RI-TS Surveillance Test Interval (STI) Evaluation

BWROG RI-TS Initiative 5b Pilot (Ref. TSTF-425)
(Exelon BRIM 132, LGS 2004 Bus. Plan Goal PR.05.LIM.03)

Station: Limerick Generating Station **Unit(s):** 1 and 2

Surveillance Test Number (s): ST-6-092-11(5-8)-*, ST-6-092-119-1, ST-6-092-32(1-4)-*

Revision Number:

ST-6-092-115-1, Rev. 3	ST-6-092-115-2, Rev. 1	ST-6-092-321-1, Rev. 3
ST-6-092-116-1, Rev. 2	ST-6-092-116-2, Rev. 5	ST-6-092-322-1, Rev. 3
ST-6-092-117-1, Rev. 1	ST-6-092-117-2, Rev. 3	ST-6-092-323-1, Rev. 3
ST-6-092-118-1, Rev. 2	ST-6-092-118-2, Rev. 3	ST-6-092-324-1, Rev. 3
ST-6-092-119-1, Rev. 2		ST-6-092-321-2, Rev. 2
		ST-6-092-322-2, Rev. 1
		ST-6-092-323-2, Rev. 1
		ST-6-092-324-2, Rev. 2

Technical Specification Surveillance Requirement (SR) Number(s): Direct verification: 4.3.3.1 (T4.3.3.1-1.5.a), 4.3.3.2, 4.7.1.2.b.2, 4.8.1.1.2.e.2-7,9-13, and UFSAR Tables 8.3-1(a) & 8.3-1(b). Indirect verification: 4.3.3.3 (T3.3.3-3.1 & T3.3.3-3.2). See also Attachment 1 – Applicable Tech Specs.
Technical Specification SR (Text): See Attachment 1 – Applicable Tech Specs.
Technical Specification SR Bases (and Intent): See Attachment 1 – Applicable Tech Specs.

Recommended STI Change: Extend Frequency from 1R **to** 2R
Station Benefit: Extension of the LOCA/LOOP testing from 2 years to 4 years will have several benefits. One, the required resources involved in performing a LOCA/LOOP test is extensive. Therefore, reducing the number of LOCA/LOOPs performed during any given outage by half will free-up resources to perform other outage tasks. This may have a positive impact by reducing outage duration. Two, the coordination of equipment to support a LOCA/LOOP test impacts the ability to perform other station work. This extension will free-up equipment to allow for maintenance on multiple systems that otherwise could not be performed. Three, this initiative will also minimize the number of temporary power installations that occur during an outage reducing the risk of misalignments and again freeing resources both during the outage and in preparation for the outage. Four, multiple perturbation of electrical equipment can result in equipment failures or complicated re-energization processes (with respect to equipment that is de-energized when the bus is de-energized).

(NOTE: Future Exelon T.S. revision request will pursue relocation of STI from T.S. to TRM, and STI extension)

A. SYSTEM & MAINTENANCE RULE (MRule) INFORMATION

SYSTEM NUMBER: 92A (Diesel Generators and Auxiliaries); Received: 20D (EDG Fuel Oils Storage and Transfer), 81C (EDG HVAC).

Current MRule R-S Classification: HSS (HSS or LSS)
Current MRule R-S Basis: The SSC is modeled by the PSA. The SSC is quantitatively risk significant.

Current PRA Model:	Explicit	
Current PRA R-S Classification (System)	EDGD13HRI	
Current PRA RAW (System):	1.78	(MRULE R-S threshold: ≥ 2.0)
Current PRA RRW (System)	1.339	(MRULE R-S threshold: ≥ 1.005)
Current PRA Limiting Cutset (System)	66	(MRULE R-S threshold: top 90% [≤1616])
NEI 00-04 R-S Insights	*MRule HSS classification retained as allowed by RITS 5b Methodology guideline document.*	

B. QUALITATIVE ANALYSIS:

1 COMMITMENT REVIEW (Is STI credited in any commitments?)

The following were reviewed to determine if any commitments were impacted as a result of the proposed Technical Specifications change: LGS Technical Specifications, Limerick Generating Station Commitment Tracking Database, UFSAR, Regulatory Guides, General Design Criteria, SER's, IST Program. (Reference Attachments 1 and 2 for additional information regarding UFSAR and RG commitment reviews.)

Technical Specifications:
(See Attachment 1)
4.8.1.1.2.e.2 - 24 m, reject largest load (performed as part of On-line LOCA/Load Reject Test)
4.8.1.1.2.e.3 - 24 m, reject 2850 KW load (performed as part of On-line LOCA/Load Reject Test)
4.8.1.1.2.e.4 - 24 m, LOOP start (performed as part of Outage LOCA/LOOP Test)
4.8.1.1.2.e.5 - 24 m, ECCS start (performed as part of On-line LOCA/Load Reject Test)
4.8.1.1.2.e.6 - 24 m, LOCA-LOOP start (performed as part of Outage LOCA/LOOP Test)
4.8.1.1.2.e.7 - 24 m, trips bypassed (performed as part of On-line LOCA/Load Reject Test)
4.8.1.1.2.e.9 - 24 m, auto load < 3100 KW (performed as part of Outage LOCA/LOOP Test)
4.8.1.1.2.e.10.a - 24 m, sync to grid while loaded (performed as part of Outage LOCA/LOOP Test)
4.8.1.1.2.e.10.b - 24 m, transfer loads to grid (performed as part of Outage LOCA/LOOP Test)
4.8.1.1.2.e.10.c - 24 m, restore to standby (performed as part of Outage LOCA/LOOP Test)
4.8.1.1.2.e.11 - 24 m, ECCS start overrides test mode (performed as part of Outage LOCA/LOOP Test)
4.8.1.1.2.e.12 - 24 m, load sequence timers within 10% design interval (performed as part of Outage LOCA/LOOP Test)
4.8.1.1.2.e.13.a - 24 m, lockout active only when required (performed as part of On-line LOCA/Load Reject Test)
4.8.1.1.2.e.13.b,c - 24 m, lockout active only when required (performed as part of Outage LOCA/LOOP Test)

TS 3.3.3 ECCS Actuation Instrumentation
4.3.3.1 - R, Channel Functional Test (performed as part of Outage LOCA/LOOP Test)
4.3.3.2 - 24m, LSF test (partially verified as part of Outage LOCA/LOOP Test)
4.3.3.3 - 24m, response time (partially verified as part of Outage LOCA/LOOP Test)

TS 3.7.1.2 ESW
4.7.1.2.b.2 - 24m, pump starts on diesel start (performed as part of Outage LOCA/LOOP Test)

Commitments:
Note: A review was performed of the RITS presentation on the 4 kV EDG Bus UV Channel/Functional Test to determine if any of the commitments identified under that review would also be impacted by this review. None of the identified commitments specified any frequency requirements and therefore would not be impacted by this initiative.

No PLS hits on test frequency.

ST-6-092-11(5,6,7,8)-1,2: D*(1,2,3,4) Diesel Generator 4 KV SFGD Loss of Power LSF/SAA and Outage Testing
T01772 SOER 83-01, Rec.#7, knowledgeable individuals present for test
T02167 LER 2-91-04, Inadvertent start of U2 C ESW pump while applying overspeed trip test equipment
T03822 LER 1-95-04, Lifting of wire leads
T03559 LER 2-94-011
T04357 LER 1-01-001, Water in Fuel Oil Storage Tanks

ST-6-092-32(1,2,3,4)-1,2: D*(1,2,3,4) Diesel Generator LOCA / Load Reject Testing and Fast Start Operability Test Run
Same commitments as ST-6-092-115-1 TS 3.8.1.1 A.C. Sources - Operating

UFSAR:
8.1.6.1.2 - RG 1.9 (defines basis for much of LOCA/LOOP test response of diesel)*
8.1.6.1.6 – RG 1.32 (uses IEEE 308, 1974 as basis, **308 does not provide specific test frequencies however it does suggest when operation of the units does permit under illustrative periodic testing)**
8.1.6.1.20 - RG 1.108 (IEEE 387, except 24 month testing frequency)**
8.1.6.1.21 – RG 1.118 (IEEE 338, 1977, section 5)
8.1.6.1.25 – RG 1.155 (station blackout)
Table 8.3-1 (a) - LOCA-LOOP sequence of events (See Attachment 1)
Table 8.3-1 (b) - LOCA sequence of events (See Attachment 1)
Table 8.3-9 - EDG and Bus Loading (U1 DBA and U2 LOCA)
8.3.1.1.2 - Class 1E AC Power System
8.3.1.1.3.7.b - Periodic EDG Testing (IAW LGS TS)
*RG 1.9 Rev.3 1993, Selection, Design, and Qualification of Diesel Generator Units Used as Standby (Onsite) Electric

Power Systems at Nuclear Power Plants
Table 1 specifies test frequencies same as IEEE 387 (24 months)

**Section 6.6.2 of IEEE 387 (1977) states,

Operational Test. The diesel-generator unit shall be given one cycle of each of the following tests, at acceptable intervals, to demonstrate its continued capability of performing its required function:

(1) starting test
(2) load acceptance test
(3) design load test
(4) load rejection test
(5) subsystem tests.

IEEE 387 Standard Criteria for Diesel-Generator Units Applied as Standby Power Supplies for Nuclear Power Generating Stations
IEEE 387 (1977) section 6.6.2 (except test frequency will be 24 month)
IEEE 387 (1995) section 7.4.2.2 provides list of 24-month tests (LOCA-LOOP)
Cont'd
RG 1.108 (August 1977) Periodic Testing of Diesel Generator Units Used as Onsite Electric Power Systems at Nuclear Power Plants
Section 2 Testing, specifies 18-month testing requirements.

Based upon the wording above, the IEEE guidance does not limit what the frequency should be. The UFSAR commitments submitted by LGS define the frequency. This would require an ECR to update the UFSAR if the new STI is approved.

Colt letter recommended maintenance and surveillance program, 8/28/86

Regulatory Guides:
RG 1.9 Selection of Diesel Generator Set Capacity for Standby Power Supplies (Safety Guide 9), March 1971

RG 1.32 Criteria for Safety-Related Electric Power Systems for Nuclear Power Plants, February 1977

RG 1.108 Periodic Testing of Diesel Generators Used as Onsite Electric Power Systems at Nuclear Power Plants (August 1977), 1976
Superseded by RG 1.9 Rev.3 1993

RG 1.118 Periodic Testing of Electric Power and Protection Systems, August 1977

RG 1.155 Station Blackout
Requires EDG reliability program. No reference to test frequencies.

GL 93-05 Line-item TS Improvements to reduce Surveillance Requirements for Testing During Power Operation
Section 10.1 is for EDG surveillance but does not address LOCA-LOOP test.

General Design Criteria:
No GDC provided that were associated with test frequencies

SER:
No PLS hits on test frequency.
TS Amend 136 18mo to 24mo for inspection and 24hour run
TS Amend 165 inspection to the TRM (surveillance will be per TS)

IST Program Commitments:
TS 4.0.5 IST program (TS 4.0.5 listed as ref doc in LOCA/ LOOP and LOCA/Load Reject Tests)
No "I" steps in ST's. No reference to IST program in ST's.

2 SURVEILLANCE TEST HISTORY OF THE COMPONENTS AND SYSTEM ASSOCIATED WITH THE STI EXTENSION:

Refer to Attachment 3, which details all tests that were graded as Unsat, Partial Failure (FP), or Retest (due to a failure), to understand the basis for the results listed below. Note, for ease of discussion below, all three conditions will generically be referred to as "unsat" unless otherwise noted. The reports generated to perform this review were run from 01/01/94 – 11/11/03.

