DEFINITIONS

α = FALSE ALARM PROBABILITY

σ = STD DEV OF MATERIALS BALANCE

MEASUREMENT IN fkg

fkg = FORMULA KILOGRAM

N = INVENTORY PERIOD IN DAYS

CQ = CONTROL QUANTITY IN fkg

$$\boxed{\begin{array}{c} \text{AMT OF LOSS} \\ \text{PER MCU} = 5 \text{ fkg} \\ \text{DETECTION PROB} \\ \text{PER MCU} \geq .99 \end{array}}$$

α	σ
.01	1.07
.05	1.26
.10	1.39
.20	1.60

$\longrightarrow$ REQUIRES $\sigma \leq 1.39$ FOR $\alpha \leq .10$
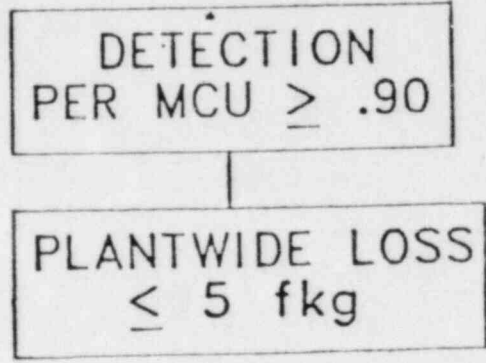
DETECTION PROBABILITY FOR A CQ LOSS

