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Director of Nuclear Reactor Regulation
ATTN: Mr. Robert W. Reid, Chief
Operating Reactors Branch #4
Division of Licensing
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Subject: Arkansas Nuclear One - Unit 1
Docket No. 50-313
License No. DPR-51
Anticipatory Reactor Trip System (ARTS)
(File: 1510)

Gentlemen:

Your letter of December 20, 1979 contained a safety evaluation (SE) approving our preliminary design for the subject system. Attachment 1 of your letter was a summary of information needed for final design approval. As an attachment to this letter, AP&L has addressed each of the items listed in Attachment 1 of your letter. Also enclosed are three copies of the drawings you requested in the S.E. We have included only the schematics for Subassembly A of the RPS since the other three channels are very similar.

We request your approval of our final design as soon as possible so we can begin preparing to install the ARTS during our upcoming refueling outage, currently scheduled to begin in March, 1981.

Very truly yours,

David C. Trimble

David C. Trimble
Manager, Licensing

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Attachments

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FUNCTIONAL DESCRIPTION

The purpose of this section is to review our preliminary design submittal concerning the functional description of the ARTS system as well as to provide more detailed information. Drawing E260, sheet 5 shows a wiring block diagram for the system. Each channel of the RPS (C41-44) accepts three new pressure switch inputs. Two of these pressure switches monitor trip oil pressure respectively for main feedwater pump turbines K2A & K2B. The remaining pressure switch monitors trip oil pressure for the main turbine. Under MFWP or turbine trip conditions this oil pressure dumps opening the pressure switch contacts. These contacts feed contact buffers in the RPS. Bailey drawings D8076163 & D8076164 show these contact buffers as well as the bistables and auxiliary relays for a typical RPS channel (Channel A.) The contact buffers provide input isolation for the RPS. For reactor trip on both MFWP's tripped the output contacts from the contact buffers are wired in parallel with the bistable output contacts. This combination is wired in series with the similar combination of output contacts from the reactor trip on turbine trip contact buffer and bistable (wired in parallel again). Bailey drawing D8042116 shows this wiring in detail as it interfaces the bistable trip string in RPS channel A. For reactor trip on both MFWP's tripped, the output contacts from both associated contact buffers must open and the bistable output contact must be open. As shown on Bailey drawings D8042077, D8076163, and D8076164, an existing reactor flux signal is fed to the bistables. The bistable compares this signal with an internally generated setpoint signal. When reactor power is above 20% FP the bistable output contact is open. Below 20% FP the contact is closed providing an automatic reactor trip bypass for normal plant startup and shutdown. The reactor trip on turbine trip functions in a similar manner.

Other output contacts from the contact buffers and bistables are used to actuate relays in the auxiliary relay modules for purposes of providing electrically isolated contact outputs for control room annunciators and the plant computer. As shown on E-455 reactor trip bypass contacts from each channel of the RPS are used to actuate relays K1-K8, the contacts of which are arranged in a three-out-of-four logic network to light the annunciator window. In other words if any three of the four RPS channels agree, for example, that the reactor trip on both main feedwater pumps tripped is bypassed, then window D3 will light. The same is true for reactor trip on turbine trip bypass (window D4 lights in this case.)

The three-out-of-four logic minimizes the number of annunciator windows needed while also minimizing the possibility of a single RPS channel giving an erroneous bypass indication to the operator. An additional contact from each relay is wired in parallel to the RPS manual channel bypass annunciator window E1 as shown on E-460. If any RPS channel initiates a reactor trip bypass or if any RPS channel is placed in manual bypass, this window will light. This will serve to annunciate isolated RPS channel bypass problems. The contact outputs from each RPS channel for reactor trip on both main feedwater pumps tripped and reactor trip on turbine trip will be connected to individual sequence-of-events type computer inputs.

The ARTS circuit has been designed to fail in the conservative or trip condition upon loss of power or module removal from the RPS.

Item 2

The pressure switches will be mounted in new cabinets C487-492 in the areas of the turbine deck shown on drawing E-649. The pressure switch arrangement within the cabinets is shown on sketch SK-M-042. As shown on the sketch, there are two pressure switches mounted in each cabinet. A barrier has been specified to be installed between adjacent pressure switches, (safety channels) in the same cabinet for channel separation and fire protection. The barrier forms two individual compartments in the cabinet separating adjacent channel wiring.

