UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

Ron E.
File as a reference
for GI-131

Reference (1170)

MAY 01 1989

PDR: per
R. EMRIT

MEMORANDUM FOR: Thomas L. King, Chief, ARGIB/DRA/RES

THRU: Ronald K. Frahm, Leader, GSIP/ARGIB/DRA/RES

FROM: Robert Riggs, GSIP/ARGIB/DRA/RES

SUBJECT: COMPUTER PROGRAM "SEALCOM" USED IN GENERIC ISSUE 131

The purpose of this memo is to document the computer program and the run results of the program I used and referenced in the prioritization analysis of Generic Issue 131.

Attachment 1 is a listing of the program "Sealcom" I developed to calculate the results provided in Attachment 2. These results were used in the generic issue prioritization analysis. Attachment 3 provides figures taken from the NRC Westinghouse Systems manual depicting a typical design configuration of the flux mapping system discussed and evaluated in Generic Issue 131.

These attachments therefore can be considered supplemental information to assist in understanding the analysis and methodology used in the issue analysis. In addition, the attachment may also provide assistance during the resolution phase of the issue.

A floppy diskette of the program, or further information on the subject issue, can be obtained from me.

Robert Riggs

Robert Riggs
Generic Safety Issues & Prioritization
Section
Advanced Reactors & Generic Issues Branch
Division of Regulatory Applications
Office of Nuclear Regulatory Research