THERE ARE FIVE CONFIGURATIONS

WITH DETECTION PROBABILITY ≥ 90

CONFIGURATION 1

ASSUME 5 MCUs
WITH CQ = 1 PER MCU

DETECTION
PER MCU ≥ .90

PLANTWIDE LOSS
≤ 5 fkg

σ (PER MCU)	α
.28	.01
.34	.05
.39	.10
.47	.20
.51	.25

→ σ MUST BE SMALL TO MEET REQUIREMENT: OTHERWISE FALSE ALARM RATE BECOMES LARGE

CONFIGURATION 2

ASSUME 1 MCU WITH CQ = 5.0 fkg AND
4 OTHERS WITH CQ = 1.25 fkg EACH

CQ IN ONE MCU   5 fkg AND SUM
OF CQ IN REMAINING MCUs   5 fkg

DETECTION PROB.
PER MCU   .90

σ per MCU	α
.35	.01
.43	.05
.49	.10
.59	.20
.64	.25

→ σ MUST BE SMALL TO MEET REQUIREMENT:
OTHERWISE FALSE ALARM RATE BECOMES LARGE

CONFIGURATION 3

ASSUME 5 MCUs WITH LOSS OF 1.6 fkg EACH

DETECTION PROB
PER MCU $\geq$ .90

CQ IN TWO MCUs $\leq$ 5 AND SUM
OF CQ IN REMAINING MCUs $\leq$ 5

$\dot{\sigma}$	α
.44	.01
.55	.05
.62	.10
.75	.20
.81	.25

→ σ MUST BE SMALL TO MEET REQUIREMENT;
OTHERWISE FALSE ALARM RATE BECOMES
LARGE

CONFIGURATION 4

ASSUME MCUs
WITH CQ = 5 fkg PER MCU

> DETECTION PROB
> PER MCU $\geq$ .90

> CQ IN EACH
> MCU = 5

σ	α
1.07	.01
1.26	.05
1.39	.10
1.58	.20
1.67	.25

(NOTE: α AND σ BASED ON MORE STRINGENT
99% DP)
→ REQUIRES EACH MCU TO BE ISOLATED

CONFIGURATION 5

DETECTION PROB
PER MCU $\geq$ .90

ANY OTHER METHOD: COMBINE
MCUs IN PLANT INTO
ONE MCU

σ	α
1.07	.01
1.26	.05
1.39	.10
1.58	.20
1.67	.25

(NOTE: α AND σ BASED ON MORE STRINGENT
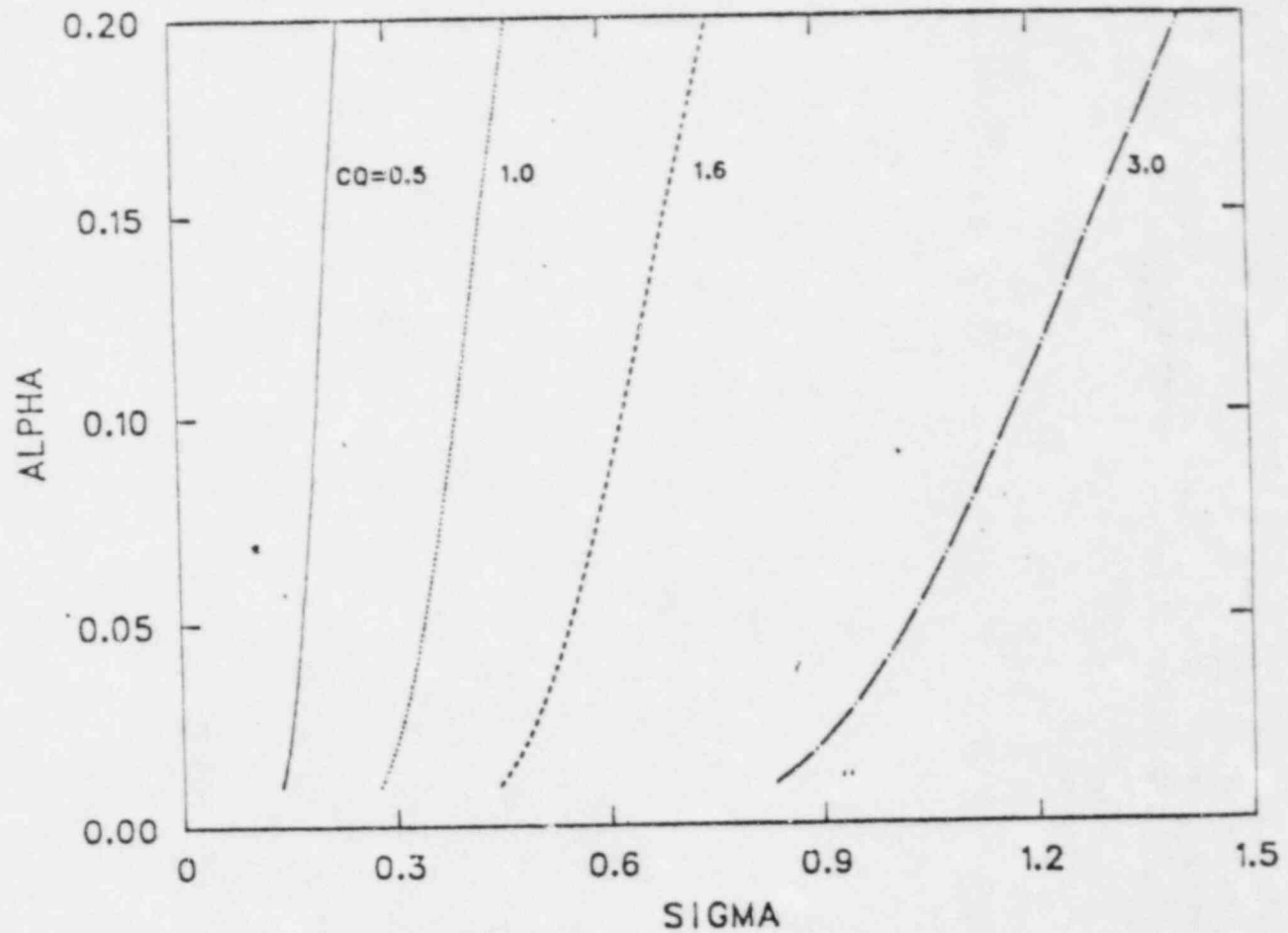99% DP)
→ REQUIRES EACH PLANT TO BE 1 MCU

RULE 70:83 (3)(iii)

