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

Docket No. 50-395

JAN 15 1981

Mr. T. C. Nichols, Jr.
Vice President & Group Executive
Nuclear Operations
P. O. Box 764
Columbus, South Carolina 29281

Dear Mr. Nichols:

SUBJECT: SUMMARY OF SITE VISIT AND REQUEST FOR ADDITIONAL INFORMATION

Members of the Instrumentation and Control Systems Branch, Power Systems Branch and Reactor Systems Branch conducted an audit drawing review and site visit at the Virgil C. Summer Nuclear Station on November 12-14, 1980. Enclosure 1 summarizes the major points of the Instrumentation and Control Systems Branch review and identifies concerns and positions on design modifications which must be addressed.

We require that you respond to the nine positions identified in Enclosure 1 in order to complete our evaluation.

Sincerely,

Robert L. Tedesco, Assistant Director
for Licensing
Division of Licensing

Enclosure:
As stated

ENCLOSURE 1

SUMMER STATION SITE VISIT SUMMARY

We conducted an audit drawing review and site visit at the Summer Nuclear Station to assure that the installation of safety related electrical and instrumentation system and equipment were implemented in accordance with the design described in the Final Safety Analysis Report. This review followed the format of Appendix 7-B of the SRP. The review also included the control features related to the operation of the auxiliary feedwater system and the main steam relief capability. We also discussed the open items in the draft ICSB safety evaluation report input for the Summer Station. Based on our review of the control and protection system for the auxiliary feedwater system, we conclude that the applicant should address several concerns and implement appropriate modifications to resolve these concerns. Our positions with regard to these concerns are as follows:

A. Auxiliary Feedwater System

During the review of the Auxiliary Feedwater (AFW) System, we noted a number of concerns related to the control and protection aspects of the system design. The following discussion of the design of the AFW system is provided to clarify these concerns. Figure 1 is a simplified schematic of the AFW system. The two motor driven feed pumps (MDFPs) supply a common header with a separate feed to each steam generator. The turbine driven feed pump (TDFP), likewise, supplies a header, with a separate feed to each steam generator. A control valve is provided in each of the two separate feeds to each steam generator (e.g., IFV-3536 and 3531 for steam generator "A" in Figure 1). The control valves fulfill two safety functions. The first is to permit manual control of auxiliary feedwater flow to maintain the desired steam generator level for safe shutdown. The second is to permit manual isolation of a steam generator on feed-water/steam line breaks to protect the containment from over pressurization and to assure an adequate supply of auxiliary feedwater for the remaining steam generators for safe shutdown.

The air operated control valves are supplied air from the control-grade instrument air system and fail open on the loss of instrument air. Thus, on a loss of the non-safety instrument air system, the safety function to regulate AFW flow can only be accomplished via local operation of the handwheels on the control valves or by cycling the MDFP and throttling the TDFP speed. With instrument air available, the regulation of AFW flow is dependent upon the availablility of electrical power

