TENNESSEE VALLEY AUTHORITY

CHATTANOOGA, TENNESSEE 37401
400 Chestnut Street Tower II

September 22, 1983

Director of Nuclear Reactor Regulation
Attention: Ms. E. Adensam, Chief
Licensing Branch No. 4
Division of Licensing
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Ms. Adensam:

In the Matter of	)	Docket Nos. 50-327
Tennessee Valley Authority	)	50-328

By my letters to you dated September 17, 1982 and July 1, 1983, we requested changes to the technical specification 3.6.1.9 to support operations for unit 1 and 2 at our Sequoyah Nuclear Plant. As requested in telephone conversations with Carl Stahle of your staff, enclosed is a probabilistic risk assessment (PRA) study to support our request for a revision in the technical specifications. This PRA study was performed to quantify the effect on containment isolation failure probability if more than one set of containment purge lines is open during modes 1, 2, 3, and 4.

If you have any questions concerning this matter, please get in touch with Jerry Wills at FTS 858-2683.

Very truly yours,

TENNESSEE VALLEY AUTHORITY

L M Mills

L. M. Mills, Manager
Nuclear Licensing

Sworn to and subscribed before me
this 23rd day of September 1983

Paulette H. White
Notary Public
My Commission Expires 9-5-84

Enclosure
cc: U.S. Nuclear Regulatory Commission (Enclosure)
Region II
Attn: Mr. James P. O'Reilly Administrator
101 Marietta Street, NW, Suite 2900
Atlanta, Georgia 30303

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ENCLOSURE

Probabilistic Risk Assessment for
Containment Purge System

Sequoyah Nuclear Plant
Units 1 and 2

Containment Purge System

Background

The containment purge system at Sequoyah is used during normal operation to reduce radiation levels inside containment and to control containment pressure, temperature, and relative humidity. During containment purge, an open path exists between the containment and the environment. In order to limit the risk due to an inability to isolate containment purge, the technical specifications (TS 3.6.1.9) permit only one pair (one supply line and one exhaust line) of purge lines to be open in modes 1, 2, 3, and 4. The following analysis will determine the effect on containment purge isolation of the proposed change to TS 3.6.1.9 which would allow the simultaneous operation of 3 sets of purge lines during normal operation.

Configuration

As shown in Figure 1, five sets of containment purge supply and exhaust lines penetrate containment. Each of these lines has two isolation valves which are normally closed except during containment purging through that line. During purge operation, these valves are energized open. Isolation capability is provided by train A and train B containment vent isolation signals which energize a relay to open a set of contacts in the solenoid circuit of the valve. The relays are designed to "latch in" and maintain the solenoid circuit in the deenergized state in the event that the isolation signal is lost. All of the valves are air-operated and are designed to "fail closed" on loss of air or control power to the solenoid circuit.

Data

The probability of failure to isolate was calculated for both the present and proposed operating configurations using data from existing probabilistic risk analyses:

Failure of SSPS to generate containment vent isolation signals (one train) = 3.56×10^{-3}/demand (Zion PSS)

Failure of SSPS to generate containment vent isolation signals (both trains) = 2.72×10^{-6}/demand (Zion PSS)

Failure of air-operated valve to transfer to the failed position = 2.66×10^{-4}/demand (Browns Ferry)

Single Line Operation

Assuming the configuration shown in Figure 1, a failure to isolate containment is dominated by the following events:

1. FCVs 30-14 and -56 remain open due to failure of train A containment vent isolation signal coupled with a hardware failure of FCV 30-15 or -57.

2. FCVs 30-15 and -57 remain open due to failure of train B containment vent isolation signal coupled with a hardware failure of FCV 30-14 or -56.

3. Failure of both train A and train B containment vent isolation signals.

The probability of failure due to events 1 through 3 is given by:

$$3.56 \times 10^{-3}(2.66 \times 10^{-4} + 2.66 \times 10^{-4}) +$$
$$3.56 \times 10^{-3}(2.66 \times 10^{-4} + 2.66 \times 10^{-4}) +$$
$$2.72 \times 10^{-6}$$

Failure to isolate = 6.51×10^{-6}

Two Line Operation

Again referring to Figure 1, it is now assumed that FCVs 30-7, -8, -50, and -51 are also open. Failure to isolate containment is dominated by the following events:

1. FCVs 30-7, -51, -14, and -56 remain open due to failure of train A containment vent isolation signal coupled with a hardware failure of FCV 30-8, -50, -15, or -57.