The results of the surveillance test review are as follows:

- The 24-month T.S. surveillance requirements and UFSAR commitments associated with the LOCA/LOOP tests (reference Attachment 1) were performed 5 times during the specified review period for each unit. With 4 diesels per unit yields a total of 20 tests per unit. In addition, in 2002 and 2003 the LOCA/LOOP testing was divided into the outage test and the on-line LOCA/Load Reject test for Unit 1 and Unit 2 respectively. This resulted in the addition of 4 tests per unit for the review period bringing the total number of tests for each unit to 24, or 48 total.
- Out of the 48 tests performed, 18 resulted in an unsat test (37.5%)
- From the 18 unsat tests, 9 were solely unsat due to coordination issues. In other words, a T.S. requirement was unable to be verified during the test due to issues such as equipment misalignment (shunt trip breakers closed before shunt trip verified, volt meters in A.C. not resistance, and strip chart recorders shut off too early), testing errors (procedural or operator), equipment out of service for maintenance/mods, and the spare contacts being used to monitor breaker closure did not make up (although the required emergency contacts functioned properly). This means that 50% of the identified unsat tests can automatically be discounted (from hardware issues) because they were either later proved to be functioning properly through a partial test or justified using a Test Results Evaluation (TRE) form. This reduces the remaining list of unsat tests to 9 of 48 (18.75%).
- Two (2) of the unsat tests resulted from the diesel generator frequency exceeding the T.S. value of 61.2 Hz (918 rpm) following the RHR pump (largest single load) reject test. For D21, on 04/21/99 the maximum EDG frequency obtained was 61.33 Hz (919.95 rpm). For D22, on 02/12/97 the maximum EDG frequency obtained was 61.28 Hz (919.2 rpm). As can be seen, the speed of the diesels exceeded the T.S. value by less than 2 rpm. This is not a significant concern, which is further justified by reviewing the Regulatory Guide on which the T.S. was based (1.9). RG 1.9 states, "During recovery from transients caused by step load increases or resulting from the disconnection of the largest single load, the speed of the diesel-generator unit should not exceed the nominal speed (900 rpm) plus 75 percent of the difference between nominal speed and the overspeed trip setpoint (900 + 0.75 * [1030 – 900] = 997.5 rpm) or 115 percent of nominal (1.15 * 900 = 1035 rpm), whichever is lower. Further, the transient following the complete loss of load should not cause the speed of the unit to attain the overspeed trip setpoint." This shows that the actual test results came no where near the regulatory guide limits of 997.5 rpm. Additionally, the improved T.S. reflect RG 1.9. This can be seen by reviewing PBAPS T.S. surveillance requirement 3.8.1.9, which derives its initial frequency response limits of 66.75 Hz (1001.25 rpm) from their minimum allowable overspeed trip value of 1035 rpm consistent with RG 1.9. The basis for this SR also reflects this methodology. LGS also has a proposed revision to the T.S. under consideration, which would bring the LGS T.S. more in line with the Regulatory Guide rather than the currently over-constrictive criteria. Based upon this review, it is reasonable to say that although these unsat tests can technically not be discounted, they are arguably insignificant with respect to the performance of the EDGs. Therefore, for the sake of this review, they will not be counted as true unsat tests. This brings the remaining number of unsat test to 7 out of 48 (14.6%).
- Two (2) of the unsat tests resulted from maintenance induced failures. The first was on D14 in 1994 where the voltage regulator auto raise adjustment failed to work properly following a PM that was performed on the voltage regulator the day prior to the test. This portion of the voltage regulator PM is no longer performed as it was determined to add little value. The second failure was on D11 in 2002. The diesel generator output breaker cell switch failed to completely make-up due to an improperly installed bolt that was interfering with the cell switch linkage. This prevented the cell switch contacts associated with the ESW pump breaker closure from making up and resulting in a delayed ESW pump breaker closure. The ESW breaker logic does have redundancy in that it will also get a start signal from the diesel when the Low Speed Relay energizes at 200 rpm. The time delay associated with the redundant breaker closure signal is slightly longer however and prevented the ESW pump breaker from closing within the required T.S. time. Both of these issues should remain counted as unsat tests as they are valid failures that likely would have only been detected by the LOCA/LOOP tests; although corrective actions and PM revisions should preclude these failures from occurring in the future. 7 out of 48 (14.6%)
- Four (4) of the unsat tests were related to shunt trip failures. Two of the failures were directly related to the shunt trip coils in that the trips did not work appropriately. The other two failures were due to the inability to energize or close in the breakers to verify they actually shunt trip. It should be noted that some shunt trip breakers are normally locked open as they are rarely used. However, since they are not abandoned, there is still the possibility that they may be used at some point in time and therefore the shunt trips need to be verified. It should also be noted

that all safety related 480 volt breakers are PM'd on either a 6 or 10 year frequency depending on their safety significance and environment. This PM includes an inspection of the shunt trip device. In many cases when shunt trips do not work properly, the LOCA/Loop test is completed and a partial is performed at a later date once the trip coil has been replaced. The breakers are typically maintained open through administrative controls until they are repaired. If necessary, there is generally enough margin in the diesel loading calculations which would allow the breakers to remain closed if necessary knowing that they would not trip open in an actual event. For this reason, failed shunt trips on a 1 or 2 per test basis is not deemed significant. However, since the shunt trip coil failures are true failures, they will be counted. The breakers that could not be closed/energized shouldn't be included in this count because if they can't be closed/energized then there is no need for them to ever shunt trip (i.e. the unsat test resulted purely because they couldn't be tested and not because the shunt trips didn't work). Subsequent testing of the two breakers that couldn't be tested per the LOCA/LOOP test verified that the breakers shunt tripped appropriately. This further reduces the number of unsat tests 5 out of 48 (10.4%).

- Finally, the last unsat test resulted on D14 in 2002 when the test had to be aborted due to a hard negative ground. The ground was subsequently traced to the D14 mechanical governor shutdown solenoid wiring. The wiring was rubbing against a knuckle-joint in the governor linkage and over time the insulation wore away exposing the wire. It was purely by coincidence that this occurred during the LOCA/Load Reject Test. This could have occurred during any surveillance test of the diesel as the same conditions were always present. As such, this is not a true failure of the test as the condition prevented the testing from ever being performed. This reduces the final number of unsat tests to 4 out of 48 (8.3%).

In summary, there were only 6 tests that actually failed as a result of a Technical Specification required step from not meeting the specification. These were the two RHR pump reject frequency events, two shunt trip coil failures, the diesel generator breaker cell switch not working properly, and finally the voltage regulator auto raise adjustment not working properly. Of these 6 items, 4 can be deemed relatively minor (RHR pump reject frequencies and the shunt trips). This leaves two significant issues in 48 tests. None of the issues discussed above were due to time-dependent failures. Based upon the LOCA/LOOP and LOCA/Load Reject ST review, the impact of extending the test frequencies seems relatively minor.

The ST review should not be limited to the LOCA/LOOP tests only as several other tests are also impacted. Both the LPCI (RHR) and Core Spray Response Time Tests (2-yr. intervals) can be impacted by the results of the LOCA/LOOP test. Currently these tests make the assumption that the LOCA/LOOP test results show the Core Spray and RHR breakers closing within their required time limits. If these breakers do not close within the specified time, then a time summation evaluation is required to ensure that the total Core Spray or LPCI response time intervals (whichever apply) are not impacted. Note: there are cautions within the LOCA/LOOP procedures, which identify that this evaluation may be required. Likewise, if one of the tested intervals of the Response Time tests is outside of its allowable band, a time summation evaluation is typically performed to determine whether or not the test can considered successful. Since 1994, the LPCI Response Time tests have required 5 such evaluations [1 - Div I (U1), 3 - Div II (U2), and 1 - Div IV (U2)]. Since 1995, the Core Spray Response Time tests have required 1 such evaluation [A loop (U2)].

The major concern associated with the link between the Response Time Tests and the LOCA/LOOP tests is ensuring that the if the LOCA/LOOP results are outside of their limits that the summation evaluation is performed. Generally speaking, if the LOCA/LOOP results are outside of their limits, the problem will be rectified and the evaluation will only be required for the original condition. However, if the summation evaluation is used to justify the RHR or Core Spray breakers to operate under a degraded condition for the proposed 4 year STI, then this evaluation would have to be performed every time the impacted Response Time Test was performed. Therefore, permanent revisions would have to be made to the impacted Response Time Test requirements for the 4 year period to ensure that the appropriate summation evaluations are performed.

3 RELIABILITY REVIEW:
PERFORMANCE (OPERATION & MAINTENANCE) HISTORY OF THE COMPONENTS AND SYSTEM ASSOCIATED WITH THE STI EXTENSION:

In order to accurately review the reliability of the components and system(s) associated with the LOCA/LOOP test, the scope of the review needs to first be defined. Below is a listing of the systems, components, and subcomponents that are uniquely tested by these surveillance requirements
[INSERT K18s ETC HERE].
[THE ENTIRE NON UNIQUE COMPONENT DISCUSSION COULD BE DELTED> THIS IS A SHORTENED VERSION IF IT IS DECIDED TO KEEP IT AT ALL]
Additionally the following equipment is non-uniquely tested by these surveillance requirements:

92A – EDG and Auxiliaries (includes 20D and 81C)

SCOPE: Generically this review includes the diesel generators and their subsystems with respect to their ability to quickly start, load, and adequately carry the design basis load for the required duration without overheating the diesel or its electrical components. These functions are tested during the Fast Start (6 mo. frequency) and 24-hour endurance run (2-year frequency. The review will also discuss vibration, oil analysis, and thermography.

More specifically, this review looks at the automatic start relays [ESSA & ESSB (LOCA), DBSA & DBSB (LOOP), and 4A & 4B(start relays)], the isochronous mode of the governors, diesel generator frequency & voltage responses, voltage regulation, starting air failures, generator failures, loss of D.C. (i.e. field flash capabilities) and any other component history or failures that could affect the diesel generators' ability to adequately perform the LOCA/LOOP function.

. This is further validated by the fact that there have only been 12 functional failures against the diesels since the inception of the Maintenance Rule program in 1996.

Since July of 1999 (beginning of electronic records) there have been over 300 start demands for each units' diesels. Many of these start demands were also load demands. Of the load demands, most operated the diesel at full load for greater than 2 hours. Out of all of these start and load demands, there have been no identified valid failures.

The following 2 items were identified during LOCA/Load Reject Testing but did not result in "Unsat" tests. However, there potential impact could have been significant so they are discussed in detail below:

- A1435483 – During the LOCA/Load Reject Test for D21, the maximum speed attained on the EDG fast start exceeded the chart value. This also exceeded the expected maximum speed for the diesel on the fast start. There are no T.S. or Regulatory Guide (RG 1.9) requirements for the maximum speed attained on a fast start not immediately followed by the addition of a load, however if the condition were to continue to degrade, potentially the overspeed trip setpoint could be exceeded. Although the fast start is tested for each diesel on a six-month basis, the maximum speed attained on the starts is not normally recorded. Therefore, the only current way to observe this condition is during the LOCA/LOOP and/or LOCA/Load Reject test. In the case of D21, the condition will be monitored to determine if it has degraded to a point where it is unacceptable and requires repairs/tuning.
- A1434624 – During the LOCA/Load Reject Test for D24, the Emergency Start Bypass relay (ESBX) did not reset for one of the 2 channels of start logic. This was identified by the fact that the Emergency Start relay (ESSB) would not seal in during the test. This only impacts the logic when it is reset and does not impact the start logic if the start logic is verified to reset properly. Previously these tests did not ensure that this piece of the start logic was properly reset following the completion of testing. Corrective actions from the related CR ensure that this will be performed in the future.

A PIMS review was conducted from January of 1998 through present for corrective maintenance items against the EDGs and their auxiliary systems (fuel oil and ventilation).

20D – EDG Fuel Oil

The majority of the fuel oil issues within the last 6 years have been primarily related to the fuel oil transfer pumps. The quarterly pump, valve and flow test (IST required) currently monitors discharge pressure and vibration in all three directions.

A major issue that occurred with the fuel oil system within the last 6 years was an event on the D21 FOST tank in 2001. During this event water intruded into the tank via FOST access pit vent valve. This was not the first time an event such as this had occurred. The difference this time was that a series of corrective actions were put in place to not only ensure no water got into the FOSTs but also to prevent water from getting into the access pits. A testament to the success of these corrective actions is that once completed, there have been no recorded instances of increased levels of water in the FOST access pits. This includes the spring/summer of 2003 where near record amounts of rainfall. In addition, these pits are routinely monitored and actions are in place to proactively inspect the pits for water in the event of large rainfalls.

Finally, Chemistry ST's test all fuel oil added to the tank and monitor the fuel oil within the tank on a monthly basis. This will ensure that if the fuel oil begins to degrade that proactive measures can be taken before the fuel oil reaches a point that it could prevent the diesel from performing its MRule function.

Based upon the CM history review for system 20, there are no issues that would impact or be impacted by the decision to extend the LOCA/LOOP test frequency.

81C – EDG HVAC

The only significant CMs regarding the diesel generator exhaust fans are the ones related to their Love Controllers.

Typically, these failures result in the fans automatically starting on false high temperatures. It is a fail safe condition for the fans to be running. There are plans to begin replacing the Love Controllers in 2004. Since there the impact of this condition is relatively minor with respect to the operation of the diesel, it is not deemed a concern with respect to the STI extension initiative.