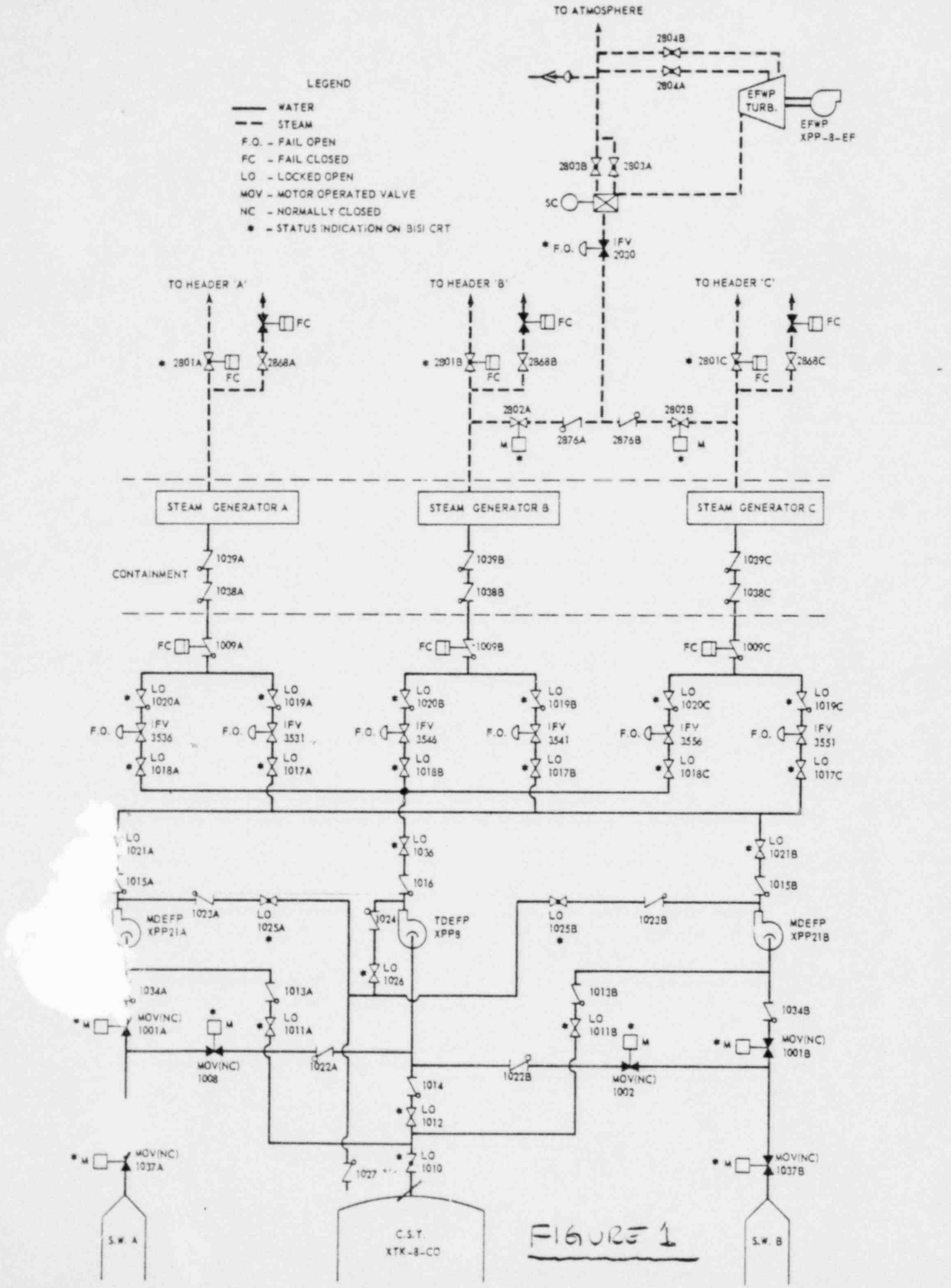

FIGURE 1 EFS FLOW SCHEMATIC

to the valve controls. As in the case of loss of air, the control valves fail open on the loss of electrical power to the control system. The control valves fed by the MDFPs are supplied power from a power source which is independent of the power source used to supply power to the control valves fed by the TDFP. Thus, a loss of an electrical power source would only prevent the capability to regulate AFW flow from one of the two sources of AFW. The power source dependence for the automatic initiation of the AFW system is such that a loss of an electrical power source would not prevent starting of the TDFP or one of the two MDFPs. Therefore, a loss of an electrical power source which could cause the control valves, associated with either the MDFPs or TDFP, to fail open, should not present a situation in which the safety function to regulate AFW flow cannot be maintained. For this event, termination of flow to the failed open control valves would require that the pump(s) associated with that water source be tripped. This capability exists for the MDFPs. For the TDFP, this capability is not straight forward. The TDFP is started by opening valve IFV-2030, see Figure 1. This valve is controlled by redundant dc power sources, the failure of either one cause the TDFP to start. These same power sources are used as the two power sources which would cause one or the other sets of control valves to fail open. Thus, the only means available to terminate steam flow to the TDFP would be the closure of the isolation valves from the two steam generators that feed the TDFP steam supply header. There are valves 2802A and 2802B in Figure 1 and operate from separate essential 480 volt buses.

