Docket Nos. 50-259
and 50-260

SEP 2 1975

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Tennessee Valley Authority
ATTN: Mr. James E. Watson
Manager of Power
818 Power Building
Chattanooga, Tennessee 37201

Gentlemen:

Your letter dated August 29, 1975, requested approval of certain restoration activities for Browns Ferry Units 1 and 2 and revised the Final Safety Analysis Report for Units 1, 2, and 3. The restoration activities for Browns Ferry Units 1 and 2 and the details of the fire protection design changes for Unit 3 are described in "Plan for Evaluation, Repair, and Return to Service of Browns Ferry Units 1 and 2 (March 22, 1975 Fire)" dated April 13, 1975, and revisions thereto up to and including Revision 20 (the Plan). In addition, your letter dated August 29, 1975, listed TVA's commitments for additional work not covered by the Plan.

We have reviewed the restoration work and design modifications proposed in the Plan and have considered the commitments made by TVA. We have concluded that TVA may proceed with the restoration and design modifications as proposed in the Plan. We find that implementation of these items are necessary and will not preclude any further modifications resulting from our continuing review, including resolution of the design details for incorporating the commitments made by TVA. Appropriate Amendments and Safety Evaluation are enclosed.

Sincerely,

Original signed by
R A Purple

Robert A. Purple, Chief
Operating Reactors Branch #1
Division of Reactor Licensing

Enclosures:
1. Amendment No. 14 to DPR-33
2. Amendment No. 11 to DPR-52
3. Safety Evaluation
4. Federal Register Notice

ccs: See next page

OFFICE	RL:ORB#1	TR	TR	OELD	RL:ORB#1
SURNAME	TVWambach:mer	Stello	Tedesco		RAPurple
DATE	9/2/75	9/ /75	9/ /75	9/ /75	9/2/75

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cc w/enclosures:
Robert H. Marquis
General Counsel
629 New Sprankle Building
Knoxville, Tennessee 37919

Athens Public Library
South and Forrest
Athens, Alabama 35611

Mr. Thomas Lee Hammons
Chairman, Limestone County Board
of Revenue
Athens, Alabama 35611

Anthony Z. Roisman, Esquire
Berlin, Roisman & Kessler
1712 N Street, NW
Washington, D.C. 20036

cc w/ enclosures & incoming
Ira L. Myers, M.D.
State Health Officer
State Department of Public Health
State Office Building
Montgomery, Alabama 36104

Mr. Dave Hopkins
Environmental Protection Agency
1421 Peachtree Street, NE
Atlanta, Georgia 30309

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

TENNESSEE VALLEY AUTHORITY

DOCKET NO. 50-259

BROWNS FERRY NUCLEAR PLANT UNIT 1

AMENDMENT TO FACILITY OPERATING LICENSE

Amendment No. 14
License No. DPR-33

1. The Nuclear Regulatory Commission (the Commission) has found that:

   A. The application for amendment by Tennessee Valley Authority (the licensee) dated August 29, 1975, complies with the standards and requirements of the Atomic Energy Act of 1954, as amended (the Act), and the Commission's rules and regulations set forth in 10 CFR Chapter I;

   B. The facility will operate in conformity with the application, the provisions of the Act, and the rules and regulations of the Commission;

   C. 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; and

   D. The issuance of this amendment will not be inimical to the common defense and security or to the health and safety of the public.

2. Accordingly, add Paragraph 2.C(4) to Facility License No. DPR-33 to read as follows:

   "(4) The facility may be modified as described in Section X of "Plan for Evaluation, Repair, and Return to Service of Browns Ferry Units 1 and 2 (March 22, 1975 Fire)" dated April 13, 1975, and revisions thereto up to and including Revision 20."

3. This license amendment is effective as of the date of its issuance.

FOR THE NUCLEAR REGULATORY COMMISSION

Original signed by
R. A. Purple

Robert A. Purple, Chief
Operating Reactors Branch #1
Division of Reactor Licensing

Date of Issuance: SEP 2 1975

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

TENNESSEE VALLEY AUTHORITY

DOCKET NO. 50-260

BROWNS FERRY NUCLEAR PLANT UNIT 2

AMENDMENT TO FACILITY OPERATING LICENSE

Amendment No. 11
License No. DPR-52

1. The Nuclear Regulatory Commission (the Commission) has found that:

   A. The application for amendment by Tennessee Valley Authority (the licensee) dated August 29, 1975, complies with the standards and requirements of the Atomic Energy Act of 1954, as amended (the Act), and the Commission's rules and regulations set forth in 10 CFR Chapter I;

   B. The facility will operate in conformity with the application, the provisions of the Act, and the rules and regulations of the Commission;

   C. 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; and

   D. The issuance of this amendment will not be inimical to the common defense and security or to the health and safety of the public.

2. Accordingly, add Paragraph 2.C(5) to Facility License No. DPR-52 to read as follows:

   "(5) The facility may be modified as described in Section X of "Plan for Evaluation, Repair, and Return to Service of Browns Ferry Units 1 and 2 (March 22, 1975 Fire)" dated April 13, 1975, and revisions thereto up to and including Revision 20."

