

FEB 1 9 1976

Dockets Nos. 50-277
and 50-278

Philadelphia Electric Company
ATTN: Mr. Edward G. Bauer, Jr., Esquire
Vice President and General Counsel
2301 Market Street
Philadelphia, Pennsylvania 19101

Gentlemen:

The Commission has issued the enclosed Amendments Nos. 17 and 16 to Facility Licenses Nos. DPR-44 and DPR-56 for Units 2 and 3 of the Peach Bottom Atomic Power Station, respectively. These amendments consist of changes to the Technical Specifications and are based on our letters to you dated September 23, 1975 and January 7, 1976.

These amendments revise the Technical Specifications to (1) add requirements that would limit the period of time operation can be continued with immovable control rods that could have control rod drive mechanism collet housing failures and (2) require increased control rod surveillance when the possibility of a control rod drive mechanism collet housing failure exists.

We have evaluated the potential for environmental impact of plant operation in accordance with the enclosed amendments and have determined that the amendments do not authorize a change in effluent types or total amounts nor an increase in power level, and will not result in any significant environmental impact. Having made this determination, we have further concluded that the amendments involve an action which is insignificant from the standpoint of environmental impact and pursuant to 10 CFR §51.5(d)(4) that an environmental statement, negative declaration or environmental impact appraisal need not be prepared in connection with the issuance of these amendments. We have also concluded that there is reasonable assurance that the health and safety of the public will not be endangered by this action.



OFFICE →						
SURNAME →						
DATE →						

Mr. Edward G. Bauer, Jr., Esquire - 2 -

A copy of the related Federal Register Notice is also enclosed. Our Safety Evaluation relating to this action was forwarded to you with our letter dated September 23, 1975.

Sincerely,

George Lear, Chief
Operating Reactors Branch #3
Division of Operating Reactors

Enclosures:

1. Amendment No. 17 to License DPR-44
2. Amendment No. 16 to License DPR-56
3. Federal Register Notice

cc w/enclosures:
See next page

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Philadelphia Electric Company

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

PHILADELPHIA ELECTRIC COMPANY
PUBLIC SERVICE ELECTRIC AND GAS COMPANY
DELMARVA POWER AND LIGHT COMPANY
ATLANTIC CITY ELECTRIC COMPANY

DOCKET NO. 50-277

PEACH BOTTOM ATOMIC POWER STATION UNIT 2

PROPOSED AMENDMENT TO FACILITY OPERATING LICENSE

Amendment No. 17
License No. DPR-44

1. The Nuclear Regulatory Commission (the Commission) has found that:
 - A. There is reasonable assurance (i) that the activities authorized by this amendment can be conducted without endangering the health and safety of the public, and (ii) that such activities will be conducted in compliance with the Commission's regulations;
 - B. The issuance of this amendment will not be inimical to the common defense and security or to the health and safety of the public;
 - C. The facility will operate in conformity with the provisions of the Act, and the rules and regulations of the Commission; and
 - D. An environmental statement or negative declaration need not be prepared in connection with the issuance of this amendment.
2. Accordingly, the license is amended by a change to the Technical Specifications as indicated in the attachment to this license amendment.
3. This license amendment is effective as of the date of its issuance.

FOR THE NUCLEAR REGULATORY COMMISSION

Karl R. Goller
Karl R. Goller, Assistant Director
for Operating Reactors
Division of Operating Reactors

Attachment:
Changes to the Technical
Specifications

Date of Issuance: February 19, 1976

ATTACHMENT TO LICENSE AMENDMENT
CHANGE TO THE TECHNICAL SPECIFICATIONS
FACILITY OPERATING LICENSE NO. DPR-44
DOCKET NO. 50-277

Replace pages 99, 100 and 108 with the attached revised pages. The changed areas on the revised pages are shown by marginal lines. Pages 99a and 100a are to be added.

