the "stop" button.

b) "Rack Fault"

This alarm indicates that the door on the rack has not been closed properly. Press the "stop" button to silence the alarm and close the door to turn off the L.E.D.

c) "Double magazine"

This alarm indicates that a magazine has been doubly loaded into the instrument. One will be under the lead castle and the place in the rack for it to return to will have also been loaded with a magazine. Press the "stop" button to silence the alarm and remove the magazine to turn the L.E.D. off

d) "Power Failure"

This L.E.D. will light and the alarm will sound, if a power failure occurred during the irradiation of dosimeters. One should look to see which magazines have been completed and these should be removed from the unit. On pressing the stop button the machine will return the magazine of dosimeters being irradiated to the rack and the rack will move to the fully up position. On pressing the "start" button irradiation of the rest of the magazines will commence.

- e) On completion of a full cycle a 1 second intermittent alarm will sound to make the operator aware of this.

B

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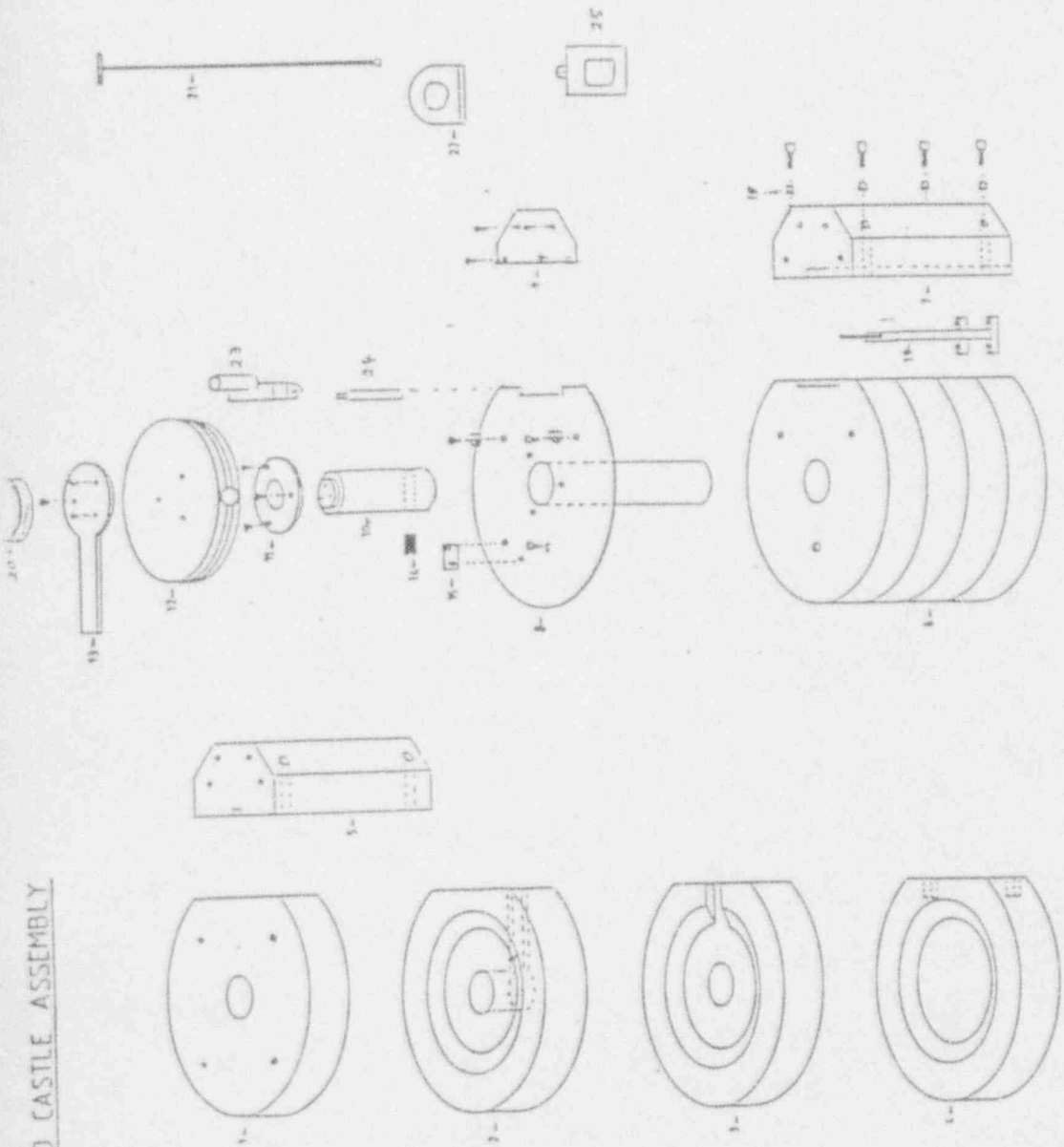
- f) If, as dosimeter gets stuck on leaving or being returned to the dosimeter magazine a time out will occur. The same will occur if a rack cannot be fed by the DC motor in under the lead castle or be returned to the rack. This alarm is a 0,1 sec. intermittent alarm, which turns off all motors and can be reset by pressing the "stop" button. This also resets the machine to start position. All magazines that have been irradiated must be removed to avoid double irradiation.
- g) A continuous alarm will occur if the irradiator's right hand side door is opened while the unit is running. This switches all motors off to avoid one getting his or her hand caught in a moving part of the instrument. In closing the door the irradiator continues from where it was interrupted in the cycle.

B (pg. 4. of 21)

ASSEMBLY OF LEAD CASTLE AND LOADING OF SOURCE

1. Remove the aluminium plate separating the lead castle from the rack. Note: Leave square tubing cross bar and angle brackets so as not to have to set light barrier after loading of lead.
2. Locate no. 5 on the lead castle assembly drawing. (groves machined at base of lead). To load, move block carefully forward towards the dosimeter push-up assembly (aluminium bridge no 19 containing brass moveable push-up rod) until it just seats. Note: For easy loading use handles supplied in spares box. Push bolts through to hole in lead block.
3. Locate lead block no. 4 (block has groves machined at lower end). Move this block gently into position with flat end towards dosimeter push-up assembly 19. Screw the two lower 8mm bolts with steel spacer 18 into lower lead ring at this stage. Load block 3, 2 and 1 sequentially in the same manner. Screw 1 to lead block with 8mm bolts supplied.
4. Locate sleeve 8. Leave whole assembly mounted as is. Remove nylon stop and turn hand so that source holding screw is visible. Remove 1 m loading rod 21 from frame of instrument located on the inside of left hand door. Remove hook 22 mounted on cross bar of frame in main machine and screw to handle 13 by removing one of the handle retaining screws.
5. Place sleeve 8 into hole in lead castle 6 and place a spacer (eg. wooden block) under it so that the hole for loading source is visible. Load the source using your own manipulator with side that is not curved facing aperture in cylinder. Screw holding screw 14 using tool 21 into cylinder (make sure not to apply too much pressure to source).
6. take tool 21 and place it through hook on top of cylinder. Hold firmly and lift cylinder slightly, in order to be able to remove wooden block. Lower cylinder gently and completely into sleeve.
7. Remove hook. Replace screw in handle.
8. Screw sleeve 8 to lead making sure to use washers in the front two holes.
9. Mount micro switch bracket to plate 8. Adjust the micro switch so that when handle is turned against the nylon stop the switch is activated.
10. Place filter 25 containing 3mm plexiglass into slot in lead castle.
11. Screw protecting cap 23 to steel plate 9 using 5mm screws supplied.
12. Place lead cap 20 on top of handle.