3. This license amendment is effective as of the date of its issuance.

FOR THE NUCLEAR REGULATORY COMMISSION

Original signed by
R. A. Purple

Robert A. Purple, Chief
Operating Reactors Branch #1
Division of Reactor Licensing

Date of Issuance: SEP 2 1975

SAFETY EVALUATION BY THE DIVISION OF REACTOR LICENSING
SUPPORTING VARIOUS RESTORATION ACTIVITIES FOR THE
BROWNS FERRY NUCLEAR POWER PLANT UNITS 1, 2 AND SUPPLEMENT
7 TO THE SAFETY EVALUATION BY THE DIVISION OF REACTOR LICENSING
U.S. NUCLEAR REGULATORY COMMISSION IN THE MATTER OF TENNESSEE VALLEY
AUTHORITY, BROWNS FERRY NUCLEAR PLANT UNITS 1, 2, AND 3 WITH
REGARD TO DESIGN CHANGES

1.0 Introduction

On March 22, 1975, a fire at the Browns Ferry Nuclear Plant required a shut down of Units 1 and 2. The facility subsequent to the shutdown was found to have incurred substantial damage to power, control, and instrumentation wiring. Unit 3 of the Browns Ferry facility did not suffer any damage as a direct result of the fire. All three units are presently in the shutdown condition with the fuel removed from the vessels for Units 1 and 2; the Unit 3 reactor is still under construction with operation for that unit scheduled for early 1976. An overall program has been developed by the licensee delineating the necessary activities required to restore damaged portions of the facility to a level so that operation of Units 1 and 2 can be resumed.[1]

As a result of the fire an NRC review plan was developed consisting of three major and parallel elements. The first element was the investigation conducted by the Office of Inspection and Enforcement of events leading to the fire, fire fighting efforts, sequence of operational events and problems experienced with the nuclear steam supply system, interaction between units, and the response of TVA, State and Local authorities. This phase of the NRC plan has been completed.[2]

The second element of the plan, being performed by the Office of Nuclear Reactor Regulation has as its objectives (1) to assure that a safe plant configuration was attained and is being maintained subsequent to the fire, (2) to assure safety during removal of fuel from Units 1 and 2, (3) to assure plant safety during fire damage removal and restoration, and (4) to determine that the design changes that are required for restoration of these plants to operational status are acceptable. Thus far there have been two licensing actions taken to assure that the plant has been placed in a safe configuration following the fire. First, the plant Technical Specifications were changed to Temporary Technical Specifications designed to assure that a safe configuration

1 "Plan for Evaluation, Repair and Return to Service of Browns Ferry Units 1 and 2 (March 22, 1975, Fire)" and revisions thereafter.

2 OI&E Investigation Report of the March 22, 1975 Fire at the Browns Nuclear Station, dated July 25, 1975.

was maintained following the fire, while further corrective action plans were under development.[3] Subsequently, the Technical Specifications were again changed to provide for the removal of fuel from both Unit 1 and 2 reactor vessels and placement into the respective storage pools.[4] These changes also assure that the necessary minimum protective equipment to assure protection of the fuel in the storage pools from damage would be available with adequate redundancy and would be protected against adverse interaction with the fire affected wiring and cables, while such fire damage was removed and when the damaged wiring and cabling was replaced.

Thus far the restoration work performed at the facility to date has been limited to various clean-up operations and removal of damaged electrical wiring and cable trays. Thus, the fourth objective of the NRR element of the NRC program remains to be accomplished. This safety evaluation considers a portion of that objective, namely, the approval of certain proposed design features needed to prepare the facility for return to power operation. Consideration of return to operation including a determination of whether additional design features are required and an assessment of the operating procedures to assure safe operation will be discussed in a subsequent safety evaluation, prior to authorizing return to power operation.

The third element of the NRC program consists of the review being performed by the Special Browns Ferry Review Group established on March 26, 1975.[5] Efforts of this review group will be to prepare for NRC recommendations to change, as required, NRC policies, procedures, and technical requirements.

By letters dated August 25 and 29, 1975 TVA requested the approval of various restoration activities required to restore the plant to operational status as a result of the fire. The approval requested by TVA in the August 25

3 See Safety Evaluation issued in connection with Amendment 9 to license DPR-33 (Unit 1) and Amendment 6 to license DPR 1-52 (Unit 2) issued May 9, 1975.

4 See Safety Evaluation issued in connection with Amendment 10 to license DPR-33 (Unit 1) and Amendment 7 to license DPR-52 (Unit 2) issued.

5 Memorandum L Gossick to all NRC employees, "Appointment of Special Review Group," dated March 26, 1975.

letter consists of the following major items:

"1. Approval to proceed with structural work which covers restoration of concrete, embedments, pipe supports, cable tray supports and the replacement of pipe and ducting in the fire-affected area. In general, the plans related to this portion of the restoration effort are described in Part VIII of the Recovery Plan and in the response to Question 1.0 under the "General" heading.

2. Approval of electrical design changes including circuit changes and permission to proceed with the restoration and installation of cable trays, conduit, and cables, including approval for splicing. The work and design changes are described in Parts VI and X of the Restoration Plan.

3. Approval for installation of the fire detection system and for the installation of distribution piping of the fixed spray system in all areas of reactor building except in the fire-affected area. The installation in Unit 2 and Unit 3, and in the area outside the fire zone is scheduled to proceed simultaneously with structural work in the fire zone of Unit 1. These systems are described in subsection 5.0 of Part X of the Recovery Plan."