LIMITING CONDITION FOR OPERATION

SURVEILLANCE REQUIREMENT

3. REACTIVITY CONTROLApplicability:

Applies to the operational status of the control rod system.

Objective:

To assure the ability of the control rod system to control reactivity.

Specification:A. Reactivity Limitations1. Reactivity margin - core loading

A sufficient number of control rods shall be operable so that the core could be made subcritical in the most reactive condition during the operating cycle with the strongest control rod fully withdrawn and all other operable control rods fully inserted.

2. Reactivity margin - inoperable control rods

- a. Control rods which cannot be moved with control rod drive pressure shall be considered inoperable. If a partially or fully withdrawn control rod drive cannot be moved with drive or scram pressure the reactor shall be brought to a shutdown condition within 48 hours unless investigation demonstrates that the cause of the failure is not due to a failed control rod drive mechanism collet housing.

4.3 REACTIVITY CONTROLApplicability:

Applies to the surveillance requirements of the control rod system.

Objective:

To verify the ability of the control rod system to control reactivity.

Specification:A. Reactivity Limitations1. Reactivity margin - core loading

Sufficient control rods shall be withdrawn following a refueling outage when core alterations were performed to demonstrate with a margin of 0.38% $\Delta k/k$ that the core can be made subcritical at any time in the subsequent fuel cycle with the analytically determined strongest operable control rod fully withdrawn and all other operable rods fully inserted.

2. Reactivity margin - inoperable control rods

- a. Each partially or fully withdrawn operable control rod shall be exercised one notch at least once each week when operating above 30% power. This test shall be performed at least once per 24 hours in the event power operation above 30% is continuing with three or more inoperable control rods or in the event power operation above 30% is continuing with one fully or partially withdrawn rod which cannot be moved and for which control rod drive mechanism damage has not been ruled out. The surveillance need not be completed within 24 hours if the number of inoperable rods has been reduced to less than three and if it has been demonstrated that control rod drive mechanism collet

LIMITING CONDITION FOR OPERATION

. SURVEILLANCE REQUIREMENT

2. Reactivity margin - inoperable control rods (cont'd)

housing failure is not the cause of an immovable control rod.

LIMITING CONDITION FOR OPERATION

SURVEILLANCE REQUIREMENT

3.3.A (cont'd)

- b. The control rod directional control valves for inoperable control rods shall be disarmed electrically and the control rods shall be in such positions that Specification 3.3.A.1 is met.
- c. Control rods with scram times greater than those permitted by Specification 3.3.C.3 are inoperable, but if they can be inserted with control rod drive pressure they need not be disarmed electrically.
- d. Control rods with a failed "Full-in" or "Full-out" position switch may be bypassed in the Rod Sequence Control System and considered operable if the actual rod position is known. These rods must be moved in sequence to their correct positions (full in on insertion or full out on withdrawal).
- e. Control rods with inoperable accumulators or those whose position cannot be positively determined shall be considered inoperable.
- f. Inoperable control rods shall be positioned such that Specification 3.3.A.1 is met. In addition, during reactor power operation, no more than one control rod in any 5 x 5 array may be inoperable (at least 4 operable control rods must separate any 2 inoperable ones). If this Specification cannot be met the reactor shall not be started, or if at power, the reactor shall be brought to a cold shutdown condition within 24 hours.

4.3 REACTIVITY CONTROL

- b. A second licensed operator shall verify the conformance to Specification 3.3.A.2d before a rod may be bypassed in the Rod Sequence Control System.

B. Control Rods

1. The coupling integrity shall be verified for each withdrawn control rod as follows:
 - a. When a rod is withdrawn the first time after each refueling outage or after maintenance, observe discernible response of the nuclear instrumentation and rod position indication for the "full in" and "full out" position. However, for initial rods when response is not discernible, subsequent exercising of these rods after the reactor is above 30% power shall be performed to verify instrumentation response.

3.3 and 4.3 BASES (cont'd.)

margin required due to control cell material manufacturing tolerances and calculational uncertainties has experimentally been determined to be 0.38% $\Delta k/k$. When this additional margin is demonstrated, it assures that the reactivity control requirement is met.