B
(Fig. 40, et seq.)



LEAD CASTLE ASSEMBLY

B
(pg 5. of 2)

SERVICE

The system is controlled by a micro processor controller which drives two stepper drives, motors and two DC motors.
The position of all light barriers, limit switches and motors are indicated in Fig. 1

CHECKS

In order to check the operation of all light barriers and limit switches, simply remove the two motor drives and the five relays in the machine. (Note: these are not in the electronic console.) Note: The SD 2 drives are not interchangeable).

Switch the instrument on and operate the limit switches manually, watching to see if the respective L.E.D. on the micro processor controller turns on and off. To test the light barriers simply interrupt the beam and watch the respective L.E.D. on the micro processor controller.

If switching does not occur replace the component.

FAULTS

a) No power

Check main fuse at rear on electronic console, 3,15A.

b) No LCD Display or lamps, a light on "on/off", "start" and "stop" buttons but micro processor controller is powered:

- 1) check fuses in SD 2 stepper motor drive module.
- 2) check fuse in display module 1090 on PCB in slot behind front panel. Remove front panel of module to locate fuse.
- 3) change "transformer" module 1069 or "SD 2 stepper motor drive".

c) No drive to a stepper motor

This can be checked by manually checking to see if a stepper motor is not powered. (will rotate freely with no power otherwise it will be locked in position)

Fault

1) no drive to one stepper motor only.

- a) check fuses in respective stepper motor drive
- b) change drive or motor

2) no drive to two stepper motors

- a) check mains fuse
- b) replace transformer module

d) No drive to DC motor

- a) check respective relays located in main machine
- b) check fuse 6,3A behind display module 1090. Remove front panel of module to locate fuse. (top fuse on PCB)

e) Magazine does not feed out of rack

- 1) feed motor turns but does not engage gear on magazine - check solenoid and solenoid relay.
- 2) check fuse behind display module 1090, fuse 6,3A. (lower fuse on PCB)

B
(pg 6. of 21)

e) Magazine feeds in and first dosimeter is pushed in front of source for irradiation but does not continue.

1) replace timer

ALIGNMENT *****

With no power to instrument. Only necessary when replacing a limit switch.

1) Door limit switch

Set switch in position that the door latch operates the limit switch.

2) Source limit switch

Mount handle on lead castle so that source handle operates this switch

3) Rack up and rack down limit switches

Mount so that rack operates these switches in the fully up and down positions.

4) Dosimeter down limit switch

Manually set this limit switch to a position where the magazine can move under the lead castle without hooking the dosimeter arm.

5) Dosimeter up limit switch

Place a dosimeter in a magazine and manually push the dosimeter out of the magazine up in front of the source. Set the limit switch so that it is operated before the arm has completely reached the end of its travel. This can be monitored by the brass rod protruding from the lead castle. Set switch operation = 1 mm from full travel

With power to instrument. Only necessary when replacing a light barrier.

Make sure that the transmitter and receiver look at each other. This can be seen by monitoring the L.E.D. in the receiver unit. Position the transmitter so that the receiver L.E.D. lights with no obstacle in the light path.

1) Magazine back light barrier

Remove the feed motor drive and solenoid relay mounted on the feed motor plate. Take a magazine and move it manually until it just moves into the light barrier path (ie. LED just goes off) make sure that the front of the magazine clears the upper loading plate.

2) Rack light barrier

Remove the rack motor drive. Manually turn the rack to the fully up position. Place a magazine into the lowest rack position and turn the rack down until one can manually feed the magazine through to the lead castle magazine slide. When these are level move the light barrier until it just switches on when being driven in the bottom direction when level.

B
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3) Dosimeter light barrier

Remove dosimeter and magazine stepper motor drive. Set the receiver so that when pushing a magazine with dosimeters through under the lead castle the dosimeter turns the light barrier on and off.

4) Rear Magazine Light Barrier

Remove the rack stepper motor drive. This is a reflective type. Make sure the door on the rack is closed. Turn the rack manually from top to bottom making sure the L.E.D. comes on before the rack light barriers L.E.D. in all cases and also that they are in coincidence when the correct rack position.

5) Front of magazine detect light barrier

When rack is pushed in check that LED switches.

6) Magazine advance light barrier

Remove the dosimeter motor relays and magazine stepper motor drive. Push a magazine with dosimeters under the lead castle. Turn the magazine motor in an anti clockwise direction until the LED of the light barrier just comes on. Check that the dosimeter arm can be pushed up through the magazine. Rotate the disc containing the sixteen holes until this can be accomplished. Then lock disc to stepper motor shaft.

7) Solenoid

Only when replacing solenoid. Adjust soft iron bar of solenoid so that when fully in "in" position the feed motor gear meshes with magazine teeth without applying excessive pressure to magazine.

8) When replacing magazine advance motor

Switch off the instrument. Push a rack through under the lead castle. Move the motor mounting forward until the motor gear meshes with the magazine's gear teeth. Tighten the holding screws lightly. Feed a magazine in until it just touches the gear and make sure that the dosimeters arm is able to move freely through the magazine's. Lock the motors in position.