The replacement activities described in Item 1 above were authorized by letter dated August 28, 1975. The TVA letter dated August 29, 1975 modified Item 3 to some extent discussed below. Our evaluation of the overall restoration of the facility and improvement of facility design from the standpoint of fire protection is still under review. In its August 29, 1975 letter, the license agreed to provide further improvements in fire protection, over and above the improvements reflected in the changes authorized herein. These improvements are listed as commitments in the August 29, 1975 letter. The staff is still considering whether such further improvements are necessary prior to authorization of return to operation or whether such further improvements may be incorporated at a later shutdown period in the future. Although further improvements may be required in the future, including additional changes that may be required before return to operation is permitted, the design modifications authorized herein provide substantial enhancement of the capability of the facility to withstand the effects of a fire.

2.0 Description of Damage Resulting from the Fire

Substantial detail concerning the cause of the fire and the extent of damage to structures, systems and components is provided in the previously noted OI&E report. The following brief summary is provided as background for the discussion of the repair and replacement activities described in this Safety Evaluation.

After ignition, the fire propagated through the penetration in the wall between the cable spreading room and the Unit 1 reactor building. As a result of the pressure differential which is maintained beween the reactor building and the cable spreading room, and because an installed carbon dioxide (CO_2) fire extinguishing system was used in the cable spreading room, only a small amount of burning occurred in the cable spreading room. Damage to the cables in this area was limited to about 2 feet immediately adjacent to the penetration where the fire started. The major damage occurred in the reactor building outside the cable spreading room, in an area roughly 40 feet by 20 feet, where a very high concentration of electrical cables exists. There was very little other equipment in the fire affected area, with the only direct damage other than cables being the melting of a soldered joint on an air line.

Electrical System Damage

The electrical cables, after insulation had been burned off, shorted together, and grounded to their supporting trays or to the conduits, resulting in the loss of control power for much of the installed equipment such as valves, pumps, blowers and the like.

The most significant aspect of the fire damage was that it resulted in the loss of redundant safety equipment.

Soot and Chloride Damage

In addition to the cable damage, the burning insulation created a dense soot which was deposited throughout the Unit 1 reactor building and in some small areas in the Unit 2 reactor building. An estimated 4,000 lbs of polyvinyl chloride insulated cable which burned released an estimated 1400 lbs of chloride to the reactor building. Chlorides are very corrosive to most materials. Components subject to stress corrosion damage from chloride contamination are limited to those

constructed of stainless steel and high strength alloy steel such as equipment hanger springs. The licensee has provided a program of cleaning, cleanliness verification, evaluation, and surveillance to mitigate any harmful consequences of the exposure to chlorides.

TVA's cleaning program consisted of dry cleaning and wet detergent cleaning using demineralized water and a chloride-free industrial detergent solution. Cleaning procedures were repeated until measured chloride levels were below 0.88 mg per dm^2. This level of chloride contamination is recognized to be an acceptable level for chloride in contact with stainless steel and is incorporated as the acceptance level in RDT Standard E5-1T. After cleanliness was verified, precautions were taken to prevent recontamination. All sources of contamination were removed and further surveys were performed to verify acceptable cleanliness levels.

In addition to cleaning efforts, the licensee will undertake an extensive program, consisting of liquid penetrant examination, metallurgical sampling and surface replica examination. During the penetrant work, the stainless steel piping and piping components will be tested by liquid penetrant in all of the principle piping areas outside of primary containment in which corrosion damage could have occurred.

Metallurgical samples will be taken from stainless steel piping, stainless components and high strength alloy steel components. The samples will be removed in the fire zone and other areas of the Unit 1 reactor building where heavy residue from the fire was deposited. In addition, surface replicas will be taken from Unit 1 piping. Surface replication is a very sensitive technique with respect to the detection of cracking due to chloride stress corrosion and was an addition to the original metallurgical evaluation plan.

The surveillance program will be worked out in detail between TVA and NRC and will be carried out before return to operation is authorized and thereafter during plant operation, and will be addressed in our subsequent safety evaluation before return to operation is authorized. However, the initial proposed program consists of quarterly visual examinations of all stainless steel components and piping for signs of leakage, cracking or distress.

We conclude that based on our evaluation the cleaning procedures were effective in reducing chloride levels to or below the recognized acceptance standards. Testing to be carried out during the restoration period along with the subsequent surveillance program which will be developed before the plant returns to operation will assure that any deleterious corrosion will be detected and corrected in a timely manner.

3.0 Overall Approach Proposed by TVA

The Browns Ferry Nuclear Facility consists of three boiling water nuclear reactors each of which are designed to produce 1067 Mw of electric power. Units 1 and 2 of that facility were authorized for operation in June 1973 and June 1974 respectively and were in operation up until the March 22, 1975, fire. Unit 3 is still under construction and is expected to go into service early in 1976.

Units 1 and 2 share a common control room with a shared cable spreading room located beneath the control room. Wiring carrying signals between the control room and various pieces of equipment in the plant are routed into the cable trays in the cable spreading room. The fire caused extensive damage to wiring located immediately outside of the cable spreading room.