2. Reactivity margin - inoperable control rods.

Specification 3.3.A.2 requires that a rod be taken out of service if it cannot be moved with drive pressure. If the rod is fully inserted and then disarmed electrically*, it is in a safe position of maximum contribution to shutdown reactivity. If it is disarmed electrically in a non-fully inserted position, that position shall be consistent with the shutdown reactivity limitation stated in Specification 3.3.A.1. This assures that the core can be shutdown at all times with the remaining control rods assuming the strongest operable control rod does not insert. Inoperable bypassed rods will be limited within any group to not more than one control rod of a (5 x 5) twenty-five control rod array. The use of the individual rod bypass switches in the Rod Sequence Control System to substitute for a failed "full in" or "full out" position switch will not be limited as long as the actual position of the control rod is known. Also if damage within the control rod drive mechanism and in particular, cracks in drive internal housings, cannot be ruled out, then a generic problem affecting a number of drives cannot be ruled out. Circumferential cracks resulting from stress assisted intergranular corrosion have occurred in the collet housing of drives at several BWRs. This type of cracking could occur in a number of drives and if the cracks propagated until severance of the collet housing occurred, scram could be prevented in the affected rods. Limiting the period of operation with a potentially severed rod and requiring increased surveillance after detecting one stuck rod will assure that the reactor will not be operated with a large number of rods with failed collet housings.

B. Control Rod Withdrawal

1. Control rod drop accidents as discussed in the FSAR can lead to significant core damage. If coupling integrity is maintained, the possibility of a rod drop accident is eliminated. The overtravel position feature provides a positive check as only uncoupled drives may reach this position. Neutron instrumentation response to rod movement provides a verification that the rod is following its drive. Absence of such response to drive movement could indicate an uncoupled condition. Rod position indication is required for proper function of the rod sequence control system and the rod worth minimizer (RWM).

*To disarm the drive electrically, four Amphenol type plug connectors are removed from the drive insert and withdrawal solenoids rendering the rod incapable of withdrawal. This procedure is equivalent to valving out the drive and is preferred because, in this condition, drive water cools and minimizes crud accumulation on the drive. Electrical disarming does not eliminate position indication.



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

PHILADELPHIA ELECTRIC COMPANY
PUBLIC SERVICE ELECTRIC AND GAS COMPANY
DELMARVA POWER AND LIGHT COMPANY
ATLANTIC CITY ELECTRIC COMPANY

DOCKET NO. 50-278

PEACH BOTTOM ATOMIC POWER STATION UNIT 3

AMENDMENT TO FACILITY OPERATING LICENSE

Amendment No. 16
License No. DPR-56

1. The Nuclear Regulatory Commission (the Commission) has found that:
 - A. There is reasonable assurance (i) that the activities authorized by this amendment can be conducted without endangering the health and safety of the public, and (ii) that such activities will be conducted in compliance with the Commission's regulations;
 - B. The issuance of this amendment will not be inimical to the common defense and security or to the health and safety of the public;
 - C. The facility will operate in conformity with the provisions of the Act, and the rules and regulations of the Commission; and
 - D. An environmental statement or negative declaration need not be prepared in connection with the issuance of this amendment.
2. Accordingly, the license is amended by a change to the Technical Specifications as indicated in the attachment to this license amendment.
3. This license amendment is effective as of the date of its issuance.

FOR THE NUCLEAR REGULATORY COMMISSION

Karl R. Goller

Karl R. Goller, Assistant Director
for Operating Reactors
Division of Operating Reactors

Attachment:
Changes to the Technical
Specifications

Date of Issuance: February 19, 1976

ATTACHMENT TO LICENSE AMENDMENT

CHANGE TO THE TECHNICAL SPECIFICATIONS

FACILITY OPERATING LICENSE NO. DPR-56

DOCKET NO. 50-278

Replace pages 99, 100 and 108 with the attached revised pages. The changed areas on the revised pages are shown by marginal lines. Pages 99a and 100a are to be added.