The new inputs to and outputs from the RPS are electrically isolated. The RPS inputs are electrically isolated by the contact buffers. As shown on the attached Bailey schematics the contact buffer uses a transformer to power the contact buffer relays. Thus the combination of the transformer and relays electrically isolate the pressure switch contacts from the RPS vital cabinet AC power and the RPS trip string. The isolation level is up to 500 volts. Therefore, the effects of the credible faults such as grounding, shorting, application of high voltage, and electromagnetic interference will not be propagated back into the RPS or degrade the RPS performance. Effects of application of high voltage to input lines leading to the RPS is further minimized by the fact that the input cables are routed no closer than 30' from cable trays and no closer than 20' from a conduit carrying voltages greater than 480 VAC. Separation between input cables of different channels is maintained by routing cables of a typical channel in conduit separate from the conduits of other cables of different channels. The separate conduits for different input channels also reduce the risk of damage by fire. Refer to the attached conduit layout drawings for details of the circuit routing.

Item 3

The pressure switches that we have ordered are ITT-Barton 288A's. After several weeks of searching for pressure switches earlier this year, Barton was the only manufacturer who claimed they could meet your implementation schedule. We have used the Barton 288A successfully in certain applications at ANO before, some of which are seismically qualified. Therefore, based on previous operating experience and delivery requirements, we felt it was prudent and expedient to purchase the Barton units. In determining a qualification basis for the switches we made the following considerations:

1. The pressure switches are to be mounted in the non-seismic turbine building. Therefore, we did not feel the units should be seismically qualified.

2. No pressure switch vendors were found who had aged their components. Barton has an IEEE 323-1974 qualification program that includes aging underway for their model 580 switch, but the program will not be complete until late this year.

3. Radiation conditions in the turbine building are considered negligible. Therefore, the units were not qualified for a radiation environment.

4. Day-to-day environmental conditions where the pressure switches will be mounted are not considered extreme. Drawing E-649 shows new cabinets C487 & 488 for mounting the pressure switches for Main Feedwater Pump Turbine (MFWPT) K2A, C489 & 490 for MFWPT K2B, and C491 & 492 for the main turbine. Cabinets C487-490 will be exposed to the least stringent environmental conditions since they are mounted in open space on the turbine deck. Temperature conditions in these areas during the summer months would be expected to be from 90°-110°F. Cabinets C491 & 492 would see the most extreme conditions of 120°-150°F during the summer months. This is due to the fact that these cabinets are to be mounted inside the turbine control valve and EHC housing. We felt it was prudent to mount the pressure switches in close proximity to the turbine and MFWP's in order to minimize the length of the pressure switch sensing lines (connected to the turbine oil system.) Long runs of hydraulic lines from high vibration pieces of equipment such as the turbine could cause repeated maintenance problems due to induced vibration loosening tube fittings. Under worst case accident conditions, we would assume a severe seismic event could break high energy steam lines in the areas where the pressure switches are mounted. Temperatures in these areas could be as high as 600°F at 100% RH under these pipe break conditions until the lines could be isolated. We were not able to find any pressure switches with a temperature rating this high. Barton specs indicate their switches are rated to 200°F.

From the above discussion it is evident that the pressure switches would need to be environmentally qualified. We have been informed by Barton that there has been no environmental qualification testing performed on the 288A and none is planned. Therefore there are no environmental qualification test reports available. Barton does seismic testing on these switches. However, as stated before, seismic qualification in the non-seismic turbine building is meaningless. Basically the switches we will be getting are being built to a nuclear quality assurance program, but they have not been qualification tested. In order to attempt to minimize the effects of direct impingement by steam from high energy pipe breaks, we are mounting the pressure switches inside NEMA 12 cabinets. There will be barriers installed in the cabinets between adjacent safety channels for separation and fire protection.

As a final note, Barton is in the process of qualifying their new model 580 pressure switch to IEEE323-1974. Attached is a pre-qualification test report for this unit. The model 580 is similar in construction to the model 288A. Both units use the same differential pressure unit, switch mechanism, and meter movement. In addition our switches will utilize the same Honeywell microswitch that is used in the model 580. The primary differences are that the 580 has a stainless steel case for in-containment use as opposed to the aluminum case used on the 288A, and the 580 is virtually hermetically sealed, where the 288A is not. Our switches will, however, have covers sealed with O-rings for improved moisture tightness. In addition we ordered our units with metal covers in place of the glass lens for the meter movement in order to minimize the possibility of glass breakage which would allow moisture to seep in due to extreme thermal shock during a steam line break. The similarities and differences between the 580 and 288A are discussed in more detail on pages 1 & 2 of the test report.

Item 4

Test procedures for ARTS have been written in rough draft and are currently under review. Provisions have been made to check proper functioning of ARTS monthly during normal operation by isolating and depressurizing the pressure switches slowly and verifying proper response at the RPS. In addition, bistable bypass setpoint and deadband as well as bypass operation is verified during the monthly tests. Channel calibration is performed and verified during refueling outages.

Item 5

FUNCTIONAL CHECKOUT PROCEDURE

The following procedure is to assure the proper functioning of the field change following installation into the existing NI/RPS subassembly.

