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CRUTCHFIELD,D. Operating Reactors Branch 5

SUBJECT: Forwards safety evaluation on dilute chemical decontamination of steam generator channel heads per 830307 telcon request. No Tech Spec change required.

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March 31, 1983

Director of Nuclear Reactor Regulation
Attention: Mr. Dennis M. Crutchfield, Chief
Operating Reactors Branch No. 5
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Subject: Steam Generator Channel Head Decontamination
R. E. Ginna Nuclear Power Plant
Docket No. 50-244

Dear Mr. Crutchfield:

Based on radiation dose estimates for steam generator maintenance activities scheduled for the current refueling outage, RG&E will be performing a dilute chemical decontamination of the channel heads of both Ginna steam generators. The decontamination, to be performed using a proprietary London Nuclear Service Inc. process, is expected to result in a radiation dose reduction of at least several hundred man-rem.

On March 7, 1983, we discussed our decontamination program with members of the NRC staff. In response to a request made during that telephone call, enclosed is the RG&E safety evaluation covering the decontamination program. The safety evaluation has been reviewed by the PORC and NSARB and it has been determined that the decontamination program does not constitute an unreviewed safety question and does not require a change in the plant Technical Specifications. Thus, the safety evaluation is provided for your information only.

Very truly yours,

John E. Maier

John E. Maier

Attachment

A001

Attachment

A&B Steam Generator Channel Head
Dilute Chemical Decontamination

1.0 **SCOPE OF ANALYSIS:**

1.1 This analysis covers the special test for A & B steam generator channel head dilute chemical decontamination whose major steps are included in Attachment A and depicted schematically in Figure 1. The primary reason for using the decontamination process is to affect a man-rem reduction during the subsequent nozzle dam installation and sleeving program. The dose estimate for the steam generator maintenance and repair program without decontamination is approximately 600man-rem. The decontamination factor for this process is estimated to be in the 2-10 range and thus a several hundred man-rem reduction will result.

2.0 **REFERENCES:**

2.1 USNRC Regulatory Guide No. 1.70 "Standard Format and Content of Safety Analysis Reports for Nuclear Power Plant."

2.2 Ginna Station Procedure A-303 Rev. 3, dated 10/6/82, Preparation, Review and Approval of Safety Analysis for Minor Modifications or Special Tests.

2.3 10CFR50.59 "Changes, Tests and Experiments", dated 2/3/82.

2.4 Ginna Tech. Spec. Section 3.6, Specification Containment Integrity, Section 3.15 Overpressure Protection System, Section 3.1.1.2 Steam Generator.

2.5 London Nuclear Services Inc. Proposal #82-71. Dilute Chemical Decontamination of Ginna Steam Generators.

2.6 Letter dated 2/1/83, titled Corrosion Investigation Report on Ginna Steam Generators Primary Side Channel Head Decontamination from RG&E Materials Engineering.

2.7 USNRC Regulatory Guide 1.109, page 44.

2.8 10CFR100, Subsection 11, Determination of Exclusion Area.

2.9 Letter dated 3/10/83 from John Cook to Tom Meyer titled Steam Generator Decontamination.

2.10 Letter dated 3/25/83, titled Corrosion Investigation Report on Ginna Steam Generators Primary Side Chanel Head Decontamination, Revision 1, from RG&E Materials Engineering.

2.11 Letter via telecopier, dated 3/25/83 from J. L. Smee, Manager Chemistry and Processes, London Nuclear Services, Inc. re: "Shipping-Port Decontamination of 1964" to T.A. Marlow.

2.12 Letter via telecopier, dated 3/25/83 from J. L. Smiee, Manager Chemistry and Processes, London Nuclear Services, Inc., re: "Corrosion Testing of Stainless Steel 3Ø4 and Inconel 6ØØ at 25Ø°F during Can-Decon tm," to T. A. Marlow.

3.Ø <u>SAFETY ANALYSIS:</u>

3.1 A review of events in Tables I and II of A-3Ø3 and of the events requiring analysis per Regulatory Guide 1.7Ø and Ginna Station Technical Specifications has been made. The events related to this special test are:

I. Procedure A-3Ø3 Table II

<u>Heading: Reactivity and Power Distribution Anomalies</u>

1) Chemical and volume control system malfunction that results in a decrease in the boron concentration in the reactor coolant of a PWR.