LIMITING CONDITION FOR OPERATION

SURVEILLANCE REQUIREMENT

3 REACTIVITY CONTROLApplicability:

Applies to the operational status of the control rod system.

Objective:

To assure the ability of the control rod system to control reactivity.

Specification:A. Reactivity Limitations1. Reactivity margin - core loading

A sufficient number of control rods shall be operable so that the core could be made subcritical in the most reactive condition during the operating cycle with the strongest control rod fully withdrawn and all other operable control rods fully inserted.

2. Reactivity margin - inoperable control rods

- a. Control rods which cannot be moved with control rod drive pressure shall be considered inoperable. If a partially or fully withdrawn control rod drive cannot be moved with drive or scram pressure the reactor shall be brought to a shutdown condition within 48 hours unless investigation demonstrates that the cause of the failure is not due to a failed control rod drive mechanism collet housing.

4.3 REACTIVITY CONTROLApplicability:

Applies to the surveillance requirements of the control rod system.

Objective:

To verify the ability of the control rod system to control reactivity.

Specification:A. Reactivity Limitations1. Reactivity margin - core loading

Sufficient control rods shall be withdrawn following a refueling outage when core alterations were performed to demonstrate with a margin of 0.38% k/k that the core can be made subcritical at any time in the subsequent fuel cycle with the analytically determined strongest operable control rod fully withdrawn and all other operable rods fully inserted.

2. Reactivity margin - inoperable control rods

- a. Each partially or fully withdrawn operable control rod shall be exercised one notch at least once each week when operating above 30% power. This test shall be performed at least once per 24 hours in the event power operation above 30% is continuing with three or more inoperable control rods or in the event power operation above 30% is continuing with one fully or partially withdrawn rod which cannot be moved and for which control rod drive mechanism damage has not been ruled out. The surveillance need not be completed within 24 hours if the number of inoperable rods has been reduced to less than three and if it has been demonstrated that control rod drive mechanism collet

LIMITING CONDITION FOR OPERATION

. SURVEILLANCE REQUIREMENT

2. Reactivity margin - inoperable control rods (cont'd)

housing failure is not the cause of an immovable control rod.

LIMITING CONDITION FOR OPERATION

SURVEILLANCE REQUIREMENT

3.3.A (cont'd)

- b. The control rod directional control valves for inoperable control rods shall be disarmed electrically and the control rods shall be in such positions that Specification 3.3.A.1 is met.
- c. Control rods with scram times greater than those permitted by Specification 3.3.C.3 are inoperable, but if they can be inserted with control rod drive pressure they need not be disarmed electrically.
- d. Control rods with a failed "Full-in" or "Full-out" position switch may be bypassed in the Rod Sequence Control System and considered operable if the actual rod position is known. These rods must be moved in sequence to their correct positions (full in on insertion or full out on withdrawal).
- e. Control rods with inoperable accumulators or those whose position cannot be positively determined shall be considered inoperable.
- f. Inoperable control rods shall be positioned such that Specification 3.3.A.1 is met. In addition, during reactor power operation, no more than one control rod in any 5 x 5 array may be inoperable (at least 4 operable control rods must separate any 2 inoperable ones). If this Specification cannot be met the reactor shall not be started, or if at power, the reactor shall be brought to a cold shutdown condition within 24 hours.

4.3 REACTIVITY CONTROL

- b. A second licensed operator shall verify the conformance to Specification 3.3.A.2d before a rod may be bypassed in the Rod Sequence Control System.

B. Control Rods

1. The coupling integrity shall be verified for each withdrawn control rod as follows:
 - a. When a rod is withdrawn the first time after each refueling outage or after maintenance, observe discernible response of the nuclear instrumentation and rod position indication for the "full in" and "full out" position. However, for initial rods when response is not discernible, subsequent exercising of these rods after the reactor is above 30% power shall be performed to verify instrumentation response.

