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SUBJECT: Submits response to NRC questions on proposed mod to plant emergency electrical sys.

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DUKE POWER

February 22, 1995

U.S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, DC 20555

Subject: Oconee Nuclear Station
Docket Nos. 50-269, -270, -287
Response to NRC questions on Technical Specification 4.6 Revision

During a meeting on January 19, 1995, Duke responded to the NRC's questions on the proposed modification to the Oconee emergency electrical system. These questions were generated by the NRC's review of a proposed modification which will address potential overfrequency scenarios. The written response to the NRC's questions is attached to this letter.

Very truly yours,

J. W. Hampton

J. W. Hampton

cc: Mr. S. D. Ebneter, Regional Administrator
U. S. Nuclear Regulatory Commission, Region II

Mr. L. A. Wiens, Project Manager
Office of Nuclear Reactor Regulation

Mr. P. E. Harmon
Senior Resident Inspector
Oconee Nuclear Site

A001

1. **QUESTION:**

LER 93-01 states that a load rejection test was performed on October 25, 1992, and that the results of that test indicate that calculations used to establish acceptable Keowee operating limits (power, head, number of operating hydro units) are conservative. Please provide the detail test results and discuss how they validate and relate to the calculations and results discussed in the Duke letter to the staff on January 4, 1995.

Also, during the EDSFI conducted at Oconee, the inspection team was supplied with results from load rejection tests conducted during initial start-up, February 18 to April 15, 1971. Please discuss how these results relate to the calculations and their results discussed in the January 4, 1995, letter. Discuss results from any other load rejection events or tests.

Duke letter dated January 4, 1995, states that Evaluation KC Unit 1-2-0106 used a bench-marked computer model. Please discuss what means was used to bench-mark this model.

RESPONSE:

These questions will be answered by reviewing the chronological order of events concerning Keowee load rejection testing.

During the Spring of 1971, load rejections were performed on Keowee for initial start up adjustments and checkouts. Three of these load rejections were performed at 66 MW. These three load rejections resulted in maximum recorded overspeeds of 171, 170 and 171 RPM. The units were not noted to have tripped the overspeed switch that was set at 180 RPM.

On October 25, 1992, a load rejection test was performed at Keowee by procedure TT/0/A/0620/02. For this test, one unit was loaded to 79 MW and an ES signal was simulated. The operating unit load rejected and the idle unit started. The maximum overspeed the operating unit reached is unknown. However, the overspeed did not reach the trip setpoint of 180 RPM.

In January, 1993, a problem associated with Keowee overspeed protection were identified. In response to this problem, Keowee was limited to one unit generating to the grid at a maximum power output of 66 MW. This limit was based on the load rejections performed in the Spring of 1971 and documented in calculation OSC-6003 Rev. 0. These restrictions ensured that a load rejecting Keowee Unit would not exceed the overspeed setpoint of 180 RPM.

In February of 1993, LER 93-01 was written to document the problems and actions taken in the previous month. In the LER, attention was called to the conservatism in the 66 MW limit by comparing it to the load rejection test conducted on Oct. 25, 1992. During this test, a 79 MW load rejection test did not exceed the 180 RPM trip setpoint. The results of the October test were not used in calculation OSC-6003 Rev. 0. Only the data from the 1971 load rejections were used in that calculation.

On March 6, 1993, load rejection testing was performed on Keowee Unit 2 using Procedure TT/0/A/0620/03. The purpose of this test was to obtain data for new calculations that would model Keowee's response to load rejections. Three load rejections were performed. Unit RPM data and gate position versus time data were obtained for 75, 85, and 94 MW load rejections. The following maximum speeds were obtained:

	75 MW	85 MW	94 MW
Test RPM	171.6	177.4	181.8

On May 22, 1993, an emergency start test was performed on Keowee using procedure PT/0/A/0610/22. During this test, unit start up characteristics were obtained in the form of unit speed versus time curves.

In June of 1993, new Keowee operating limits were issued. These new limits were based on Calculation OSC-6003 Rev. 1. The new limits were issued in the form of operating curves which were added to the Keowee Modes of Operation procedure. The curves indicate the maximum power output for Keowee for a given set of lake conditions. These restrictions were based on a hand calculation model of Keowee overspeed. This model was benchmarked using the test results of the March 6, 1993 load rejection tests.