It should be noted that once in a great while an exhaust fan may fail to auto-start. This feature is tested during the LOCA/LOOP testing but it is also tested on a monthly basis as part of the monthly operability runs. Since it is tested routinely outside of the LOCA/LOOPs, there are concerns with respect to this type of failure when considering the STI extension.

92A – Emergency Diesel Generators
The CM history review against system 92 resulted in quite a number corrective maintenance items, which included both the diesel generators and the 4KV system. Generally speaking, the EDG items are mostly minor maintenance type items such as minor leaks (lube oil, air, or jacket water), loose bolts or fittings, non-safety related equipment being out of tolerance (temperature indicators or panel gauges) and other various nuisance type items. These items are all reviewed for functional failures and operability where appropriate. More significant issues include:
The D14 diesel generator experienced a ground on the shutdown solenoid within the mechanical governor. The ground resulted from the insulation on the D.C. wiring being worn away by contact with a knuckle-joint. The engine was shutdown, the governor was repaired, and the engine was restarted and tested satisfactorily. Although this was discovered during the online LOCA/Load Reject Test, this could have occurred during any surveillance test.

The D22 was found to be indicating 300 rpm with the diesel running at full speed and carrying load. Inspections determined that the signal generator had a frayed cable preventing it from outputting the proper speed signal. An evaluation was performed to determine the impact to the LOCA/LOOP response times due to the fact that the LOCA/LOOP logic may no longer be actuated off of the low or high speed relay but rather the redundant jacket water pressure switch. The evaluation showed that the diesel would have been able to meet its function. This was discovered during on-line testing. Corrective actions are in place to proactively replace all signal generators that are original equipment.

The D22 blower was found during the overhaul to be outside of its impeller to wall clearances. There was still margin in this clearance, which would have allowed the blower to continue to operate. The cause was due to the manufacturing process
D21 experienced a generator field ground. The resulting inspections revealed that the generator field leads were the source of the ground. All generators were proactively repaired during subsequent overhauls to prevent this issue from occurring on the other diesel generator sets. Several generator bearings (D11 and D14) currently being monitored by Predictive Maintenance for off-normal vibrations. The D11 generator bearing has already been replaced once within the last 4 years. The cause is believed to be related to the field ground repairs that were performed as a result of the generator ground found on D21 (see above). During the field ground repairs the generator end bell was removed. It is believed that during either disassembly or reassembly that the bearing may have become improperly seated.

On D24, rack oscillations were observed during a run. Tuning was unable to completely resolve the problem and as a result the frequency response during the RHR pump load reject PMT exceeded the T.S. criteria. During the following overhaul the fuel injection pumps were discovered to be binding causing excessive rack tension. Once replaced, the frequency issue was able to be resolved

The D21 diesel generator experienced a major failure resulting from what was believed to be a lower connecting rod bearing having been installed incorrectly. Inspections were performed on the other diesels resulting from this failure

As can be seen by the list above, there are quite a variety of issues that have occurred on the diesels. In most cases however the issues have not prevented the diesel from performing its function. In all cases, the issues were able to be identified via either on-line maintenance or on-line testing. ,

The one component type that can't be challenged or monitored on-line very well are the governors. Although the governors are challenged on a fast start surveillance test, the true way to put them through their paces is via the LOCA/LOOP and/or LOCA/Load Reject testing. It should be noted however that there have no governor related issues within at least the last 4 years on the diesels. Also, for Unit 1, any governors that have not been recently replaced will be replaced via their governor PMs within the next 2 years. The Unit 2 governors will follow shortly after that as they are a little newer

92B – 4KV Bus, Breakers, and Associated Logic

SCOPE: This review will look at the LOCA and LOOP logic associated with the 4KV bus, the automatic closure and trip functions of the applicable breakers, and any breaker failures. The logic includes but is not limited to the applicable 4KV undervoltage/degraded bus relays (Div I / 101: 127-115, 127X-115, 127Y-115, 127Z-115, 127Z-11509, 162Z-11509, 162Y-11509, 127Y-11509, 127Y-1-11509, 127-11509, and 102-11509), the feeder breaker trip relays (162-11502 and 162-11509), and the associated 4KV LOCA start relays (Div I: E21A-K18A). This review does not include any components or failures that occur downstream of the 4KV breakers.

MRule Train Actual Unreliability (includes discussion of PIMS review):
[MOVE WITH UNIQUELY TESTED RELAYS]
LOOP/Undervoltage Relays and 4KV Buses -
There is no specific reliability tracking mechanism nor any Maintenance Rule performance criteria for reliability associated with 4 kV UV relays. The performance indicators (PIs) for the 4 kV System consist of tracking availability of the individual 4 kV buses. If a relay failure occurs, a CM is normally generated that initiates a functional failure review. These relays are normally energized and normally fail-safe. The function of these relays is to detect degraded bus voltage and to automatically transfer power to the alternate bus.

The Maintenance Rule functional failures were reviewed for the 4 kV system. With respect to the degraded bus relays, there have been no functional failures or MPFF's on the system in the last six years. The specific relay failure identified under CM A1296288 (undervoltage relay) was considered a functional failure since failure of this relay prevented the required loads from automatically loading back onto the bus. This would not have impacted the ability of the bus to sense a degraded voltage. This is because there is redundancy in the system through the use of three relays in parallel. Each of the three relays has different operating characteristics using over-lapping trip functions. Therefore, loss of one relays does not defeat the function of the degraded bus scheme. System 092B has been an (a)(2) system over the last six years.

Additional PIMS component history review:
Corrective Maintenance (CM's) tasks written against the associated 4 kV UV relays identified no relay failures other than the one identified above under A1296288. Other CMs against the 4KV system were typically minor. There were some instances of certain breakers not functioning properly as well as some relays. In most cases the relays and breakers not impact the reliability of the bus rather impacted only the components down stream of the breakers. It's also important to note that there are four divisions providing a significant amount of redundancy. Therefore, failures of a single breaker or relay will not result in the plant from being able to successfully respond to a LOCA or LOOP condition.

MRule Unreliability Performance Criteria:
The following Maintenance Rule PI's reflect no train or breaker MPFF's over the last 6 years.

P.I. #1: "4 kV Bus Train MPFFs/24 months" – Actual (0) and Reliability Performance Criteria (RPC) (0)
P.I #3: "Train MPFFs (Switchgear)/24 months" – Actual (0) and RPC (1)
Note: This particular PI addresses protective relaying as well as the bus. Protective relays considers all 4 kV associated relaying including the degraded relays.
P.I. #5: "Breaker MPFFs/24 months" - Actual (0) and RPC (1)

52 – Core Spray Initiation
SCOPE: This system/component review is limited solely to the 4KV/EDG LOCA initiation relay (E21A-K18). Contacts from this relay provide the initiation signals to both the 4KV logic and the EDG logic. The initiation signals that cause the K18 relay to actuate are not part of the LOCA/LOOP test logic and are therefore not part of the scope for this review.

PIMS component history review:
[MOVE TO UNIQUELY TESTED RELAYS]
A review was performed in PIMS for any Action Requests generated against the E21A-K18 relays and none were found under the current search nor the archived search. This relay is deemed reliable. This was also confirmed by the fact that the relay is a GE HFA style relay, which is generally viewed throughout the industry as being very reliable.

4 UNAVAILABILITY REVIEW:

Unavialbility under the maintenenace rule is not specifically monitoced for the uniquely tested components.
Note: The Maintenance Rule unavailability review in this section was limited to the diesels. The 4KV unavailability review is listed in the

reliability section above and an unavailability review was not deemed necessary for the 480-volt or Core Spray systems.

MRule Train Actual Unavailability:

5 PAST INDUSTRY AND PLANT-SPECIFIC EXPERIENCE WITH THE FUNCTIONS AFFECTED BY THE PROPOSED CHANGES

There are two plant specific experiences that apply to the logic tested under the LOCA/LOOP tests. The first is related to the change from an 18-month outage cycle to a 24-month outage cycle. Following this increase in frequency (albeit relatively short) there was not a notable increase in failures of the systems associated with the testing. This is evidenced by the ST review detailed above. The second plant specific item is related to the bus undervoltage relays (127-115,6,7,8). During all four LOCA/LOOP tests in the outage prior to January of 1995, the undervoltage relays were identified to be "sticking" due to an excess buildup of oxidation. This was due to the fact that the normally energized Agastat relays were only cycled during the 24-month outage tests. As a result, LGS instituted on-line testing of the undervoltage relays, which is currently performed on a quarterly interval [RT-2-092-32(1-4)-*]. Since the inception of this test, these relays have not had a "sticking" issue during the LOCA/LOOP testing.

An industry review of Operating Experience revealed few insights with respect to test failures of LOCA or LOOP components resulting from test periodicity issues. This is mainly due to the fact that the testing at all sites is being performed on the same frequency that LGS is currently using. No one is performing the LOCA/LOOP test at a greater frequency than 2 years. Therefore, if the relays weren't capable of withstanding a 2-year frequency, then they wouldn't be installed in the first place.
[NEED TO DO THIS FOR THE UIQUELY TESTED RELAYS]
Due to the extent of relays and relay types associated with the LOCA and LOOP logic, a relay-specific OE search was not able to be performed in the time allotted for this review. In addition, since there is such a large volume of OE related to LOCA and LOOP testing/actuation, it was difficult to sort and review all the results that came up for the various searches. It may be worthy to arrange for additional reviews to be performed for all applicable relay types and 4KV breaker types to determine if there are generic concerns worth addressing.

Just to name of few of the results that came up in the search, the following list has been created:
ECCS actuation logic (eg. Reactor low level, high pressure logic) failed to initiate LOCA relays
Spurious actuation of both LOCA and LOOP start relays (affecting 4KV, EDGs, and ECCS)
4KV breakers not closing due to relay or cell switch contacts not making up
Governor problems preventing EDGs from responding appropriately
EDG logic not allowing EDG to respond in appropriate time frequency
EDG failures due to adapter leaks (PBAPS)
EDG output breaker spurious trips
4KV breaker faults
Auto transfer logic not working appropriately for Bus feeder breakers

6	VENDOR-SPECIFIED MAINTENANCE FREQUENCY <u>System 92A – EDGs and Auxiliaries</u> The emergency diesel generator overhaul frequency has been specified by the both the owners' group and the vendor to be 2 years. Certain maintenance items associated with the diesels have longer frequencies and other routine inspections are recommended at shorter frequencies. However, the bulk of the maintenance is performed on a 2-year frequency. Extension of the LOCA/LOOP testing will impact the maintenance frequency of the diesel generators. In fact, the extension of this test is actually preferred by the vendor. The vendor has stated that fast starts followed immediately by fast loads (typical of a LOCA/LOOP test) can cause significant stress and wear on the engine. Therefore the vendor recommends that all starts be slow starts followed by slow loading whenever possible. Experience in the 1980's led to a change in technical specifications for the industry to: primarily slow starts and gradual loading. A failure at Seabrook occurred approximately 2 years ago because they were slow in implementing the Tech. Spec. change to move to the new testing methodology. They have since implemented this Tech. Spec. change. <u>System 92B – 4KV</u> NGV relays: GEI-90806 for NGV15 Under Voltage relays recommends periodic testing on a one to two years basis. Items to test and/or check include mounting, contact cleaning, relay inspection, wiring, voltage pickup and dropout time. Relay repeatability is listed as +/- 2%. No specific drift values were identified in the vendor data. However, GE FAQ described drift conditions for this type relay to be minimal similar to an electromechanical relay. Amerace ETR relays: Vendor data does not provide any specific maintenance for these relays. No drift data was provided. ABB 2(4)11T and 2(4)11R relays: ABB Instruction manual IB 18.4.7-2 was reviewed and per page 19 under "Maintenance and Renewal Parts" these relays require no specific maintenance. No intervals for maintenance are therefore provided. No specific drift criteria is provided. Preventative maintenance tasks associated with the 4 kV degraded relays are not affected by the performance of this test on a quarterly frequency. Note that this does not address all 4KV LOCA/LOOP relays nor does it address the 4KV breakers. The 480-volt breakers are overhauled on a 6 or 10 year frequency. This STI extension will not impact this maintenance. There were no PMs specific to the E21A-K18 relays.
7	ASME AND OTHER CODE-SPECIFIED TEST INTERVAL The ASME Inservice Testing (IST) Program utilizes LGS surveillance tests to perform quarterly testing for Diesel Fuel Oil Transfer System pumps, and check and diaphragm valves. (Ref. LGS Specification ML-008, IST Program) These test frequencies are not affected. Therefore, there is no impact to the ASME IST Program
8	OTHER QUALITATIVE CONSIDERATIONS (include (a) Comparison to Improved T.S., (b) Alternate ST Test List [retained], (c) LCO Review is optional) The LGS T.S. bases do not provide any detail regarding the recommended frequencies associated with the LOCA/LOOP testing. It is believed that the test interval is intended to be consistent with the refuel cycle as the most appropriate time to perform the testing is during a refueling outage. An example of this is under UFSAR section 8.1.6.1.20 where LGS takes exception to the RG 1.108 recommended test frequency of 18 months and states that the applicable testing will be performed on a 24-month frequency. The 18-month frequency likely originated with the original BWR refuel cycle of 18 months. This is further confirmed by the following two statements taken from the PBAPS ITS Bases. Note: these two statements were utilized by PBAPS to provide a basis as to the recommended frequency associated with their LOCA/LOOP testing. The 24 month Frequency takes into consideration plant conditions required to perform the Surveillance, and is intended to be consistent with expected fuel cycle