2. FCVs 30-8, -50, -15, and -57 remain open due to failure of train B containment vent isolation signal coupled with a hardware failure of FCV 30-7, -51, -14, or -56.

3. Failure of both trains A and train B containment vent isolation signals.

The probability of failure due to events 1 through 3 is given by:

$$3.56 \times 10^{-3}(2.66 \times 10^{-4} + 2.66 \times 10^{-4} + 2.66 \times 10^{-4} + 2.66 \times 10^{-4}) +$$
$$3.56 \times 10^{-3}(2.66 \times 10^{-4} + 2.66 \times 10^{-4} + 2.66 \times 10^{-4} + 2.66 \times 10^{-4}) +$$
$$2.72 \times 10^{-6}$$

Failure to isolate = 1.03×10^{-5}

Three Line Operation

We now assume that FCVs 30-7, -8, -9, -10, -14, -15, -50, -51, -52, -53, -56, and -57 are open. Failure to isolate containment is dominated by the following events.

1. FCVs 30-7, -10, -14, -51, -52, and -56 remain open due to failure of train A containment vent isolation signal coupled with a hardware failure of FCVs 30-8, -9, -15, -50, -53, or -57.

2. FCVs 30-8, -9, -15, -50, -53, and -57 remain open due to failure of train B containment vent isolation signal coupled with a hardware failure of FCVs 30-7, -10, -14, -51, -52, or -56.

3. Failure of both trains A and B containment vent isolation signals.

The probability of failure due to events 1-3 is given by:

$(6)(3.56 \times 10^{-3})(2.66 \times 10^{-4})$ +

$(6)(3.56 \times 10^{-3})(2.66 \times 10^{-4})$ +

2.72×10^{-6}

Failure to isolate = 1.41×10^{-5}

Conclusions

The probability of failure to isolate three pairs of purge lines using containment isolation valves is a factor of 2.23 higher than for the case where only one pair is open. Even at 1.41×10^{-5}, however, the isolation capability is quite reliable, and this event is not a significant contributor to risk. The Reactor Safety Study (WASH-1400) found that sequences involving containment isolation failure were low in probability. In addition, secondary containment isolation valves also close upon receipt of either train containment vent isolation signal and provide an additional way to isolate flow through the purge lines.