EXPECTED AMOUNT OF MATERIAL IN INVENTORY PERIOD ASSOCIATED WITH UNRESOLVED FALSE ALARMS ≤ 2

α	CONTROL QUANTITY	σ	INVENTORY PERIOD N
.01	1.0	.28	270
	2.0	.55	135
	2.5	.83	90
.05	1.0	.34	56
	2.0	.68	28
	2.5	.85	22
.10	1.0	.39	29
	2.0	.78	14
	2.5	.98	11

$\longrightarrow \sigma$ MUST BE SMALL TO MEET REQUIREMENT: OTHERWISE INVENTORY PERIOD IS TOO SMALL.

α VS σ FOR VARIOUS CQ WHEN 2 fkg SPEC IS MET FOR 1 MCU. (NOTE: INVENTORY PERIODS ARE VERY SMALL FOR CQ > 3)

→ SIGMA MUST BE SMALL TO MEET REQUIREMENTS; OTHERWISE FALSE ALARM RATE BECOMES LARGE.
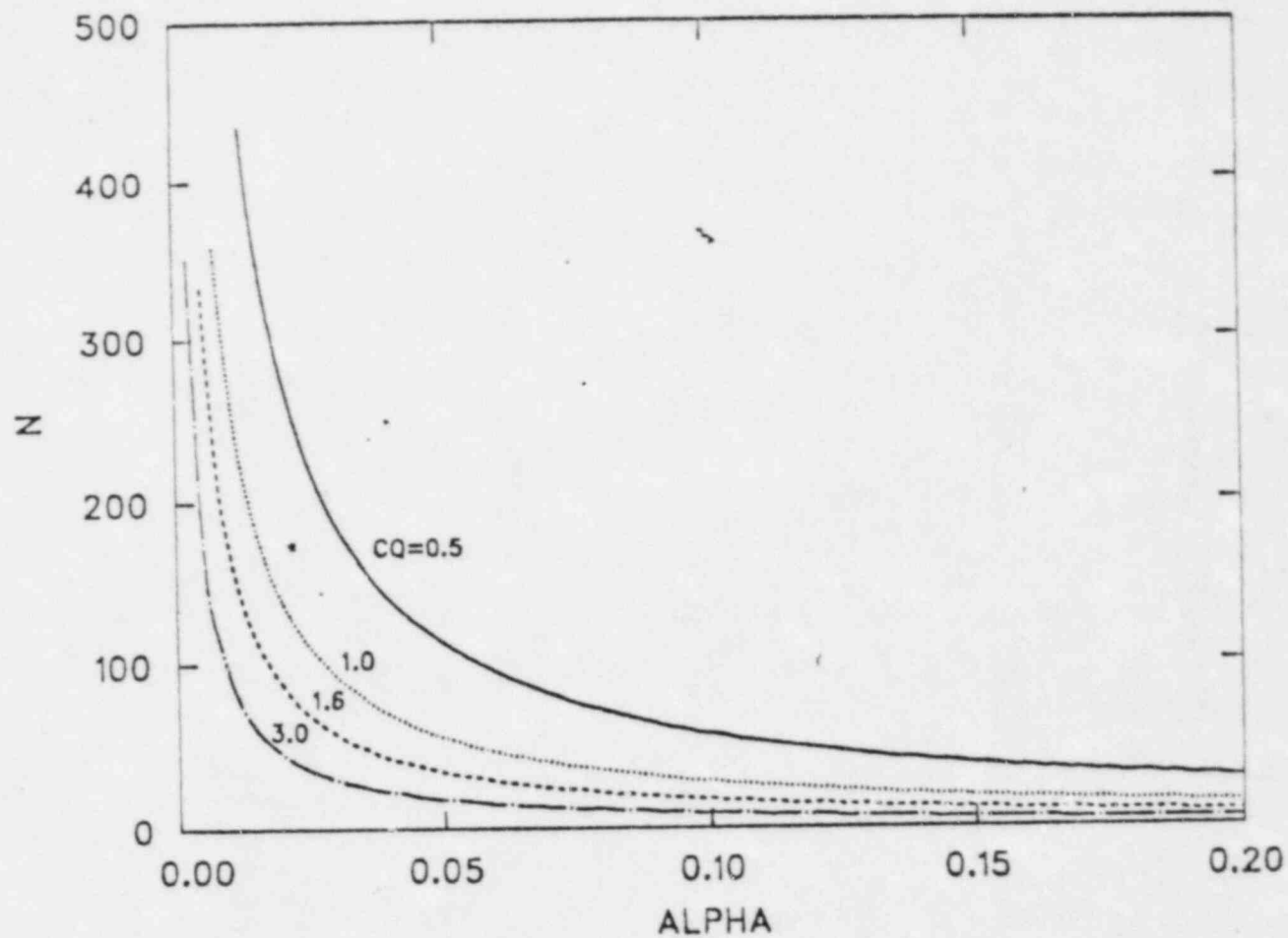
LENGTH OF INVENTORY VS α FOR VARIOUS CQ WHEN 2 fkg
IS MET FOR 1 MCU