<u>Heading: Increase in Reactor Coolant Inventory</u>

1) Chemical and volume control system malfunction (or operator error) that increases reactor coolant inventory.

<u>Heading: Radioactive Release from a Subsystem or Components</u>

1) Postulated radioactive releases due to liquid tank failures.

<u>General Heading: Internal and External Events</u>

II. Regulatory Guide 1.7Ø, Rev. 3, Section 4.5, Reactor Materials

<u>Subheading: Austentic Stainless Steel Components</u>

1) Provide a description of the processes, inspections, and tests on austenitic stainless steel components to ensure freedom from increased susceptibility to intergranular stress-corrosion cracking caused by sensitization.

[illegible]

Subheading: Other Materials

2) The processing and treatment of other special purpose materials such as Inconels should be described.

III. Technical Specification

Section 3.1.1.2

1) The temperature difference across the tubesheet shall not exceed 100°F.

3.2 Chemical and volume control system malfunction that results in a decrease in the boron concentration in the reactor coolant of a PWR.

3.2.1 Calculations contained in Attachment B reveal that if the RCS is borated to 2400 ppm prior to adding the dilute chemical solution volume equal to 2500 gallons, the Technical Specification on Containment Integrity that states "Positive reactivity changes shall not be made by rod drive motion or boron dilution whenever the containment integrity is not intact unless the boron concentration is greater than 2000 ppm", is assured.

3.2.2 Calculations performed in reference 2.9 reveal that inadvertent criticality is not possible since the channel head contains a relatively small volume of water and the circulation from the RHR system will prevent a slug of unborated water from reaching the core.

3.3 Chemical and volume control system malfunction (or operator error) that increases reactor coolant inventory.

3.3.1 This event is analyzed for the potential to overpressurize the reactor coolant system. The operability of the pressurizer PORV's or an RCS vent opening of greater than 1.1 square inches ensures that the RCS will be protected from pressure transients which could exceed the limits of Appendix G to 10CFR Part 50 when one or more of the RCS cold legs are $\leq$ 330°F. Since the special test will be done during refueling shutdown this requirement can be satisfied in all cases.

3.3.2 Temporary steam generator nozzle isolation devices will be utilized to contain the dilute chemical solution within the channel head areas. These devices have the ability to withstand the small differentials that will occur during the decontamination process.

3.4 Radioactive Release from a Subsystem or Components.

[illegible]

3.4.1 Attachment C. The doses which could be attributed to an accidental spill of resin would be unsignificant when compared to the 10CFR part 20 & 100 dose limits.

3.5 Internal and External Events.

3.5.1 Since this special test is a temporary one and conducted during plant refueling shutdown, no further evaluation is required.

3.6 Austenitic Stainless Steel Components.

3.6.1 Corrosion data studies on material compatibility of corrosion mechanisms like intergranular attack on 304 sensitized stainless steel was very slight and not considered to be a cause for concern. References 2.5, 2.10, and 2.12 contain material supporting corrosion data of tests performed using Con-Decon process at temperatures up to 250°F. There is no evidence that this process produces deleterious effects due to general or localized corrosion.

3.7 Other Reactor Materials.

3.7.1 Corrosion data studies on other reactor materials including Inconel, and Zircaloy were found to be acceptably low.

Exxon Nuclear Company, Inc. (Fuel Supplier) has technically reviewed the dilute chemical decontamination process and has verbally concurred with the above statement.

In addition, relative to items 3.6 and 3.7, this process will require isolation at the S/G nozzles. The following are some characteristics of the reagents:

1) They are dilute, mainly organic compounds.

2) They are quickly decomposed at reactor operating temperatures to innocuous compounds; carbon dioxide, nitrogen, ammonia, water, potassium, oxygen and manganese.

3) They are very susceptible to radiolytic decomposition to the same innocuous, volatile compounds.

