Docket Files
NRC PDR
Local

December 1, 1981

Docket Nos. 50-556
and 50-557

MEMORANDUM FOR: Elinor G. Adensam, Chief
Licensing Branch #4, DL

FROM: Karl Kniel, Chief
Generic Issues Branch, DST

SUBJECT: SER INPUT - BLACK FOX UNITS 1 AND 2

Plant Name: Black Fox Units 1 and 2
Docket Numbers: 50-556 and 50-557
Licensing Stage: Construction Permit
Responsible Branch and Project Manager: Licensing Branch #4, D. Scaletti
DST Branch Involved: Generic Issues Branch
Description of Review: Unresolved Safety Issues
Review Status: Complete

Enclosed is the Generic Issues Branch, DST, input to Supplement 3 to the Black Fox Safety Evaluation Report. This input consists of an update of the Generic Safety Issues, Appendix to the Black Fox SER, and the supplemental testimony dated September 25, 1978 regarding this topic. The update is limited to those additional issues designated as USIs since the Black Fox Safety Evaluation Report was issued in June 1977. This includes issues A-43 through A-48. Several issues have been technically resolved since the Black Fox SER was issued. These include A-9, A-10, A-24, A-31, A-36 and A-42. The LPM should assure that the plant-specific implementation regarding these resolved USIs is addressed in the body of the SER supplement.

Closure of several of the USIs (A-46 and A-48) addressed in Section C.5 is predicated on certain Black Fox plant specific actions by the functional branches. A table of these items is enclosed (Enclosure 1). The Black Fox LPM should confirm with the appropriate functional review branch that the appropriate action has been taken.

/s/

Karl Kniel, Chief
Generic Issues Branch
Division of Safety Technology

Enclosures:
1. Functional Branch Interfaces
2. Supplemental SER Input

OFFICE ▶	cc: w/enclosures					
SURNAME ▶	See next page					
DATE ▶	8112210057 811201 PDR ADOCK 05000556 E PDR					

NRC FORM 318 (10-80) NRCM 0240 OFFICIAL RECORD COPY

cc: w/enclosures
F. Schroeder
N. Anderson
P. Norian
R. Tedesco
D. Scaletti
C. Anderson

DISTRIBUTION
Docket Files 50-556/557
GIB Reading
F. Schroeder
K. Kniel

OFFICE	DST:GIB	DST:GIB	DST:GIB	DST:GIB	DST:AD:GP		
SURNAME	CJAnderson:jb	PENorian	NRAnderosn	KKniel	FSchroeder		
DATE	11/23/81	11/24/81	11/24/81	11/24/81	11/30/81		

NRC FORM 318 (10-80) NRCM 0240

OFFICIAL RECORD COPY

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

December 1, 1981

Docket Nos. 50-556
and 50-557

MEMORANDUM FOR: Elinor G. Adensam, Chief
Licensing Branch #4, DL

FROM: Karl Kniel, Chief
Generic Issues Branch, DST

SUBJECT: SER INPUT - BLACK FOX UNITS 1 AND 2

Plant Name: Black Fox Units 1 and 2
Docket Numbers: 50-556 and 50-557
Licensing Stage: Construction Permit
Responsible Branch and Project Manager: Licensing Branch #4, D. Scaletti
DST Branch Involved: Generic Issues Branch
Description of Review: Unresolved Safety Issues
Review Status: Complete

Enclosed is the Generic Issues Branch, DST, input to Supplement 3 to the Black Fox Safety Evaluation Report. This input consists of an update of the Generic Safety Issues, Appendix to the Black Fox SER, and the supplemental testimony dated September 25, 1978 regarding this topic. The update is limited to those additional issues designated as USIs since the Black Fox Safety Evaluation Report was issued in June 1977. This includes issues A-43 through A-48. Several issues have been technically resolved since the Black Fox SER was issued. These include A-9, A-10, A-24, A-31, A-36 and A-42. The LPM should assure that the plant-specific implementation regarding these resolved USIs is addressed in the body of the SER supplement.