In December 1994, Calculation KC-UNIT 1-2-0106 was completed for proposed Modification ON-52966. This calculation produces new power and lake level restrictions which incorporate the effects of the proposed modification. A computer based model was used to determine the conditions where a load rejecting Keowee unit's speed would be at or below 110% overspeed in 20 seconds. The model was benchmarked using the data obtained from the March 6, and May 22, 1993 tests. The results of this bench marking showed that the computer model and the actual test data differed non-conservatively by as much as 1.4 seconds. Therefore, a 2 second penalty is added to the results of this model in the calculation.

In a letter dated January 27, 1995, Duke notified the NRC of the need to include additional conservatism into the calculations for present and future load restrictions. A copy of the revised calculation will be provided to the NRC for use in completing the review of the modification.

2. **QUESTION:**

EDSFI inspection report for Oconee raised the issue of possible adverse effects on Keowee auxiliary equipment during overvoltage/overfrequency transients related to Keowee load rejection scenarios (Finding 2). Duke letter dated November 1, 1994, (on corrective action for EDSFI findings) states that analyses of the overvoltage/overfrequency effects on the Keowee auxiliaries will not be completed until June 1, 1995. Please discuss how satisfactory operation of Keowee auxiliaries following load rejection scenarios is ensured without supporting tests or analyses being available.

Duke letter of January 4, 1995, states that during overspeed transient Keowee output voltage remains relatively constant. Discuss voltage control circuits and any limitations for their operation.

RESPONSE:

In response to Oconee's EDSFI Finding #2, Duke committed to perform an analysis addressing the possible adverse effects of overfrequency transients, resulting from load rejection scenarios, on the Keowee auxiliary equipment. This corrective action is being addressed by the proposed modification. The modification will eliminate the possible concern. This is accomplished by preventing the Keowee generator output breakers (ACB-1,2,3 & 4) from closing until the frequency has returned to an acceptable level. Thus, the Keowee auxiliary or Oconee auxiliary loads will not be subjected to the overfrequency transient.

Since the modification was not going to be installed by December 1994 (previous committed completion date), Duke's letter dated November 30, 1994 requested an extension for the completion of this analysis to March 1, 1995. The new completion date was chosen to bound any possible delays in the review of this modification to circumvent another request for completion extension. In the November 1, 1994 letter referenced in the question, Duke extended the completion of the voltage adequancy analysis for the Keowee Auxiliaries to June 1, 1995.

The Keowee units generator output voltage is controlled by its voltage regulator. The regulator controls the generator output voltage maintaining it relatively constant following a load rejection scenario. The voltage regulators at Keowee are Westinghouse brand type WTA. These type regulators are used in applications ranging from 50Hz up to 420Hz. These particular regulators were designed to withstand frequencies up to 120Hz which is well above the expected maximum load rejection frequencies of Keowee (88Hz).

3. **QUESTION:**

LER 93-01 discusses a scenario whereby the Keowee units could trip on overspeed. The LER implies that the setpoint for this trip is 140% of rated speed but no time delay value is discussed. Duke letter of January 4, 1995, implies that the time delay may be 30 seconds but no setpoint for the overspeed is provided. Please provide the specific setpoints and time delays associated with all overspeed trips (normal and emergency) and discuss any corrective action associated with the overspeed trips resulting from the load rejection scenario in the LER.

RESPONSE:

The 140% overspeed switch contact mentioned in LER 93-01 is wired in the emergency portion of the units shut down solenoid circuit. The function of this switch's contact is to provide overspeed governor failure protection. As documented in the LER, the design of this logic was inadequate. During certain load rejection scenarios the overspeed switch could actuate resulting in loss of the unit's excitation.

The proposed modification which addresses this design deficiency removes the overspeed switch contact from the shut down solenoid circuit and uses other logic added by the modification to perform the contact's intended function. The governor failure protection function will be accomplished by the installation of a magnetic speed switch on each unit's governor and by the addition of overfrequency relay logic in each unit's generator output breakers. The new logic will prevent any unit's auxiliaries from being supplied by the failed governor unit.