MICRO PROCESSOR

INPUTS

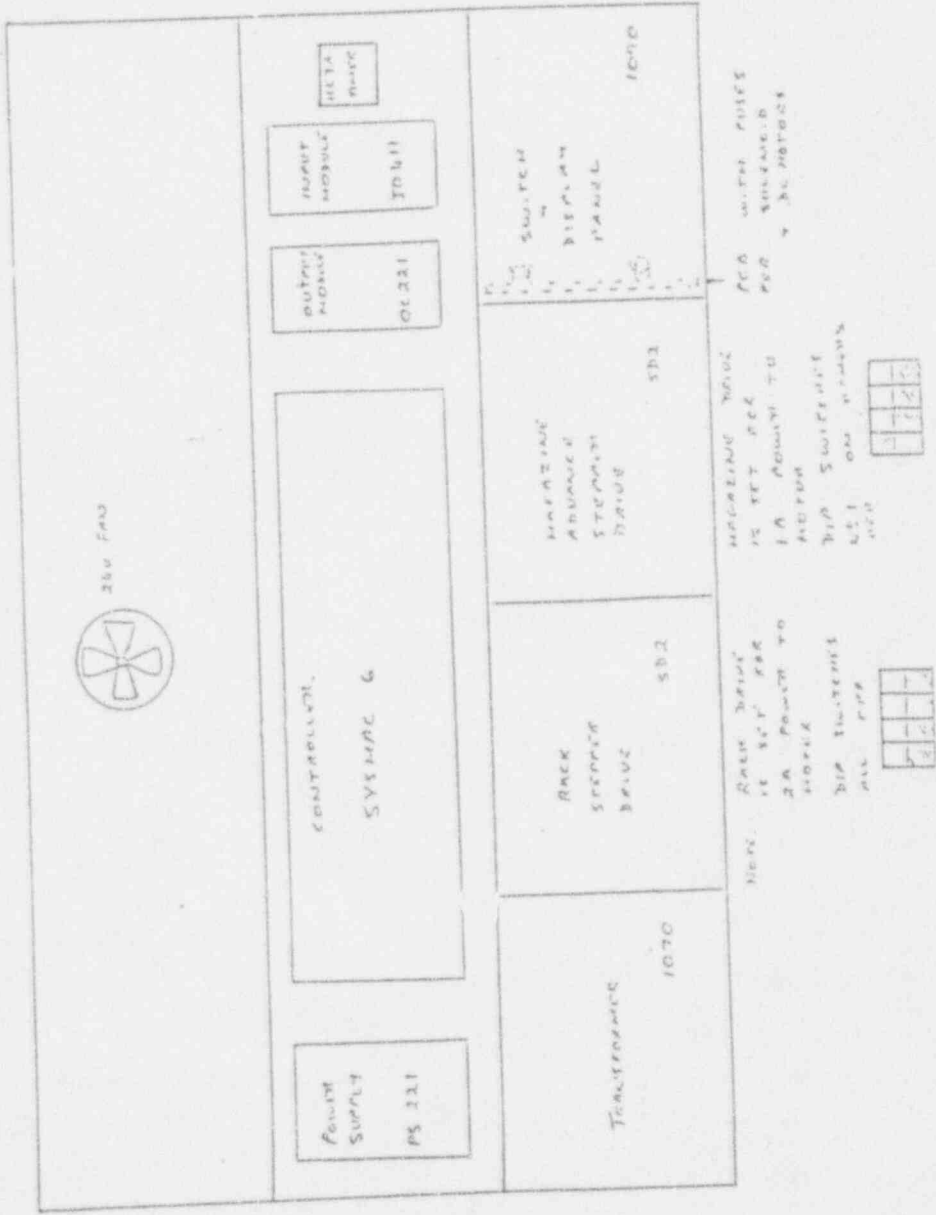
B
(19 E.c.f.a.)

0	START
1	RACK UP LIMIT SWITCH
2	RACK DOWN LIMIT SWITCH
3	MAG LIGHT BARRIER REFLECTIVE TYPE
4	FRONT MAG LIGHT BARRIER DIAGONAL
5	DOSIMETER LIGHT BARRIER
6	DOSIMETER UP LIMIT SWITCH
7	DOSIMETER DOWN LIMIT SWITCH
8	MAG ADVANCE LIGHT BARRIER
9	SOURCE LIMIT SWITCH
10	RACK LIGHT BARRIER
11	BACK MAG LIGHT BARRIER
24	STOP
25	POWER FAIL CONTACT
26	DOOR_LIMIT SWITCH (RACK)
27	TIMER CONTACT

OUTPUTS

12	DIRECTION MAG MOTOR
13	SLOW MAG MOTOR
14	DIRECTION RACK MOTOR
15	SLOW RACK MOTOR
16	DIRECTION DOSIMETER MOTOR
17	SLOW DOSIMETER MOTOR
18	SLOW FEED MOTOR (SOLENOID)
19	DIRECTION FEED MOTOR
20	POWER FAIL
21	DOUBLE RACK
22	BUZZER
23	TIMER

B
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C/10.07
21

		B	A	1	RACK UP L/S
		C	B	2	RACK DOWN L/S
		D	C	3	53 MAGAZINE L/S
		E	D	4	54 ROTIMETER L/S
		F	E	5	58 FRONT MAG. L/S
		G	F	6	DOGS UP L/S
		H	G	7	DOGS DOWN L/S
		I	H	8	55 MAG. ADV L/R
		J	I	9	SOURCE L/S
		K	J	10	56 RACK L/S
		L	K	11	57 MAG. RACK L/R
		M	L	16	66 DIRECTION DOGS MOTOR
		N	M	17	67 START DOGS MOTOR
		O	N	19	68 DIRECTION FEED MOTOR
		P	O	18	69 START FEED MOTOR
		Q	P	12	DIRECTION RACK MOTOR
		R	Q	13	START RACK MOTOR
		S	R	14	DIRECTION MAG MOTOR
		T	S	15	START MAG. MOTOR
		U	T	20	POWER FAIL LED
		V	U	21	DOUBLE MAG. LED
		W	V	22	RUBBER
		X	W	24	STOP SWITCH
		Y	X	25	POWER FAIL CONTACT
		Z	Y	26	38 DOGS L/S
		a	Z	0	START SWITCH
		b	a	61	RACK CLOSE } OUTPUT
		c	b		RACK RESET } OUTPUT
		d	c	60	DOGS RESET } OUTPUT
		e	d		CHANNELS
		f	e	69	ORANGE } RACK
		g	f	47	BLACK } STOPPER
		h	g	50	YELLOW } MOTOR
		i	h	48	RED } WIRE
		j	i	43	CHANNEL } MAGAZINE
		k	j	41	BLACK } ADVANCE
		l	k	44	YELLOW } OPPOSE
		m	l	42	RED } MOTOR
		n	m	62/65	-24V DC
		o	n	64/65	0V DC
		p	o		SOURCE LED
		q	p		RACK LED
		r	q	74	+26V } SOLINOID
		s	r	80	-26V } POINT
		t	s	73	-10V } DC MOTOR
		u	t	72	-10V } POWER
		v	u		SWITCHED LIVE
		w	v		WIRING
		x	w		DOGS CLOCK

3W SDZ 15
 53 ROTIMETER DRIVE
 L/S = LIMIT SWITCH
 L/R = LIGHT RACKING

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Figure 1
Lift and Limit Switches

- 1 Back up L/S
- 2 Back down L/S
- 3 Hog back L/B
- 4 Front mag L/B
- 5 Drummer L/B
- 6 Drummer up L/S
- 7 Drummer down L/S
- 8 Hog advance L/B
- 9 Source L/S
- 10 Back L/B
- 11 Front mag L/B
- 12 Hog master
- 13 Hog advance stop
- 14 Drummer motor
- 15 Stop and feed motor
- 16 Limit Switch
- 17 Hog Limit Switch