Closure of several of the USIs (A-46 and A-48) addressed in Section C.5 is predicated on certain Black Fox plant specific actions by the functional branches. A table of these items is enclosed (Enclosure 1). The Black Fox LPM should confirm with the appropriate functional review branch that the appropriate action has been taken.

Original signed by
K. Kniel

Karl Kniel, Chief
Generic Issues Branch
Division of Safety Technology

Enclosures:
1. Functional Branch Interfaces
2. Supplemental SER Input

cc: w/enclosures
See next page

cc: w/enclosures
F. Schroeder
N. Anderson
P. Norian
R. Tedesco
D. Scaletti
C. Anderson
S. Hanauer

Enclosure 1

BLACK FOX -- APPENDIX C.5
UNRESOLVED SAFETY ISSUE
FUNCTIONAL BRANCH INTERFACES

Task	LPM/Functional Branch Interface
A-46, Seismic Qualification of Equipment in Operating Plants	Appendix C.5, p. C-5 states that: "Black Fox was reviewed and approved by the Commission staff in accordance with current design criteria and methods for seismic qualifications." The LPM should confirm that the Black Fox review for seismic qualification of equipment to current criteria is complete and acceptable.
A-48, Hydrogen Control Measures	Appendix C.5, p. C-8 indicates that the review of Black Fox to the near term CP rule is complete and acceptable. The LPM should confirm that this review is complete and acceptable.
A-44, A-46, A-48	In the discussion of these issues in Appendix C.5, references were made to applicable sections of the SER and the SER supplement. These specific section numbers were not available at this writing. The appropriate section numbers should be supplied by the LPM.

Enclosure 2

SUPPLEMENT TO BLACK FOX
SAFETY EVALUATION REPORT
APPENDIX C
UNRESOLVED SAFETY ISSUES

C.5 Discussion of New Unresolved Safety Issues as they Relate to Black Fox

This section provides the NRC staff's evaluation of Black Fox for each of the new "Unresolved Safety Issues." Our discussion is limited to those issues that were identified as Unresolved Safety Issues since the Black Fox Safety Evaluation Report was issued in June 1977. Previously identified USIs are discussed in the Black Fox Safety Evaluation Report. This section includes our bases for licensing prior to the ultimate resolution of these issues. Our conclusions are based in part on the information provided by the applicant in their letter of _____.

A-43 Containment Emergency Sump Reliability

Following a postulated loss-of-coolant accident (i.e., a break in the reactor coolant system piping) the water flowing from the break would be collected in the suppression pool. This water would be recirculated through the reactor system by the emergency core cooling pumps to maintain core cooling. This water may also be circulated through the containment spray system to remove heat and fission products from the drywell and wetwell atmosphere. Loss of the ability to draw water from the suppression pool could disable the emergency cooling and containment spray systems.

One postulated means of losing the ability to draw water from the suppression pool could be blockage by debris. A principal source of such debris could be the thermal insulation on the reactor coolant system piping. In the event of a piping break, the subsequent violent release of the high pressure water in the reactor coolant system could rip off the insulation in the area of the break. This debris could then be carried over into the suppression pool, potentially causing blockage.

A second postulated means of losing the ability to draw water from the suppression pool could be abnormal conditions at the pump inlet such as air entrainment or vortices. These conditions could result in pump cavitation, reduced flow and possible damage to the pumps.

Public Service Company of Oklahoma has incorporated the following measures to minimize these concerns:

a. Mass type insulation has been kept to a bare minimum within the containment.

b. Each strainer has minimum inlet area of at least 200 percent of that required to satisfy the pump flow requirements.

c. The strainers are located 5 feet 7 inches above the bottom of the pool and the approach velocities are low, thus minimizing debris pick up.

d. The various pump strainers are diversely located, thus minimizing the chances of disabling multiple trains in the event of local conditions.