4) Those that are not organic compounds are applied in a very dilute solution, and have been used in much more concentrated solutions with no deleterious effects.

5) Control of the solvent concentrations will be closely monitored by the vendor as well as our own laboratory analysis. The concentrations are controlled by small additions of reagents or removal by ion exchange equipment which may be rapidly placed in and out of service. This system will allow close control of the process chemical concentrations.

Thus, even if isolation failed, and a quantity of reagent entered the primary circuit, it would be further diluted, and the constituents would be thermally and radiolytically degraded to innocuous volatile compounds.

Samples from the Ginna steam generators have been sent to London Nuclear Services, Inc. for decontamination studies. These tests were performed at 200°F, however supporting corrosion data up to 250°F show no adverse effects on the already low corrosion rates.

This process has been used to decontaminate one channel head of the removed Surry steam generator. The results of this decontamination supported the conclusions in items 3.6.1 and 3.7.1.

In addition this process has been used to decontaminate total systems with zircaloy clad fuel in the vessel since 1973 with no adverse affects.

3.8 Technical Specifications - Section 3.1.1.2 the temerature difference across the tubesheet shall not exceed 100°F.

3.8.1 Administrative and procedural control of the dilute chemical decontamination solution height above the top of the tubesheet throughout the process at all times will satisfy this requirement and minimize thermal stresses in the tubesheet.

3.9 Therefore the margins of safety during normal operation and transient conditions anticipated during the life of the plant will not be reduced. The adequacy of structures systems and components provided for the prevention of accidents and for the mitigation of the consequences of accidents will be unchanged by the performance of this special test.

4.0 PRELIMINARY SAFETY EVALUATION

4.1 The probability of occurrence or the consequences of an accident or malfunction of equipment important to safety, previously evaluated in the safety analysis report will not be increased by the proposed special test.

4.2 The possibility of an accident or malfunction of a different type than any evaluated previously in the safety analysis will not be created by the proposed special test.

4.3 The margin of safety as defined in the basis for Technical Specifications will not be reduced by the proposed special test.

4.4 The proposed special test does not involve an unreviewed safety question or require a Technical Specification change.