3.3 and 4.3 BASES (cont'd.)

margin required due to control cell material manufacturing tolerances and calculational uncertainties has experimentally been determined to be 0.38% $\Delta k/k$. When this additional margin is demonstrated, it assures that the reactivity control requirement is met.

2. Reactivity margin - inoperable control rods.

Specification 3.3.A.2 requires that a rod be taken out of service if it cannot be moved with drive pressure. If the rod is fully inserted and then disarmed electrically*, it is in a safe position of maximum contribution to shutdown reactivity. If it is disarmed electrically in a non-fully inserted position, that position shall be consistent with the shutdown reactivity limitation stated in Specification 3.3.A.1. This assures that the core can be shutdown at all times with the remaining control rods assuming the strongest operable control rod does not insert. Inoperable bypassed rods will be limited within any group to not more than one control rod of a (5 x 5) twenty-five control rod array. The use of the individual rod bypass switches in the Rod Sequence Control System to substitute for a failed "full in" or "full out" position switch will not be limited as long as the actual position of the control rod is known. Also if damage within the control rod drive mechanism and in particular, cracks in drive internal housings, cannot be ruled out, then a generic problem affecting a number of drives cannot be ruled out. Circumferential cracks resulting from stress assisted intergranular corrosion have occurred in the collet housing of drives at several BWRs. This type of cracking could occur in a number of drives and if the cracks propagated until severance of the collet housing occurred, scram could be prevented in the affected rods. Limiting the period of operation with a potentially severed rod and requiring increased surveillance after detecting one stuck rod will assure that the reactor will not be operated with a large number of rods with failed collet housings.

B. Control Rod Withdrawal

1. Control rod drop accidents as discussed in the FSAR can lead to significant core damage. If coupling integrity is maintained, the possibility of a rod drop accident is eliminated. The overtravel position feature provides a positive check as only uncoupled drives may reach this position. Neutron instrumentation response to rod movement provides a verification that the rod is following its drive. Absence of such response to drive movement could indicate an uncoupled condition. Rod position indication is required for proper function of the rod sequence control system and the rod worth minimizer (RWM).

*To disarm the drive electrically, four Amphenol type plug connectors are removed from the drive insert and withdrawal solenoids rendering the rod incapable of withdrawal. This procedure is equivalent to valving out the drive and is preferred because, in this condition, drive water cools and minimizes crud accumulation on the drive. Electrical disarming does not eliminate position indication.

UNITED STATES NUCLEAR REGULATORY COMMISSION

DOCKETS NOS. 50-277 AND 50-278

PHILADELPHIA ELECTRIC COMPANY
PUBLIC SERVICE ELECTRIC AND GAS COMPANY
DELMARVA POWER AND LIGHT COMPANY
ATLANTIC CITY ELECTRIC COMPANY

NOTICE OF ISSUANCE OF AMENDMENTS
TO FACILITY OPERATING LICENSES

Notice is hereby given that the U.S. Nuclear Regulatory Commission (the Commission) has issued Amendments Nos. 17 and 16 to Facility Operating Licenses Nos. DPR-44 and DPR-56, respectively, to the Philadelphia Electric Company, Public Service Electric and Gas Company, Delmarva Power and Light Company, and Atlantic City Electric Company (the licensees), which revised Technical Specifications for operation of the Peach Bottom Atomic Power Station Units 2 and 3 (the facilities), located in York County, Pennsylvania. The amendments are effective as of their date of issuance.

These amendments revise the Technical Specifications to (1) add requirements that would limit the period of time operation can be continued with immovable control rods that could have control rod drive mechanism collet housing failures and (2) require increased control rod surveillance when the possibility of a control rod drive mechanism collet housing failure exists.