Attachments:
As stated

cc: B. Morris
Z. Rosztoczy
R. Emrit
R. Riggs

1/1

DF03

150052

Add: R. EMRIT, RES CFSubj RES

Attachment 1

Seacom Program

```
LIST
10        LPRINT
20        LPRINT
30        LPRINT "
40        LPRINT "                                          ************************* "
50        LPRINT "                                          *                       * "
60        LPRINT "                                          *     SEALCOM.BAS       * "
70        LPRINT "                                          *        BY             * "
80        LPRINT "                                          *    ROBERT  RIGGS      * "
90        LPRINT "                                          *     APRIL, 1989       * "
100       LPRINT "                                          *                       * "
110       LPRINT                                            ************************* "
120     LPRINT "This program was written to solve the Poisson distribution"
130     LPRINT "sums for generic issue 131 (potential Seismic Interaction "
140     LPRINT "Involving The Movable In-Core Flux Mapping System Used In "
150     LPRINT "Westinghouse plants). Based on the Westinghouse estimate. "
160     LPRINT "three seals were calculated to fail if the movable tray"
170     LPRINT "dislodged from its track during a seismic event and fell onto
180     LPRINT "the seal table. Using the Westinghouse estimate, and average
190     LPRINT "value of the number of seal failures (U) can be obtained"
200     LPRINT "from the table. Various probabilities can then be assigned"
210     LPRINT "to the goodness of the Westinghouse estimate."
220     LPRINT "As an example; for three seal failures a probability of 0.95
230     LPRINT "is assigned to the Westinghouse estimate.  The resulting U "
240     LPRINT "from the table is 1.37."
250     LPRINT "Inputing  U=1.37, and PU=0.95, when asked for by the program"
260     LPRINT "(user unteraction during the program execution), the"
270     LPRINT "probabilities of certain ranges of tube failures are"
280     LPRINT " calculated."
290     LPRINT "Different values of U and the corresponding PU can be assigne
300     LPRINT "to obtain the sensitivity of the effects created by variation
310     LPRINT "in the probability of the Westinghouse estimate."
320     LPRINT
330     LPRINT
340     LPRINT
350     'LPRINT "123456789/123456789/123456789/123456789/123456789/123456789/"
360     '-------------------------------------------------------------------
370     LPRINT "
380     LPRINT "                                          TABLE 1 " 'Print Table heading
390     LPRINT                                           ---------" 'and underline.
400     '-------------------------------------------------------------------
410     FOR CV=0! TO 9.000001E-02 STEP .01    'setup table column indices
420         CV$="    .## "                    'format for table column heading
430       LPRINT USING CV$;CV;                'Print col heading values
440     NEXT CV
450     '-------------------------------------------------------------------
460     LPRINT TAB(1) "    ----    ----    ----    ----    ----";
470     LPRINT TAB(36) "   ----    ----    ----    ----    ----"
480
490   '-------------------------------------------------------------------
500   VPL$=".#####     "                    'format for printing values of P as
510   VPH$=".######### "                    'strings with decimal number format
520   '-------------------------------------------------------------------
530     S0$="p0              =   .#####"       'Print formats for Prob. Sums
540     S1$="p1+p2+...+p5    =   .#####"
550     S2$="p6+....+p10     =   .#####"
560     S3$="p11+....+p15    =   .#########"
570     SR$="p16 or more     =   .#########"
580   '-------------------------------------------------------------------
590     '
600     '
610     '
620     '
630     '
```

```
660 '
670 '
680 U=1.3                                                    'This section calculates
690 FOR U=U TO (U+9.000001E-02) STEP .01                     'the range of Probs for
700       A=EXP(-U)                                          'variable values of U based
710       D=(U^2)/2                                          'W estimated 3 failures.
720       E=(U^3)/6                                          'The results are printed in
730       F=(1+U+D+E)                                        'tabular format. The table can
740       P=A*F                                              'be used to select values of U
750       LPRINT USING "    .###";P;                         'based on various prob estimat
760       'visual aid:  1234567  to count spaces in print columns
770 NEXT U
780 LPRINT
790 IF U<=3 GOTO 690 ELSE GOTO 810
800 '-------------------------------------------------------------------------------
810 LPRINT
820 LPRINT "*************************************************************************"
830 LPRINT "***************"
840 LPRINT "Row 1 starts with U=1.3. For each  row U increases by 0.1.
850 LPRINT "*************************************************************************"
860 LPRINT "***************"
870 LPRINT
880 CLS
890 PRINT "From table select a value of U for an estimated value"
900 PRINT "of the probability (PU).  You may select as many as you
910 PRINT "like. You will then be ask to input these values (U, PU)"
920 PRINT "to proceed with the calculations."
930 PRINT
940 PRINT "After selecting values for U, PU; press key F5 to continue"
950 STOP
960 LPRINT
970 INPUT "Enter a selected value of U,  or enter 0(zero) to quit";U
980 INPUT "Enter a selected value of PU, or enter 0 again to quit";PU
990 LPRINT USING "U = #.###  with  PU = .###";U,PU
1000  LPRINT "---------          ---------"
1010  LPRINT
1020  IF U=0 THEN GOTO 1560 ELSE GOTO 1030
1030 '-------------------------------------------------------------------------------
1040                  P0=EXP(-U)
1050                  P1=P0*U
1060                  P2=P1*(U/2)
1070                  P3=P2*(U/3)
1080                  P4=P3*(U/4)
1090                  P5=P4*(U/5)
1100                  P6=P5*(U/6)
1110                  P7=P6*(U/7)
1120                  P8=P7*(U/8)
1130                  P9=P8*(U/9)
1140                  P10=P9*(U/10)
1150                  P11=P10*(U/11)
1160                  P12=P11*(U/12)
1170                  P13=P12*(U/13)
1180                  P14=P13*(U/14)
1190                  P15=P14*(U/15)
1200 LPRINT "(p0                          ) = ";
1210 LPRINT USING VPL$;P0
1220 LPRINT "(P1,  P2,  P3,  P4,  P5) = ";
1230 LPRINT USING VPL$;P1;P2;P3;P4;P5
1240 LPRINT "(P6,  P7,  P8,  P9,  P10)= ";
1250 LPRINT USING VPL$;P6;P7;P8;P9;P10
1260 LPRINT "(P11, P12, P13, P14, P15)= ";
1270 LPRINT USING VPH$;P11;P12;P13;P14;P15
1280 '-------------------------------------------------------------------------------
1290 '
```

```
1320      '
1330      '
1340      '
1350      '
1360      '
1370      '
1380      LPRINT
1390      LPRINT "
--------
1400      LPRINT
1410      SUM0=P0                                 'Prob. of zero failures
1420      SUM1=P1+P2+P3+P4+P5                     'Prob. of one to five failures
1430      SUM2=P6+P7+P8+P9+P10                    'Prob. of six to ten failures
1440      SUM3=P11+P12+P13+P14+P15                'Prob. of 11 to 15 failures
1450      SUMT=SUM0+SUM1+SUM2+SUM3
1460      SUMR=1-SUMT                             'Prob. of 16 or more failures
1470              LPRINT USING S0$;SUM0
1480              LPRINT USING S1$;SUM1
1490              LPRINT USING S2$;SUM2
1500              LPRINT USING S3$;SUM3
1510              LPRINT USING SR$;SUMR
1520      LPRINT
1530      LPRINT "*************************************************************************
1540      LPRINT "***************"
1550      GOTO 970
1560      END
Ok
```