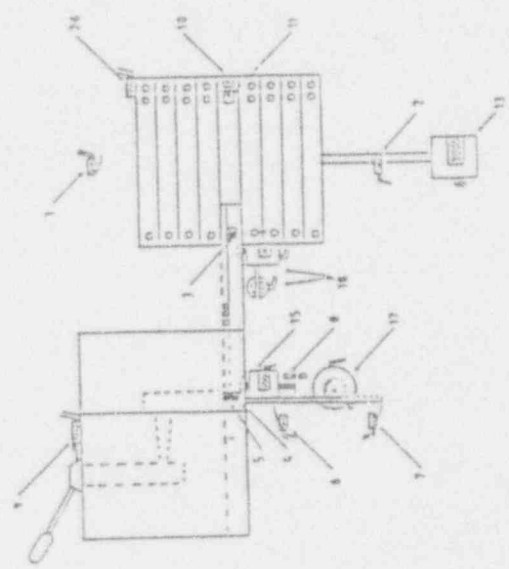


Fig. 1

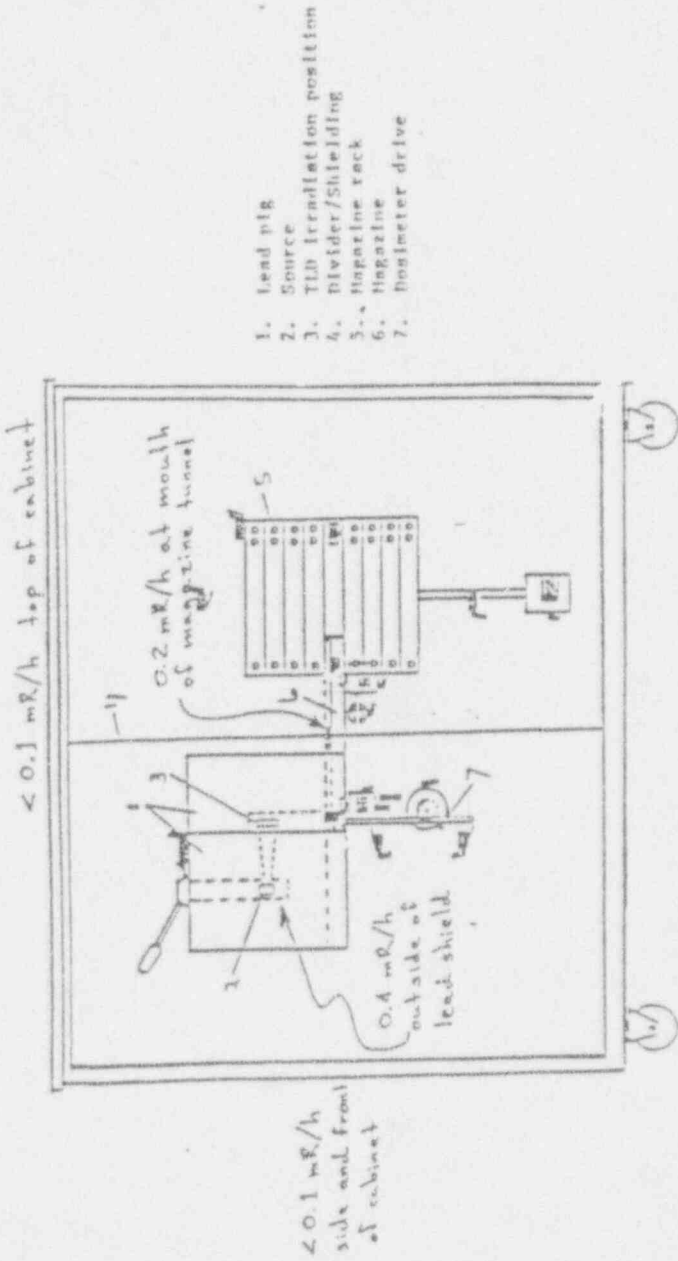


Figure 2. Exposure rate profiles made on a prototype device at the University of Michigan using an Eberline EO-2 survey meter. (loaded with G-2) (S-137)

B
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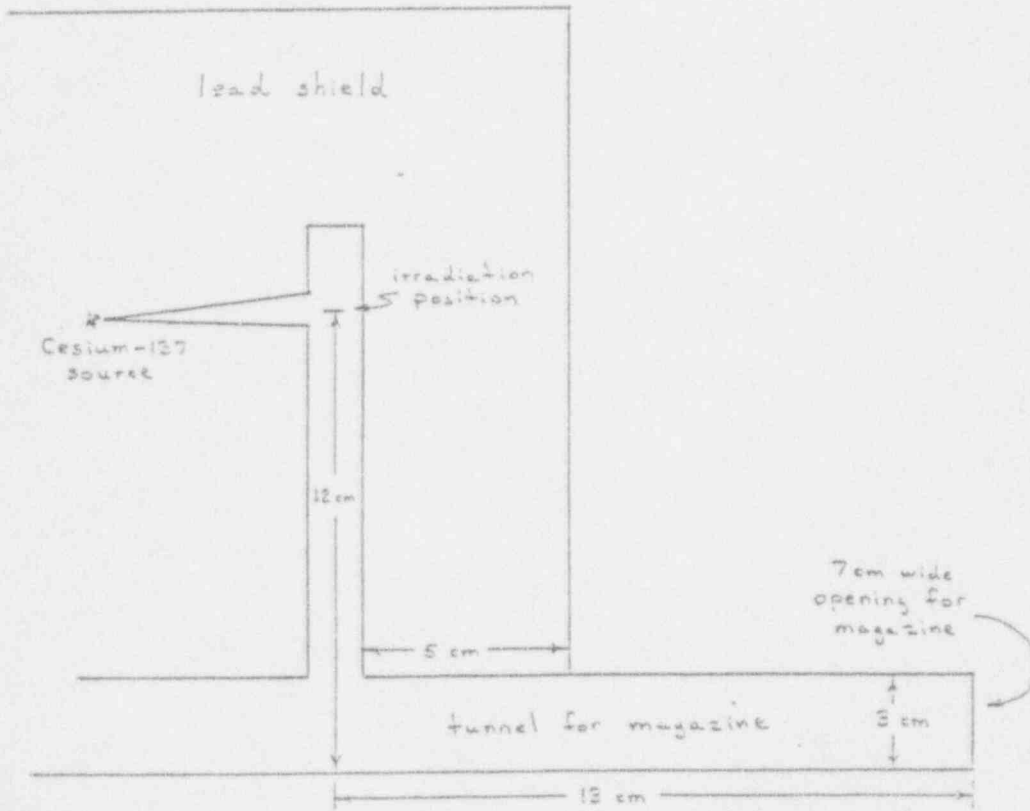
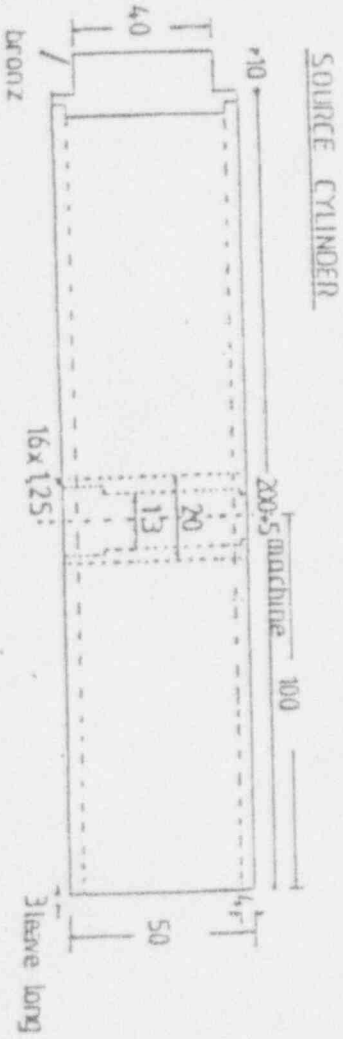


Figure 3. Diagram showing the path from the elevator chamber to the irradiation position.