The 30 second time delay that was mentioned in the Duke letter of January 4, 1995 is an added feature of the proposed modification. This addition will lock the respective unit out (ie. shut it down) in the event that it has encountered a failure resulting in unit run-away. Existing overspeed trips for commercial operation, which are bypassed during an emergency, are not removed by this modification.

The present restrictive operating limits, which reduce the generator output megawatts, are a result of this identified overspeed problem. These restrictions will prevent the Keowee unit maximum overspeed from exceeding the 140% overspeed switch setpoint until the permanent resolution as described above can be implemented. These restrictions are located in the Keowee Modes of Operation procedure.

4. **QUESTION:**

LER 93-01 references FSAR Section 15.14.3.3.6 as containing the requirements that ECCS flow be established within 48 seconds for the LOCA/LOOP scenario. Please provide a detailed discussion (using detailed timelines) of the sequence of events for worse case load rejection/overfrequency scenario which includes the worst case values (considering uncertainties) for undervoltage relay reset, frequency relay setpoints (pickup and reset) and associated time delays, breaker closure times, retransfer startup time delays, etc. Compare this to the worst case sequence for a non-overfrequency scenario to provide the basis for margin between the current FSAR analyses and a worse case load rejection scenario. Discuss any modifications and/or administrative controls that have been or will be implemented that ensure the analysis of FSAR Section 15.14.3.3.6 remains bounding.

RESPONSE:

The basis for this modification is to ensure the Keowee emergency power system meets it design basis.

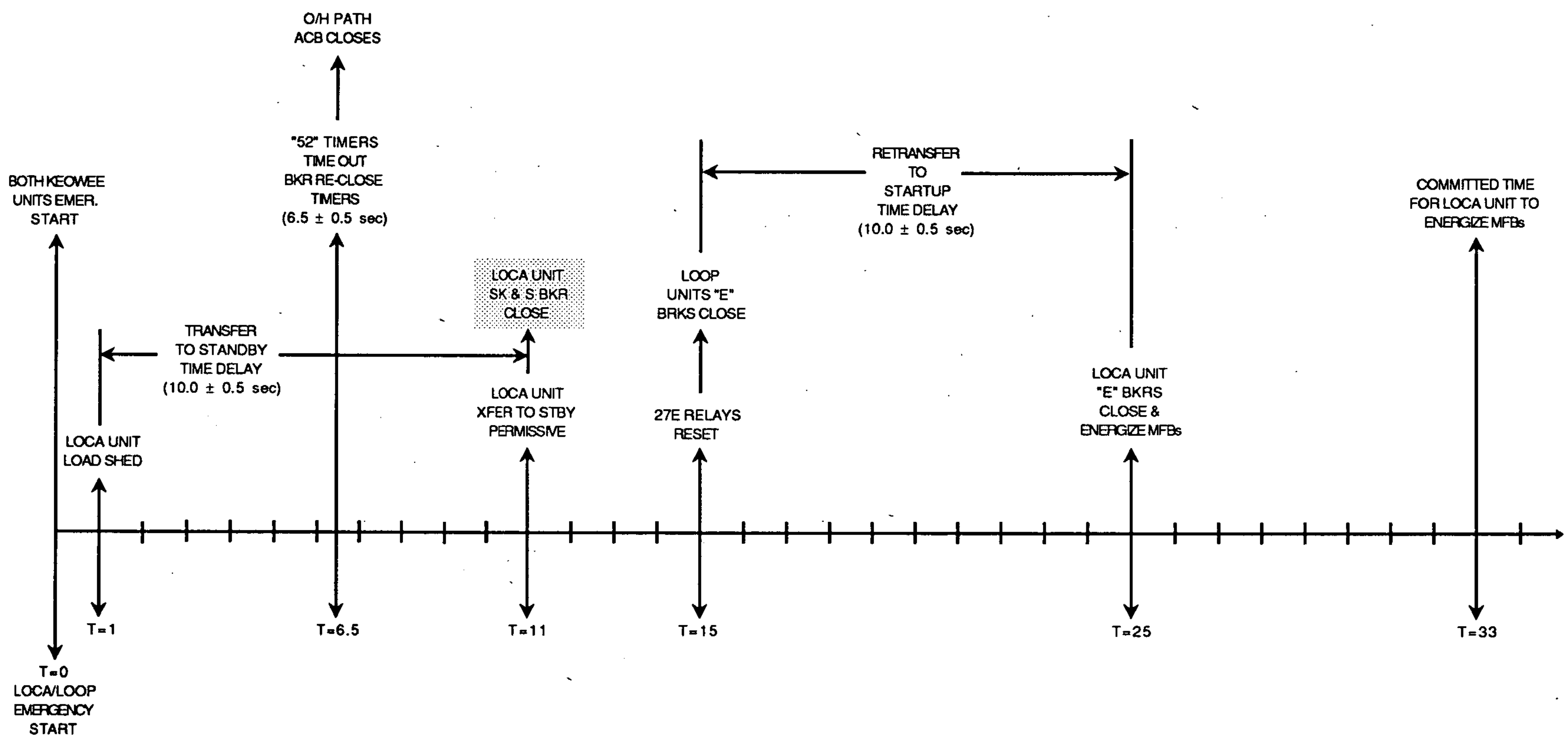
The 48 second requirement that is listed in FSAR Section 15.14.3.3.6 can be described in two separate steps. The first part is the Keowee/EPSL time and the second part is the MOV stroke time. FSAR Section 6 describes the MOV stroke time as being 15 seconds. This 15 second allowance also bounds the start times for the Engineered Safeguards pumps. Thus, the Keowee/EPSL function must be performed within 33 seconds. Attachments 4-1, 4-2, 4-3 and 4-4 show the timelines for non-load rejection and load rejection scenarios. Tolerances are included in these figures to quantify the worst case response time. Also, these timelines indicate the pre-modification and post modification configurations.