Attachment 2

Seal com Run

```
**************************
*                        *
*      SEALCOM.BAS       *
*          BY            *
*     ROBERT  RIGGS      *
*      APRIL. 1989       *
*                        *
**************************
```

This program was written to solve the Poisson distribution sums for generic issue 131 (potential Seismic Interaction Involving The Movable In-Core Flux Mapping System Used In Westinghouse plants). Based on the Westinghouse estimate, three seals were calculated to fail if the movable tray dislodged from its track during a seismic event and fell onto the seal table. Using the Westinghouse estimate, and average value of the number of seal failures (U) can be obtained from the table. Various probabilities can then be assigned to the goodness of the Westinghouse estimate.
As an example; for three seal failures a probability of 0.95 is assigned to the Westinghouse estimate. The resulting U from the table is 1.37.
Inputing U=1.37, and PU=0.95, when asked for by the program (user unteraction during the program execution), the probabilities of certain ranges of tube failures are calculated.
Different values of U and the corresponding PU can be assigned to obtain the sensitivity of the effects created by variations in the probability of the Westinghouse estimate.

TABLE 1

.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
.957	.956	.955	.954	.953	.952	.951	.950	.949	.947
.946	.945	.944	.943	.942	.940	.939	.938	.937	.936
.934	.933	.932	.931	.929	.928	.927	.925	.924	.923
.921	.920	.918	.917	.916	.914	.913	.911	.910	.908
.907	.905	.904	.902	.901	.899	.898	.896	.894	.893
.891	.890	.888	.886	.885	.883	.881	.880	.878	.876
.875	.873	.871	.870	.868	.866	.864	.862	.861	.859
.857	.855	.853	.852	.850	.848	.846	.844	.842	.841
.839	.837	.835	.833	.831	.829	.827	.825	.823	.821
.819	.817	.815	.813	.811	.809	.807	.805	.803	.801
.799	.797	.795	.793	.791	.789	.787	.785	.783	.781
.779	.777	.775	.772	.770	.768	.766	.764	.762	.760
.758	.755	.753	.751	.749	.747	.745	.743	.740	.738
.736	.734	.732	.729	.727	.725	.723	.721	.718	.716
.714	.712	.710	.707	.705	.703	.701	.699	.696	.694
.692	.690	.687	.685	.683	.681	.679	.676	.674	.672
.670	.667	.665	.663	.661	.658	.656	.654	.652	.649
.647	.645	.643	.641	.638	.636	.634	.632	.629	.627