⟶ SMALL VALUES OF α ARE NEEDED TO OBTAIN
60–360 DAY INVENTORY PERIODS.
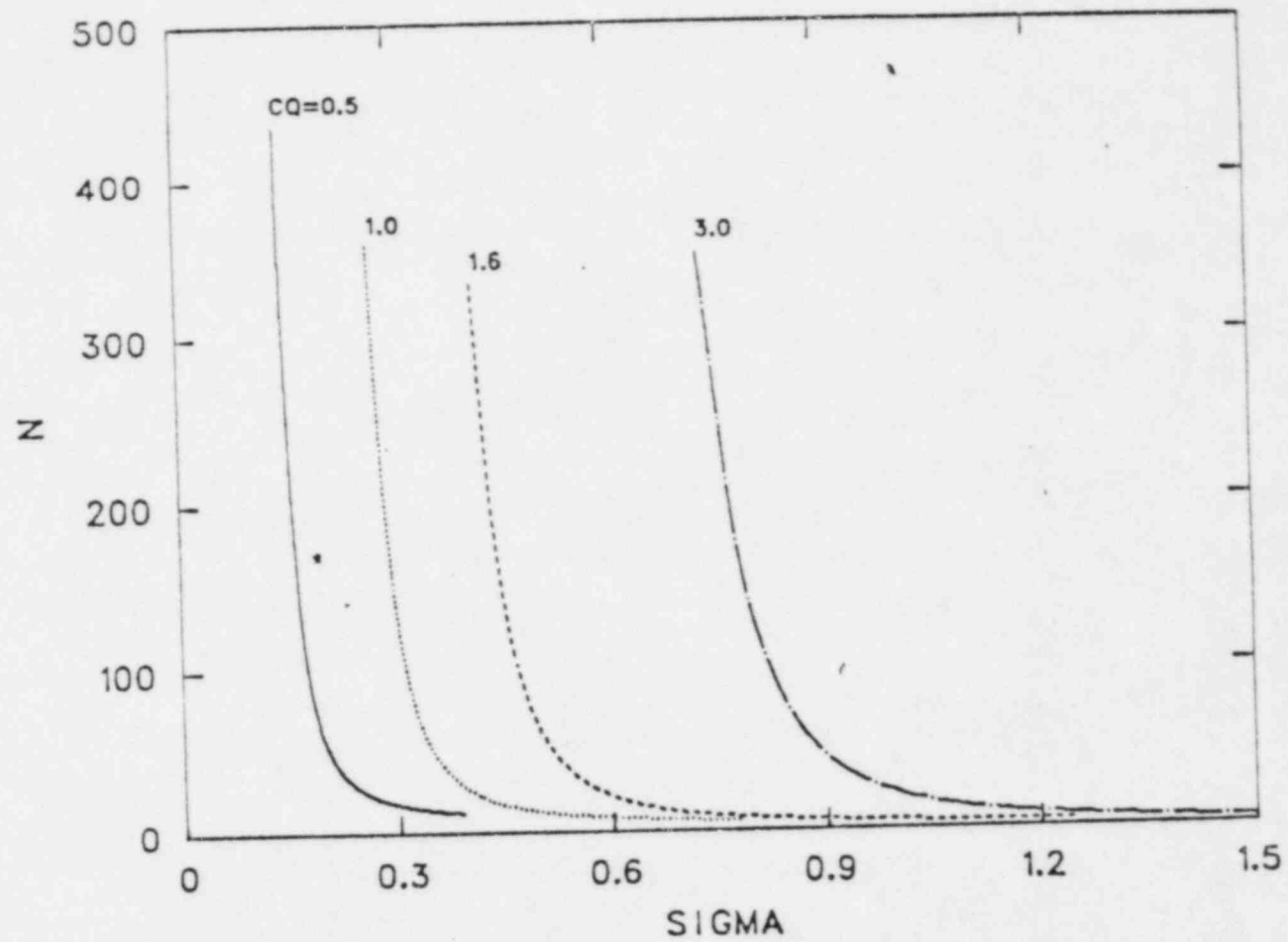
LENGTH OF INVENTORY VS σ FOR VARIOUS CQ WHEN 2 fkg SPEC IS MET FOR 1 MCU