During a Design Basis Accident, the ECCS strainers have a minimum submergence of greater than 8 feet 4 inches from the center of the ECCS suction pipe. This, coupled with the low intake velocity, should preclude vortex formation.

Accordingly, we conclude that there is reasonable assurance that Black Fox can be constructed and operated at the proposed location without undue risk to the health and safety of the public.

A-44 Station Blackout

Electrical power for safety systems at nuclear power plants must be supplied by at least two redundant and independent divisions. The systems used to remove decay heat to cool the reactor core following a reactor shutdown are included among the safety systems that must meet these requirements. Each electrical division for safety systems includes an offsite alternating current power connection, a standby emergency diesel generator alternating current power supply, and direct current sources.

Task A-44 involves a study of whether or not nuclear power plants should be designed to accommodate a complete loss of all alternating current power (i.e., a loss of both offsite and the emergency diesel generator alternating current power supplies). This issue arose because of operating experience regarding the reliability of alternating current power supplies. A number of operating plants have experienced a total loss of offsite electrical power, and more occurrences are expected in the future. During each of these loss-of-offsite power events, the onsite emergency alternating current power supplies were available to supply the power needed by vital safety equipment. However, in some instances, one of the redundant emergency power supplies has been unavailable. In addition, there have been numerous reports of emergency diesel-generators failing to start and run in operating plants during periodic surveillance tests.

A loss of all alternating current power was not a design basis event for the Black Fox facility. Nonetheless, a combination of design, operating, and testing requirements that have been imposed on the applicant will assure that these units will have substantial resistance to a loss of all alternating current and that, even if a loss of all alternating current should occur, there is reasonable assurance that the core will be cooled. These are discussed below.

If offsite alternating current power (three independent lines) is lost, three diesel generators and their associated distribution systems will

deliver emergency power to safety-related equipment. Our review of the design, testing, surveillance, and maintenance provisions for the onsite emergency diesels is described in Section ____ of this SER. The requirements include preoperational testing to assure the reliability of the installed diesel generators is in accordance with our requirements discussed in this report.

If both offsite and onsite alternating current power are lost, boiling water reactors may use a combination of safety/relief valves and the reactor core isolation cooling system to remove core decay heat without reliance on alternating current power. These systems assure that adequate cooling can be maintained for at least two hours, which allows time for restoration of alternating current power from either offsite or onsite sources.

The issue of station blackout was considered by the Atomic Safety and Licensing Appeal Board (ALAB-603) for the St. Lucie Unit No. 2 facility. In addition, in view of the completion schedule for Task A-44 (March 1983), the Appeal Board recommended that the Commission take expeditious action to ensure that other plants and their operators are equipped to accommodate a station blackout event. For plants undergoing an operating license review, the staff requires that interim emergency procedures and operator training for safe operation of the facility and restoration of alternating current power be provided. This issue is scheduled to be complete prior to operation of this facility. This issue will be re-reviewed at the operating license review stage. The need for station blackout emergency procedures and operator training will be established at that time.

Accordingly, we conclude that there is reasonable assurance that Black Fox can be constructed and operated at the proposed location without undue risk to the health and safety of the public.

A-45 Shutdown Decay Heat Removal Requirements

Following a reactor shutdown, the radioactive decay of fission products continues to produce heat (decay heat) which must be removed from the primary system. The principal means for removing this heat in a boiling water reactor while at high pressure is via the steam lines to the turbine condenser. The condensate is normally returned to the reactor vessel by the feedwater system, however, the steam turbine-driven reactor core isolation cooling system is provided to maintain primary system inventory, if alternating current power is not available. When the system is at low pressure, the decay heat is removed by the residual heat removal systems. This "Unresolved Safety Issue" will evaluate the benefit of providing alternate means of decay heat removal which could substantially increase the plants' capability to handle a broader spectrum of transients and accidents. The study will consist of a generic system evaluation and will result in recommendations regarding the desirability of and possible design requirements for improvements in existing systems or an alternative decay heat removal method if the improvements or alternative can significantly reduce the overall risk to the public.

