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RECEIVED
ADVISORY COMMITTEE ON
REACTOR SAFEGUARDS U.S. N.R.C
JUN 20 1979
AM PM
7,8,9,10,11,12,1,2,3,4,5,6

A. Bates
Staff Engineer

The Oconee breaker failures which you have called to our attention are instructive. I have discussed the matter with S.J. Ditto who concurs with the attached discussion.

E.P. Epler

RO-7

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E.P.E.
6-18-69

By letter, 5-26-79 to W. Kerr, ATWS subcommittee chairman, A. Bates has called to our attention four failures of scram breakers within a period of three weeks at Oconee Units 1 and 3. These are tabulated as follows.

		Failed, demands	worked
Unit 3	Jan 18	First	Next six
Unit 1	Jan 22	First	Next several
Unit 1	Jan 31	First three	Next six
Unit 1	Feb 8	First	Next six.

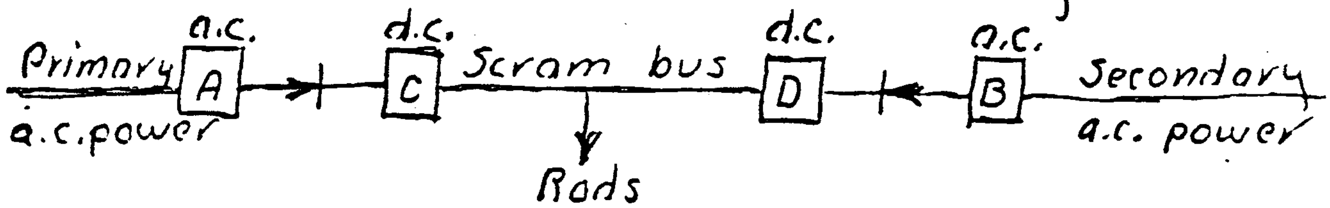
The LERs for each event contained the following language:

> "The breaker failed to open because its linkage did not operate correctly. It was determined that minor adjustments to the trip mechanism were required, and these adjustments are currently being made."

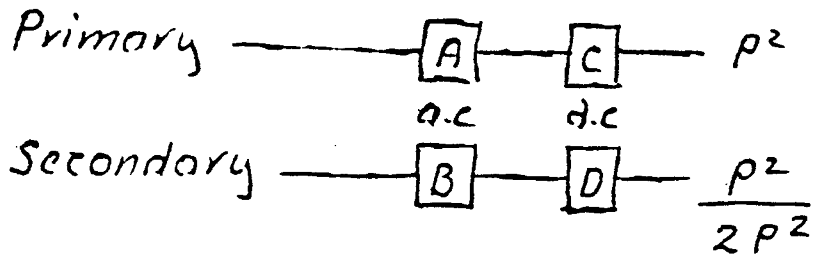
It is to be noted that, although the breaker, in each case failed on demand, succeeding tests showed it to be operable. There can be no assurance, therefore, that the "minor adjustment" was effective inasmuch as having been exercised, the breaker worked on succeeding tests without any adjustment.

The Oconee system is described in the attached letter to H.O. Monson dated 6-26-1972. This letter is significant at this time as it relates both to the breaker failures and to the TMI delayed scram.

The breakers are shown schematically below.



In order to scram, breakers A, or C, plus B, or D, must be tripped. Failure probabilities are as follows



p = Failure probability of one breaker

p^2 = Failure probability of primary, or secondary

$2p^2$ = Failure to scram from this source.

To achieve a modest scram failure probability of 5×10^{-5}/Ryr from this source, with 6 demands per year, $2p^2 = \frac{5 \times 10^{-5}}{6}$, $p = 2 \times 10^{-3}$/demand.

This corresponds to one failure in 40 years for each breaker when tested once per month. We have seen in three weeks, four failures in a group of 8 breakers, and can not be assured that the remedy, the minor adjustment, is effective. This matter should be pursued.

We have been aware that the logic, specifically the breakers, are the weak link in the PWR shutdown system. This point is also discussed in the paper recently brought to our attention by Dr Okrent. This paper by G. Apostolakis et.al., to be published in Nuclear Safety, contains the following.

"A review of the histograms reveals that we believe that the logic has the greatest frequency of failure of the five subsystems."

The logic system, which includes the breakers, is indeed the weak link as it stands as a bottleneck through which must pass signals from all of the instruments to all of the rods. This is accomplished in B&W systems, not just once, but twice; the relays accomplish this in the conventional manner, and the two-of-four capability exists again in the scram breaker arrangement. The relay logic is not only superfluous, it contributes a potential for failure, and makes periodic testing more difficult, inasmuch as a test signal inserted at the sensor, actuates only a logic relay. The remainder of the system must then be tested separately. It can be seen in Fig 3 (of the 1972 letter) that if the logic matrices were to be eliminated, a test signal inserted at the sensor would exercise a scram breaker, but would not cause rods to drop.

Fig. 5 proposes that the relay logic be removed, that breakers be added so as to provide two independent and diverse shutdown systems. By increasing the number and diversity of breakers, their individual or common mode failure would be of less consequence.

A second and equally important point is the number of failures to scram which have been experienced by LWRs. The Kahl relay logic failure is the single event in the data base.