With respect to the safety function of the AFW control valves to permit isolation of a steam generator for feedwater/steam line breaks, a single channel system is provided to automatically close the AFW control valves on high AFW flow to a steam generator. Since this automatic isolation does not satisfy the requirements to be classified as a safety related system, i.e., it does not satisfy the single failure criterion, manual isolation of the steam generators is the means by which this safety function is accomplished. Nevertheless, the automatic isolation features are a system important to safety even though these do not satisfy all the requirements of a safety-grade protection system. Figure 2 is the P&I drawing of the AFW system. The control valves fed from the MDFP header are closed on high flow that is measured by a flow element located down stream of the control valves (FE-3531 for steam generator A in Figure 2).

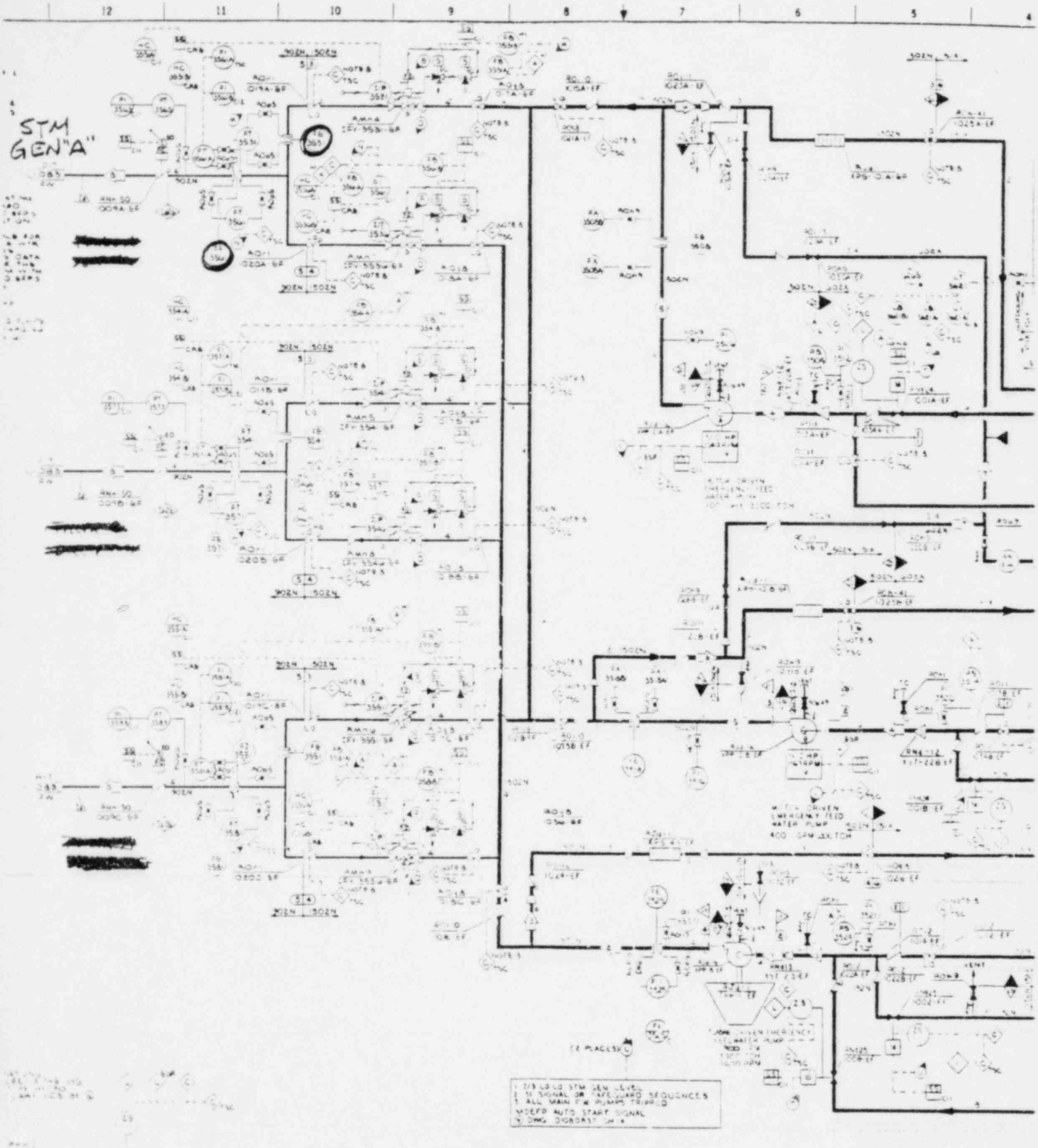

FIGURE 2

AMENDME
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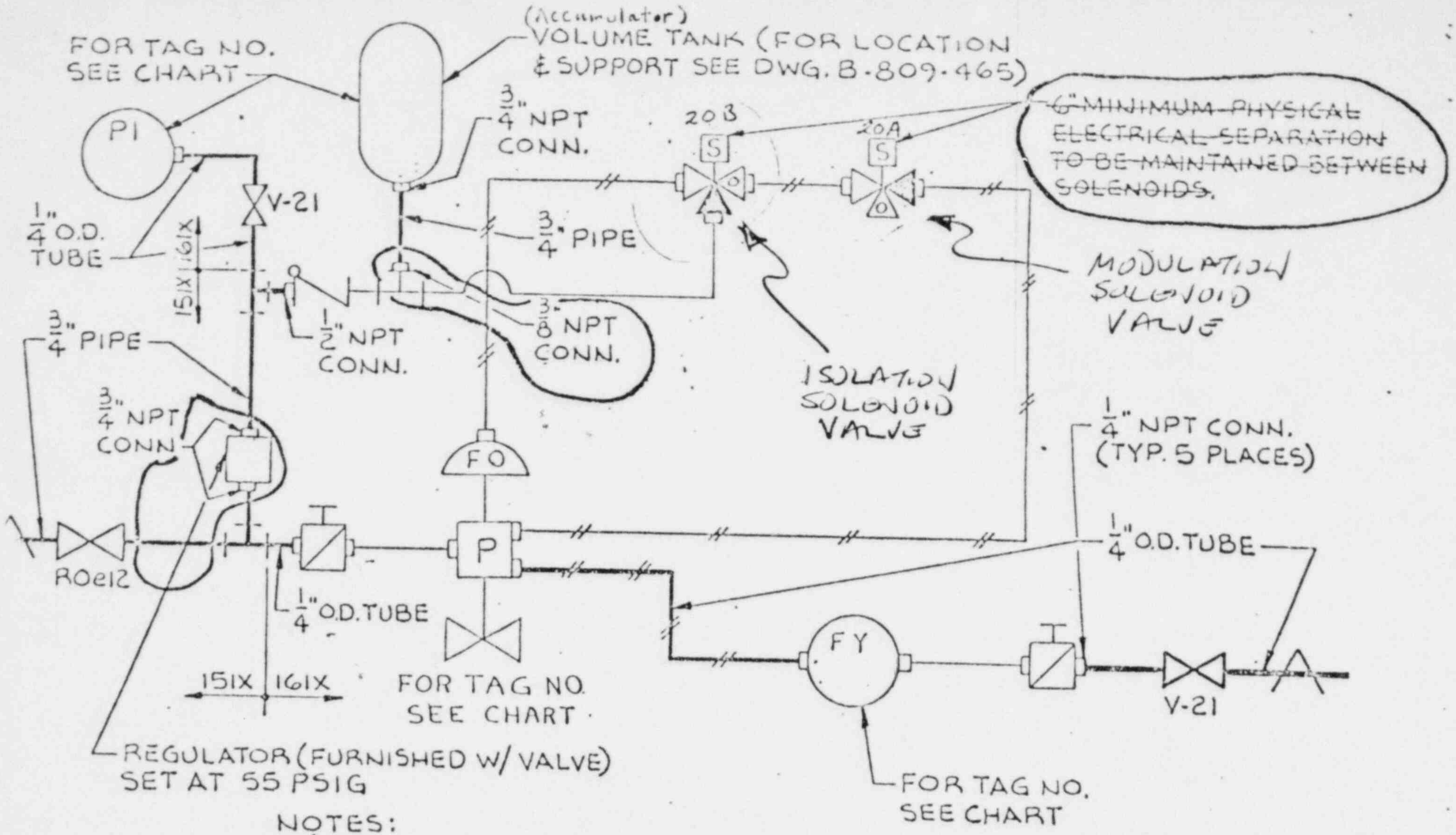
The control valves fed from the TDFP header are closed on high flow that is measured by a flow element located in the feed line to each steam generator (FE-3561 for steam generator A in Figure 2). A time delay is included in the isolation circuits such the high flow condition must exist for 30 seconds before isolation is initiated. The set points for isolation on high flow are 600 gpm for the MDFP supply and 700 gpm for the total flow to the steam generator. In addition, a separate high flow alarm is provided for each flow measurement which is set at 50 gpm above the isolation set points. The automatic isolation signal for the control valves actuates a three-way solenoid valve that connects an accumulator air supply to the valve diaphram to close the control valve. This arrangement is shown in Figure 3. The air accumulator is provided to assure the availability of an air supply to close the valve, since the normal air supply is from the non-safety grade instrument air system. As previously noted, the electrical power for the two control valves for each steam generator are provided from separate power sources. Thus, from a single failure view point, at least one of the two control valves would be automatically closed on a high flow condition. For this event, termination of flow to a faulted steam generator would require that the pump(s) associated with the other water source be tripped. This capability was discussed above.