Some sharing of equipment exists between all three units; the sharing of electrical systems is most extensive in Units 1 and 2. The electrical design concept employed in the design of the Units 1 and 2 is based on using a two-division concept. The purpose of dividing the electrical system into two divisions was to assure that the facility could be maintained in a safe configuration even with the postulated loss of one entire division.

Consideration of a fire as a design basis event, requires that the capability be maintained during and following the fire to safely shutdown the reactor and remove the decay heat. Previous analyses (PSAR and FSAR) have shown that only one division of electrical equipment is required to assure that the facility is maintained in a safe condition. The control rod system in a BWR is designed to be fail safe. That is, a loss of electrical power results in initiating a scram of the control rods and shutdown of the reactor.* Therefore, the major objective for protection of the reactor from the effects of fire is to assure that necessary equipment to remove decay heat remains operable in the event of a fire.

Thus, it is important to limit fire induced failures to one division of the safety related equipment for shutdown heat removal from each reactor which provides, for each reactor at least one core spray system with two associated pumps and valves, and one RHR system with associated pumps, heat exchangers, and valves, together with enough relief valves for reactor system blowdown to low pressure. (It should be noted that non-safety grade equipment is normally used to perform this function). In order to assure that a fire would not cause a loss of both divisions, some changes in the facility design and equipment layout are necessary.

Facility modification that would be required to allow complete physical separation of the divisions would be extremely difficult to achieve in an already designed and existing facility. There are however, combinations of methods which can be used to accomplish the same purpose, e.g., 1) fabrication of the electrical distribution system with fireproof wiring, 2) fire detection and extinguishing systems that protect the critical areas of the plant, 3) elimination of substances which can be the source of fire would also reduce the potential for fire damage to both electrical divisions; and 4) relocation of the divisions as well as installation of physical barriers to limit the susceptibility of damage occurring in both divisions.

In recognition of the difficulty of achieving complete physical independence of the two divisions, the licensee proposed an overall program that con-

* The control rod system in a BWR is a mechanical system whose operating power is derived from a hydraulic system. An interruption of the electrical power to the scram circuitry causes a scram which initiates the hydraulic system and becomes independent of the electrical system and eliminates the need for continuous power supply.

sidered a number of elements. These include design changes, improved fire fighting methods, and improved administrative procedures which would assure that postulated fires within the facility would not result in a loss of both electrical divisions. This overall approach proposed by the licensee is presented in Part X of the recovery plan. The essential ingredients of that proposal are to provide changes to the electrical circuits via either sufficient separation or by the installation of various fire barriers to assure that a fire induced failure in one division could not damage the second division. A one-hour fire protection interval was selected to assure that a fire in any location in one division would not damage any portion of its redundant division even if the fire should last for one full hour. The licensee analyzed its systems taking into account the materials pertaining to the particular arrangement of the division of cabling under consideration to determine the need for additional protection. Using these analytical techniques, fire barriers are proposed to be installed such that the stated objective of a one hour fire protection interval would be available through the facility. On the basis of a one hour fire protection interval, procedures were derived to assure that a fire which could threaten the safe shutdown of the facility, would be extinguished well within one hour. Reliance is placed on using augmented administrative procedures in conjunction with hand held fire protection equipment already installed in the facility and additional hand held extinguishers which will be added throughout the facility. In those areas for which easy access by personnel with hand held fire equipment would be difficult, licensee will install fixed manually operated water sprays. The areas which have been specifically identified as requiring fixed spray systems are as follows:

a. Along cable tray runs parallel to the north wall of Reactor Building at elevation 593 feet of units 1, 2, and 3.

b. All penetrations from the cable spreading room into the turbine building and from the cable spreading room into the Reactor building containing congested cable trays where several trays make each inaccessible.

c. In other Reactor building areas where concentration of cables, as determined by visual surveys, make it difficult for immediate, easy access for fire fighting application of extinguishing agents.

To assure that any fires that may start are promptly detected, so that they may be extinguished promptly, the licensee has proposed installing a substantially extended fire detection system which will detect the start of fires and will promptly alarm in the control room. Operating procedures under development will result in prompt dispatch of fire fighting personnel to extinguish the fire.

Two types of detector will be employed to provide the fire detection function in those areas determined from the plant reanalysis to be critical. Products of combustion detectors will be installed in general on a 30 ft. grid basis. These areas will be zoned and no less than two detectors will be installed in a given zone. All detectors within a given zone will be wired in "OR" logic. Sensitivity or trip point will be 6 milligrams of products of combustion per cubic foot of air. Heat cable detectors will be installed on cable trays in the critical areas. This will provide both redundancy and diversity of detectors. The heat cable detectors will respond when the temperature at any point along the cable reaches 250 F. All sensors will be tested on a periodic basis. Products of combustion detectors within a given zone will provide one alarm for detection and another alarm for circuit trouble. Heat detectors within a given zone will provide one alarm for detection of heat or loss of power. And all detectors will receive power from the plant preferred bus.