The Commission has made appropriate findings as required by the Act and the Commission's rules and regulations in 10 CFR Chapter I, which are set forth in the license amendments. Notice of the Proposed Issuance of Amendments to Facility Operating Licenses in connection with this action was published in the FEDERAL REGISTER on January 19, 1976 (41 F.R. 2694). No request for a hearing or petition for leave to

OFFICE >	intervene was filed following notice of the proposed action.					
SURNAME >						
DATE >						

The Commission has determined that the issuance of these amendments will not result in any significant environmental impact and that pursuant to 10 CFR §51.5(d)(4) an environmental statement, negative declaration or environmental impact appraisal need not be prepared in connection with issuance of these amendments.

For further details with respect to this action, see (1) the Commission's letters to Philadelphia Electric Company dated September 23, 1975 and January 7, 1976, (2) Amendment No. 17 to License No. DPR-44, (3) Amendment No. 16 to License No. DPR-56, and (4) the Commission's related Safety Evaluation issued on September 23, 1975. All of these items are available for public inspection at the Commission's Public Document Room, 1717 H Street, N. W. Washington, D. C. and at the Martin Memorial Library, 159 E. Market Street, York, Pennsylvania 17401.

A single copy of items (1) through (4) may be obtained upon request addressed to the U.S. Nuclear Regulatory Commission, Washington, D. C. 20555, Attention: Director, Division of Operating Reactors.

Dated at Bethesda, Maryland this *19th* day of *February*, 1976.

FOR THE NUCLEAR REGULATORY COMMISSION

George Lear, Chief
Operating Reactors Branch #3
Division of Operating Reactors

OFFICE >	ORB#3	ORB#3	OELD	ORB#3		
SURNAME >	GParrish:kmf	EVerdery		GLear		
DATE >	2/ /76	2/ /76	2/ /76	2/ /76		

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

*Trans w/ letter
Att. 9-23-75*

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

SUPPORTING AMENDMENT TO LICENSE NOS. DPR-44 AND DPR-56

AND

CHANGES TO THE TECHNICAL SPECIFICATIONS

INOPERABLE CONTROL ROD LIMITATIONS

PHILADELPHIA ELECTRIC COMPANY

PEACH BOTTOM UNITS 2 AND 3

DOCKET NOS. 50-277 AND 50-278

INTRODUCTION

On June 27, 1975, Commonwealth Edison Company (CE) informed NRC that cracks had been discovered on the outside surface of the collet housings of four control rod drives at Dresden Unit 3⁽¹⁾. The cracks were discovered while performing maintenance of the control rod drives; the reactor was shutdown for refueling and maintenance. In a letter dated July 3, 1975, CE informed us that if the cracks propagated until the collet housing failed, the affected control rod could not be moved⁽²⁾. In a meeting with representatives of General Electric (GE) and CE the NRC staff was advised that further inspections revealed cracks in 19 of the 52 Dresden 3 control rod drives inspected, in one spare Dresden 2 control rod drive, in one Vermont Yankee spare control rod drive and in two GE test drives⁽³⁾. In a report dated July 30, 1975, after additional rod drives were inspected, CE stated that cracks had been found in 24 of 65 drives inspected⁽⁴⁾. Recently, the Tennessee Valley Authority reported that cracks were found in the collet housing of

- (1) Telegram to J. Keppler, Region III of the NRC, June 27, 1975, Docket No. 50-249.
- (2) Letter from B. B. Stephenson, Commonwealth Edison Company to James G. Keppler, U. S. Nuclear Regulatory Commission, July 3, 1975, Docket No. 50-249.
- (3) Memo from L. N. Olshan, Division of Technical Review (DTR) to T. M. Novak, DTR, "Meeting on Cracks Found in Dresden 3 Control Rod Drive Collet Retainer Tubes," July 18, 1975.
- (4) Letter from B. B. Stephenson, Commonwealth Edison Company to James G. Keppler, U. S. Nuclear Regulatory Commission, July 30, 1975, Docket No. 50-249.

seven of nineteen drives inspected at Browns Ferry 1 and Vermont Yankee found cracks in the collet housing of 4 of 10 control rod drives inspected. Because a number of control rod drives have been affected, because complete failure of the drive collet housing could prevent scram of the affected rod, and because we do not consider existing license requirements adequate in view of the collet housing cracks experienced, we have concluded that the Technical Specifications should be changed for those reactors with control rod drive designs susceptible to collet housing cracks. The change should assure that reactors which could be affected would not be operated for extended periods of time with a control rod which cannot be moved.