During normal plant operation, the AFW control valves are maintained in the open position. The AFW system is used during plant startup until the main feedwater system is placed in operation. Two means are provided to assure that the AFW control valves are open on automatic initiation of the AFW system. The first consist of an alarm which tells the operator that the AFW control valves are not in the open position. As an additional precaution that this alarm will not be acknowledged and subsequently ignored, the alarm incorporates a reflash circuit that will reactivate the alarm once every hour. These features are further enhanced in that the reflash circuits and the annunicator windows are powered from essential dc power sources. The second means to assure that the valves are open is provided by using one of the two automatic AFW initiation output logic channels to provide a signal to open the control valves. This signal deenergizes the modulating solenoid valve, see Figure 3, and vents air from the valve diaphram causing the valve to open. The modulating solenoid is controlled by a 3-position selector switch



NOTES:

1. FOR PIPE MATERIAL SHOWN ON THIS DWG. REFER TO PIPING SPECIFICATION SP-337-4461-00 LINE SPEC. PIPE 151X, TUBE 161X

REFERENCES:

TUBE FITTING B/M RKf5
TUBE B/M RKf4
VALVE B/M RKf9a
D-302-085 EMERGENCY FEEDWATER (NUCLEAR) FLOW DIAGRAM.

FIGURE 3

DETAIL "A"

on the main control board. The switch positions are manual, auto, and reset. In the manual position, the modulating solenoid valve is energized. For this mode of operation, the control valve position is controlled by a manual loading station on the control board. In the auto position, the modulating solenoid is deenergized and the control valve is open. Since automatic initiation of the AFW system provides a signal to open the control valves, the reset position of the selector switch is needed to permit the modulating solenoid to be reenergized following auto initiation such that manual control of AFW flow can be obtained.

Based on our review of this system, the following concerns and positions have been identified.

1. The capabilty to manually isolate a steam generator for a feedwater/steam line break is a safety function of the system which in the short term should not rely upon manual closure of the control valves using their local handwheels nor rely upon the availability of instrument air from the non-safety class instrument air system. Further, the automatic features which isolate the steam generators on high flow do not satisfy the requirement of a safety grade protection system to fulfill this safety function. While the automatic closure of the control valves incorporates an accumulator to assure the availability of air source to effect closure, the means by which the plant operator can close the valve is only by using manual loading station to position the valve to the closed limit and this is dependent upon the availability of the non-safety related instrument air system.

Position 1:

> The manual closure capability for the AFW control valves should be modified to permit manual actuation of isolation solenoid valve from the control room to effect valve closure with a safety related air source.

The accumulator for the closure of the AFW control valve is isolated from the non-safety related instrument air system by a check valve (See Figure 3). The operation of this check valve is essential for the availability of the air source to effect valve closure.

Position 2:

> The accumulator air system for the AFW control valves should be modified to permit periodic testing of the operability of the accumulator system. The technical specification should include surveillance requirements for the accumulator system and the operability of the manual valve closure capability of the control valves on a schedule consistent with that used for safety related valves.

The automatic features for isolation of the steam generator on high flow is a system important to the safety even though it does not satisfy all of the requirements of a safety related protection system. The design of this system does not provide the operator with any indication that a high flow trip condition has occurred other than would be provided by the fact that the valve position lights would indicate that the control valve is closed.