Cable Replacement and Repair

The major effort in restoring the facility to a condition in which it will be able to operate, is the replacement and repair of damaged wiring and cables. This amounts to some 9500 conductors to be replaced or spliced. All cabling of the reactor protection system, primary containment isolation system, engineered safeguards (divisional) cables will be replaced from terminal to terminal (without splicing). Only non-divisional cables (that is those not required for providing either power or control to safety systems) will be spliced and repaired. Of these, the specific repair requirements provide for protection against high temperature or interruption of vital circuits that could result from a poor splice. The procedures proposed call for splicing at undamaged locations determined by measurements made on the insulation material, for splices in accordance with applicable codes; for accessibility to facilitate inspection; and for measures that assure no mechanical loading exists on the splices. Appropriate fire stops are provided along the cable trays away from the splice.

Replacement or repair of cabling will be of equivalent quality or better than the original cabling which was damaged by the fire.

Circuitry Changes

In addition to replacement and repair of damaged wiring and cables, TVA proposes design changes to enhance fire protection and eliminate the source of the loss of redundant safety equipment which occurred as a result of the March 22, 1975 fire.

The most significant loss of redundant equipment was associated with failures of their power sources which were caused by short circuits to lamp circuits leading from the control circuits of Reactor Motor Operated Valve (MOV) boards. These cables were considered to be non-divisional because a dropping resistor was provided in the lamp circuit for the purpose of isolating this circuit from the control circuit. Several of these cables from both divisions were run together in common trays and were, subsequently, all damaged by the fire. TVA has proposed to remove the cables leading from Reactor MOV board control circuits to breaker indication lamps to eliminate the major problem which was the loss of ability to operate the boards in both divisions. We agree with this approach and conclude that these circuit changes will eliminate the loss of redundant division MOV board controls.

The second most significant cause for loss of redundant equipment was due to the proximity of conduits containing division I and divison II cables to cable trays which were the primary source of combustible material. Although the use of conduit may provide adequate protection against some affects of fire, the fire which occurred proved that conduit protection alone was insufficient for a fire of that magnitude without additional protection in the form of additional separation or fire barriers. To remedy this TVA will modify the cabling and wiring systems to assure that cross divisional affects during fires due to the proximity of conduits are minimized. To accomplish this the cabling and wiring is to be modified, wherever divisional cables are routed in conduit near open trays carrying cables of the opposite division. Separation of divisional conduits will be provided by structures, distance, barriers, interposing ducts, pipes, etc., or combinations thereof to provide at least a one hour fire protection interval. The proposed criteria to be used to effect these changes are contained in Part X of the plan.

An analysis of the plant cable tray and conduit network has been made using the proposed criteria and approximately 80 locations have been identified for which conformance to the above proposed requirements had to be examined. The supplemental separations requirement involves the use of barriers and fire stops to inhibit cross divisional effects during a fire and to minimize fire propagation within divisions. In addition, conduits are no longer treated as adequate barriers to fire and therefore separation or other barriers are required to protect the conduit circuits. Together these additional requirements will provide a minimum of one hour fire protection interval against cross divisional effects.

A third cause for loss of redundant equipment was damage to their cables sharing the same cable tray contrary to the stated criteria. This third significant cause for loss of equipment will be remedied by separating the involved cables. Selective changes will also be made in the electric power system to improve isolation. These changes will provide individual normal feeders to the 4KV/480-V transformers. One change will eliminate sharing between units of the 4 KV feeder that was the normal supply to 480 V Shutdown Board 2A and 2B through TS3E. Other changes will provide individual 4 KV feeds to transformers TDA and TDB which supply 480-V Diesel Auxiliary Boards A and B, respectively. The only shared 4KV feeder will be the alternate supply to transformers TSIE and TDE.

The requirements for replacement and for splicing and repair of cables damaged by the fire will provide for replacement in which the cabling integrity and performance will be essentially equivalent to that provided in the original installation. The design changes in circuitry will provide substantially enhanced protection for the redundant safety system circuitry by providing increased separation so as to provide at least a one hour fire protection barrier to assure that fires in one division will not adversely affect another division even if the fire should last for a full hour.

With the increased and improved fire detection system proposed and the installation of fixed sprays in areas in which access is restricted to augment improved fire fighting procedures throughout the plant, the design changes which TVA proposes will substantially improve

the ability of the facility to withstand fire.

4.0 NRR Evaluation of the TVA Approach

Although the fire that occurred caused damage to the electrical system greater than that which had been considered in our original evaluation of that facility, our evaluation has shown that even with this extensive damage considerable flexibility remained with respect to methods available to remove the decay heat from the reactor and assure the reactor was maintained in a safe condition.

In spite of the capability already inherent in the facility, the fire demonstrates that additional emphasis on the protection of the facility from a fire is needed. In this connection we have considered those features, actions and design approaches that should be a part of fire protection capability. The three basic considerations in minimizing the effects of the fire are: administrative actions that can prevent a fire from occurring; use of separation as a mechanism by which to prevent a fire from damaging redundant safety equipment; and, incorporation of a means to detect and extinguish a fire quickly.

The principal difference in our approach from that used by TVA, is that we would emphasize that each of these elements should be considered by themselves to the extent practical. As previously noted, no one of these three elements can be relied upon to completely eliminate problems associated with fires. TVA's approach instead was based on selection of a one hour fire protection separation and providing detection and fire protection equipment and procedures to extinguish fires within one hour. This is to be combined with strict administative control to prevent fires from occurring.