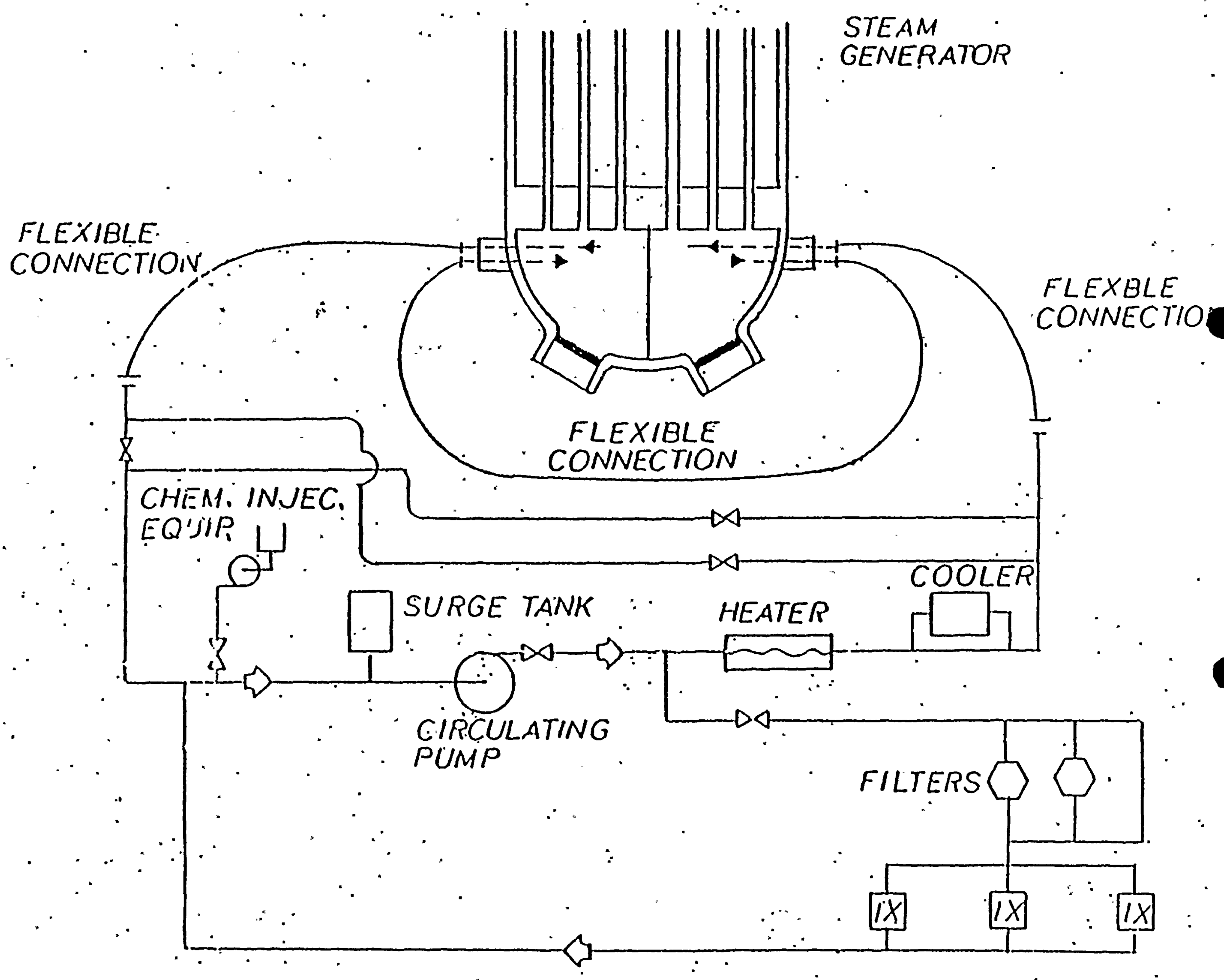

Figure 1

W.C.Z.
DATE 2-11-83
TO Tom Marlow

CAN DECON DECONTAMINATION EQUIPMENT

Attachment A

CAN-DECON DECONTAMINATION OF THE
GINNA STEAM GENERATORS
OUR PROPOSAL 82-71

1. The Key Events in the Dilute Chemical Decontamination Process

After draining the steam generators, installing the nozzle dams, and connecting the decontamination equipment, the following key events will take place:

- General inspection of installation to insure proper hookup.

- Radiation Survey of Channel Head

- Insert steam generator nozzle isolation device into each nozzle. Preload this device and compress the one half inch thick by two inch wide Duro Neopreme sealing material against nozzle wall.

- Fill channel heads and decon equipment with condensate or demin water to agreed level above tube sheet as indicted on tygon tube level indicator.

- Fill S/G U Tubes with ~ 2Ø psig nitrogen overpressure to provide sufficient degreees subcooling to allow operation at $\leq$ 25Ø °F and prevent steam formation.

- Isolate from water supply and check for leaks by performing a hydrostatic test of the interconnected piping at a test pressure equal to 25 psig.

  NOTE: The piping on the London Nuclear skids has been previously hydrostatically tested to 1.5 times design pressure (-15Ø).

- Liquid level will be monitored periodically throughout the decon.

- Start circulation, check for leaks.

- Start heaters with temperature set at desired valve, $\leq$ 25Ø °F.

- Add hydrazine to reduce oxygen to low levels.

- Based on calculated volume (25ØØ gallons), for two channel heads and the decontamination equipment, add chemical to give concentration of Ø.1-Ø.2 wt%. Note: No further chemical is added unless a reagent deficiency is observed.

- Five decontamination steps are planned.

1	Reduction
2, 4	Oxidation
3, 5	Reduction

- Steps 1, 3, and 5 consist of three parts:
  - Reagent Injection
  - Reagent Regeneration
  - Reagent Removal

- Steps 2 and 4 consist of two parts:
  - Reagent Injection
  - Reagent Removal

- Using high-pressure demineralized or condensate water, slurry the resin from the shielded ion exchange columns to the available collection tank or flask.

- All operations, except reagent removal are done at $\leq$ 250°F.