Black Fox Station has several ways for removing decay heat. The normal method is via the steam lines to the main condenser. The condensate is returned to the reactor by the Condensate and Feedwater Systems. In the event the Feedwater System is not available, the RCIC and/or the HPCS Systems can supply the required water from the condensate storage tanks.

If the condenser is not available, decay heat can be removed by operating the RHR in the steam condensing mode and returning the condensate via the RCIC System. Alternatively, the heat may be removed, without depressurizing the reactor, by cycling the safety-relief valves (SRV) which discharge to the suppression pool and returning suppression pool water to the reactor vessel using the RCIC or HPCS.

If the RCIC and HPCS are not available, decay heat may be removed by depressurizing the reactor using the safety-relief valves in the ADS mode and controlling reactor water inventory by using the RHR or LPCS.

The RHR, LPCS, and HPCS are safety-related systems which use motor driven pumps powered by on-site safety-related diesel generators. The RCIC is a safety-related system which uses a turbine driven pump. Control power is supplied to the RCIC from a safety-related on-site DC power source.

The reactor core isolation cooling and high pressure core spray systems at Black Fox Station have improvements over comparable systems at older Boiling Water Reactors. The RCIC system has been upgraded to a safety-grade quality (now required for all boiling water reactors), and high pressure core spray is powered by its own dedicated diesel so it can operate with an assumed loss of all other sources of AC power. Also, the RHR System contains three pumps and the LPCS System contains a fourth pump. Either one of the three RHR System pumps or the LPCS System, in conjunction with the ADS, can maintain reactor water level.

Accordingly, we conclude that there is reasonable assurance that Black Fox can be constructed and operated at the proposed location without undue risk to the health and safety of the public.

A-46 Seismic Qualification of Equipment in Operating Plants

The design criteria and methods for the seismic qualification of mechanical and electrical equipment in nuclear power plants have undergone significant changes during the course of the commercial nuclear power program. Consequently, the margins of safety provided in existing equipment to resist seismically induced loads and perform the intended safety functions may vary considerably. The seismic qualification of the equipment in operating plants must, therefore, be reassessed to ensure the ability to bring the plant to a safe shutdown condition when subjected to a seismic event. The objective of this "Unresolved Safety Issue" is to establish an explicit set of guidelines that could be used to judge the adequacy

of the seismic qualification of mechanical and electrical equipment at all operating plants in lieu of attempting to backfit current design criteria for new plants. This guidance will concern equipment required to safely shut down the plant, as well as equipment whose function is not required for safe shutdown, but whose failure could result in adverse conditions which might impair shutdown functions.

Black Fox was reviewed against current seismic criteria and approved by the Commission staff in accordance with current design criteria and methods for seismic qualification. The staff's review is discussed in Section _____ of this Safety Evaluation Report. Accordingly, we conclude that there is reasonable assurance that Black Fox can be constructed and operated at the proposed location without undue risk to the health and safety of the public.

A-47 Safety Implications of Control Systems

This issue concerns the potential for transients or accidents being made more severe as a result of control system failures or malfunctions. These failures or malfunctions may occur independently or as a result of the accident or transient under consideration. One concern is the potential for a single failure such as a loss of a power supply, short circuit, open circuit, or sensor failure to cause simultaneous malfunction of several control features. Such an occurrence could conceivably result in a transient more severe than those transients analyzed as anticipated operational occurrences. A second concern is for a postulated accident to cause control system failures which would make the accident more severe than analyzed. Accidents could conceivably cause control system failures by creating a harsh environment in the area of the control equipment or by physically damaging the control equipment. Although it is generally believed that such control system failures would not lead to serious events or result in conditions that safety systems cannot safely handle, in-depth studies have not been rigorously performed to verify this belief. The potential for an accident that would affect a particular control system, and effects of the control system failures, may differ from plant to plant. Therefore, it may not be possible to develop generic answers to all of these concerns; it is possible to develop generic criteria that can be used for future plant-specific reviews. The purpose of this "Unresolved Safety Issue" is to verify the adequacy of existing criteria for control systems or propose additional generic criteria (if necessary) that will be used for plant-specific reviews.