Position 3:

> The automatic features for isolation of the steam generator should be modified to provide indication that control valve closure has been initiated on a high flow condition. This indication should be provided separately for each control valve, i.e., each isolation circuit.

The automatic features for isolation of the steam generators on high flow include the provision to manually reset the trip circuit. The means used to effect a reset is the selector switch which is used to reset the opening of the control valves on auto initiation of the AFW system. Since the latter is a normal follow up action on initiation of the AFW system, care must be taken by the operator inorder that this same action is not taken to reset an automatic isolation of a steam generator on high flow.

Position 4:

> The reset of the automatic features for isolation of the steam generator on high flow should be modified so that it is independent of the reset to provide manual control of the AFW control valves following automatic AFW initiation. This modification need not include a separate reset for each valve so long as a separate reset is provided for the separate "A" and "B" logic circuits for all control valves.

The control of AFW flow is a feature which is provided at the remote shutdown panels. However, the automatic AFW initiation circuit, which overrides the throttling control capability and opens the control valves, cannot be reset from the remote shutdown panels. Since auto initiation can be initiated on low steam generator level, the potential exist that this may occur.

Position 5:

The capability should be provided to permit a reset of auto initiation of the AFW system from the remote shutdown panels such that subsequent control of AFW flow can be achieved from this location.

The high flow alarms associated with the detection of feedwater/steam line breaks are set at value of 50 gpm above that which is used to initiate automatic isolation of the AFW control valves. These alarms should function to alert the operator of conditions which are indicative of the potential existence line breaks. As such they should have a setting which is indicative of an abnormal amount of flow to the steam generator.

Position 6:

The set point for alarms actuated on high AFW flow should be lowered to a value which is indicative of an abnormal condition and should not be set at a value which exceeds that for which automatic action is taken. Revised settings and their basis should be established and provided for our review.

With reguard to the capability to terminate AFW flow to a steam generator for feedwater/steam line breaks, the response to Question 211.59 states: "Manual controls are provided in the control room for start and stop of the emergency feedwater pumps and for the control valves associated with the emergency feedwater system. The means for detecting the faulted steam generator and isolating emergency feedwater to it requires only the use of safety grade equipment available following the break". Position 1 above addresses the deficiencies in the design of the control valves to satisfy this commitment. The design of the turbine driven feed pump controls also do not satisfy this commitment. The closure of the steam supply value for the turbine driven pump (IFV-2030 on Figure 1) is dependent on the availability of air from the non-safety related instrument air system. In addition, the redundant logic channels that control the operation of this valve require the availability of electrical power to each channel to effect valve closure. A single failure, i.e., loss of a bus, which could prevent the capability to close the control valves to terminate AFW flow to a steam generator from the TDFP header, also fails open the valve for the TDFP steam supply. This precludes the capability to stop the TDFP as a means to terminating flow to a faulted steam generator.

As noted earlier in the discussion above, the isolation valves from the two steam generators that feed the TDFP steam supply header may afford a means to terminate steam flow to the TDFP. We do not find that this provides an acceptable alternative for the following reasons:

1) It is contrary to the commitment made in response to Q 211.5[illegible].

2) The control circuits for isolating the steam generators from the TDFP steam supply header are physically routed in two separation divisions, one of which is common to those circuits which are the source of the problem (i.e., valves 2902B and IFV-3536, 3546, and 3556 are all in the same separation division).

3) The design of the controls for the TDFP steam supply value (IFV-2030) do not conform to the principles for design given in GDC-23 with respect to being able to stop the pump.

Position 7:

The design of the TDFP steam supply valve should be modified to permit closure independent of the non-safety related instrument air system. If an air accumulator is used to satisfy this requirement, it should satisfy Positions 1 and 2 above. The control circuits for the valve should be modified to assure that any single failure which could lead to conditions for which the safety function to close the valve may be required, that failure shall not preclude the capability to close the valve from the control room. The design modification shall satisfy the requirements of GDC-23 with reguard to the capability to fulfilling the safety function to terminate flow to a faulted steam generator.