As noted in the January 4, 1995 letter, restrictions on Keowee generation are and will be imposed upon Keowee operation. The revised operating restrictions for the modification will be included in the Keowee Modes of Operation procedure.

As evident by the timelines, following the installation of the proposed modification, Keowee will be in compliance with its design basis.

ATTACHMENT 4-1

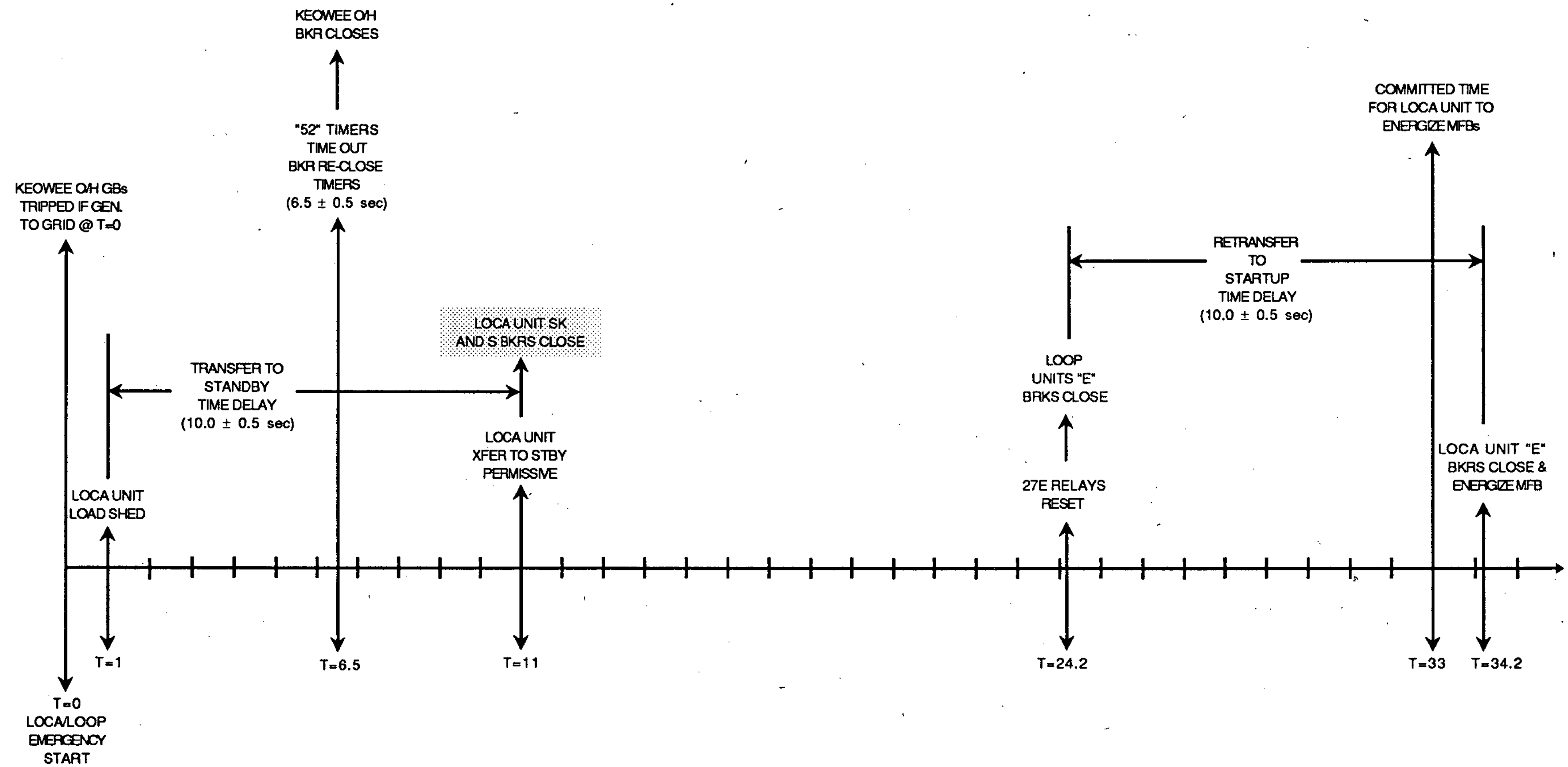
PRE- MODIFICATION
KEOWEE/EPSL SEQUENCE OF EVENTS FOR NON-LOAD REJECTION SCENARIO
KEOWEE UNITS NOT PREVIOUSLY ONLINE @ T=0