	lengths. The 24 month Frequency is based on engineering judgment, takes into consideration plant conditions required to perform the Surveillance, and is intended to be consistent with expected fuel cycle lengths. Based upon this review, there are no specific commitments identified to require retention of the 2 year test frequency. Additional testing or alternate testing is already being performed for the degraded bus and undervoltage relays respectively via the undervoltage STs and RTs [ST-2-092-32(1-4)-* and RT-2-092-32(1-4)-*]. This only tests part of the LOOP logic. Additionally, response time tests for LPCI (RHR) and Core Spray partially test the LOCA components but do not really touch the logic associated with the LOCA/LOOP tests. This is mainly due to the fact that most of the logic can not be actuated while the plant is in operation at power. As such, other than the undervoltage relay tests listed above, there are no other specific alternate tests performed for this logic or components.
9	IMPACT ON DEFENSE-IN-DEPTH PROTECTION. The number and operation of LOCA or LOOP relays for a diesel generator start is unchanged by the extension of the surveillance test interval. The extension of the STI, given that reliability remains the same does not affect the defense in depth of the plants. The defense in depth protection of the plant remains unchanged.
10	THE IMPACT OF SYSTEMS NOT QUANTIFIED USING THE INTERNAL EVENT PRA All relevant systems were included in the internal events quantification thus there is no impact of non-modeled systems.
11	THE IMPACT OF SYSTEMS FOR WHICH LERF RESULTS ARE NOT AVAILABLE The Large Early Release Frequency (LERF) is calculated for full power internal events and is addressed quantitatively in section C.
12	THE IMPACT OF SYSTEMS FOR WHICH EXTERNAL EVENTS AND SHUTDOWN PRA ARE NOT AVAILABLE There is no quantitative external events (fire and Seismic) or shutdown PRA available for this analysis. For fire risk, the only areas that could be affected would be those that include a loss of offsite power where the subject relays are required to function. Here, the potential change in risk would be comparable to that quantified for the internal events PRA. No fire area in the current fire hazards analysis for Limerick causes a design basis LOCA thus there would be no impact on fire risk because the relays are not called upon to function. For Seismic risk, only those earthquake magnitudes that would cause a loss of offsite power (but would not fail the diesels) would require thethe LOOP relays to function. Again the change in risk would be comparable to that calculated for the internal events PRA. Seismic events of a magnitude to induce a Large LOCA would also fail the diesels again causing no impact on risk because The system is not available to be initiated and this is independent of the test frequency. For shutdown risk, the impact of failure of one of these relays would be less due to the greater response times available during shutdown and due to the need for less than the full complement of electrical support equipment.
13	UNCERTAINTY ASSOCIATED WITH THE QUANTITATIVE (PRA) PROCESS A parametric uncertainty analysis was performed on the quantitative internal events CDF and LERF calculation. The 95th percentile values compared to the point estimate mean values were shown to be about 3 for CDF and about 4 for LERF. A factor of 3 or 4 would not significantly impact the conclusions from this analysis.

14 QUALITATIVE ANALYSIS – CONCLUSIONS

There is no LGS Technical Specification Bases for performing the LOCA/LOOP testing at a 2-year frequency. As stated in the PBAPS ITS Bases, the 24-month Frequency takes into consideration plant conditions required to perform the surveillance, and is intended to be consistent with expected fuel cycle lengths. Most of the applicable Regulatory Guides that established the testing methodology state that testing should simply be performed at an appropriate frequency/period/interval. Those that do specify a frequency have a frequency consistent with an established refuel cycle period (18 months or 2 years).

Originally it was believed that these tests would only be performed off-line and therefore had to be consistent with the refuel cycle. Only recently have portions of these tests been moved to on-line to reduce the outage scope. With this changing philosophy, it is only natural that the next would be to increase the frequency of these tests where justification can be provided.

This review was performed from the perspective of the diesel system engineer, which is why there is a large focus on the diesel system. Typically the diesel system engineer solely is associated with the LOCA/LOOP tests. In reality, the LOCA/LOOP tests impact multiple systems. Wherever possible, as much information was gathered from the other applicable systems to provide as much detail as could be achieved within the allotted time to ensure this review was as complete as it could be. It may be warranted to have the other applicable system engineers perform at least a cursory review of their systems to identify any concerns that may have been missed in this review. It should also be noted that this review did not take into account the reliability of the D.C. system. This system is generally overlooked when considering the LOCA/LOOP test, however none of the LOCA/LOOP or EDG logic would work without D.C. power. Nor could the diesel start without D.C. power.

Another piece of information that should be considered when reviewing the EDG reliability is that there is currently an initiative under way to extend the frequency between certain overhaul inspections. Although this initiative shows much promise, the application of the techniques being used to accomplish this initiative are new to the Fairbanks Morse Engines. As such, LGS is essentially establishing the groundwork for this new initiative. The aggregate impact of the overhaul extension combined with this STI extension, for which the EDG is an integral piece, should be weighed heavily when making the decision as to whether or not this STI extension should be approved.

Finally, it is also important to note that from the diesel generator perspective, most of its components are relatively old and outdated. As a matter of fact, many of them are obsolete and there are very few spares available in the industry if at all. Some examples are the electronic governors & MOPs, the relays associated with the EDG start logic, the K1 contactor associated with the self-excitation circuit, the voltage regulator, etc. This year an obsolescence program will attempted to be established for the diesels, however when considering the total number diesels and components impacted within the diesels, the reliability of the diesels may be somewhat in question. After all, you can't replace parts that you don't have.

Therefore, based upon the above reviews and informational items, it is recommended that the following actions be taken prior to providing a final decision:

1) An independent review be performed for the applicable Regulatory Guides to ensure that there were no missed commitments (recommend ROG SMEs for diesels and 4KV systems).
2) Additional reviews be performed by other applicable system engineers.
3) A detailed OE search be performed on all applicable components (or as much as reasonably possible).

If these reviews provide no information contradicting the proposed STI frequency change, then it is recommended that the test frequency be extended from 1R to 2R.

15 PHASED IMPLEMENTATION RECOMMENDATIONS

Based on the surveillance test, maintenance rule, and availability history, it is recommended that surveillance tests ST-6-092-11(5-8)-*, ST-6-092-119-1, ST-6-092-32(1-4)-* be changed directly to a 2R (4 yr.) frequency with the tests being performed at staggered outages i.e. 2 divisions per outage. A phased approach to this extension is not necessary. The EDG, 4KV, 480-Volt, and Core Spray systems' reliability will continue to be monitored through the maintenance rule program.

16 PROPOSED SURROGATE MONITORING RECOMMENDATIONS: (Consider use of Existing MRule monitoring)

Since thecurrent Maintenacnc rule performance criteria do not address the uniquely tested components monitoring of the shunt trip failure rate and xxxx relay failure rate should be performed.

17 PREPARERS (SECTION B – QUANTITATIVE ANALYSIS – signatures not required):

Prepared by: ___Benjamin M. Sauers____________________ (Subject Matter Expert) Date: ___01/07/04__
(System Manger or Component Specialist)

Prepared by: ___Victoria A. Warren ____________________ (PRA input) Date: ___01/02/04__
(Risk Management Engineer)

C.	PRA (QUANTITATIVE) ANALYSIS ☐ check if not modeled in PRA
1	OVERVIEW OF PRA MODELLING of STI (Include bounding risk analysis techniques if used, and PRA Quality Issues) The subject surveillance requirement verifies the capability of 4kv bus relays to sense low bus voltage or the presence of a LOCA initiation signal. This initiates, for the purposes of the PRA, a start of the emergency diesel generator on that 4kV bus. The relays were included in diesel initiation logic. The Limerick PRA has been reviewed against the ASME PRA standard and DG-1122 (now RG 1.200). The identified gaps that affect this analysis were addressed as follows. • Explicit modeling of the diesel initiation logic (with manual backup) was added to the model for this assessment. • An examination of LOCA scenarios with consequential LOOP was also added to the model for this assessment. • Existing modules that related to the diesel generator initiation logic were expanded in the R2 model. • The parameter file was fully populated for performance of the parametric uncertainty assessment. • There is very limited use of plant-specific data in the LGS models. The incorporation of more plant-specific data and the incorporation of revised common cause failure probabilities are anticipated, for the most part, to reduce the failure probabilities used in the model. This means that the currently calculated impacts are most likely conservative. • Other remaining issues from the GAP analysis are considered as being bounded by the uncertainty assessment performed for this analysis. The above changes created the application specific PRA model named LGS101R2 and LGS201R2 (See LGS04AF-002). The Unit 1 application model base CDF is 4.539E-6/yr. which is equivalent to the base Unit 1 level 1 PRA model CDF. The Unit 1 base application model LERF is 4.46E-8 which is equivalent to the base Unit 1 model LERF. The Unit 2 application model CDF is equivalent to the Unit 2 base model CDF. There is no quantified Unit 2 level 2 model. When evaluating a standby, periodically tested failure rate the projection of the data beyond the current known interval must be addressed. The base test interval of 2 years is infrequent. The proposed extension to 8 years would push the data well beyond a reasonable bound because of the scarcity of data beyond the original two years. Therefore an extension to 4 years(2R) is more reasonable.
2	FULL POWER INTERNAL EVENTS (FPIE) LEVEL 1 PRA MODEL IMPACTS (CDF Comparison against R.G 1.174 limits) The change in CDF is less than 1.0E-9/yr when extending the test interval from once per refueling cycle to once per 2 refueling cycles. This is much less than the R.G. 1.174 limit of 1E-6/yr. Note: CDF = Core Damage Frequency
3	FPIE LEVEL 2 PRA MODEL IMPACTS (LERF Comparison against R.G 1.174 limits) The change in LERF is less than 1E-11/yr. This is much less than the R.G. 1.174 limit of 1E-7/yr. Note: LERF = Large Early Release Frequency
4	FIRE RISK IMPACTS (CDF & LERF Comparison against R.G 1.174 limits) Based on the very small impact on the FPIE model, it is judged that the impact from fire risk is also very small though no quantitative assessment is available.
5	SEISMIC RISK IMPACTS (CDF & LERF Comparison against R.G 1.174 limits) Based on the very small impact on the FPIE model, it is judged that the impact from seismic risk is also very small though no quantitative assessment is available.
6	SHUTDOWN RISK IMPACTS (CDF & LERF Comparison against R.G 1.174 limits) Based on the very small impact on the FPIE model, it is judged that the impact from shutdown risk is also very small. Additional time would also be available to manually initiate the diesel generators should the initiation logic fail under shutdown conditions. Additionally for many of the shutdown plant operating states, a LOCA would be a loss of inventory/ draindown event because the reactor would be depressurized and potentially open.