****
Row 1 starts with U=1.3. For each row U increases by 0.1.
****

U = 1.370 with PU = .950

```
(p0.                          ) = .25411
(P1,  P2,  P3,  P4,  P5) = .34813    .23847    .10890    .03730    .01022
(P6,  P7,  P8,  P9,  P10)= .00233    .00046    .00008    .00001    .00000
(P11, P12, P13, P14, P15)= .00000020 .00000002 .00000000 .00000000 .00000000

                    ----------------------------------------

p0            =  .25411
p1+p2+...+p5  =  .74301
p6+.....+p10  =  .00288
p11+....+p15  =  .00000023
p16 or more   =  .00000000

*************************************************************************************
U = 1.745  with  PU = .900
---------        ---------

(p0                           ) = .17465
(P1,  P2,  P3,  P4,  P5) = .30476    .26590    .15466    .06747    .02355
(P6,  P7,  P8,  P9,  P10)= .00685    .00171    .00037    .00007    .00001
(P11, P12, P13, P14, P15)= .00000200 .00000029 .00000004 .00000000 .00000000

                    ----------------------------------------

p0            =  .17465
p1+p2+...+p5  =  .81634
p6+.....+p10  =  .00901
p11+....+p15  =  .00000233
p16 or more   =  .00000000

*************************************************************************************
U = 2.295  with  PU = .800
---------        ---------

(p0                           ) = .10076
(P1,  P2,  P3,  P4,  P5) = .23125    .26536    .20300    .11647    .05346
(P6,  P7,  P8,  P9,  P10)= .02045    .00670    .00192    .00049    .00011
(P11, P12, P13, P14, P15)= .00002348 .00000449 .00000079 .00000013 .00000002

                    ----------------------------------------

p0            =  .10076
p1+p2+...+p5  =  .86953
p6+.....+p10  =  .02968
p11+....+p15  =  .00002892
p16 or more   =  .00000024

*************************************************************************************
U = 2.765  with  PU = .700
---------        ---------

(p0                           ) = .06298
(P1,  P2,  P3,  P4,  P5) = .17413    .24073    .22188    .15337    .08481
(P6,  P7,  P8,  P9,  P10)= .03909    .01544    .00534    .00164    .00045
(P11, P12, P13, P14, P15)= .00011394 .00002625 .00000558 .00000110 .00000020

                    ----------------------------------------

p0            =  .06298
p1+p2+...+p5  =  .87492
p6+.....+p10  =  .06195
p11+....+p15  =  .00014708
p16 or more   =  .00000000
```