(SECONDS)

ATTACHMENT 4-2

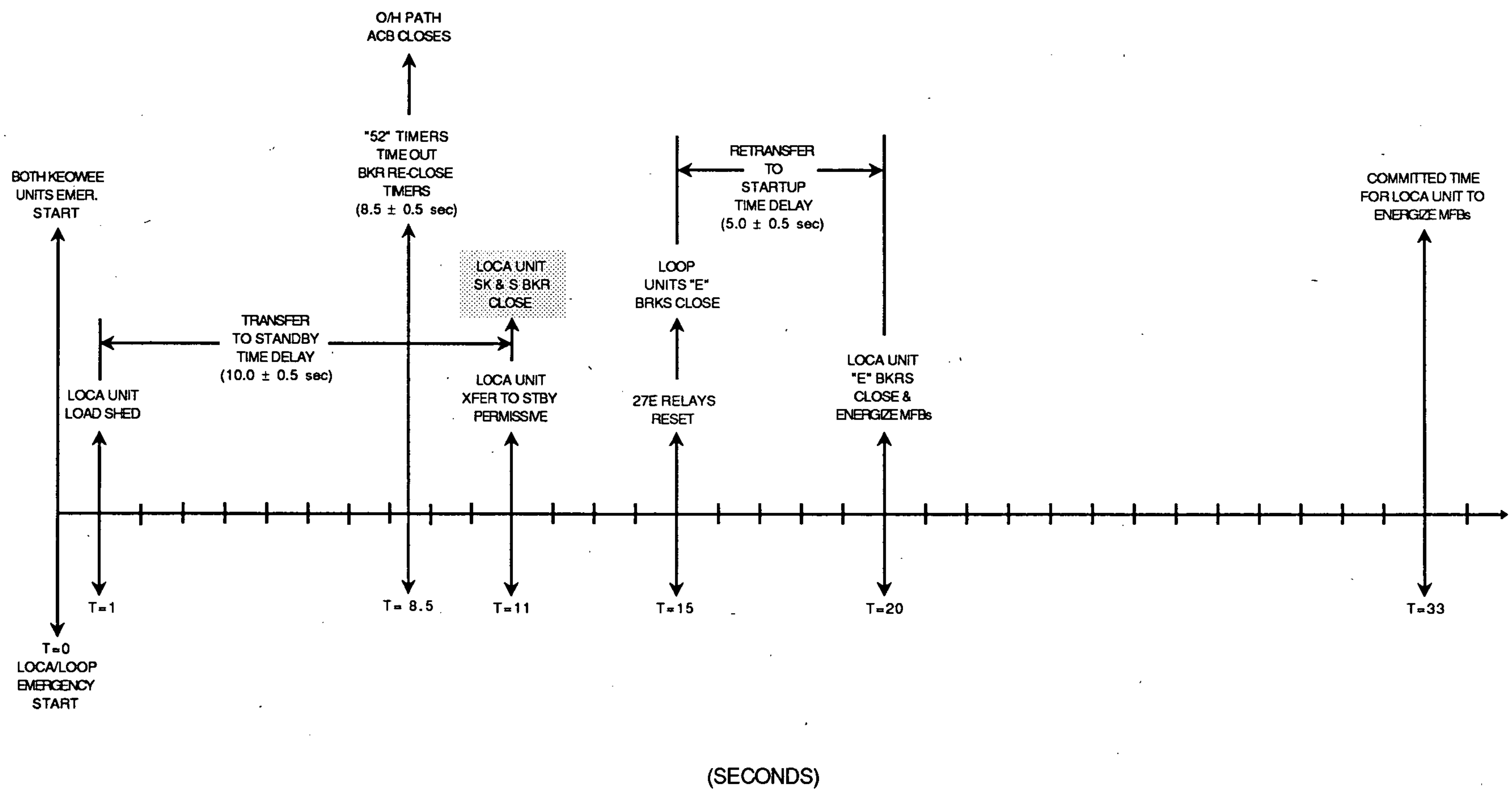
PRE-MODIFICATION
KEOWEE/EPSL SEQUENCE OF EVENTS FOR WORST CASE LOAD REJECTION SCENARIO
KEOWEE UNITS ONLINE (GENERATING MAX MW) @ T=0