As indicated above the one hour fire protection separation which the changes in circuitry will provide, will substantially enhance the ability of the facility to withstand fire. However, we believe and have indicated to TVA our position that such separation should be considered as providing a base protection standard and that if practicable application of additional thermal barriers could significantly extend the one hour interval, then such additional barriers should be installed.
TVA will substantially upgrade its operating procedures and training for fire protection to assure that fires can be extinguished within one hour using the hand held fire equipment available in the facility. TVA proposes to install a fixed manually operated spray system, to supplement the hand held equipment, only in areas in which access prevents effective use of hand held fire fighting equipment.

We believe that an automatically actuated fixed spray system should be extended throughout all areas in which the potential for inter-divisional effects exist. The advice we have received from expert consultants supports this approach. The experience gained as a result of the Browns Ferry Fire indicates that if a water spray had been used earlier in the fire, considerably less damage would have resulted and the fire would have been extinguished sooner than it was. After discussions between the staff and TVA, the licensee in a letter dated August 29, 1975, has committed to converting those fixed spray systems he has presently designed to an automatic system within approximately one year. He has also committed in that letter to evaluate the installation of additional fixed spray systems to extend the fire protection coverage throughout all those areas in which such protection is required. Such studies will be completed and any areas for which this extended coverage should be provided will be identified and discussed in our subsequent evaluation prior to authorization of power operation of any of these units.

The operation of the installed CO2 (Carbon Dioxide) fire extinguishing system in the cable spreading room was effective in preventing substantial damage to the cables located in that room. The licensee did not propose to make any further changes to the fire extinguishing equipment provided in the cable spreading room. Reliance on the manual operation of CO_2 system as is now provided is not adequate. We have informed TVA of our conclusion and TVA has agreed to make necessary changes to provide automatic actuation of the CO_2 system. We have also informed TVA that we believe that there should be a liberal application of a flamemastic material to coat the cable trays located within the cable spreading room. The CO_2 system when exhausted may not have sufficient cooling capability to fully extinguish a deep-seated fire. The licensee has indicated that in such an event the system could be augmented to extinguish any fire by using hand held equipment. Although this may be an appropriate method for augmenting the CO_2 system, we have indicated our position to the licensee that he should study further additional measures, including consideration of installing fixed water spray systems, that could be used within the cable spreading room. The licensee has agreed to provide such a study. The study will be completed and any changes will be identifed and discussed in our subsequent safety evaluation prior to authorization of return to power.

We have informed the licensee that the design of the penetration which requires building a fire stop be modified to incorporate a new material which will be demonstrated by tests to be of a fire resistant nature. This would include all penetrations that were damaged as a result of the fire as well as all new penetrations. Those in the Unit 3 cable spreading room are to be constructed using the new design. We have also informed the licensee to reexamine the penetration that now exists and assure that they are placed into the originally designed condition. We have further asked that whenever it is necessary as a result of the restoration program to breach a fire stop that the repair of that fire stop to the extent practical include removal of the original materials with replacement made of materials used for the design of new fire stops. The licensee has agreed to these provisions.

During our detailed evaluation we and our consultants have looked into the manner in which the ventilation systems throughout the plant should perform. We have concluded that in the event a fire is detected in the cable spreading room, its ventilation system should be stopped. We have not been able to complete our determinations as to whether the ventilation system used for other rooms should also be stopped in the event of a fire. There is a need for ventilation to clear and remove the combustion products thereby providing accessibility into the fire area. On the other hand, the increased ventilation rate may be undesirable with respect to the capability for causing the fire to burn with an increased force. We have informed the licensee that this matter must be studied further prior to authorizing any power operation. The licensee has committed to perform this further evaluation.

Our evaluation of the facility will continue and our subsequent evaluation prior to facility operation will discuss further facility improvements still under study as described above. However, authorization of the changes and the work activities proposed by TVA will improve facility safety as described in Section 5.0. Moreover, such work is of such a nature that further changes to effectuate potential improvements discussed above would not be precluded or hampered by the restoration activities approved at this time.

5.0 Requested Approval

There are three major action items for which the licensee has requested approval, namely, structural work, electricl design changes including installation of cables, and installation of the fire detection and spray systems. Following are the bases for the approval for each of these action items.

1. Approval to proceed with structural work which covers restoration of concrete, embedments, pipe supports, cable tray supports and the replacement of pipe and ducting in the fire-affected area. In general, the plans related to this portion of the restoration effort are described in Part VIII of the Recovery Plan and in the responses to Question 1.0 under the "General" heading.

Basis for NRC Approval

The programs and procedures for restoration of process piping, HVAC ducts and supports, hangers, restraints, cable trays and supports of affected mechanical equipment have been reviewed. The restoration program requires the evaluation of all the above mentioned components for the effects of the cable fire. Thermal sensitivity based on minimum acceptable material properties and safety function will be determined for these components and items and then compared to the fire temperature zones determined by inspection of damage and analyses. Where thermal sensitivity was lower than the actual temperature experienced, the component or item may be eliminated from further consideration and replaced to the original specification or an evaluation will be made to justify continued use of the component.

Evaluation of all process piping is required regardless of the level of exposure to temperature effects. In lieu of further evaluation some piping may be replaced to the original specifications. If piping is to remain in service the restoration program requires removal of insulation, complete cleaning of the pipe surfaces and dye penetrant inspection of the pipe and pipe fitting surfaces.