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SD2 and SD3 STEPPER DRIVES

Edge Connections

2a	Motor phase 2A	2c	Motor phase 2A
4a	Motor phase 2B	4c	Motor phase 2B
6a	Motor phase 1B	6c	Motor phase 1B
8a	Motor phase 1A	8c	Motor phase 1A
10a	+24v DC out	10c	+24v DC out
12a	Logic supply input 1	12c	Motor supply input 1
14a	Logic supply input 2	14c	Motor supply input 2
16a	0v	16c	0v
18a	0v	18c	0v
20a	Fast input	20c	Fault output
22a	Slow input	22c	Zero phase output
24a	Rate adjust common	24c	Slow rate adjust
26a	Fast Rate adjust	26c	Direction input
28a	Internal clock output	28c	Clock input
30a	Sync (input or output)	30c	Energise input
32a	External reference input	32c	Signal 0v

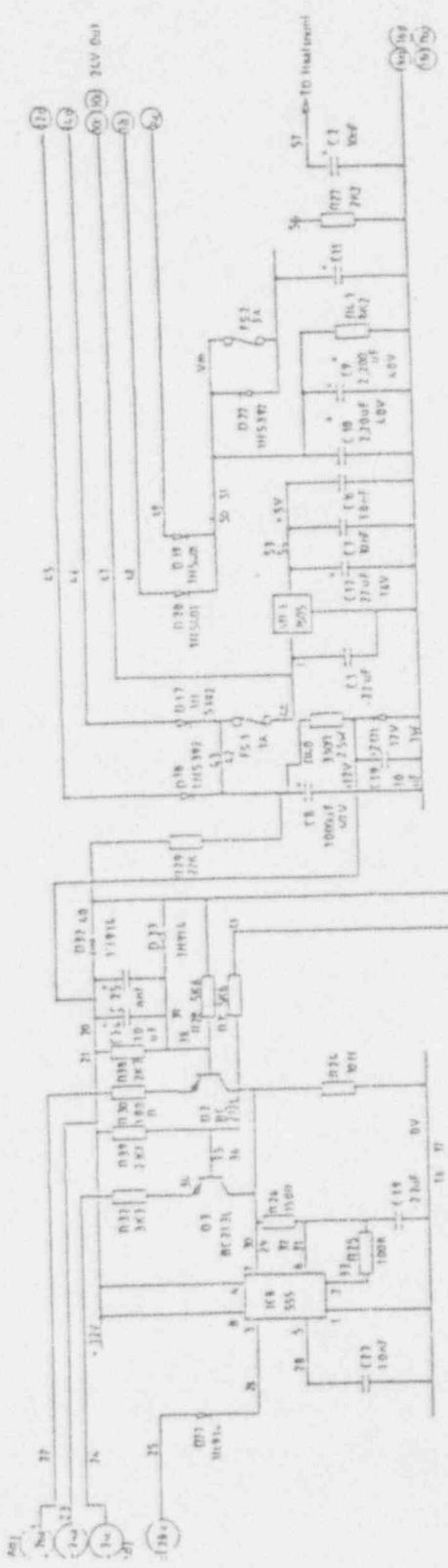
List of link functions

- Link 1 (insert) Sets the sync pin to an output, making the drive a "master". This link must be fitted when there is only one drive in the system. The chopper regulator produces 5v 1uS pulses on the sync output.
- Link 2 (do not insert) Sets the sync pin to an input, making the drive a "slave". All interconnected drives in a multi-axis system should have link 2 fitted except the master drive which should have link 1.
- Link 3 (do not insert) Fit this link to operate in the full-step mode. A standard stepper motor will produce 200 steps/rev with this link fitted, and 400 steps/rev without. The 400 step/rev mode is to be preferred in most applications, the slight torque loss being offset by smoother operation at low speeds.
- Link 4 (insert) With this link fitted the drive will remain energised without the need to make an external connection from the "energise" input to 0v.

Setting the motor current

Nominal current	Switch settings			
	1	2	3	4
SD2				
1A	on	off	off	off
2A	off	off	off	off

