NRC FORM 195 (2-76)

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TO: D.L. Ziemann

FROM: Arkansas Power & Light Co.
Little Rock, Arkansas
W. Cavanaugh, III

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PROP

INPUT FORM

DESCRIPTION

Ltr. re. our lte. of 10-7-75...
Ltr. trans the following.....

ENCLOSURE

Proposed Amdt. to OL/Change to Tech. Spec. Consisting of revisions to Tech. Specs. with regard to Effects of Thiosulfate Concentration on the Thyroid Dose.....W/Attached Tables...

(1 Signed & 39 C. Cys. Received)

PLANT NAME: Arkansas # 1

THIS DOCUMENT CONTAINS POOR QUALITY PAGES

FOR ACTION/INFORMATION

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NRC FORM 195 (2-76)

HELPING BUILD ARKANSAS

ARKANSAS POWER & LIGHT COMPANY

9TH & LOUISIANA STREETS • LITTLE ROCK, ARKANSAS 72203 • (501) 371-4000

March 1, 1976

Director of Nuclear Reactor Regulation
ATTN: Mr. Dennis L. Ziemann, Chief
Operating Reactor Branch #2
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Subject: Arkansas Power & Light Company
Arkansas Nuclear One-Unit 1
Docket No. 50-313
License No. DPR-51
Proposed Technical Specification Changes

Gentlemen:

Attached find our evaluation concerning the effect that the reduction in sodium thiosulfate concentration in the Reactor Building Spray System will have on iodine removal capability, as requested by Mr. Bill Converse of your staff. This information is submitted as a supplement to our original request for changes to the technical specifications concerning tank level and chemical concentration limits in the Reactor Building Spray System, as was transmitted on October 7, 1975.

Whereby, with this supplemental information, we request those changes as were originally proposed in the aforementioned letter.

Very truly yours,

William Cavanaugh III
Manager, Nuclear Services

WC:ay

Attachment

2126

Effect of Thiosulfate Concentration on the Thyroid Dose

A study was conducted to determine the effect on the thyroid dose of lowering the sodium thiosulfate spray solution concentration, from the design value of 1.0 wt % to the current technical specification value of 0.66 wt %. The calculation determined the net percentage change in the FSAR two-hour thyroid dose at the exclusion area boundary (EAB) and the 30 day thyroid dose at the low population zone (LPZ).

The calculation was based upon the same assumptions and parameters noted in Chapter 14 of the FSAR except for the iodine fraction values. The old Safety Guide 4 iodine fractions (85% elemental, 10% organic, 5% particulate) used originally to calculate the thyroid doses for the Maximum Hypothetical Accident (MHA) in Chapter 14 of the FSAR were replaced by Regulatory Guide 1.4 iodine fractions (91% elemental, 4% organic, 5% particulate).

The iodine removal rate for each iodine species is shown in the attached Table 1 for sprays with different sodium thiosulfate concentration. The removal rates for the elemental and particulate forms of iodine are assumed to be independent of the thiosulfate concentration, because:

a) the chemical reaction rate between thiosulfate and elemental iodine is so fast at these high concentrations (approximately 1000 times greater than required for complete reaction) that the rate of elemental iodine absorption by the spray drops is controlled by the relatively slow diffusion rate of iodine through the gas-film surrounding each drop and is essentially unaffected by several fold changes in the thiosulfate concentration; and,

b) the removal rate of particulate iodine is controlled by the physical scrubbing action of the spray drops, and the chemical action of the thiosulfate has little or no effect.

The chemical reaction rate between thiosulfate and organic iodine is slow enough that the concentration of thiosulfate does have a significant affect on the rate of organic iodine absorption by spray drops. The effect of thiosulfate concentration (c) on the organic iodine removal rate (λ) was calculated using the following empirical relationship.[1]

$$\lambda_2 = \lambda_1 \ (C_2/C_1)^{1/2}$$

The relative thyroid doses at the EAB and LPZ were calculated for three different spray conditions and are summarized in Table 2.

Case 1 (base case) assumes operation with one spray header, Regulatory Guide 1.4 iodine fractions, and a constant sodium thiosulfate concentration of 1.0 wt% in the spray solution. The spray is turned off after 200 hours of operation. Also, the thyroid doses were adjusted to account for 50% of the iodine activity leaking from the containment being processed by a 90% efficient penetration room ventilation system.

Case 2 uses the same parameters and assumptions as in Case 1, except the organic iodine removal rate is 0.08124 hr^{-1} which corresponds to a constant sodium thiosulfate concentration of 0.66 wt % in the spray. The resultant two-hour and 30-day thyroid doses (as compared to the base case) would increase by 0.51% and 3.2%, respectively.

Case 3 assumes a more realistic approach of calculating the 2 hour and 30 day thyroid doses by taking credit for the higher sodium thiosulfate concentration in the spray header during the injection period. After suction is switched to the sump, the spray solution sodium thiosulfate concentration will be at the technical specification value of 0.66 wt %. A conservative estimate of the sodium thiosulfate concentration in the one header during the 42 minute injection period is 3.0 wt %. Results of Case 3 calculation shows that by spraying with a 3.0 wt % sodium thiosulfate solution for the 42 minute injection period followed by a spray containing 0.66 wt % thio results in a two-hour thyroid dose at the EAB which is 0.17% lower than Case 1. On the other hand, this short spray period with 3.0 wt % thio has very little affect on the 30 day thyroid dose, which still shows an increase of 3.1% compared to Case 1.

Reference

(1) "Effectiveness of Sodium Thiosulfate Spray for Iodine Removal", BAW-10024, January 1971, p. 5-24.

Table 1

Effect of Thiosulfate Concentration on Iodine Removal Rates

Sodium Thiosulfate Concentration (wt%)	Iodine Removal Rates/Iodine Form		
	Elemental	Organic	Particulate
1.0	9.533*	0.1000**	0.45
0.66	9.533*	0.08124**	0.45
3.0	9.533*	0.1724**	0.45

*Elemental iodine removal rate $= \frac{105\ FH}{V}$

Where:

F = spray flow rate, 1500 gpm (one header operation)

H = fall height of spray, 115 ft

V = Free volume of Containment Building, $1.9 \times 10^6\ ft^3$

**The organic iodine removal rate is half of the indicated value after the first 2 hours due to the lower temperature in the reactor building.

Table 2

Effect of Thiosulfate Concentration on the Thyroid Doses

Case Number	Iodine Fractions			Change in Thyroid Dose	
	Elemental	Organic	Particulate	2 Hour (EAB)	30 Day (LPZ)
1*	0.91	0.04	0.05		
2*	0.91	0.04	0.05	+0.51%	+3.2%
3*	0.91	0.04	0.05	-0.17%	+3.1%

*Definition of Cases:

Case 1 - Base case, one header operation, sodium thiosulfate concentration of 1.0 wt%, sprays turned off after 200 hours, 50% of the iodine leakage from the containment is processed by the penetration room ventilation system.

Case 2 - One header operation, sodium thiosulfate concentration of 0.66 wt%, spray turned off after 200 hours, 50% of the iodine leakage from the containment is processed by the penetration room ventilation system.

Case 3 - One header operation, initial 42 minute of spray containing 3.0 wt% sodium thiosulfate followed by 0.66 wt% sodium thiosulfate spray for 199.3 hours, 50% of the iodine leakage from the containment is processed by the penetration room ventilation system.