The scope of the dye penetrant inspection is set in accord with the piping material strengths and sensitivity to the chemical environment resulting from the fire.

Carbon steel piping found to have been in a 500 F temperature zone will receive an initial inspection of twenty percent of the pipe surface and one

hundred percent of the fittings. The discovery of fire related cracks will require inspection of one hundred percent of the pipe surface in the same temperature zone. The boundary of the temperature zone will be extended by ten feet if the crack is found within ten feet of the initially determined boundary.

Stainless steel pipe and fittings will receive a one hundred percent inspection.

Aluminum piping will receive an inspection similar to that specified for carbon steel with the exception that the temperature zone is reduced to below 340 F. Any aluminum pipe found exposed to temperatures above 340 F will be replaced without further evaluation. In addition, if any fire related cracks are found within twenty feet of the 340 F zone a one hundred percent inspection will be performed in that twenty foot length and inspection will continue for another twenty feet of length.

We find that these procedures for restoration of process piping are properly set in accord with the material properties of the piping material and in recognition of the sensitivities of the various materials to the chemical environment resulting from the fire and that these procedures provide adequate assurance that the restored process piping will be fully capable of performing all design basis safety functions.

Safety related heating ventilating and air conditioning ducts will be evaluated on the basis of exposure to temperature of 500 F or greater as gaged by the established temperature zones and visible distortion of the ducts. All ducts showing visual distortions will be replaced or reworked to original specifications. All duct work influenced by the fire will be cleaned regardless of temperature exposure.

Evaluation of cable trays, cable tray supports and fixed members of pipe supports will be based on exposure temperatures and stress analysis considering material strengths reduced by any possible annealing affects of higher temperature exposure. Any structural steel found to have been immersed in a temperature of 1000 F or higher will be replaced without further evaluation.

In general all cable trays in direct and near contact with cables actually consumed by the fire will be replaced without further evaluation. The larger cable tray supports will be re-evaluated based on the actual load to be sustained. The acceptable stress levels for these analyses will be set at either seventy five percent of the original design allowable stress or based on the measurement of actual physical properties from a sample of the material exposed to the actual fire conditions.

The requirements specified above for acceptance of cable tray supports will also be employed for acceptance of the fixed members of pipe supports. Additional requirements have been established for acceptance of the variable elements of pipe supports. In the absence of variations in setting from the effects of the fire and the absence of actual fire damage the support setting will be corrected to give a properly aligned piping system. Setting changes as a result of the fire with no visible evidence of heat damage will require evaluation of spring characteristics to assure the necessary range of support as required by the system design. Visible heat damage will require replacement of the spring mechanism and if necessary the entire support.
We find that the procedures set forth for the evaluation and restoration of the safety related HVAC ducts cable trays, cable tray supports, and the fixed and variable members of pipe supports provide adequate assurance that these items will be capable of performing as designed throughout the range of loads and functions specified in the design bases for Browns Ferry Unit 1.

With respect to the structural steel components and the reinforced concrete structures which either support the cables or were in the vicinity of the burning cables TVA has initiated a restoration program which consists of:

1. Identification of the affected structures;
2. Establishment of the most probable temperature to which each structure was subjected during the fire;
3. Evaluation of the extent of damage of each structure;
4. Establishment of criteria for the requirement of replacement or repair of the damaged structure; and,
5. Development of procedures for detailed repair.

The structural steel components affected consist of miscellaneous structural steel supports, steel embedment, and portions of the building superstructure steel. The reinforced concrete structures affected consist of walls, columns, and floor slabs, which form the permanent building superstructure.

The temperature zones are established on the basis of the color of the structures of different materials of construction, melting of metals and burning of other materials. The extent of damage of each structure is evaluated on the basis of the temperature to which the structure was subjected and the physical condition of the structure.

The criteria for the requirement of replacement or repair of damaged

structure are as follows:

1. Steel Structures

Structural steel components will be replaced or will continue to be used depending upon whether their thermal sensitivity is lower or higher than the temperature to which the structural component was subjected during the cable fire. In addition any steel structure found to have been immersed in a temperature zone of 1000 F or more shall be replaced.

2. Concrete Structure

For reinforced concrete structures, the procedures for the evaluation of the concrete will consist of detailed visual inspection, comparison of temperature zones and testing of samples from core borings. For reinforcing steel, the procedures of evaluation will consist of the following:

(a) Analyze the adequacy of the structure by neglecting the steel bars exposed to high temperatures, and if found adequate no further evaluation will be done; and,

(b) Conduct sampling and testing of steel bars to determine their material characteristics. The measured material characteristics will be evaluated by rechecking the design of the affected structure. If the reduced characteristics are still adequate to resist the loads imposed on the structure, no modifications are necessary.

On the basis of the above criteria, the floor slab at elevation 621.25 in the reactor building which appeared to be most seriously damaged was evaluated by TVA. Reinforcing steel bar and concrete core samples were taken and tested. The results of the tests show that the material characteristics of the reinforcing steel and concrete were not adversely affected by the fire. On the basis of these findings, TVA concluded that the fire damage to reinforced concrete is structurally minor. Consequently, the repairs to be undertaken are considered non structural.