DESCRIPTION

The control rod drive is a hydraulically operated unit made up primarily of pistons, cylinders and a locking mechanism to hold the movable part of the drive at the desired position. The movable part of the drive includes an index tube with circumferential grooves located six inches apart. The collet assembly which serves as the index tube locking mechanism contains fingers which engage a groove in the index tube when the drive is locked in position. In addition to the collet, the collet assembly includes a return spring, a guide cap, a collet retainer tube (collet housing) and collet piston seals. The collet housing surrounds the collet and spring assembly. The collet housing is a cylinder with an upper section of wall thickness 0.1 inches and a lower section with a wall thickness of about 0.3 inches. The cracks occurred on the outer surface of the upper thin walled section near the change in wall thickness.

1. Consequences of Cracking

The lower edges of the grooves in the index tube are tapered, allowing index tube insertion without mechanically opening the collet fingers, as they can easily spring outward. If the collet housing were to fail completely at the reported crack location, the coil collet spring could force the upper part of the collet housing and spring retainer upward, to a location where the spring and spring retainer would be adjacent to the collet fingers. The clearance between the collet fingers and the spring when in this location will not permit the collet fingers to spring out of the index tube groove. This would lock the index tube in this position so that the control rod could not be inserted or withdrawn.

The failure of one control rod to operate in any 5 x 5 array has previously been evaluated and the Technical Specifications presently allow no more than one control rod in any 5 x 5 array to be inoperable (at least 4 operable control rods must separate any 2 inoperable ones). If more than one rod in any 5 x 5 array is inoperable, or if the scram reactivity rate is too small, or if shutdown reactivity requirements are not met, the existing Technical Specifications require the reactor to be brought to a cold shutdown condition. Reactor power operation with one rod in each 5 x 5 array inoperable would not involve a new hazards consideration nor would it endanger the health and safety of the public.

2. Probable Cause of Cracking

The cause of the cracking appears to be a combination of thermal cycling and intergranular stress corrosion cracking. The thermal cycling results from insertion and scram movements. During these movements hot reactor water is forced down along the outside of the collet housing, while cool water is flowing up the inside and out of flow holes in the housing. These thermal cycles are severe enough to yield the material, leaving a high residual tensile stress on the outer surface.

The collet housing material is type 304 austenitic stainless steel. The lower portion of the collet housing has a thicker wall and its inner surface is nitrided for wear resistance. In 1960-61, similar drives using high hardness 17-4 PH material for index tubes and other parts were found to have developed cracks. The problem caused GE to switch to nitrided stainless steel. The nitriding process involves a heat treatment in the 1050 F to 1100 F range, which sensitizes the entire collet housing, making it susceptible to oxygen stress corrosion cracking.

The cooling water used in the drives is aerated water. This water contains sufficient oxygen for stress corrosion to occur in the sensitized material if it is subjected to the proper combination of high stresses and elevated temperatures.

We believe that the cracking is caused by a combination of thermal fatigue and stress corrosion. GE has determined that both full stroke insertion and scram will cause high thermal stress. The cracks are completely intergranular and extensively branched, indicating that corrosion is a major factor. The type of thermal cycling, plus the buildup of corrosion products in the cracks between cycles probably results in a ratcheting action. This is also indicated by the "bulged" appearance of the cracks on the OD.

3. Probability of Early Failure

We believe that the cracking is progressive and is cycle dependent. Although the details of the cracking process are still not clear, we have not identified any mechanism that would cause rapid cracking with progression to complete circumferential failure.