(SECONDS)

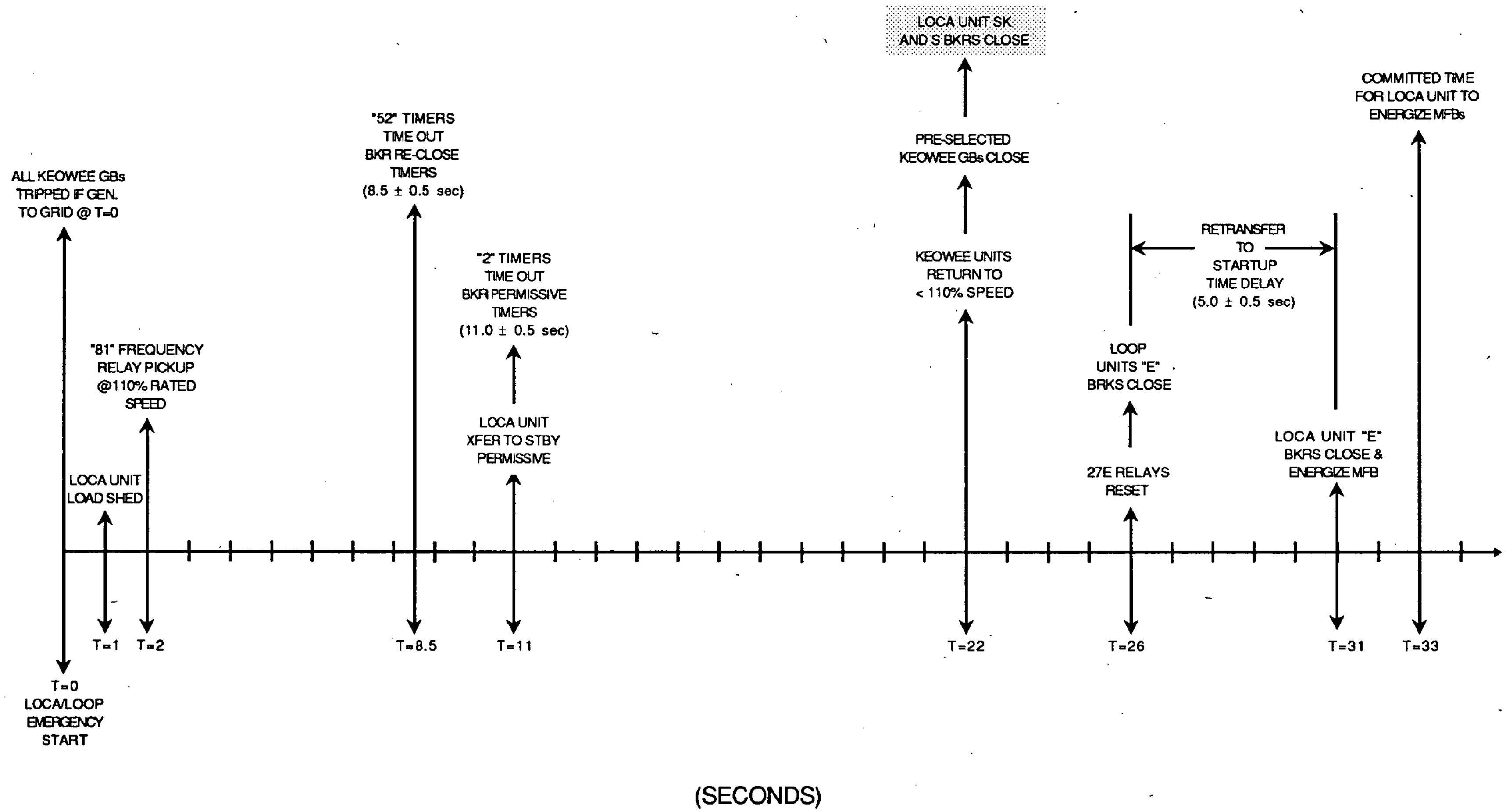
ATTACHMENT 4-3

PROPOSED MODIFICATION NSM-ON-52966
KEOWEE/EPSL SEQUENCE OF EVENTS FOR NON-LOAD REJECTION SCENARIO
KEOWEE UNITS NOT PREVIOUSLY ONLINE @ T=0



ATTACHMENT 4-4

PROPOSED MODIFICATION NSM-ON-52966
KEOWEE/EPSL SEQUENCE OF EVENTS FOR WORST CASE LOAD REJECTION SCENARIO
KEOWEE UNITS ONLINE (GENERATING MAX MW) @ T=0



5. **QUESTION:**

Duke letter of January 4, 1995, states that overhead circuit parameters were used in lieu of the corresponding underground path parameters. Please provide detailed justification for the validity of this approach.

RESPONSE:

The analysis that was referenced in the January 4, 1995 letter was associated with documenting the adequacy of the Keowee emergency overhead path. This analysis was performed using a new dynamic modeling tool, CYME. Since the underground model had not been developed at that time, the overhead circuit was used as a test case to simulate the emergency loading of the underground path (ie. t=11 seconds) following a load rejection.

The test case predicted that the underground loads would trip. Therefore, conservative actions were taken to administratively limit the Keowee power level. These administrative limits ensure that the underground loads will remain available during an accident. Duke Power believes this was a timely and conservative action in that additional time was necessary to develop an underground model. The load rejection response of the Keowee units is the same and the impedance of the underground path is judged to be higher than the impedance of the overhead path. Therefore, it was reasonable to assume that an explicit model which simulated loading of the underground path would also produce unfavorable results. For this reason, LER 93-01 was revised to document these concerns. If the test case had produced favorable results, more detailed analysis or justification would have been required.

6. **QUESTION:**

Discuss the design basis for the Keowee/Oconee units, how commercial operation of the Keowee units fits into the design basis, how the load rejection/overspeed/overfrequency event impacts that design basis, and how the modifications and administrative controls ensure that design basis is met.

RESPONSE:

The design basis for the Keowee Emergency Power system is to provide the emergency power needs for ONS within the committed time under all applicable conditions assuming a single failure. This design basis is compiled from various FSAR chapters. Chapter 3 of the FSAR provides the AEC proposed design criteria which were used to design Oconee. FSAR Chapter 6 and Chapter 15 discuss the time requirements for initiation of ECCS injection. The single failure requirements are discussed in FSAR Chapter 8.

The design of Keowee is such that it can perform its design basis function whether starting from commercial operation or standby. Through internal and external reviews, discrepancies with Keowee's original design have been identified. The two specific concerns that are addressed by this modification are documented in LER 269/92-16 and 269/93-01. In each case, the proposed modification corrects the identified problems and ensures that Keowee maintains its original design basis.