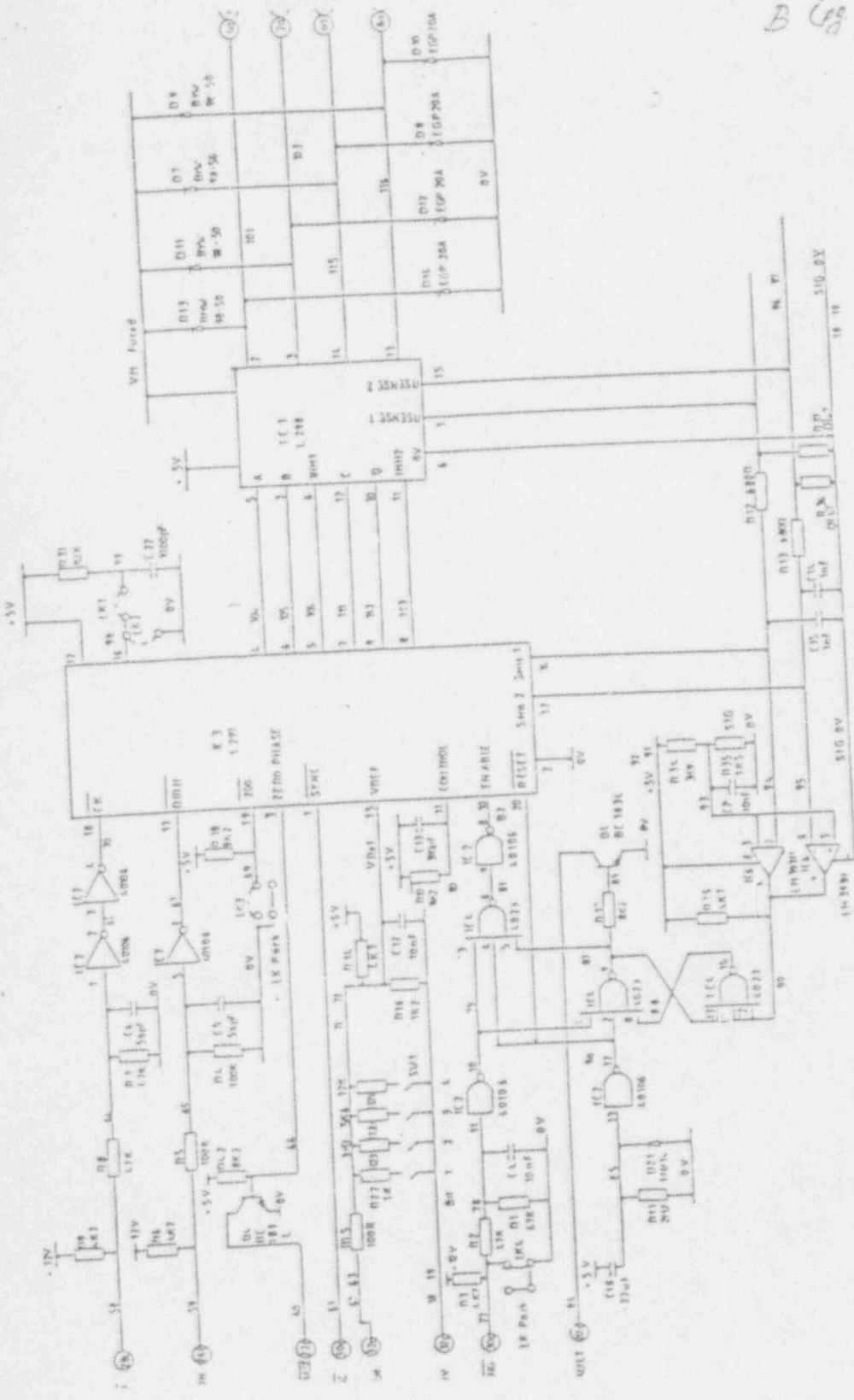
STEPPER DRIVE CIRCUIT



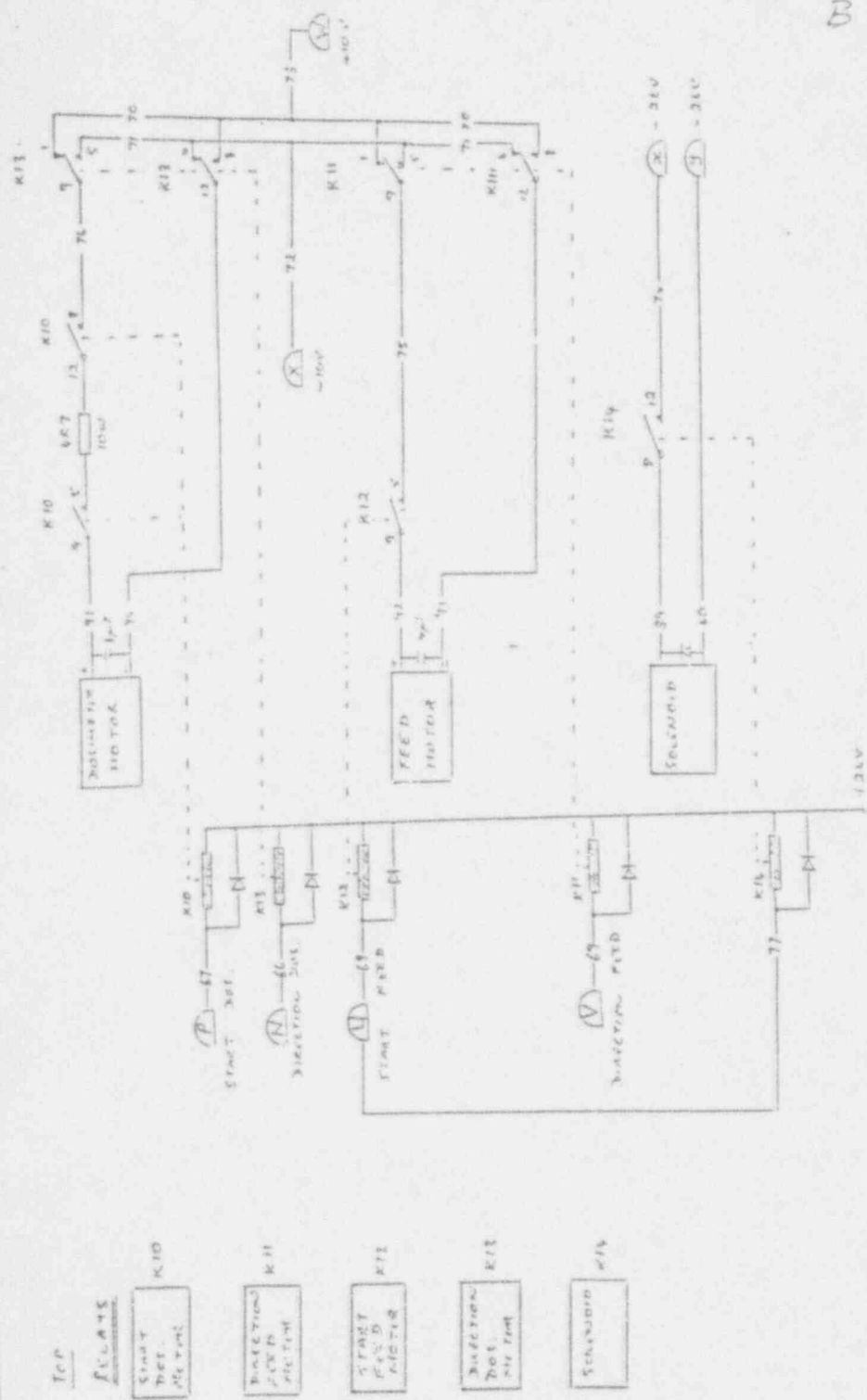
B
 (12.13.14)

STEPPER DRIVE CIRCUIT

B (pg 14 of 21)