The axial loads on the housings are very low at all times so that through wall cracks would have to progress at least 90% around the circumference before there would be concern about a circumferential failure. Although one housing at Dresden 3 had three cracks which nearly joined around the circumference, no cracks at Dresden 3 were through wall and none of the housings examined approached the degree of cracking necessary for failure. The collet housing has three flow holes in the thin section equally spaced around the circumference. The observed cracks have been confined primarily to the areas below and between the holes and near the area where the wall thickness of the collet housing changes. Since all the cracks except those located at the change in wall thickness are fairly shallow and since those at the change in wall thickness are largely confined to the circumferential area between holes, the net strength of the cracked housings is still far greater than necessary to perform their function.

A test drive at GE that had experienced over 4000 scram cycles had a more extensive developed crack pattern. Although the satisfactory experience with this cracked test housing is encouraging, its performance may not be correlated directly to that of drives in service, as this test drive was subjected to lower temperatures, and possibly less severe thermal cycles than could be encountered in actual service. The cracks were first noticed on the test drive after about 2000 cycles - many more cycles than the cracked housings at Dresden 3 had experienced.

The chance that a large number of collet housing would fail completely at about the same time is very remote. This is primarily true because the distributions of failures by cracking mechanisms such as stress corrosion and fatigue are not linear functions. That is, failure is a function of log time or log cycles. Distribution of failures of similar specimens generally follow a log normal pattern, with one to two orders of magnitude in time or cycles between failures of the first and failures of the last specimen. As no collet housing has yet failed, we are confident that there would be very few, if any, failures during the next time period corresponding to the total service life to date.

4. Changes to Technical Specifications

Existing limiting conditions of operation allow operation to continue with up to one inoperable control rod in any 5 x 5 array. Existing surveillance requirements specify that daily surveillance of the condition of all fully or partially withdrawn rods would not have to begin until three rods are found inoperable. We do not consider that these existing limiting conditions of operation and surveillance requirements sufficiently limit the possibility of operating for an extended period of time with a number of rod drive mechanisms which cannot be moved. We have therefore concluded that the Technical Specifications should be changed as discussed below.

- (a) One stuck control rod does not create a significant safety concern. However, if a rod cannot be moved and the cause of the failure cannot be determined, the rod could have a failed collet housing. A potentially failed collet housing would be indicative of a problem which could eventually affect the scram capability of more than one control rod. Since the cracks appear to be of a type which propagate slowly, it is highly unlikely that a second control rod would experience a failed collet housing within a short period of time after the first failure. Therefore, a period of time of 48 hours can be allowed to determine the cause of failure. This period is considered long enough to determine if the cause of failure is not in the drive mechanism, yet short enough to be reasonably assured that a second collet failure does not occur. Therefore Section 3.3.A.2 (Reactivity Margin - Inoperable Control Rods) should be expanded to require that if a control rod cannot be moved during normal operation, testing or scram, the reactor shall be shutdown within 48 hours if the reason that it cannot be moved cannot be shown to be due to causes other than a failed collet housing.
- (b) If a control rod drive cannot be moved, the cause of the stuck rod might be a problem affecting other rods. To ensure prompt detection of any additional control rod drive failures which could prevent movement, Section 4.3.A.2 should be expanded to require surveillance every 24 hours of all partially and fully withdrawn rods if one rod drive is found to be stuck.

Until permanent corrective measures are taken to resolve the potential for stuck control rods due to failed collet housings, we believe that these additional specifications provide reasonable assurance that an unacceptable number of control rod collet housing will not fail during

operation. Upon completion of the investigations being performed by GE, additional corrective actions may permit revision of these requirements.

CONCLUSION

We have concluded, based on the considerations discussed above, that: (1) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, and (2) such activities will be conducted in compliance with the Commission's regulations and the issuance of this amendment will not be inimical to the common defense and security or to the health and safety of the public.

Date: SEP 23 1975