7	OTHER PRA ISSUES (ex. Impacts from Other External Events excluding Seismic & Fire Risk Impacts) Sensitivity cases with increased failure probabilities indicate a non-trivial increase in risk (about 10%) when 3-times the extended interval failure rates are utilized. This supports the extension of the interval to only 2R rather than 4R because data uncertainty is coming into play for this STI. The parametric uncertainty assessment indicates that the 95th percentile CDF value is about a factor of 3 times the base point estimate mean value, and the 95th percentile LERF value is about a factor of 4 times the base point estimate mean value. The low change in CDF and LERF for this assessment indicates that even at the 95th percentile values for CDF and LERF, the change in risk would be of very low risk significance. No other external events are applicable. Internal flooding is contained in the internal events PRA model.
8	CUMMULATIVE EFFECT OF ALL RI-TS STI EXTENSIONS ON INTERNAL, EXTERNAL & SHUTDOWN PRAs. (CDF & LERF Comparison against R.G 1.174 limits) The previous cumulative increase in CDF was 1E-9/yr. With this STI the cumulative increase in CDF becomes approximately 2E-9/yr. The previous cumulative increase in LERF was 1E-11/yr. With this STI the cumulative increase in LERF becomes approximately 2E-11/yr. These cumulative values remain within the RG 1.174 limits.
9	QUANTITATIVE (PRA) ANALYSIS – CONCLUSIONS The change to the surveillance test interval from 1R to 2R is of very low risk significance from a CDF and LERF perspective as evidenced by the changes remaining within RG 1.174 limits but should not be extended beyond that due to data uncertainty.
10	PREPARER (SECTION C – PRA (QUANTITATIVE) ANALYSIS) Prepared by: Victoria A. Warren (Risk Management Engineer) Date 01/02/04

D	**INTEGRATED DECISION-MAKING PANEL (IDP, a/k/a EXPERT PANEL) REVIEW**	MEETING DATE:
1	Presenter(s):	
2	Meeting Discussion: (Review of Qualitative and Quantitative Analyses, and Cumulative Impact)	
3	Meeting Results / Recommendations / Bases: (Consider: phased implementation, additional performance monitoring of failure rates)	
4	Approval / Disapproval: Check one of the following: ☐ STI Approved ☐ STI Approved with Comments ☐ STI Disapproved **IDP / Expert Panel Members:** 1. Engineering Manager * 2. Maintenance Manager * 3. Operations Manager * 4. Risk Management (PRA) Engineer * 5. Maintenance Rule Coordinator * 6. Surveillance Test Coordinator 7. System Manager or Component Engineer Listing of IDP attendees: (signatures not required – see MRule Expert Panel / IDP meeting minutes) * also Maintenance Rule Expert Panel Member	
5	IDP / Expert Panel Coordinator Final Review / Closure: ______________________ Date: ____________ (IDP Coordinator)	

Attachment 1 – Applicable Tech Specs

ST-6-092-11(5-9)-1, D1(1-4) DIESEL GENERATOR 4 KV SFGD LOSS OF POWER LSF/SAA AND OUTAGE_TESTING:

Yellow – indicates 24 month frequency (i.e. Tech Specs applicable to this review)

Test Freq:	Refuel Cycle -OR Initiating Events:		
Tech Spec:	4.3.3.1	T3.3.3-3.1	
	4.3.3.2	T3.3.3-3.2	
	4.3.3.3	T4.3.3.1-1.5.a	
	4.7.1.2.b.2		
	4.8.1.1.2.e.4 - 7,9-13		
	4.8.1.2		
	UFSAR TABLES		8.3-1 (a)
			8.3-1 (b)

ST-6-092-32(1-4)-1, D1(1-4) DIESEL GENERATOR LOCA/LOAD REJECT TESTING AND FAST START OPERABILITY TEST RUN:

Test Freq:	24 Month	
Tech Spec:	4.0.5	4.8.1.1.2.e.7 partial
	4.8.1.1.2.a.1-7	4.8.1.1.2.e.13.a
	4.8.1.1.2.b.1	4.8.1.1.2.h
	4.8.1.1.2.b.2	4.8.1.2
	4.8.1.1.2.e.2	T4.8.1.1.2-1
	4.8.1.1.2.e.3	UFSAR 8.3.1.1.3.7.b
	4.8.1.1.2.e.5	UFSAR 9.5.6.2

ST-6-092-11(5-8)-2, D2(1-4) DIESEL GENERATOR 4 KV SFGD LOSS OF POWER LSF/SAA AND OUTAGE_TESTING:

Test Freq:	Refuel Cycle -OR Initiating Events:		
Tech Spec:	4.3.3.1	T3.3.3-3.1	
	4.3.3.2	T3.3.3-3.2	
	4.3.3.3	T4.3.3.1-1.5.a	
	4.7.1.2.b.2		
	4.8.1.1.2.b.1		
	4.8.1.1.2.e.4, 6, 7, 9-12, 13b, 13c		
	4.8.1.2		
	UFSAR TABLES		8.3.1-(a)
			8.3.1-(b)

ST-6-092-32(1-4)-2, D2(1-4) DIESEL GENERATOR LOCA/LOAD REJECT TESTING AND FAST START OPERABILITY TEST RUN:

Test Freq:	24 Month	
Tech Spec:	4.0.5	4.8.1.1.2.e.7 partial
	4.8.1.1.2.a.1-7	4.8.1.1.2.e.13.a
	4.8.1.1.2.b.1	4.8.1.1.2.h
	4.8.1.1.2.b.2	4.8.1.2

4.8.1.1.2.e.2	T4.8.1.1.2-1
4.8.1.1.2.e.3	UFSAR 8.3.1.1.3.7.b
4.8.1.1.2.e.5	UFSAR 9.5.6.2

ST-6-092-31(1-4)-*, D*(1-4) DIESEL GENERATOR SLOW START OPERABILITY TEST RUN

Test Freq: Monthly/Variable

Tech Spec:

4.0.5	4.8.1.2
4.8.1.1.2.a.1-7	T4.8.1.1.2-1
4.8.1.1.2.b.1	UFSAR 8.3.1.1.3.7.b
4.8.1.1.2.b.2	UFSAR 9.5.6.2

ST-6-092-31(5-8)-*, D*(1-4) DIESEL GENERATOR FAST START OPERABILITY TEST RUN

Test Freq: 6 Months

Tech Spec: 4.8.1.1.1.b (partial)
4.8.1.1.2.a.1-7
4.8.1.1.2.b.1
4.8.1.1.2.b.2
4.8.1.1.2.h
4.8.1.2
T4.8.1.1.2-1
UFSAR 8.3.1.1.3.7.b
UFSAR 9.5.6.2

ST-1-092-11(1-4)-1, D1(1-4) DIESEL GENERATOR 4KV SFGD LOSS OF POWER LSF/SAA AND OUTAGE TESTING {SUPERCEDED}:

Test Freq: Refuel Cycle -OR Initiating Events:

Tech Spec: 4.3.3.1 T3.3.3-3.1
4.3.3.2 T3.3.3-3.2
4.3.3.3 T4.3.3.1-1.5.a
4.7.1.2.b.2
4.8.1.1.2.e.2 - 7,9-13
4.8.1.2
UFSAR TABLES 8.3-1 (a)
8.3-1 (b)

ST-1-092-11(1-5)-2, D2(1-4) DIESEL GENERATOR 4KV SFGD LOSS OF POWER LSF/SAA AND OUTAGE TESTING {SUPERCEDED}:

Test Freq: Refuel Cycle -OR Initiating Events:

Tech Spec: 4.3.3.1 T3.3.3-3.1
4.3.3.2 T3.3.3-3.2
4.3.3.3 T4.3.3.1-1.5.a
4.7.1.2.b.2
4.8.1.1.2.e.2 - 7,9-13
4.8.1.2
UFSAR TABLES 8.3-1 (a)
8.3-1 (b)

Tech Specs

4.3.3.1 Each ECCS actuation instrumentation channel shall be demonstrated OPERABLE by the performance of the CHANNEL CHECK, CHANNEL FUNCTIONAL TEST and CHANNEL CALIBRATION operations for the OPERATIONAL CONDITIONS and at the frequencies shown in Table 4.3.3.1-1.

4.3.3.2 LOGIC SYSTEM FUNCTIONAL TESTS and simulated automatic operation of all channels shall be performed at least once per 24 months.

4.3.3.3 The ECCS RESPONSE TIME of each ECCS trip function shown in Table 3.3.3-3 shall be demonstrated to be within the limit at least once per 24 months. Each test shall include at least one channel per trip system such that all channels are tested at least once every N times 24 months where N is the total number of redundant channels in a specific ECCS trip system.

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EMERGENCY CORE COOLING SYSTEM ACTUATION INSTRUMENTATION

TABLE 3.3.3-3

EMERGENCY CORE COOLING SYSTEM RESPONSE TIMES

ECCS	RESPONSE TIME (Seconds)
1. CORE SPRAY SYSTEM	≤ 27#
2. LOW PRESSURE COOLANT INJECTION MODE OF RHR SYSTEM	≤ 40#

ECCS actuation instrumentation is eliminated from response time testing.

****

TABLE 4.3.3.1-1

EMERGENCY CORE COOLING SYSTEM ACTUATION INSTRUMENTATION SURVEILLANCE REQUIREMENTS

TRIP FUNCTION	CHANNEL CHECK	CHANNEL FUNCTIONAL TEST	CHANNEL CALIBRATION	OPERATIONAL CONDITIONS FOR WHICH SURVEILLANCE REQUIRED
5. LOSS OF POWER				
a. 4.16 kV Emergency Bus Undervoltage (Loss of Voltage)##	N.A.	R	N.A.	1, 2, 3, 4**, 5**

Loss of Voltage Relay 127-11X is not field setable.

****

4.7.1.2 At least the above required emergency service water system loop(s) shall be demonstrated OPERABLE:

b. At least once per 24 months by verifying that:

2. Each pump starts automatically when its associated diesel generator starts.

****

4.8.1.1.2

e. At the following frequency by:

2. Every 24 months verify each diesel generator's capability to reject a load of greater than or equal to that of its single largest post-accident load while maintaining voltage at 4285 ± 420 volts and frequency at 60 ± 1.2 hz and after steady state conditions are reached, voltage is maintained at 4280 ± 120 volts.

3. Every 24 months verifying the diesel generator capability to reject a load of 2850 kW without tripping. The generator voltage shall not exceed 4784 volts during and following the load rejection.

4. Every 24 months simulating a loss-of-offsite power by itself, and:

   a) Verifying deenergization of the emergency busses and load shedding from the emergency busses.

   b) Verifying the diesel generator starts* on the auto-start signal, energizes the emergency busses within 10 seconds, energizes the auto-connected loads through the individual load timers and operates for greater than or equal to 5 minutes while its generator is loaded with the shutdown loads. After energization, the steady-state voltage and frequency of the emergency busses shall be maintained at 4280 ± 120 volts and 60 ± 1.2 Hz during this test.

5. Every 24 months verifying that on an ECCS actuation test signal, without loss-of-offsite power, the diesel generator starts* on the auto-start signal and operates on standby for greater than or equal to 5 minutes. The generator voltage and frequency shall reach 4280 ± 120 volts and 60 ± 1.2 Hz within 10 seconds after the auto-start signal; the steady state generator voltage and frequency shall be maintained within these limits during this test.

6. Every 24 months simulating a loss-of-offsite power in conjunction with an ECCS actuation test signal, and:

   a) Verifying deenergization of the emergency busses and load shedding from the emergency busses.

   b) Verifying the diesel generator starts* on the auto-start signal, energizes the emergency busses within 10 seconds, energizes the auto-connected shutdown loads through the individual load timers and operates for greater than or equal to 5 minutes while its generator is loaded with the emergency loads. After energization, the steady-state voltage and frequency of the emergency busses shall be maintained at 4280 ± 120 volts and 60 ± 1.2 Hz during this test.

7. Every 24 months verifying that all automatic diesel generator trips, except engine overspeed and generator differential over-current are automatically bypassed upon an ECCS actuation signal.

* This test shall be conducted in accordance with the manufacturer's recommendations regarding engine prelube and warm-up procedures, and as applicable regarding loading and shutdown recommendations.

****

9. Every 24 months verifying that the auto-connected loads to each diesel generator do not exceed the 2000-hour rating of 3100 kW.

10. Every 24 months verifying the diesel generator's capability to:

    a) Synchronize with the offsite power source while the generator is loaded with its emergency loads upon a simulated restoration of offsite power,

    b) Transfer its loads to the offsite power source, and

    c) Be restored to its standby status.

11. Every 24 months verifying that with the diesel generator operating in a test mode and connected to its bus, a simulated ECCS actuation signal overrides the test mode by (1) returning the diesel generator to standby operation, and (2) automatically energizes the emergency loads with offsite power..

12. Every 24 months verifying that the automatic load sequence timers are OPERABLE with the interval between each load block within ± 10% of its design interval.