$\longrightarrow$ SMALL DECREASES IN SIGMA CAUSE SHARP INCREASES IN N.

ACTION THRESHOLD FOR A CUMULATIVE IMBALANCE WITH
90% DETECTION PROBABILITY OF A 5-fkg LOSS
REQUIRES FREQUENT RESPONSES.

CUSUM TEST

Use Σx as a test statistic with 5-fkg
loss and D.P.=.90

SIGMA=1		SIGMA=.5	
n	α	n	α
1	<.01	1	<.01
4	.11	4	<.01
9	.26	9	.02
16	.51	16	.16
25	.61	25	.24
50	.76	50	.45
		61	.50

→ SIGMA MUST BE SMALL TO MEET REQUIREMENT;
OTHERWISE ALPHA GETS TOO LARGE TOO FAST.

SUMMARY

RULE	CONCLUSIONS
70:83 (a)(3)(i)	RULE CAN BE MET SATISFACTORILY
70:83 (a)(3)(ii)	
CONFIGURATIONS 1 2 3	SIGMA MUST BE SMALL TO MEET REQUIREMENT: OTHERWISE FALSE ALARM RATE BECOMES LARGE
4 5	REQUIRES EACH MCU TO BE ISOLATED REQUIRES EACH PLANT TO BE 1 MCU
70:83 (a)(3)(iii)	LARGE FALSE ALARM RATES AND LARGE SIGMAS GIVE SMALL VALUES OF N: SMALL DECREASE IN SIGMA RESULTS IN LARGE DECREASE IN ALPHA
70:83 (d)(1)(i)	SIGMA MUST BE SMALL TO MEET REQUIREMENT: OTHERWISE FALSE ALARM RATE BECOMES LARGE
70:83 (d)(1)(ii)	SIGMA MUST BE SMALL TO MEET REQUIREMENT: OTHERWISE TOO MANY ERRONEOUS RESPONSES

EXAMPLE SYSTEM BETA
MCU STANDARD DEVIATIONS, σ
$\underline{UF_6 \text{ TO } U_3O_8 \text{ CONVERSION}}$

		$\sigma (KG)$
MCU-1:	PREHEAT - STORAGE:	0.3058
MCU-2:	FEED MAKEUP - CALCINE:	1.6400
MCU-3:	BLEND - CROSS BLEND:	0.1562
MCU-4:	ION EXCHANGE:	0.0624
	SUM	2.1644