The Black Fox safety systems have been designed with the goal of ensuring that control system failures (either single or multiple failures) will not prevent automatic or manual initiation and operation of any safety system equipment required to trip the plant or to maintain the plant in a safe shutdown condition following any "anticipated operational occurrence" or "accident." This has been accomplished by either providing independence between safety and non-safety grade systems or providing isolating devices between safety and non-safety grade systems. These devices preclude the propagation of non-safety grade system equipment faults such that operation of the safety grade system equipment is not impaired.

A wide range of bounding transients and accidents is presently analyzed to assure that the postulated events would be adequately mitigated by the safety systems. In addition, systematic reviews of safety systems have been performed with the goal of ensuring that the control system failures (single or multiple) will not defeat safety system action.

With the emphasis on the availability of post-accident instrumentation, the staff review of Black Fox at the operating license stage will also evaluate the designs to assure that control system failures will not deprive the operator of information required to maintain the plant in a safe shutdown condition after an accident.

For recent operating license reviews the applicants have been requested to evaluate their control systems and identify any control system whose malfunction could seriously impact safety. The applicants have been requested to identify the use (if any) of common power supplies, and the use of common sensors or common sensor impulse lines whose failure could have potential safety significance. The results of these reviews are (or will be) documented in the Safety Evaluation Reports on a case-by-case basis.

Also, current operating license applicants have been requested to review the possibility of consequential control system failures which could exacerbate the effects of high energy line breaks (HELB) and adopt design changes or new operator procedures where needed, to assure that the postulated events would be adequately mitigated. As part of the staff's on-going review of the adequacy of the equipment qualification program for operating license applicants, the staff evaluates the design in order to verify that sufficient assurance has been provided to assure that equipment that may be potentially exposed to a HELB environment has been adequately qualified or an adequate basis has been provided to not qualify the equipment to the limiting hostile environment. The staff reviews are documented in the Safety Evaluation Reports on a case-by-case basis.

In addition, as part of the recent OL licensing reviews, applicants have been required to perform evaluations on a case-by-case basis to ensure the adequacy of plant procedures for accomplishing shutdown upon loss of power to any single electrical bus supplying power for the instruments and control systems.

These reviews have not as yet identified the need for requiring any additional measures beyond those required as a result of the above activities.

The reactor overfill transient in boiling water reactors which is also a subtask of this USI, is currently under a separate review by the BWR Owners' Group of which Public Service Company of Oklahoma is a member. Pending ultimate resolution of this item, the applicant has incorporated in the Black Fox Station design, a commercial grade high level trip (Level 8) of the RCIC, HPCS, and feedwater systems to prevent the occurrence of overfill transients.

Changes in the design of control systems can be accommodated prior to the issuance of the operating license since instrumentation design is normally completed in the latter stages of plant construction.

Based on the above, we have concluded that there is reasonable assurance that Black Fox can be constructed and operated prior to the ultimate resolution of this generic issue without endangering the health and safety of the public.

A-48 Hydrogen Control Measures and Effects of Hydrogen Burns on Safety Equipment

Following a loss-of-coolant accident in a light water reactor plant, combustible gases, principally hydrogen, may accumulate inside the primary reactor containment as a result of: (1) metal-water reaction involving the fuel element cladding; (2) the radiolytic decomposition of the water in the reactor core and the containment sump; (3) the corrosion of certain construction materials by the spray solution; and (4) any synergistic chemical, thermal and radiolytic effects of post-accident environmental conditions on containment protective coating systems and electric cable insulation.