Attachment 3

Typical Westinghouse

Movable Flux Mapping System

MOVABLE DETECTOR SYSTEM

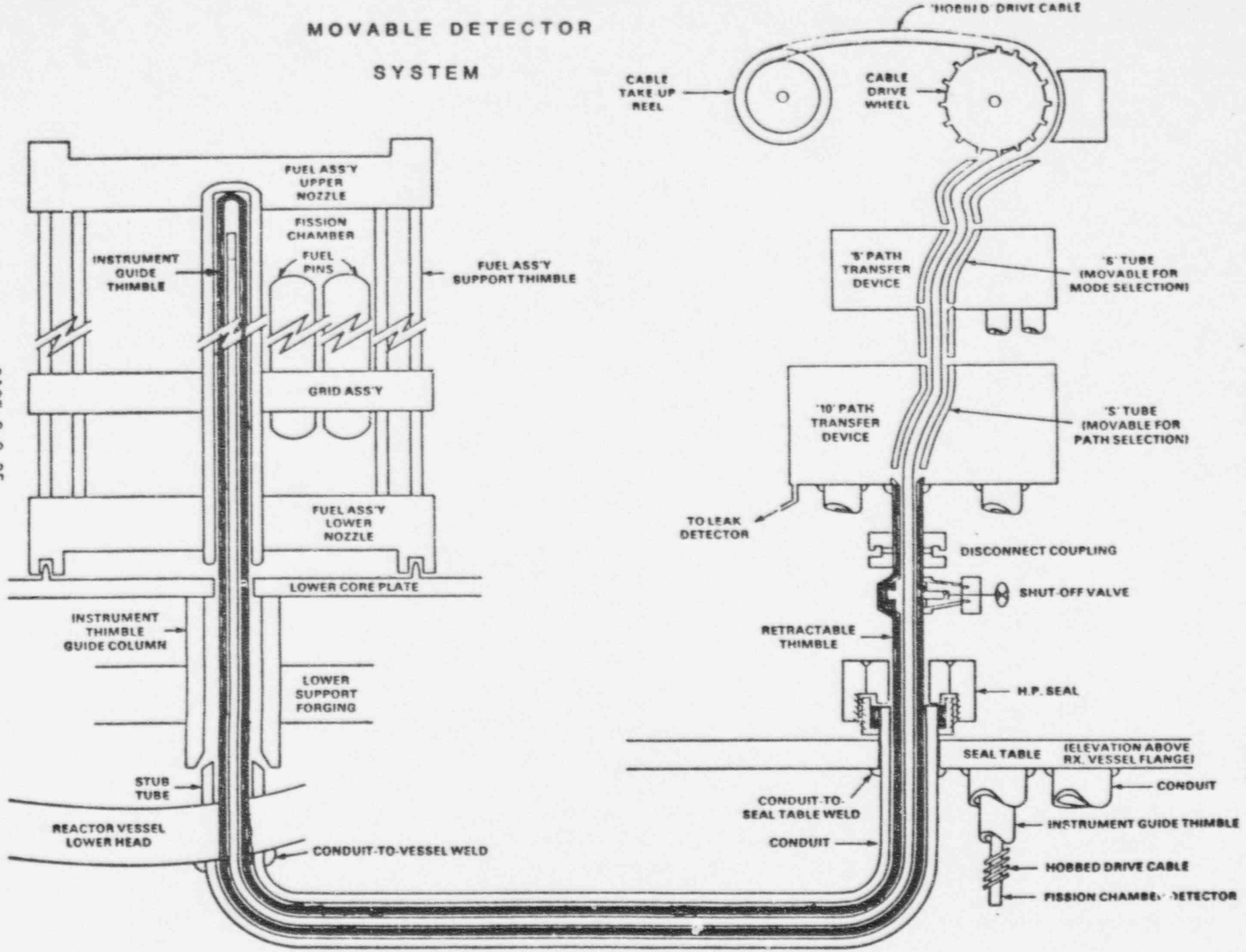
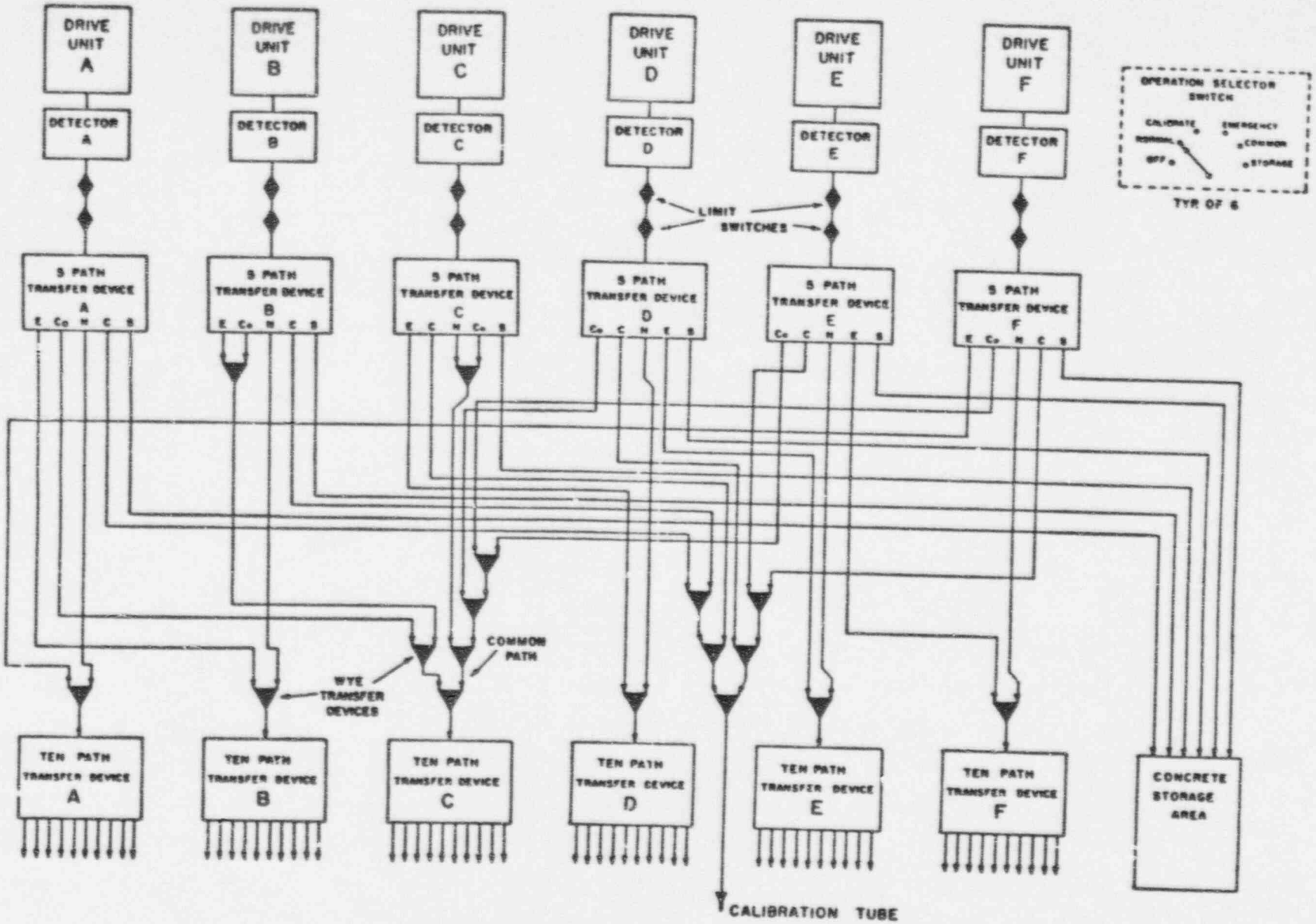