There has been much discussion of this failure, and whether the Navy experience should also be considered, which would yield a lower failure rate. There has also been much confusion as to the definition of failure to scram. The Reactor Safety Study used, correctly, the three adjacent rod failure in the LOCA sequence and also, incorrectly, in the Anticipated Transient event. It is now recognized that a group of at least five adjacent rods must fail in the ATWS event. The Apostolakis paper contains the following.

> "We have allowed a certain degree of fuzziness to remain in our definition of scram failure. For example, we have said that failure of five adjacent rods to insert constitutes a failure to scram, but we have not precisely defined what we mean by adjacent, or insert, nor said exactly why this should be regarded as scram failure. For suppose one could find five rods which, were they to remain fully withdrawn at the most reactive time in the fuel cycle, would allow the reactor to remain hot critical. .... Nevertheless we choose the five rod way to calculate an upper bound estimate of the frequency of the class of events we envision under the term, scram failure."

If the five rod failure, which leaves the reactor in the hot critical condition, is accepted as the upper bound of scram failure, then we must accept the TMI delayed scram on loss of feedwater, also as a scram failure to be added to the data base.

There can be no doubt that the TMI delayed scram should be counted as a scram failure inasmuch as it is now being required, for B&W units, that anticipatory trips be installed in the form of Turbine trip and Loss of Feedwater. It was the delay in initiating scram on the part of the High Pressure trip, that made it necessary that the power operated relief valve be actuated.

There is yet another point to be considered. The Kahl event was the failure of components which was discovered by periodic test, with the result that the reactor was unprotected for 1/24 year. The TMI delayed scram was a design error, not discoverable by periodic test, which remained constantly in wait, in all B&W units, for the first challenge, which would be loss of main feedwater coupled with the delay or failure of aux feedwater. It is not entirely clear whether protection would invariably be afforded even for the simple loss of main feedwater. Whether this should be counted as an Anticipated Transient should be given further consideration, taking into account the recent ANO-1 event wherein aux feedwater was found to be valved out.

It is noteworthy that the 1972 letter proposed that Turbine Trip be used to initiate the diverse control rod scram. This was not proposed to correct the delayed response, which was unsuspected, but rather as a means of improving scram reliability. It is also a proper function of a control system to attempt to reduce the number of challenges to the shutdown system by first initiating a rapid control action, which has been designated as Front Up. In this instance the function was assigned to the diverse shutdown system.

In view of the several failures of scram breakers experienced at Oconee and the anticipatory trips which are being added as a result of the delayed scram, the 1972 letter should be of interest to both the ATWS and LER subcommittees as an aid in evaluating the consequences of the failures and the effectiveness of the remedies,

EPEpler

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5/15/79

DOCKETED USNRC MAY 15 1979 Office of the Secretary Docketing & Service Section

May 15, 1979

Joseph Hendrie, Chairman
Victor Gilinksy, Commissioner
Richard Kennedy, Commissioner
Peter Bradford, Commissioner
John Ahearne, Commissioner
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Gentlemen:

Enclosed please find Attachment A to Dr. Vince Taylor's statement which was appended to the Union of Concerned Scientists Petition for Immediate Reconsideration of the Errors of the Order of May 8, 1979 and for Immediate Shutdown of Oconee Units 1 and 2. This attachment was inadvertently omitted from the package.

Very truly yours,

Ellyn R. Weiss

ERW/dmw
Enclosure

cc: ✓Docketing & Service Section
General Counsel

ATTACHMENT A

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

April 24, 1979

MEMORANDUM FOR: Chairman Hendrie
Commissioner Gilinsky
Commissioner Kennedy
Commissioner Bradford
Commissioner Ahearne

FROM: Al Kenneke, Acting Director, OPE

SUBJECT: DOE INFORMATION ON RESERVE MARGINS

Attached are data obtained from DOE on how reserve margins for summer 1979 are estimated to be affected by a shutdown of B&W plants. In addition, their analysis also considers the impact on reserves of shutting down all PWR's and all nuclear units.

Utilities typically prefer to maintain a 15 to 20% reserve margin. This margin is intended to cover planned maintenance as well as unscheduled outages (typically 5 to 11% of total capability for unscheduled). After adjustment for outages and subregional power transfers, the reserves and margins for the subregions where B&W plants are located are estimated to be (see assumptions listed below):*

Reactor	Electric-region	Reserves (in MWe) after shut-down	Margin after shut-down
1. Davis-Besse (904 MWe)	CAPCO	668 MWe	5.9%
2. Oconee Units 1-3 (2580 MWe)	VACAR	(513 MWe)	(1.8%)*
VCARR + Southern Co + AEP**		4564 MWe	7.5%
3. Arkansas Unit (836 MWe)	MSU	1177 MWe	9.7%
4. Crystal River Unit 3 (753 MWe)	FCG	504 MWe	2.9%
5. Three Mile Island Unit 1 (776 MWe)	PJM	8595 MWe	25.7%
6. Rancho Seco (875 MWe)	North Cal.-Nev.	(1811 MWe)	(11 %)
WSCC: except	Rocky Mt. and Ari.-N.M.	6880 MWe	10.9%

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* Parentheses on figures indicates negative.
** Assumes resources of Southern Co. and American Electric Power could be be utilized to meet summer peak. Transmission lines to Duke Power could permit import of 3950 MWe (absolute maximum).