The capability is provided at the remote shutdown panels to operate one of the two pilot solenoid valves that are associated with the redundant protection system channels for initiating the operation of the TDFP. Hence, if an automatic start condition had occurred, such action could not be overriden by the control system capability available from the remote shut down panel. The transfer switches for this control are implemented in a manner that the automatic start features, for this channel, are bypassed when the control is transferred to the remote shutdown panel. There does not appear to be any basis for bypassing the automatic start feature for the TDFP, recognizing that this control feature is only implemented for one of the two channels of the controls for this valve. Further, the transfer scheme for this control from the remote shutdown panel provides a separate fused power source for the control of the valve. Since power is required to stop the TDFP with this control, the basis for having the availability of a separate power source appears to be moot in that power must be applied to both of the redundant pilot solenoid values in order to stop the TDFP and as previously noted only one channel can be controlled from the remote shutdown panel. We can only conclude that the design basis for the AFW system in general and its control capability from both the control room and the remote shut down panel have not been established and implemented in a consistent and logical manner.

Position 8:

> The design basis for the manual and automatic control features of the AFW system should be established and a discussion of the design of those features should be provided which confirms that the design basis has been satisfied. The design basis should clearly define the safety related functional requirements of the the AFW system in contrast to those features which may be desirable, however, are not relied upon in the safety analysis. The automatic features provide to isolate a steam generator on feedwater/steam line breaks is an example of those which fall into the latter category. To the extent that the design basis is defined in Section 10.4.9.1 of the FSAR, it may be referenced in the response. The design basis should address all manual actions required in order for the AFW system to fulfill its safety functions and time limitation imposed consistent with the plant safety analysis for completing such actions. The design basis should address the use of the AFW system in plant safety analysis for events under which it is controlled automatically, manually from the control room and by local manual control from the remote shutdown panel.

B. <u>Steam Generator Atmospheric Relief Valves</u>

An atmospheric relief valve is provided on the main steam line for each steam generator and is located upstream of the main steam stop valves. Interlocks are provided in these valves, as well as all other steam dump valves, which prevent these valves from being opened. The protective action of these interlocks is provided to prevent over cooling which could result from failures within the control system for these valves. The interlocks operates such that on deenergization of either or both of two redundant pilot solenoid valves, air is vented from the valve actuator and the valve cannot be opened. Thus, a single failure in either of the protection system interlock channels, such as the loss of an instrument bus, removes the capability to control steam generator pressure by the control system. In this event the steam generator safety valves perform the safety function to permit hot shutdown conditions to be maintained. For cold shutdown, the handwheels on the atmospheric relief valves permit a means by which steam generator pressure can be controlled for system cooldown. General Design Criterion 23 addresses the failure modes of the protection system in that they shall be designed to fail into a safe state or into a state demonstrated to be acceptable on some other defined design basis if conditions such as disconnection of the system, loss of energy (e.g., electrical power, instrument air) or postulated adverse environment (e.g., extreme heat or cold, fire, pressure, steam, water, and radiation) are experienced. The failure modes of the design of the interlock satisfy this criteria from the standpoint of the safety function to prevent over cooling, however, it disregards the importance to safety of maintaining the operational capability of the atmospheric relief valves to effect safe shutdown. While it is recognized that the design of the controls for the atmospheric relief valves do not satisfy safety grade requirements, the associated interlocks, unnecessarily further reduces the availability of this system to effect safe shutdown. In discussions of this concern with the applicant, he has indicated that the failure mode is dictated by the fact that the pilot solenoids cannot be qualified to operate in harsh environments. In view of the fact that some of the pilot solenoid valves involved with the auxiliary feedwater system as discussed in "A" above, operate in an energized state to perform their safety function and are subject to similar harsh environmental conditions leads us to conclude that such arguments in this regard are invalid.

Position 9:

The interlocks for the atmospheric relief valves should be modified such that a single failure in either protection system channel shall not preclude their availability for being used to effect safe shutdown.

C. Potential Design Deficiencies in Bypass, Override, and Reset Circuits of Engineered Safety Features

On March 13, 1980, the Office of Inspection and Enforcement issued Bulletin 80-06, "Engineered Safety Feature (ESF) Reset Controls", to address the concern that the use of reset pushbuttons alone could permit certain engineered safety feature components to revert to the normal state following safety system actuation. On May 14, 1980, we requested South Carolina Electric and Gas Company to provide additional information related to this subject. Both the 80-06 Bulletin and our May 14, 1980 letter require that upon reset of an engineered safety feature actuation signal; all associated safety-related equipment should remain in its emergency mode. A design review at the schematic diagram level was requested and Bulletin 80-06 further required confirmatory testing of all engineered safety feature reset actions.