- Reagent removal is done at 160°F or lower.

- Upon completion, water in channel head will be approximately 10-20 micromho/cm conductivity and will contain less than 1×10^{-5} uCi/ml of activity.

- Shut down decontamination equipment and isolate.

- Drain channel head, disconnect and repeat for second steam generator.

- Frequent chemical analyses throughout the application will be used to monitor the reagent concentrations and to assess the effectiveness of the application. At the end of the decontamination, a radiation survey of identified points on the steam generator channel heads will be made compared with the before application readings and the decontamination factors determined.

Attachment B

Boron Dilution Calculations

Equation: $C_3V_3 = C_1V_1 + C_2V_2$

where C_n = concentration of ppm Boron (B)

V_n = volume in gallons of fluid

Assumptions:

1) Maintain $\geq$ 2050 ppm B
2) $V_3 = V_1 + V_2$
3) V_1 = dilute chemical solution = 2500 gal.
4) V_2 = RCS refueling shutdown volume = 15,000 gal.
5) C_1 = 0 ppm B

$$C_2 = \frac{C_3 V_3}{V_2}$$

$$C_2 = \frac{C_3 (V_1 + V_2)}{V_2}$$

$$C_2 = \frac{2050\ (17{,}500)}{15{,}000}$$

$$C_2 = 2392 \text{ ppm B}$$

[illegible]

Attachment C

Safety Analysis: London Nuclear Process
Resin Slurry to Liner Outside Containment

<u>Assumptions:</u>

1) 30 Curies of total activity in cation bed *1

2) 2.1% Co-58 94.9% Co-60; 2.84% Cs-134; 3% Mn-54 *2

3) 50 ft of pipe length, 2 in diameter or $3.1\text{x}10^4$ cc's

4) $\frac{30\ \text{Curies}}{7\ \text{cf}} = 1057\ \text{uCi/cc}$ *1

5) 0.1% non-association of contamination from resin beads is released over 2 hrs.

Assume

A rupture of the section of pipe outside of the CV, and 100% loss of contents. Two hours elapse and 0.1% of activities become airborne and expose an individual at the site boundry.

$3.10\text{x}10^4\ \text{cc} \times 1057\ \text{uCi/cc} \times 0.001 = 32.7\ \text{mCi}$
or $32{,}700$ uCi on the ground

$\frac{32{,}700\ \text{uCi}}{7{,}200\ \text{sec}}$ or $4.55\ \frac{\text{uCi}}{\text{sec}}$ released

$4.8\text{x}10^{-4}\ \frac{\text{sec}}{\text{M}^3}$ *4 $\times\ 4.55\ \frac{\text{uCi}}{\text{sec}} = 2.2 \times 10^{-3}\ \frac{\text{uCi}}{\text{M}^3}$

During 8 hrs, adult man inhales $\frac{9.6\text{x}10^3}{8\ \text{hrs}}$ liters *3

or $1.2\text{x}10^3$ liter/hr $\times\ \frac{1000\ \text{cc}}{\text{L}} = 1.2\text{x}10^6\ \frac{\text{cc}}{\text{hr}} \times 2$ hrs

$*2.4\text{x}10^6\text{cc} \times \frac{1\text{M}^3}{10^6\text{cc.}} = \underline{2.4\ \text{M}^3}$

$2.2\text{x}10^{-3}\ \frac{\text{uCi}}{\text{M}^3} \times 2.4\ \text{M}^3 = 5.23\text{x}10^{-3}$ uCi or $5.23\text{x}10^3$ pico curie total

*1 Based on 40 uCi/cm^2 (99% removal efficiency) per London Nuclear Inc. Analysis

*2 Based on Isotopic Data from London Nuclear

*3 Rad Health Handbook

*4 Letter from Dennis Crutchfield to John E. Maier SEP Topic II-2.C "Athospheric Transport & Diffusion Characteristics for Accident Analysis" (R.E. Ginna) Sept. 24, 1981.

$5.23x10^3$ total, of which

110.3 pCi is Co-58

$4.95x10^3$ pCi is Co-60

$1.58x10^2$ pCi is Mn-54

Using tables found in Reg. Guide 1.109, page 44, the total annual dose from the postulated accident would be for the whole body and lungs.