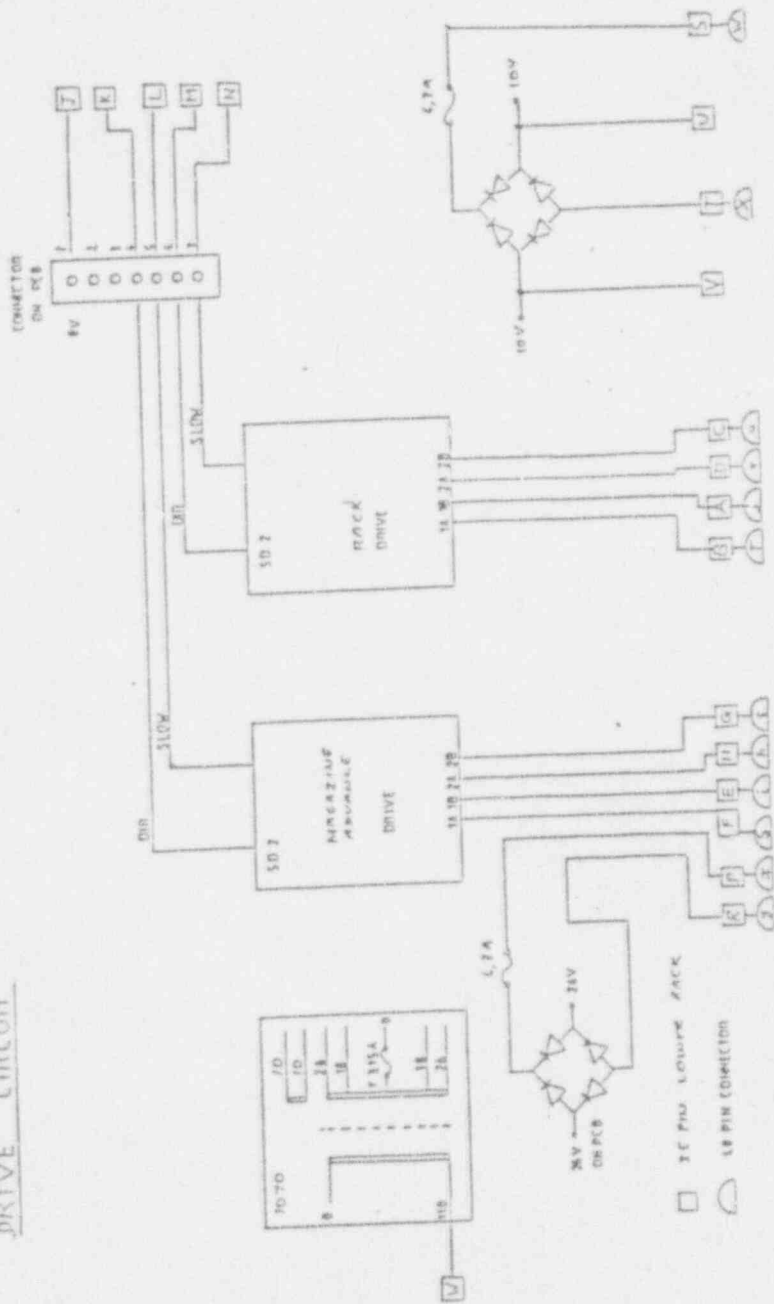
RELAY SWITCHING



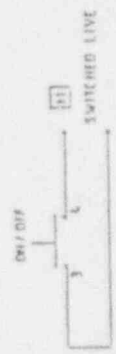
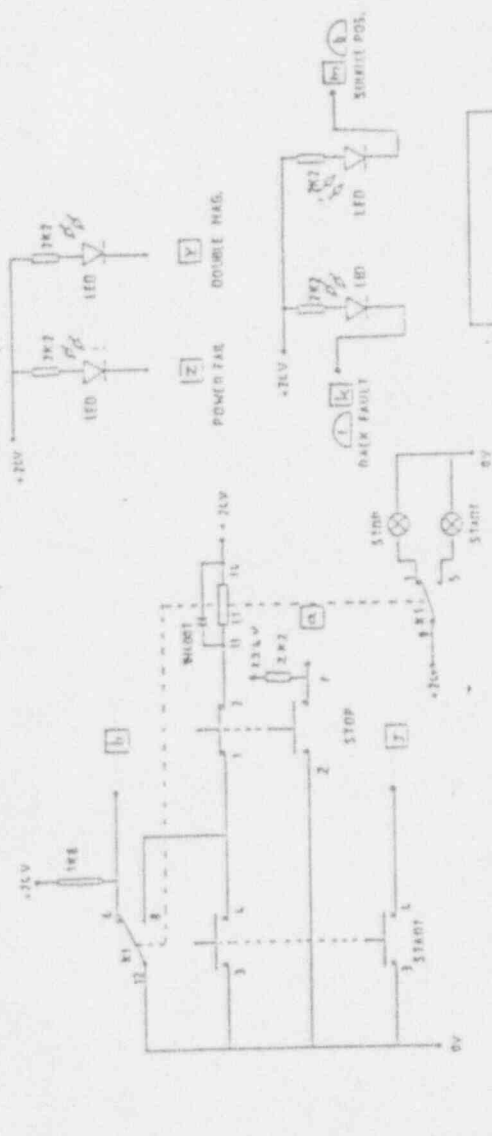
B (15.02)

B
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DRIVE CIRCUIT

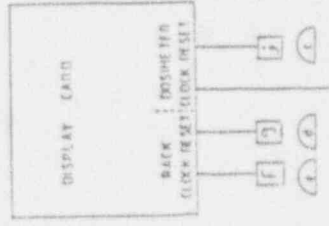
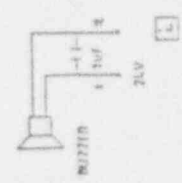


SWITCH CIRCUIT



CORRECTORS
 [] 3S PIN LOGIC BACK

[] 24V PIN MOTOR



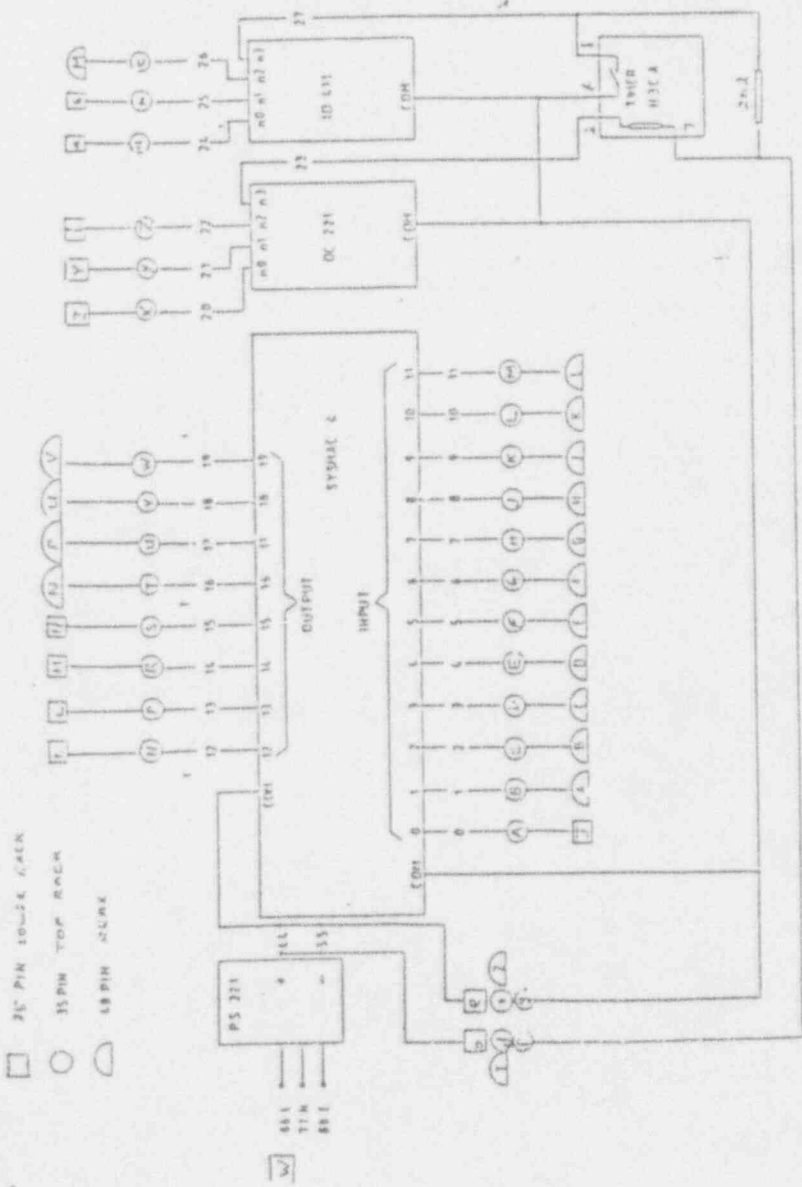
SLOW Input
 to SD2
 has motor
 drive
 Pin 5 of PCB
 drive unit