During the site visit, we performed an audit review on the manual override on control room ventilation isolation circuits. We noted that a manual switch can bypass both the radiation and the safety injection signals. This design is not in conformance with the Criterion No. 1 of our May 14, 1980 letter. We noted that the applicant's response to Criterion No. 1 is not valid for this circuit due to an apparent limited scope of review using this criterion. We request that the applicant review all engineered safety features control circuits with respect t deficiencies in bypass, override and reset of ESF actions. Any deviation from this criterion should be justified. We further request that a test be conducted to confirm the conclusion of this review as was required for operating plants by Bulletin 80-06.

D. Discrepancy Between FSAR and the As-Built Schematic

During our audit drawing review, we noted that in several cases the FSAR description or figure does not reflect the changes made in the latest as-built schematic diagrams. For example, the functional diagram Figure 7.2-1, Sheet 8 does not shown the current design of containment isolation on high radiation. The FSAR should be updated to reflect the design changes that have subsequently been made.

E. Safety Evaluation Report - Open Items

The draft ICSB safety evaluation report input for the Summer Nuclear Station was discussed. We indicated that the following items are still open. The applicant should provide additional information to permit resolution of those items.

1. Trip Setpoint and Margins

A document to discuss in detail of the methodology used in determining the setpoints and setpoint allowances (drift and calibration error) for RPS and ESF instrumentation should be submitted for our review. We will address the final resolution in the Technical Specification review stage.

2. Field Audit for Separation of Electrical Equipment and Systems

The results of the applicant's field audit should be submitted with a discussion of any corrective action taken and the need for further action if significant deficiencies are revealed in the audit process.

3. Failure Modes and Effects Analysis (FMEA) Interface Requirements

The FSAR should address the compliance of Summer Station design to interface requirements in Westinghouse Topical Report WCAP-8584. This report is referenced in the FSAR as the basis for satisfying the requirement for the Failure Modes and Effects Analysis.

4. IE Bulletin 79-27, Loss of Non-Class IE Instrumentation and Control Power System Bus During Operation

We have not completed our review of the applicant's response dated October 31, 1980 to this bulletin. However, during our plant tour, we noticed that some of the alarms indicating a loss of a power source are ambiguous, e.g., (a) combined alarms on loss of Inverter 1, 2, and 7. (b) loss of power on bus due to an open supply breaker is not alarmed. We expect to provide further comments in the near future.

5. Remote Shutdown Panel Modifications

(a) Final design documentation on remote shutdown panel modification should be submitted for our review.

(b) During our audit drawing review, we noted that the power source for control circuits operated from the remote shutdown panel are not totally independent from the power sources for control circuits operated from the main control board. In some circuits the power feed is from the same fuse or circuit breaker used for both the remote shutdown panel and the main control board. We expect the final design will correct this descripancy, such that a fire in either the control room or spreading rooms will not jeopardize operation of the alternate shutdown capability from the remote shutdown panels. This requirement was stated in the fire protection safety evaluation report input prepared by the Chemical Engineering Branch.

6. Post Accident Monitoring Instruments

This is an open item which will be resolved in part by the applicant's response to NUREG-0737. Further clarification will also be provided by the issuance of Regulatory Guide 1.97, Revision 2.

F. <u>I&E Concerns on Separation Requirements for Class IE Redundant Instrumentation Cables Internal to the Process Instruments and Control Cabinets</u>

The applicant will provide a response to I&E on their item 325/80-2-02 which addresses this subject. We request that a copy of this response be forwarded for our information.

ENCLOSURE 2

SUMMARY SITE VISIT (NOVEMBER 12, 13, 14, 1980)

LIST OF ATTENDEES

NRC

Thomas Dunning
Amira Gill
Om Chopra
Hulbert Li
Jack Skolds (Resident Inspector - part time)

South Carolina Electric and Gas Company

Ronald Clary
Andy Wactor
Ken Woodward
C. A. Price
Nancy Clark
Gary Moffatt
Al Koon
Steve Cunningham
James LaBorde
Al Alvarez