We have concluded that the criteria, methods and procedures that are used in the evaluation of damage of structures and in the replacement of structural steel components and repair of reinforced concrete structures will asssure that all structural components affected by the fire will be returned to their originally acceptable condition. Accordingly, since no facility modification is involved in the repair work, the work was approved by our letter dated August 28, 1975.

2. Approval of electrical design changes including circuit changes and permission to proceed with the restoration and installation of cable trays, conduit, and cables, including approval for splicing. The work and design changes are described in parts VI and X of the Restoration.

Basis for NRC Approval

The basis for the approval of this work is provided in Sections 3.0 and 4.0.

3. Approval for installation of the fire detection system and for the installation of distribution piping of the fixed spray system. These systems are described in subsection of Part X of the Recovery Plan.

Basis of NRC Approval

The basis for the approval of this work is provided in Sections 3.0 and 4.0. A number of additional modifications were requested regarding the installation of the spray system as proposed above. The modifications include features required to make the fixed spray system capable of automatic actuation. Additional automatic fixed spray systems may also be required. The approval and performance of the work identified above does not preclude these additional requirements. The approval of the final disposition of certain of the commitments made by TVA in their letter dated August 29, 1975 will be the subject of a later safety evaluation prior to the return to operation. Some of the commitments require that TVA investigate and make proposals regarding certain areas of system improvement; (i.e., additional fixed water spray coverage, fixed water spray or alternative in the the cable spreading room, modification of cable spreading room ventilation system, additional penetration seal material). The later safety evaluation, prior to authorization for return to operation will address the final resolutuion of these items. There also may arise during the course of the restoration work additional items that will require resolution and these will also be addressed at that time.

6.0 Conclusions

As discussed in our Safety Evaluation issued in connection with Amendment 10 to DPR-33 and Amendment 7 to DPR-52, June 13, 1975, the requirements of the Technical Specifications issued on that date provide for protection of the fuel, which has been placed in the storage pools. These requirements assure ample safety systems to protect the fuel from damage. Such systems were made independent of systems involved in the restoration work and eliminate the potential for adverse interactions resulting from removal of fire damaged systems and restoration of the facility.

The replacement and repair work authorized in connection with this safety evaluation, will provide for replacement of cabling equivalent to that provided in the original installation. The design changes and improvements in circuit separation and resulting improved fire protection, along with the design improvements in fire detection systems and fire extinguishing systems proposed by TVA, substantially enhance the capability of the facility to withstand fires and will provide reasonable assurance that the public health and safety will not be endangered. These changes do not involve a significant increase in the probability or consequences of accidents previously considered and do not involve a significant decrease in a safety margin.

Based on the foregoing considerations, we have concluded that there is reasonable assurance that the public health and safety will not be endangered by the proposed changes and the restoration activities authorized herein and that such changes do not involve significant hazard considerations.

Our review of the safety of the facility to return to operation is still in progress and additional changes may be required as a result of our continuing review, or as a result of the additional studies which we have indicated are needed and which TVA has proposed as discussed above. This safety evaluation does not address resumption of operation at Browns Ferry Units 1 and 2. Any authorization to resume operation will be considered in a subsequent safety evaluation which will also consider necessary changes to plant operating technical specifications required in connection with such authorizations.

UNITED STATES NUCLEAR REGULATORY COMMISSION

DOCKET NOS. 50-259 AND 50-260

TENNESSEE VALLEY AUTHORITY

NOTICE OF ISSUANCE OF AMENDMENTS TO FACILITY OPERATING LICENSES

Notice is hereby given that the U.S. Nuclear Regulatory Commission (the Commission) has issued Amendment No. 14 to Facility Operating License No. DPR-33 and Amendment No. 11 to Facility Operating License No. DPR-52 issued to Tennessee Valley Authority for operation of the Browns Ferry Nuclear Plant, Units 1 and 2, located in Limestone County, Alabama. The amendments are effective as of their date of issuance.

The amendments modify the licenses to authorize modifications to Units 1 and 2 in conformance with "Plan for Evaluation, Repair, and Return to Service of Browns Ferry Units 1 and 2 (March 22, 1975 Fire)" in accordance with the licensee's request dated August 29, 1975. These amendments do not authorize return to operation of Units 1 and 2. That authorization will be the subject of another action upon completion of our review of the total restoration work required.

The application for these amendments complies with the standards and requirements of the Atomic Energy Act of 1954, as amended (the Act), and the Commission's rules and regulations. 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. Prior public notice of these amendments is not required since the amendments do not involve a significant hazards consideration.

For further details with respect to this action, see (1) the application for amendments dated August 29, 1975, (2) Amendment No. 14 to License No. DPR-33 and Amendment No. 11 to License No. DPR-52, and (3) the Commission's related Safety Evaluation. All of these items are available for public inspection at the Commission's Public Document Room, 1717 H Street, NW., Washington, D.C. and at the Athens Public Library, South and Forrest, Athens, Alabama 35611.

A copy of items (2) and (3) may be obtained upon request addressed to the U.S. Nuclear Regulatory Commission, Washington, D.C. 20555, Attention: Director, Division of Reactor Licensing.

Dated at Bethesda, Maryland, this SEP 2 1975

FOR THE NUCLEAR REGULATORY COMMISSION

Original signed by
R. A. Purple

Robert A. Purple, Chief
Operating Reactors Branch #1
Division of Reactor Licensing