Because of the potential for significant hydrogen generation as the result of an accident, 10 CFR 50.44, "Standards for Combustible Gas Control System in Light Water Cooled Power Reactors," and Criterion 41 of the General Design Criteria, "Containment Atmosphere Cleanup," in Appendix A to 10 CFR Part 50, require that systems be provided to control hydrogen concentrations in the containment atmosphere following a postulated accident to ensure that containment integrity is maintained.

The regulation, 10 CFR Section 50.44, requires that the combustible gas control system provided be capable of handling the hydrogen generated as a result of degradation of the emergency core cooling system such that the hydrogen release is five times the amount calculated in demonstrating compliance with 10 CFR Section 50.46 or the amount corresponding to reaction of the cladding to a depth of 0.00023 inch, whichever amount is greater.

The accident at TMI-2 on March 28, 1979 resulted in hydrogen generation well in excess of the amounts specified in 10 CFR Section 50.44. Following a thorough investigation of the circumstances contributing to this accident, the NRC established a number of new licensing requirements called the TMI Lessons Learned requirements. Implementation of these requirements has made more remote the likelihood of occurrence of another TMI type of accident. As a result of this knowledge it became apparent to NRC that specific design measures are needed for handling larger hydrogen releases, particularly for smaller, low-pressure containments. As a result, the Commission determined that a rulemaking proceeding should be undertaken to define the manner and extent to which hydrogen evolution and other effects of a degraded core need to be taken into account in plant design. An advance notice of this rulemaking proceeding on degraded core issues was published in the Federal Register on October 2, 1980.

Recognizing that a number of years may be required to complete this rulemaking proceeding, the staff has developed requirements dealing with hydrogen control for currently pending applications for construction permits. These requirements are detailed in a proposed change to the Commission's rules published on March 23, 1981 and based on NUREG-0718.

A summary of these requirements is that: (1) the minimum pressure capacity of the containment shall be no less than 45 psig; (2) degraded core scenarios involving as much as 100% cladding-water reaction are to be considered in the containment design; (3) the maximum hydrogen concentration uniformly distributed throughout the containment must be less than 10% by volume; (4) the hydrogen control system must keep the containment pressure and, therefore, the containment structural stresses within Service Level C limits; and (5) equipment essential to assuring safe shutdown and maintaining containment integrity must be able to survive the environmental consequences of the degraded core accident. In addition, containment penetration(s) are to be provided for possible future use with a filtered vent system. These requirements were made more severe than those established for OL and OR cases so as to minimize the extent to which construction of these plants would foreclose the ability to impose those new requirements that might develop as a result of the long-term rulemaking proceeding on degraded core cooling.

Black Fox was requested to comply with these requirements. In a submittal made to the staff on October 22, 1981, the applicant's evaluation of hydrogen control measures was provided. The applicant has tentatively selected a Hydrogen Control System consisting of a Distributed Igniter System (DIS) operated in conjunction with a spray system.

The DIS consists of glow plug igniters distributed throughout the containment and drywell. The DIS is designed to ignite hydrogen at low concentrations, thereby maintaining the concentration of hydrogen below its detonable limit and preventing containment overpressure failure. Containment response to the burning of hydrogen has been analyzed using the MARCH and HYBRID computer codes. The applicant is studying various alternative systems of hydrogen control. The final evaluations and selection will be completed by the applicant and submitted to the NRC two years after the issuance of the construction permit.

In addition, Mark III owners have formed an owners group to evaluate hydrogen control measures for Mark III containments, and the applicant is actively involved in the ongoing evaluations of that owners group.

The staff has reviewed and found acceptable the Black Fox applicant's preliminary design for and commitments relative to the Hydrogen Ignition System. This evaluation is provided in Section _____ of this Safety Evaluation Report.

Accordingly, we conclude that there is reasonable assurance that Black Fox can be constructed and operated at the proposed location without undue risk to the health and safety of the public.