13. Every 24 months verifying that the following diesel generator lockout features prevent diesel generator starting only when required:

    a) Control Room Switch In Pull-To-Lock (With Local/Remote Switch in Remote)

    b) Local/Remote Switch in Local

    c) Emergency Stop

* This test shall be conducted in accordance with the manufacturer's recommendations regarding engine prelube and warmup procedures, and as applicable regarding loading and shutdown recommendations.

** This band is meant as guidance to avoid routine overloading of the engine. Loads in excess of this band for special testing under direct monitoring by the manufacturer or momentary variations due to changing bus loads shall not invalidate the test.

Table 8.3-1(a)

SEQUENCE OF EVENTS IN THE AUTOMATIC APPLICATION OF EMERGENCY AC LOADS ON LOCA[(1)] AND LOOP

EVENT	TIME (sec)
Signal to start diesel	0
Diesel ready to load; start one RHR pump motor	10
Apply power to 440 V auxiliaries and MOVs	13
Start one core spray pump motor	17
Start one ESW pump motor	55
Control room chiller	177
Reactor building recirculation fan	193

(1) This sequence applies to one diesel and its associated loads. The other diesels have a similar sequence and loa

Table 8.3-1(b)

SEQUENCE OF EVENTS IN THE AUTOMATIC APPLICATION OF EMERGENCY AC LOADS ON LOCA WITH OFFSITE POWER AVAILABLE[(1)]

EVENTS	TIME (sec)
Start RHR pumps C & D	0
Apply power to 440 V auxiliaries and MOVs	3.5
Start RHR pumps A & B	5
Start core spray pumps A & C	10
Start core spray pumps B & D	15
Start 4 ESW pumps	55
Control room chillers	167
Reactor buildings recirculation fans	183.5

(1) Diesel is started and remains on standby when offsite power is available.

3/4.3 INSTRUMENTATION

3/4.3.3 EMERGENCY CORE COOLING SYSTEM ACTUATION INSTRUMENTATION

The emergency core cooling system actuation instrumentation is provided to initiate actions to mitigate the consequences of accidents that are beyond the ability of the operator to control. This specification provides the OPERABILITY requirements, trip setpoints and response times that will ensure effectiveness of the systems to provide the design protection. Although the instruments are listed by system, in some cases the same instrument may be used to send the actuation signal to more than one system at the same time.

Specified surveillance intervals and maintenance outage times have been determined in accordance with NEDC-30936P, Parts 1 and 2, "Technical Specification Improvement Methodology (with Demonstration for BWR ECCS Actuation Instrumentation)," as approved by the NRC and documented in the SER (letter to D. N. Grace from A. C. Thadani dated December 9, 1988 (Part 1) and letter to D. N. Grace from C. E. Rossi dated December 9, 1988 (Part 2)).

Successful operation of the required safety functions of the Emergency Core Cooling Systems (ECCS) is dependent upon the availability of adequate power for energizing various components such as pump motors, motor operated valves, and the associated control components. If the loss of power instrumentation detects that voltage levels are too low, the buses are disconnected from the offsite power sources and connected to the onsite diesel generator (DG) power sources. The loss of power relays in each channel have sufficient overlapping detection characteristics and functionality to permit operation subject to the conditions in Action Statement 37. Bases 3/4.8.1, 3/4.8.2, and 3/4.8.3 provide discussion regarding parametric bounds for determining operability of the offsite sources. Those Bases assume that the loss of power relays are operable. With an inoperable 127Z-11X0X relay, the grid voltage is monitored to 230kV (for the 101 Safeguard Bus Source) or 525kV (for the 201 Safeguard Bus Source) to increase the margin for the operation of the 127Z-11X0X relay.

Operation with a trip set less conservative than its Trip Setpoint but within its specified Allowable Value is acceptable on the basis that the difference
between each Trip Setpoint and the Allowable Value is an allowance for instrument drift specifically allocated for each trip in the safety analyses.

****

3/4.7 PLANT SYSTEMS

3/4.7.1 SERVICE WATER SYSTEMS - COMMON SYSTEMS

The OPERABILITY of the service water systems ensures that sufficient cooling capacity is available for continued operation of safety-related equipment during normal and accident conditions. The redundant cooling capacity of these systems, assuming a single failure, is consistent with the assumptions used in the accident conditions within acceptable limits.

The RHR and ESW systems are common to Units 1 and 2 and consist of two independent subsystems each with two pumps. One pump per subsystem (loop) is powered from a Unit 1 safeguard bus and the other pump is powered from a Unit 2 safeguard bus. In order to ensure adequate onsite power sources to the systems during a loss of offsite power event, the inoperability of these supplies are restricted in system ACTION statements.

RHRSW is a manually operated system used for core and containment heat removal. Each of two RHRSW subsystems has one heat exchanger per unit. Each RHRSW pump provides adequate cooling for one RHR heat exchanger. By limiting operation with less than three OPERABLE RHRSW pumps with OPERABLE Diesel Generators, each unit is ensured adequate heat removal capability for the design scenario of LOCA/LOOP on one unit and simultaneous safe shutdown of the other unit.

Each ESW pump provides adequate flow to the cooling loads in its associated loop. With only two divisions of power required for LOCA mitigation of one unit and one division of power required for safe shutdown of the other unit, one ESW pump provides sufficient capacity to fulfill design requirements. ESW

pumps are automatically started upon start of the associated Diesel Generators. Therefore, the allowable out of service times for OPERABLE ESW pumps and their associated Diesel Generators is limited to ensure adequate cooling during a loss of offsite power event.

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<u>3/4.8 ELECTRICAL POWER SYSTEMS</u> (Note: Sections referring to D.C. Distribution and Batteries removed)

<u>3/4.8.1, 3/4.8.2, and 3/4.8.3 A.C. SOURCES, D.C. SOURCES, and ONSITE POWER DISTRIBUTION SYSTEMS</u>

The OPERABILITY of the A.C. and D.C. power sources and associated distribution systems during operation ensures that sufficient power will be available to supply the safety-related equipment required for (1) the safe shutdown of the facility and (2) the mitigation and control of accident conditions within the facility. The minimum specified independent and redundant A.C. and D.C. power sources and distribution systems satisfy the requirements of General Design Criterion 17 of Appendix A to 10 CFR Part 50.

An offsite power source consists of all breakers, transformers, switches, interrupting devices, cabling, and controls required to transmit power from the offsite transmission network to the onsite Class 1E emergency bus or buses. The determination of the OPERABILITY of an offsite source of power can be made using three factors, that when taken together, describe the design basis calculation requirements for voltage regulation. The combination of these factors, described below, ensures that the offsite source(s), which provide power to the plant emergency buses, will be fully capable of supporting the equipment required to achieve and maintain safe shutdown during postulated accidents and transients.

An offsite source of electrical power is considered OPERABLE if it is within the bounds of analyzed conditions. The most limiting analysis provides the following bounds:

1. The Startup Transformer (#10 and/or #20) Load Tap Changer(s) (LTC) are in service and in automatic operation,
2. offsite source grid voltages are maintained above 218.5 kV on the 230 kV system and 498 kV on the 525 kV networks,
3. electrical buses and breaker alignments (13 kV and 4 kV) are maintained within the bounds of approved plant procedures.

Based on specific design analysis, variations to any of these parameters can be determined, usually at the sacrifice of another parameter, based on plant conditions. Specifics regarding these variations must be controlled by plant procedures or by operability determinations, backed by specific design calculations.

The ACTION requirements specified for the levels of degradation of the power sources provide restriction upon continued facility operation commensurate with the level of degradation. The OPERABILITY of the power sources are consistent with the initial condition assumptions of the safety analyses and are based upon maintaining at least two of the onsite A.C. and the corresponding D.C. power sources and associated distribution systems OPERABLE during accident conditions coincident with an assumed loss-of-offsite power and single failure of the other onsite A.C. or D.C. source. At least two onsite A.C. and their corresponding D.C. power sources and distribution systems providing power for at least two ECCS divisions (1 Core Spray loop, 1 LPCI pump and 1 RHR pump in suppression pool cooling) are required for design basis accident mitigation as discussed in UFSAR Table 6.3-3. Under Modes 1, 2 and 3, an offsite circuit is considered to be inoperable if it is not capable of supplying at least three Unit 1 4 kV emergency buses. If both offsite sources are capable of supplying only three Unit 1 4 kV emergency buses, then each of the four Unit 1 4 kV emergency buses must be supplied from at least one operable offsite source. Onsite A.C. operability requirements for common systems such as RHRSW and ESW are addressed in the appropriate system specification action statements.

The A.C. source allowable out-of-service times are based on Regulatory Guide 1.93, "Availability of Electrical Power Sources," December 1974. When one or more diesel generators are inoperable, there is an additional ACTION requirement to verify that all required systems, subsystems, trains, components, and devices, that depend on the remaining OPERABLE diesel generators as a source of emergency power, are also OPERABLE. The LPCI mode of the RHR system is considered a four train system, of which only two

trains are required. The verification for LPCI is not required until two diesel generators are inoperable. This requirement is intended to provide assurance that a loss-of-offsite power event will not result in a complete loss of safety function of critical systems during the period when one or more of the diesel generators is inoperable. The term verify as used in this context means to administratively check by examining logs or other information to determine if certain components are out-of-service for maintenance or other reasons. It does not mean to perform the surveillance requirements needed to demonstrate the OPERABILITY of the component.

The OPERABILITY of the minimum specified A.C. and D.C. power sources and associated distribution systems during shutdown and refueling ensures that (1) the facility can be maintained in the shutdown or refueling condition for extended time periods and (2) sufficient instrumentation and control capability is available for monitoring and maintaining the unit status. Under Modes 4, 5 and *, an offsite source is considered operable if it is capable of supplying all 4 kV emergency buses necessary for operating in that Mode.

The surveillance requirements for demonstrating the OPERABILITY of the diesel generators are in accordance with the recommendations of Regulatory Guide 1.9, "Selection of Diesel Generator Set Capacity for Standby Power Supplies," March 10, 1971, Regulatory Guide 1.137 "Fuel-Oil Systems for Standby Diesel Generators," Revision 1, October 1979 and Regulatory Guide 1.108,

"Periodic Testing of Diesel Generator Units Used as Onsite Electric Power Systems at Nuclear Power Plants," Revision 1, August 1977 except for paragraphs C.2.a(3), C.2.c(1), C.2.c(2), C.2.d(3) and C.2.d(4), and the periodic testing will be performed at least once per 24 months. The exceptions to Regulatory Guide 1.108 allow for gradual loading of diesel generators during testing and decreased surveillance test frequencies (in response to Generic Letter 84-15). The single largest post-accident load on each diesel generator is the RHR pump.

The Surveillance Requirement for removal of accumulated water from the fuel oil storage tanks is for preventive maintenance. The presence of water does not necessarily represent failure of the Surveillance Requirement, provided the accumulated water is removed during performance of the Surveillance. Accumulated water in the fuel oil storage tanks constitutes a collection of water at a level that can be consistently and reliably measured. The minimum level at which accumulated water can be consistently and reliably measured in the fuel oil storage tank sump is 0.25 inches. Microbiological fouling is a major cause of fuel oil degradation. There are numerous bacteria that can grow in fuel oil and cause fouling, but all must have a water environment in order to survive. Removal of accumulated water from the fuel storage tanks once every (31) days eliminates the necessary environment for bacterial survival. This is the most effective means of controlling microbiological fouling. In addition, it eliminates the potential for water entrainment in the fuel oil during DG operation. Water may come from any of several sources, including condensation, ground water, rain water, contaminated fuel oil, and from breakdown of the fuel oil by bacteria. Frequent checking for and removal of accumulated water minimizes fouling and provides data regarding the watertight integrity of the fuel oil system. The Surveillance Frequencies are established by Regulatory Guide 1.137.

8.1.6.1.2 Regulatory Guide 1.9 (March 1971) - Selection of Diesel Generator Set Capacity for Standby Power Supplies (Safety Guide 9)

The standby diesel generator capacities are in compliance with this edition of Regulatory Guide 1.9. Revisions 1 and 2 of the guide are not applicable to LGS as discussed in Section 1.8.

The continuous or the 2000 hour rating of the standby diesel generators is greater than the sum of conservatively estimated loads needed to be supplied following any design basis event. Load requirements are listed in Table 8.3-2.