FIGURE 8.2-7

0882



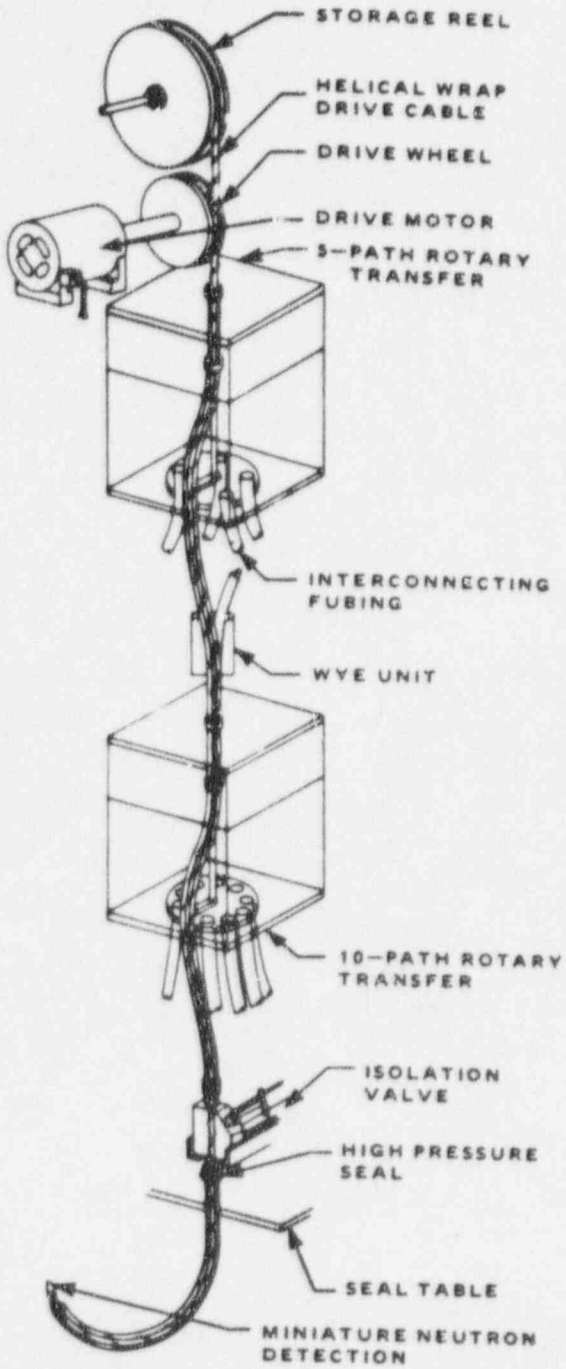
IN-CORE NUCLEAR INSTRUMENTATION DRIVE SYSTEM

Figure 10.2-4

FIGURE 8.2-6

FIGURE 8.2-11

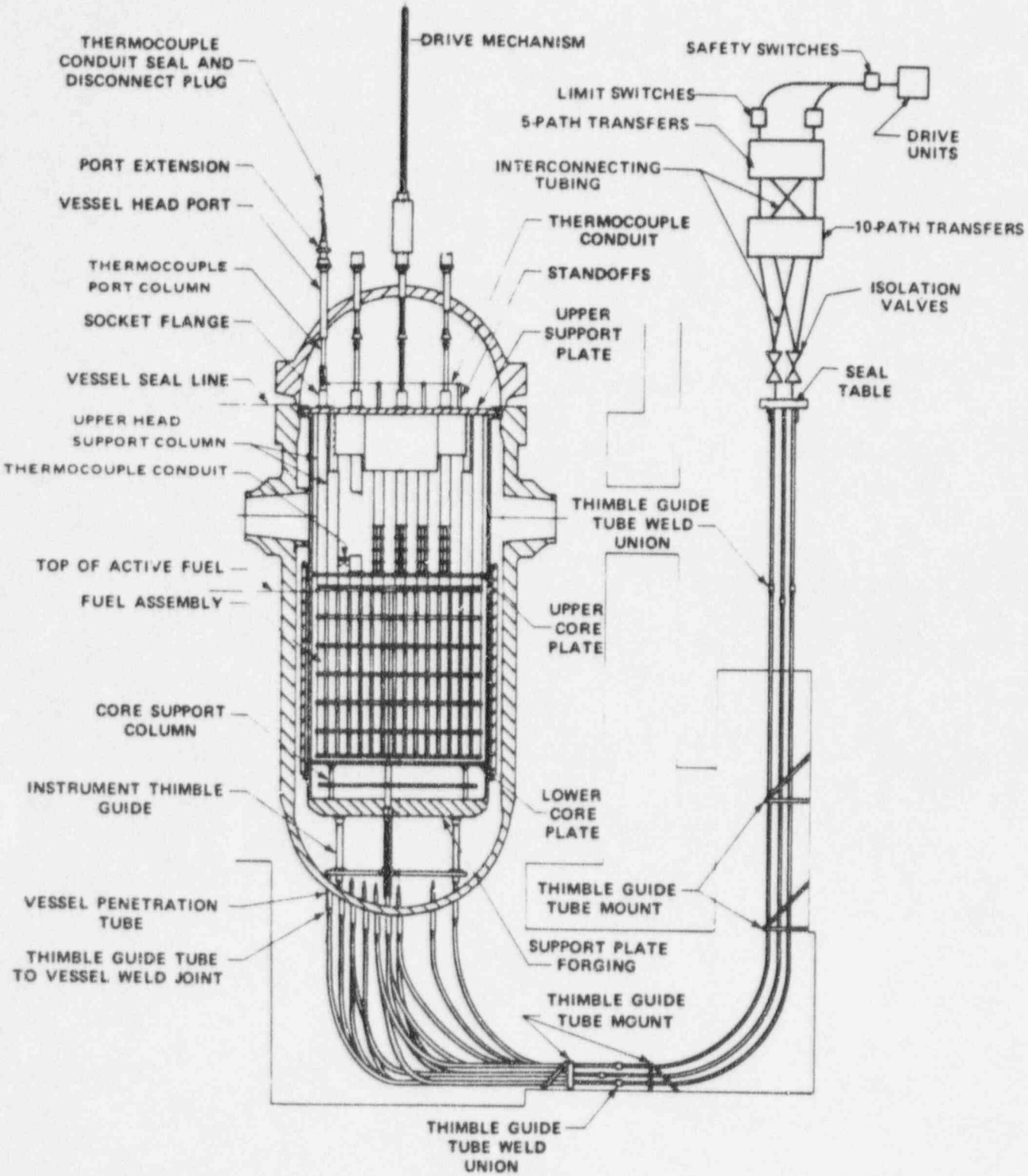
0882



TYPICAL DRIVE SYSTEM FOR
IN-CORE INSTURMENTATION

FIGURE 8.2-5

0882



SCHEMATIC OF IN–CORE INSTURMENTATION