HTGR COATED PARTICLE

MCU-1:	DISSOLUTION - BROTH PREPARATION:	1.1793
MCU-2:	DROP FEED - DRYER:	1.2244
MCU-3:	CALCINER (UO_2):	0.6946
MCU-4:	SINTER - SCREEN:	0.5087
MCU-5:	CARBON COATER - INSPECTION:	0.2636
	SUM	3.8706

SCRAP RECOVERY

MCU-1:	PRETREATMENT - DISSOLUTION:	0.5496
MCU-2:	PURIFICATION:	0.8205
MCU-3:	CONVERSION (U_3O_8):	0.7490
MCU-4:	BLEND:	1.1003
	SUM	3.2194

INNOCENT CAUSES

ANOMALY IN PROCESSING MATERIAL (FAILURE TO RECORD A MATERIAL MOVEMENT)

RANDOM ERROR

ERROR IN RECORDING

OTHER ERRORS
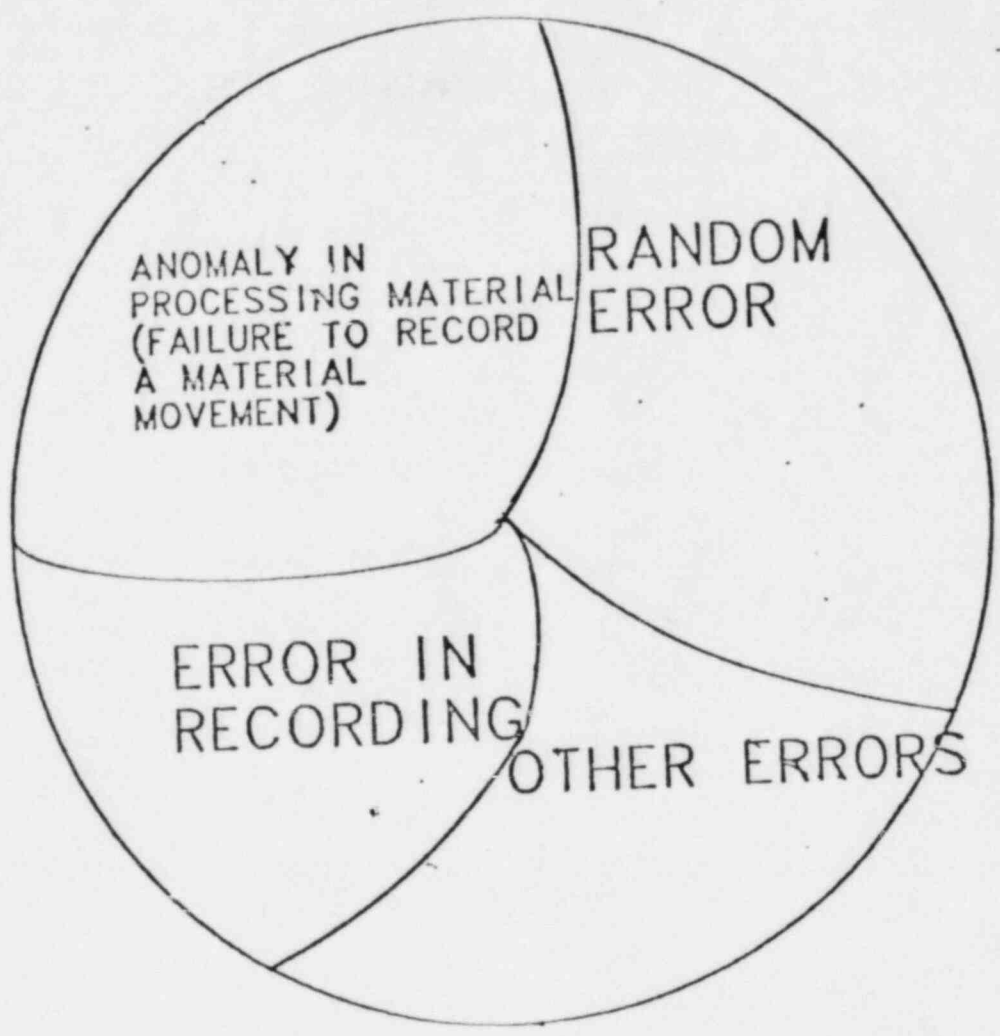
→ RESPONSE TO FALSE ALARMS WILL NOT RESULT IN A SIGNIFICANT CHANGE IN EXPECTED SHORT INVENTORY PERIODS

UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION II
10' MARIETTA ST., N.W., SUITE 3100
ATLANTA, GEORGIA 30303

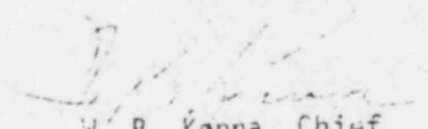In Reply Refer To: JUN 11, 1980
R.:AT
70-143/80-08

Nuclear Fuel Services, Inc.
ATTN: W. C. Manser, Jr.
       General Manager
Erwin, TN 37650

Gentlemen:

Thank you for your letter of May 14, 1980, informing us of steps you
have taken to correct the item of noncompliance concerning activities
under NRC License No. SNM-124 brought to your attention in our letter
of April 23, 1980. We will examine your corrective actions and plans
during subsequent inspections.

We appreciate your cooperation with us.

Sincerely,

W. B. Kenna, Chief
Safeguards Branch

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In Reply Refer To: JUN 1 1 1980
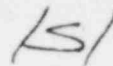RII:AT
70-143/80-08

Nuclear Fuel Services, Inc.
ATTN: W. C. Manser, Jr.
       General Manager
Erwin, TN 37650

Gentlemen:

Thank you for your letter of May 14, 1980, informing us of steps you
have taken to correct the item of noncompliance concerning activities
under NRC License No. SNM-124 brought to your attention in our letter
of April 28, 1980. We will examine your corrective actions and plans
during subsequent inspections.

We appreciate your cooperation with us.

                                   Sincerely,

                                   /S/

                                   W. B. Kenna, Chief
                                   Safeguards Branch

    bcc: Local Public Document Room
          Washington Public Document Room
          Central Files
          Nuclear Safety Information Center
          Technical Information Center
          IE Mail and File
          Region II Reading Room
          State of Tennessee

          U.S. Nuclear Regulatory Commission
          T. D. Lee, Resident Inspector
          P. O. Box 627
          Erwin, TN 37650

8007010105   264

OFFICE ▶	RII	R	RII	RII		
SURNAME ▶	ATillman:nb	FPGillespie	JBKante	WBKenna		
DATE ▶	6/11/80	6/ /80	6/ /80	6/11/80		

NFS

Nuclear Fuel Services, Inc. ERWIN. TENNESSEE 37650

A Subsidiary of Getty Oil Company

(615) 743-914

May 12, 1980

U. S. Nuclear Regulatory Commission
Region II
101 Marietta Street, Suite 3100
Atlanta, Georgia 30303
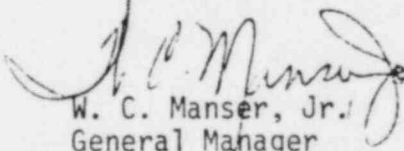
Attention: Mr. W. B. Kenna, Chief
               Safeguards Branch

Reference: (1) Docket 70-143; SNM License 124
               (2) RII:TDL;70-143/80-10 dated April 24, 1980

Gentlemen:

In response to Reference (2), we have reviewed the referenced

letter and found no proprietary information.

Very truly yours,

W. C. Manser, Jr.
General Manager

WCM:clr

cc: Mr. James G. Partlow, Chief
     Material Control & Accountability
       Licensing Branch

     U. S. Nuclear Regulatory Commission
     c/o Document Management Branch
     Washington, DC 20555