A. Verify subassembly is deenergized.

B. Perform continuity tests to verify wiring connecting the prewired & tested module mounting case to the NI/RPS subassembly.

C. Connect jumper leads across the field contact input terminals to simulate closed field contacts.

NOTE: Clip leads are preferable as later they will be opened to simulate field contact opening and terminals will have approximately 120 volts interrogating voltage on terminals.

D. Referring to the cabinet layout for the subassembly being changed, reinsert modules into their proper positions in the module mounting case.

E. Reenergize subassembly and place in manual bypass. If reactor power is below the bypass setpoint (20% full power), place the subassembly power range channel into test and increase the simulated power to above the bypass setpoint. Check that the bypass bistables output state lights are dim, and reset the output memory. Allow thirty minutes warmup of subassembly.

F. Module Interlock Test:

1. Remove the MFP "A" Tripped contact buffer. Check test trip light on reactor trip module is bright. Reinsert module and reset reactor trip module. Check test trip light dim.
2. Repeat Test F-1 for MFP "B" Tripped contact buffer.
3. Repeat Test F-1 for Main Feed Pump Trip Bypass bistable.
4. Repeat Test F-1 for Turbine Tripped contact buffer.
5. Repeat Test F-1 for Turbine Trip Bypass bistable.

G. Test Trip Test:

1. Depress test switch S-1 on MFP "A" Tripped contact buffer and hold. Check DS-1 off and DS-2 on. Check test trip lamp bright on reactor trip module. Release S-1 and check test trip dim on reactor trip module. Depress test switch S-2 on contact buffer. Check DS-1 on and DS-2 off. Reset reactor trip module and

2. Repeat Test G-1 on MFP "B" Tripped contact buffer.

3. Repeat Test G-1 on Turbine Tripped contact buffer.

H. Trip Tests:

Prior to beginning the trip tests, if reactor power is below the bypass setpoint (20% full power), place the subassembly power range channel into test and increase simulated power to above the bypass setpoint. Check that the bypass bistables output state lights are dim and reset the output memory.

1. Main Feed Pump Trip

   a. Remove the jumper simulating the MFP "A" field contact. Check that on the MFP "A" Tripped contact buffer DS-1 is off and DS-2 is on. Verify the channel trip light on the reactor trip module remains dim. Check annunciator and computer output terminals are open for the MFP "A" Tripped function and closed for the MFP Trip function.

   b. Remove the jumper simulating the MFP "B" field contact. Check that on the MFP "B" Tripped contact buffer DS-1 is off and DS-2 is on. Check the channel trip light on the reactor trip module is now bright. Check annunciator and computer output terminals are open for both the MFP "B" Tripped function and the MFP Trip function.

   c. Reconnect jumpers simulating MFP "A" & "B" field contacts. Check that the contact buffers do not change state.

   d. Reset the MFP "A" & "B" contact buffers by depressing test switch S-2 on the contact buffer modules and verify the output contacts are now closed. Reset the reactor trip module.

2. Turbine Trip

a. Remove the jumper simulating the Turbine Tripped field contact. Check that on the Turbine Tripped contact buffer DS-1 is off and DS-2 is on. Check the channel trip light on the reactor trip module is now bright. Check annunciator and computer output terminals are open for both the Turbine Tripped function and the Turbine Trip function.

b. Reconnect jumper simulating the Turbine Tripped field contact. Check that the contact buffer does not change state.

c. Reset the Turbine Tripped contact buffer by depressing test switch S-2 on the contact buffer module and verify the output contacts are now closed. Reset the reactor trip module.

I. Bypass Tests:

From previous tests, the subassemblies' power range is either above the bypass set point or simulated above the bypass setpoint. The output state lamps on the two bypass bistables should be dim.

1. Verify the annunciator and computer output terminals are closed for both the MFP Trip bypass and Turbine Trip Bypass functions.

2. If power range is not in test, place in test and reduce simulated power below the bypass setpoint. Check that the output state lamps on the bypass bistables are bright. Check the annunciator and computer output terminals are open for both the MFP Trip Bypass and Turbine Trip Bypass functions.

3. Depress the test switches for both MFP "A" and MFP "B" Tripped contact buffers. Check that the channel trip lamp on the reactor trip module remains dim. Check the annunciator and computer output terminals are still closed for the MFP Trip Function.

4. Reset the MFP "A" & "B" Tripped contact buffers by depressing test switch S-2 on the contact buffer modules. Repeat steps I-3 and I-4 for the Turbine Trip function.

J. Remove power from the subassembly.

K. Remove the jumpers simulating field contacts.

L. Referring to the field change supplied external connection drawing for the subassembly being modified, connect field wiring to designated terminals.

M. Return subassembly to normal operation using standard site procedures.

N. Perform normal site functional tests on the subassembly to verify the field change did not affect the balance of the subassemblies' functions.