The standby diesel generators are capable of starting and accelerating all engineered safeguard loads to the rated speed within the time and in the sequence shown in Table 8.3-1. They are capable of maintaining, during the steady-state and loading sequence, the frequency and voltage above a level that may degrade the performance of any of the loads below their minimum requirements. The standby diesel generators are capable of recovering from transients caused by step load increases or resulting from the disconnection of a partial or full load. Specifically, the standby diesel generators are designed to maintain frequency and voltage to not less than 95% and 75% of nominal, respectively, following a step load change. The frequency and voltage are restored to within 2% and 10% of nominal, respectively, within 60% of each load sequence time interval except for the time interval (3 seconds) between the RHR pump motor start and the load center breaker closure. However, during the preoperational tests, these loads started, accelerated, and operated successfully. In addition, during the recovery from transients caused by step load increases or resulting from the disconnection of the largest single load, the speed of the diesel generator will not exceed 75% of the difference between the nominal speed and the overspeed trip setpoint or 115% of nominal, whichever is lower.

8.1.6.1.6 Regulatory Guide 1.32 (February 1977) - Criteria for Safety-Related Electric Power Systems for Nuclear Power Plants

All safety-related electric systems are in compliance with Regulatory Guide 1.32, except as it refers to Regulatory Guide 1.75, which is discussed in Section 8.1.6.1.14. The portions of Regulatory Guide 1.32 applying to offsite power and dc power are discussed in Sections 8.2 and 8.3.2, respectively.

IEEE 308 (1974), "IEEE Standard Criteria for Class 1E Power Systems for Nuclear Power Generating Stations" is generally accepted by Regulatory Guide 1.32.

Class 1E ac power systems are designed to ensure that any design basis event, as listed in table 1 of IEEE 308, does not cause either loss of electric power to more than one division,

surveillance device, or protection system that could jeopardize the safety of the reactor unit; or transients in the power supplies, which could degrade the performance of any system.

Controls and indicators for the Class 1E 4 kV bus supply breakers are provided in the control room and on the switchgear. Controls and indicators for the standby ac power supplies are also provided in the control room and on the local diesel generator control panels. Control and indication for the standby power system is described in Section 8.3.1.

Class 1E equipment is distinctly identified in the field and in associated design, operating, and maintenance documents. Physical identification is described in Section 8.3.1.3.

Class 1E equipment is qualified by analysis, by successful use under required conditions, or by actual testing to demonstrate its ability to perform its function under any applicable design basis events.

The surveillance requirements of IEEE 308 are followed in design, installation, and operation of Class 1E equipment and consist of:

a. Preoperational equipment tests and inspections are performed in accordance with the requirements described in Chapter 14, with all components installed. These tests and inspections demonstrate:

    1. All components are correct and are properly mounted.

    2. All connections are correct, and circuits are continuous.

    3. All components are operational.

    4. All metering and protective devices are properly calibrated and adjusted.

b. Preoperational system tests are performed in accordance with the requirements described in Chapter 14, with all components installed. These tests demonstrate that the equipment operates within design limits and that the system is operational and meets its performance specifications. These tests also demonstrate:

    1. The Class 1E loads can operate on the preferred power supply.

    2. The loss of the preferred power supply is detected.

    3. The standby power supply is started and accepts design load in the sequence and time duration shown in Table 8.3-1.

    4. The standby power supply is independent of the preferred power supply.

c. Periodic equipment tests are performed at scheduled intervals in accordance with the requirements of Chapter 16 to detect the deterioration of the equipment toward an unacceptable condition, to demonstrate that standby power equipment and other components that are not running during normal operation of the station are operable, and to demonstrate the operational readiness of the system. (see section 6 of IEEE 308, 1974)

The standby ac power supplies are not shared by the two units. The standby capacity of each unit is sufficient to operate the engineered safeguard loads following a DBA on that unit.

The two preferred offsite power supplies are shared by both units. The capacity of each offsite power supply is sufficient to operate the loads required for safe shutdown of both units with a LOCA in one unit and a simultaneous safe shutdown of the other unit.

Battery testing is described in Technical Specifications.

8.1.6.1.20 Regulatory Guide 1.108 (August 1977) - Periodic Testing of Diesel Generator Units Used as Onsite Electric Power Systems at Nuclear Power Plants

The periodic testing of the diesel generator units will be in conformance with the requirements of Regulatory Guide 1.108 and IEEE 387 (1977) as follows:

a. The preoperational testing will be performed in accordance with the site test outlined in section 6.4 of IEEE 387 (1977).

b. A starting test as described in section 6.6.1 of IEEE 387 (1977) will be performed on each diesel generator at least once per month.

c. Periodic testing in accordance with section 6.6.2 of IEEE 387 (1977) except the test frequency will be performed at least once per 24 months.

In accordance with Station Blackout requirements, an emergency diesel generator reliability program which meets the requirements of USNRC Regulatory Guide 1.155 "Station Blackout" is in place.

8.1.6.1.21 Regulatory Guide 1.118 (June 1978) - Periodic Testing of Electric Power and Protection Systems

The LGS design provides the necessary capability for periodic testing of electric power systems in conformance with Section 5 of IEEE 338 (1977) as endorsed and amended by the guide.

Periodic testing capability of instrumentation and controls systems is discussed in Section 7.1.2.5.

Periodic testing of the Class 1E systems will be in accordance with Regulatory Guide 1.118 and IEEE 338 (1977).

8.1.6.1.25 Regulatory Guide 1.155 (June 1988) - Station Blackout

LGS complies with Regulatory Guide 1.155 and was evaluated in accordance with the requirements using guidance from NUMARC 87-00, except where RG 1.155 takes precedence.

For LGS Units 1 and 2, the minimum required Station Blackout coping duration shall be four hours as determined by NUMARC 87-00 guidelines.

LGS has opted to use an alternate ac power (AAC) approach (excess diesel generator capacity) to cope with and recover from a station blackout. AAC power is available within one hour of the station blackout. For LGS Units 1 and 2, the AAC power source satisfies the requirements for station blackout.

For LGS Units 1 and 2, Emergency Diesel Generator target reliability levels are maintained at or above 0.95 per demand. An Emergency Diesel Generator reliability program is established to ensure that target reliability program is established to ensure that target levels are maintained.

Station Blackout is further described in Section 15.12.

8.1.6.2 <u>Conformance with IEEE Standards</u>

8.1.6.2.1 IEEE 387 (1972) - Criteria for Diesel Generator Units Applied as Standby Power Supplies for Nuclear Power Generating Stations

The design of the standby power supplies is in compliance with IEEE 387 (1972). The following paragraphs analyze compliance.

a. Adequate cooling and ventilation equipment is provided to maintain an acceptable service environment within the diesel generator compartments during and after any design basis event, even without support from the preferred power supply.

b. Each diesel generator is capable of starting, accelerating, and accepting load as described in Section 8.3.1. The diesel generator automatically initiates its cooling equipment within an acceptable time after starting.

c. Frequency and voltage limits and the basis of the continuous rating of the diesel generator are discussed in the compliance statement to Regulatory Guide 1.9 in Section 8.1.6.1.2.

d. Mechanical and electrical systems are designed so that a single failure affects the operation of only a single diesel generator.

e. Design conditions such as vibration, torsional vibration, and overspeed are considered in accordance with the requirements of IEEE 387 (1972).

f. Each diesel governor can operate in either the isochronous or droop mode and the voltage regulator can operate in either the parallel or nonparallel mode. During testing, the diesel generator is connected to and operated in parallel with the offsite power source. The electric governor is set in the droop mode whenever connected in parallel with a system in which another prime mover is controlling the frequency. Under automatic or emergency start conditions, the electric governing system and the voltage regulator are set automatically for isochronous and nonparallel mode, respectively.

g. Each diesel generator is provided with control systems permitting automatic and manual control. The automatic start signal is functional except when the diesel generator is in the maintenance mode. Provision is made for controlling the diesel generator from the control room and from the diesel generator room. Section 8.3.1 provides further description of the control systems.

h. Voltage, current, frequency, and output power metering is provided in the control room to permit assessment of the operating condition of each diesel generator.

i. Surveillance instrumentation is provided in accordance with IEEE 387 as follows:

   1. Starting system - starting air pressure low alarm

   2. Lubrication system - lube oil pressure low, lube oil temperature high, lube oil level low, and lube oil keep-warm failure alarms

   3. Fuel system - fuel oil level in day tank high and low, fuel oil pressure low, fuel oil strainer differential pressure high, fuel oil filter differential pressure high, fuel oil level in storage tank high, and low alarm

   4. Primary cooling system - ESW low pressure

   5. Secondary cooling system - jacket water temperature high, jacket water keep-warm failure, jacket water pressure low, and jacket water expansion tank level low alarms

6. Combustion air systems - no alarm is provided, because the diesel generator duct-work does not contain any automatic dampers or features to cause failure in the combustion air supply

7. Exhaust system - pyrometers located at local gauge panel

8. Generator - generator differential overcurrent, ground neutral overcurrent, generator phase overcurrent, and antimotoring trip and alarm

9. Excitation system - generator loss of excitation and overexcitation alarm and field ground alarm

10. Voltage regulation system - generator overvoltage alarm

11. Governor system - engine overspeed trip

12. Auxiliary electric system - 480 V ac auxiliary power off, 125 V dc control power off, dc fuel pump power off alarms

A detailed list of trip and alarm functions and testing of the diesel generator is discussed in Section 8.3.1.1.3.

Table 8.3-1(a)

SEQUENCE OF EVENTS IN THE AUTOMATIC APPLICATION OF EMERGENCY AC LOADS ON LOCA[1] AND LOOP

EVENT	TIME (sec)
Signal to start diesel	0
Diesel ready to load; start one RHR pump motor	10
Apply power to 440 V auxiliaries and MOVs	13
Start one core spray pump motor	17
Start one ESW pump motor	55
Control room chiller	177
Reactor building recirculation fan	193

(1) This sequence applies to one diesel and its associated loads. The other diesels have a similar sequence and load.

Table 8.3-1(b)

SEQUENCE OF EVENTS IN THE AUTOMATIC APPLICATION OF EMERGENCY AC LOADS ON LOCA WITH OFFSITE POWER AVAILABLE[1]

EVENTS	TIME (sec)
Start RHR pumps C & D	0
Apply power to 440 V auxiliaries and MOVs	3.5
Start RHR pumps A & B	5
Start core spray pumps A & C	10
Start core spray pumps B & D	15
Start 4 ESW pumps	55
Control room chillers	167
Reactor buildings recirculation fans	183.5

(1) Diesel is started and remains on standby when offsite power is available.

DIESEL GENERATOR AND EMERGENCY BUS LOADING WITH UNITS 1 & 2 IN OPERATION
ALL DIESEL GENERATORS IN SERVICE
UNIT 1 DESIGN BASIS ACCIDENT; UNIT 2 SPURIOUS LOCA (7)