B
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B Log 18. of 2

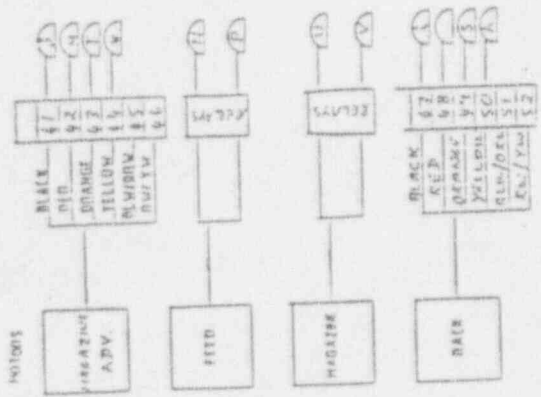
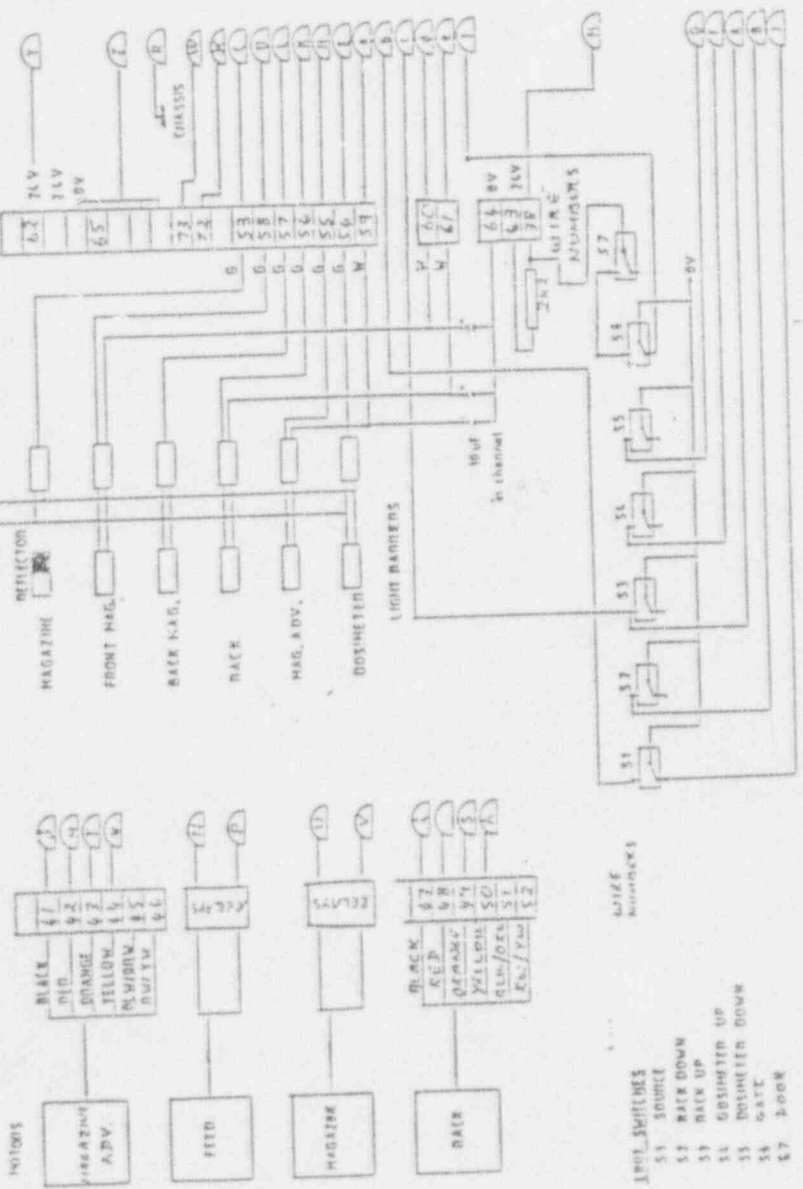
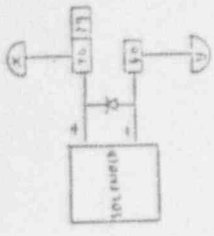
CONTROL CIRCUIT (TOP RACK)

LDWEL1003.



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CABINET CONNECTIONS 'A'



- ...
 LIGHT SWITCHES
 S1 SOURCE
 S2 BACK DOWN
 S3 BACK UP
 S4 DODSHETER UP
 S5 DODSHETER DOWN
 S6 GATE
 S7 DOOR

G - GREEN WIRE
 W - WHITE WIRE

MAE
Conn.

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MAE Stepping Motor Connections

DRIVE OUTPUTS & CONNECTION TYPE	
	1 Black 5 Or/White 2 Red 6 Bl/White 3 Orange 7 Yl/White 4 Yellow 8 Red/White
UNIPOLAR	TERMINAL COLOUR
Φ 1	1 Black
Φ 1	3 Orange
Φ 1 Common	5 & 6 Wh/Or & Wh/Blk - (LINK)
Φ 2	2 Red
Φ 2	4 Yellow
Φ 2 Common	7 & 8 Wh/Yw & Wh/Rd - (LINK)
BIPOLAR SERIES	
Φ 1	1 Black
Φ 1	3 Orange
Φ 2	2 Red
Φ 2	4 Yellow
Isolate - (LINK)	5 & 6 Wh/Or & Wh/Blk
Isolate - (LINK)	7 & 8 Wh/Yw & Wh/Rd
BIPOLAR PARALLEL	
Φ 1	1 & 5 Black & White/Orange
Φ 1	3 & 6 Orange & White/Black
Φ 2	2 & 7 Red & White/Yellow
Φ 2	4 & 8 Yellow & White/Red