		Whole Body	Lungs
Mn-54	$1.58x10^2$ pCi x $7.87x10^{-7}$ $\frac{mRem}{pCi}$ =	$1.24x10^{-4}$mRem	
	$1.58x10^2$ pCi x $1.75x10^{-4}$ $\frac{mRem}{pCi}$		$2.75x10^{-2}$mRem
Co-58	110.3 pCi x $7.59x10^{-7}$ $\frac{mRem}{pCi}$ =	$2.85x10^{-5}$mRem	
	110.3 pCi x $1.16x10^{-4}$ $\frac{mRem}{pCi}$		$1.28x10^{-2}$mRem
Co-60	$4.98x10^3$ pCi x $1.85x10^{-6}$ $\frac{mRem}{pCi}$	$9.21x10^{-3}$mRem	
	$4.98x10^3$ pCi x $7.46x10^{-4}$ $\frac{mRem}{pCi}$		3.72mRem
	Totals:	$9.36x10^{-3}$mRem	3.72 mRem

The 50 year total integrated dose committment at the site boundary from a 2 hour exposure.

Total external dose from a point source of 4 curies using the same ratios as stated before and calculating for 1/2 mile,

"Mn-54"

$$(0.03) \times 30 \text{ Curies} \times 3.7\times10^{10} \frac{dis}{sec}/\text{Ci} \times 0.32\frac{Mev}{\gamma} \times .09\frac{\gamma}{d} \times 3.6\times10^{-5}\text{cm}^{-1}$$

$$\times\ 3600 \frac{sec}{hr} \times 1000 \frac{mR}{R} \div 4\times3.14\ (80520\text{cm})^2 \quad 7.02\times10^4 \frac{Mev/}{cm^3/R}$$

-or- 2.17×10^{-5} mR/hr

"Co-58"

$$(0.021)\times30C\times 3.7\times10^{10} \times (0.511 \frac{Mev}{\gamma} \times .38\frac{\gamma}{d} + .81\frac{Mev}{\gamma} \times 1\frac{\gamma}{d}) \times$$

$$3.8\times10^{-5} \text{ cm}^{-1}\times3600 \frac{sec}{hr} \times 1000 \frac{mR}{R}$$

$$\div\ 4\times3.14\ (80520 \text{ cm})^2 \times 7.02\times10^4 \frac{Mev\ /}{cm^2/R}$$

-or- 5.6×10^{-4} mR/hr

"Co-60"

$$(0.949) \times 30C\times 3.7\times10^{10}\times(2\frac{\gamma}{d} \times 1.25 \frac{Mev}{\gamma})\times3.0\times10^{-5}\text{cm}^{-1} \times$$

$$3600\frac{sec}{hr} \times 1000\frac{mR}{R}$$

$$\div\ 4\times3.14\ (80520 \text{ cm})^2 \times 7.02\times10^{-4}\frac{Mev\ /}{cm^3/R}$$

-or- $5.0059\times10^{-2}\frac{mR}{hr}$

Total External Dose ~ 1/2 mile from spill would be ~ $5.03\times10^{-2}\frac{mR}{hr}$

-or-

The external dose, at the fence ~ 700 feet away would be (using inverse square law)

0.72 mR/hr

The external dose 20 feet away (distance observer would be during fill)

866 mR/hr

Chelating Agent Requirements -

The chemical agents which involve chelating agents are less than 0.1% by weight at the start of the process. The state of South Carolina requires that chelating agents be identified when greater than 0.1% by volume.

The maximum volume of resins generated by the decontamination process is approximately 40 cubic feet. The density of the chelating agents is approximately 1 gram per cm^3. Therefore the quantity of volume should be less than 0.1 by volume as an additional 20 cubic feet of cement will be added. This will effectively reduce the quantity of chelating agents by volume to less than 0.066% by volume, or non-reportable by South Carolina standards.

Solidification of Resins -

The resin generated by the decontamination will be solidified by a vendor, in a vendor cask, performed by vendor technician and a plant approved procedure.