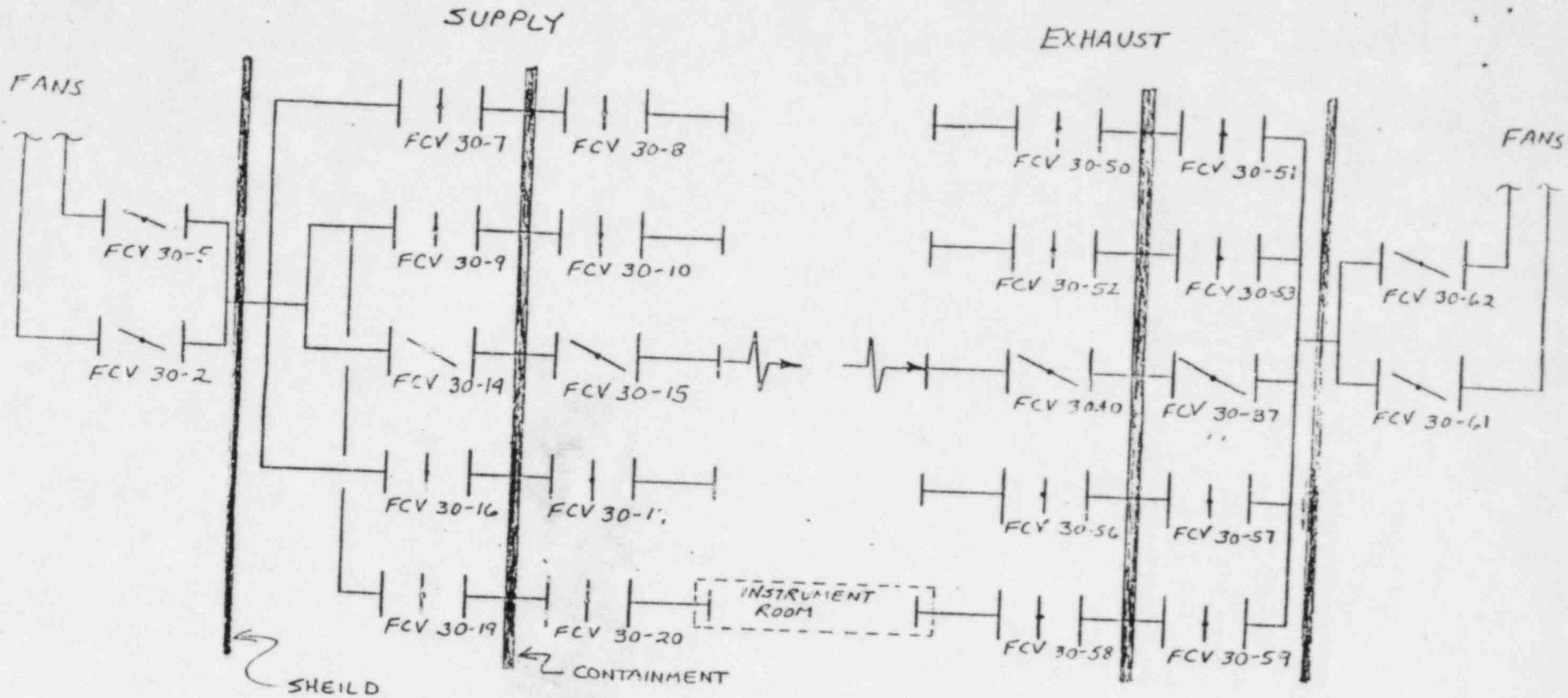
Supply Valve	Containment Vent Isolation Signal	Solenoid Circuit Power Source 125V dc Battery Bd Unit 1(Unit 2)	Manual Control	Exhaust Valve
FCV 30-2	TRA,TRB(buffered)	I(III)(a)	HS 30-2	
FCV 30-5	TRA,TRB(buffered)	I(III)(b)	HS 30-5	
FCV 30-7	TRA	I(III)	HS 30-7	FCV 30-51
FCV 30-8	TRB	II(IV)	HS 30-8	FCV 30-50
FCV 30-9	TRB	II(IV)	HS 30-9	FCV 30-53
FCV 30-10	TRA	I(III)	HS 30-10	FCV 30-52
FCV 30-14	TRA	I(III)	HS 30-14	FCV 30-56
FCV 30-15	TRB	II(IV)	HS 30-15	FCV 30-57
FCV 30-16	TRB	II(IV)	HS 30-16	
FCV 30-17	TRA	I(III)	HS 30-17	
	TRB	II(IV)	HS 30-37	FCV 30-37
	TRA	I(III)	HS 30-40	FCV 30-40
FCV 30-19	TRA	II(IV)	HS 30-19	FCV 3-58
FCV 30-20	TRA	I(III)	HS 30-20	FCV 30-59
	TRA,TRB(buffered)(a)	I(III)	HS 30-61	FCV 30-61
	TRA,TRB(buffered)(a)	I(III)	HS 30-62	FCV 30-62

All FCV listed deenergize to close.

All FCV fail closed on loss of air or control power to the valve solenoid circuit.

Containment vent isolation signals train A and train B energize a relay to open a contact in valve solenoid circuit.

(a) FCV 30-2, -5, -61, -62 receive two isolation signals: (1) a train A containment vent isolation signal which energizes a relay to open a contact in the valve solenoid circuit and (2) a train B (buffered) containment vent isolation signal which has a train A power source and deenergizes a relay to open a contact in the valve solenoid circuit.



CONTAINMENT PURGE AIR SYSTEM
FIGURE 1