			0 - 10 MINUTES								10 - 60 MINUTES								1 HOUR AND LONGER							
			UNIT 1				UNIT 2				UNIT 1				UNIT 2				UNIT 1				UNIT 2			
ITEM	LOAD DESCRIPTION	EQUIP NO	D/G BUS D11	D/G BUS D12	D/G BUS D13	D/G BUS D14	D/G BUS D21	D/G BUS D22	D/G BUS D23	D/G BUS D24	D/G BUS D11	D/G BUS D12	D/G BUS D13	D/G BUS D14	D/G BUS D21	D/G BUS D22	D/G BUS D23	D/G BUS D24	D/G BUS D11	D/G BUS D12	D/G BUS D13	D/G BUS D14	D/G BUS D21	D/G BUS D22	D/G BUS D23	D/G BUS D24
1	RHR PUMP	P202	993	993	993	993	977	993	993	993	993	993	0	0	977	993	0	0	993	993	0	0	977	993	0	[illegible]
2	CORE SPRAY PUMP	P206	529	529	529	529	529	529	529	529	529	0	529	0	529	529	0	0	529	0	529	0	529	529	0	[illegible]
3	RHR SERVICE WATER PUMP	P506	0	0	0	0	0	0	0	0	519	519	0	0	519	519	0	0	519	519	0	0	519	519	0	[illegible]
4	ESW PUMP	P548	389	389	0	0	0	0	389	389	0	0	0	0	0	0	389	389	0	0	0	0	0	0	389	[illegible]
5	125V BATTERY CHARGER	D103	51	50	9	9	51	51	9	9	51	50	9	9	51	51	9	9	51	50	9	9	51	51	9	[illegible]
6	DRYWELL COOLER FAN	V212	80	80	0	0	80	80	0	0	80	80	0	0	80	80	0	0	80	80	0	0	80	80	0	[illegible]
7	DG ROOM VENT FAN	V512	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	[illegible]
8	RHR ROOM COOLING UNIT	V210	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	[illegible]
9	CORE SPRAY ROOM COOLING UNIT	V211	7	8	7	8	7	7	7	7	7	8	7	8	7	7	7	7	7	8	7	8	7	7	7	[illegible]
10	HPCI ROOM COOLING UNIT	V209	0	10	0	0	0	10	0	0	0	10	0	0	0	10	0	0	0	10	0	0	0	10	0	[illegible]
11	RCIC ROOM COOLING UNIT	V208	8	0	0	0	8	0	0	0	8	0	0	0	8	0	0	0	8	0	0	0	8	0	0	
12	INSTRUMENT AC POWER SUPPLY	Y101	11	11	12	11	12	12	12	12	11	11	12	11	12	12	12	12	11	11	12	11	12	12	12	[illegible]
12	INSTRUMENT AC POWER SUPPLY	Y102																								
12	INSTRUMENT AC POWER SUPPLY	Y103																								
12	INSTRUMENT AC POWER SUPPLY	Y104																								
13	DG START AIR COMPRESSOR	K513	0	0	0	0	0	0	0	0	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	
14	DG FUEL OIL TRANSFER PUMP	P514	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
15	SGTS HEATER	E189	44	0	0	0	0	0	0	0	44	0	0	0	0	0	0	0	44	0	0	0	0	0	0	
16	SGTS ROOM UNIT COOLER	V140	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	
17	SGTS ROOM ACCESS UNIT COOLER	V141	6	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	6	0	0	0	0	0	0	
18	SGTS EXHAUST FAN	V183	32	0	0	0	0	0	0	0	32	0	0	0	0	0	0	0	32	0	0	0	0	0	0	
19	RERS FAN	V213	151	0	0	0	151	0	0	0	151	0	0	0	151	0	0	0	151	0	0	0	151	0	0	
20	HVAC DAMPER POWER	Y183	4	4	16	20	2	2	2	2	4	4	16	20	2	2	2	2	4	4	16	20	2	2	2	
20	HVAC DAMPER POWER	Y184																								
20	HVAC DAMPER POWER	Y206																								
20	HVAC DAMPER POWER	Y207																								
21	CONTROL ROOM CHILLER	K112	0	0	309	0	0	0	0	0	0	0	309	0	0	0	0	0	0	0	309	0	0	0	0	
22	CONTROL ROOM CHILLER WATER PUMP	P162	0	0	16	0	0	0	0	0	0	0	16	0	0	0	0	0	0	0	16	0	0	0	0	
23	AUX PNL & COMP RM FAN COIL UNIT	V114	0	0	24	0	0	0	0	0	0	0	24	0	0	0	0	0	0	0	24	0	0	0	0	
24	AUX PNL & COMP RM RETURN AIR UNIT	V120	0	0	16	0	0	0	0	0	0	0	16	0	0	0	0	0	0	0	16	0	0	0	0	
25	CONTROL ROOM AIR COND UNIT	V118	0	0	32	0	0	0	0	0	0	0	32	0	0	0	0	0	0	0	32	0	0	0	0	
26	CONTROL ROOM RETURN AIR FAN	V121	0	0	12	0	0	0	0	0	0	0	12	0	0	0	0	0	0	0	12	0	0	0	0	
27	EMER SWGR & BTRY RM AIR COND UNIT	V116	0	0	9	0	0	0	0	0	0	0	9	0	0	0	0	0	0	0	9	0	0	0	0	
28	AUX EQUIP & COMP RM AREA HTR (11)	E193	0	0	0	0	0	0	0	0	0	0	52	0	0	0	0	0	0	0	52	0	0	0	0	
29	CONTROL ROOM AREA HEATER (11)	E192	0	0	0	0	0	0	0	0	0	0	40	0	0	0	0	0	0	0	40	0	0	0	0	
30	CONTROL RM FRESH AIR INTAKE HTR (11)	E191	0	0	32	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
31	SPRAY POND STA. HTG COIL FAN (11)	V543	7	7	0	0	0	0	0	0	7	7	0	0	0	0	0	0	7	7	0	0	0	0	0	
32	SLCS HEATERS	S213	0	0	8	0	0	0	8	0	0	0	8	0	0	0	8	0	0	0	8	0	0	0	8	

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DIESEL GENERATOR AND EMERGENCY BUS LOADING WITH UNITS 1 & 2 IN OPERATION
ALL DIESEL GENERATORS IN SERVICE
UNIT 1 DESIGN BASIS ACCIDENT; UNIT 2 SPURIOUS LOCA (7)

			0 - 10 MINUTES								10 - 60 MINUTES								1 HOUR AND LONGER						
			UNIT 1				UNIT 2				UNIT 1				UNIT 2				UNIT 1				UNIT 2		
ITEM	LOAD DESCRIPTION	EQUIP NO	D/G BUS D11	D/G BUS D12	D/G BUS D13	D/G BUS D14	D/G BUS D21	D/G BUS D22	D/G BUS D23	D/G BUS D24	D/G BUS D11	D/G BUS D12	D/G BUS D13	D/G BUS D14	D/G BUS D21	D/G BUS D22	D/G BUS D23	D/G BUS D24	D/G BUS D11	D/G BUS D12	D/G BUS D13	D/G BUS D14	D/G BUS D21	D/G BUS D22	D/G BUS D23
33	CONTAINMENT H2 RECOMBINER	S403	0	0	0	0	0	0	0	0	0	0	48	0	0	0	48	0	0	0	48	0	0	0	48
34	CONTROL ROOM FRESH AIR SUPPLY FAN	V127	0	0	6	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	6	0	0	0	0
35	CONTROL ROOM CHILLER OIL PUMP	P168	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0
36	DG AUXILIARIES	G501	0	0	0	0	0	0	0	0	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14
37	DELETED																								
37	DELETED																								
38	DELETED																								
39	CRD PUMP	P158	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
40	DELETED																								
41	RECW PUMP	P210	0	0	0	0	0	0	0	0	0	0	67	0	0	0	67	0	0	0	67	0	0	0	67
42	TECW PUMP	P103	0	0	0	0	0	0	0	0	11	11	0	0	12	11	0	0	11	11	0	0	12	11	0
43	INSTRUMENT AC POWER SUPPLY	Y105	0	0	0	0	0	0	0	0	5	10	24	14	24	24	24	24	5	10	24	14	24	24	24
43	INSTRUMENT AC POWER SUPPLY	Y106																							
43	INSTRUMENT AC POWER SUPPLY	Y201																							
43	INSTRUMENT AC POWER SUPPLY	Y202																							
44	EMERGENCY LIGHTING	MISC	0	0	0	0	0	0	0	0	11	70	108	99	0	59	80	68	11	70	108	99	0	59	80
45	TURBINE GEN BEARING LIFT PUMP	P109	0	0	0	0	0	0	0	0	36	0	0	0	36	0	0	0	36	0	0	0	36	0	0
46	TURBINE GEN TURNING GEAR OIL PUMP	P111	0	0	0	0	0	0	0	0	32	0	0	0	32	0	0	0	32	0	0	0	32	0	0
47	TURBINE GEN TURNING GEAR	S103	0	0	0	0	0	0	0	0	48	0	0	0	24	0	0	0	48	0	0	0	24	0	0
48	RFPT TURNING GEAR	S106	0	0	0	0	0	0	0	0	2	1	0	0	2	1	0	0	2	1	0	0	2	1	0
49	INSTRUMENT GAS COMPRESSOR	K203	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0	1	0	0
50	INSTRUMENT AIR COMPRESSOR	K101	0	0	0	0	0	0	0	0	0	0	33	0	0	0	33	0	0	0	33	0	0	0	33
51																									
52	OSC XFMR PNLS 00L140 & 00L141	X186	0	0	0	0	0	0	0	0	0	24	0	0	0	0	0	0	0	24	0	0	0	0	0
53	TEST ENGINEER'S WORKSHOP	X187	0	0	0	0	0	0	0	0	0	12	0	0	0	0	0	0	0	12	0	0	0	0	0
54	NORTH STACK RM ANTENNA SYS XFMR	X585	0	0	0	0	0	0	0	0	0	9	0	0	0	0	0	0	0	9	0	0	0	0	0
55																									
56	CRD REPAIR RM COOLING FAN	V904	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
57	125V BATTERY CHARGER	D113	0	0	0	0	0	0	0	0	0	0	0	96	0	0	0	96	0	0	0	96	0	0	0
58	FIRE ALARM & P/A	1X5	0	0	0	12	0	0	0	0	0	0	0	12	0	0	0	0	0	0	0	12	0	0	0
59	FUEL POOL COOLING WATER PUMP	P211	0	0	0	0	0	0	0	0	32	32	0	0	32	32	0	0	32	32	0	0	32	32	0
60	FUEL POOL SVC WATER BOOSTER PUMP	P212	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
61	INSTR. AC PWR SUPPLY (SPRAY POND)	Y601	1	1	0	0	0	0	8	8	1	1	0	0	0	0	8	8	1	1	0	0	0	0	8
62	SPRAY POND PP STA. HTG COIL (8,11)	E701	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
63	SGTS RM VENT EXHAUST FAN	V131	0	0	0	0	0	0	0	0	8	0	0	0	0	0	0	0	8	0	0	0	0	0	0
64	CAS/SAS ROOM AIR COND.	V585	0	0	0	0	0	0	0	0	0	0	14	0	0	0	0	0	0	0	14	0	0	0	0
65	PIPING FILL PUMP	P256	0	0	0	0	0	0	0	0	3	3	0	0	3	3	0	0	3	3	0	0	3	3	0
66	DRYWELL H2O2 ANALYZER	S205	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0

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DIESEL GENERATOR AND EMERGENCY BUS LOADING WITH UNITS 1 & 2 IN OPERATION
ALL DIESEL GENERATORS IN SERVICE
UNIT 1 DESIGN BASIS ACCIDENT; UNIT 2 SPURIOUS LOCA (7)

ITEM	LOAD DESCRIPTION	EQUIP NO	0 - 10 MINUTES								10 - 60 MINUTES								1 HOUR AND LONGER						
			UNIT 1				UNIT 2				UNIT 1				UNIT 2				UNIT 1				UNIT 2		
			D/G BUS D11	D/G BUS D12	D/G BUS D13	D/G BUS D14	D/G BUS D21	D/G BUS D22	D/G BUS D23	D/G BUS D24	D/G BUS D11	D/G BUS D12	D/G BUS D13	D/G BUS D14	D/G BUS D21	D/G BUS D22	D/G BUS D23	D/G BUS D24	D/G BUS D11	D/G BUS D12	D/G BUS D13	D/G BUS D14	D/G BUS D21	D/G BUS D22	D/G BUS D23
67	SUPPRESSION POOL H2O2 ANALYZER	S206	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	[illegible]
68	CHILLER PUMP-OUT COMPRESSOR	K114	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	2	0	0	0	[illegible]
69	SPRAY POND SUMP PUMP	P578	0	0	0	0	0	0	0	0	2	2	0	0	0	0	2	2	2	2	0	0	0	0	[illegible]
70	AUX EG. RM & COMP RM ELE. HUMID (11)	E743	0	0	0	0	0	0	0	0	43	0	0	0	0	0	0	0	43	0	0	0	0	0	[illegible]
71	CONTROL RM ELEC HUMIDIFIER (11)	E744	0	0	0	0	0	0	0	0	29	0	0	0	0	0	0	0	29	0	0	0	0	0	[illegible]
72	250V BATTERY CHARGER	D123	0	0	0	0	0	9	0	0	0	9	0	0	0	9	0	0	0	9	0	0	0	9	[illegible]
73	ALT POWER SUPPLY TO 10X161 XFMR	10X161	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	[illegible]
74	STATIC INVERTER 00D162 XFMR	20X161	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	[illegible]
75	TELEPHONE EQUIP POWER XFMR	X503	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	6	0	0	0	0	0	[illegible]
76	RECOMBINER HYDROGEN ANALYZER	P947	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	[illegible]
77	DIESEL GENERATOR BRIDGE CRANE	H501	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	[illegible]
78	440V POWER RECEPTACLE	W508	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	[illegible]
79	SPRAY POND PUMP HOIST	H511	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	[illegible]
79	SPRAY POND PUMP HOIST	H513																							
80	TURB BLDG EQUIP COMPT EXHAUST FAN	V106	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
81	DRYWELL CHILLER COMPRESSOR	K111	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
82	ROD DRIVE CONROL CABINET XFMR	X516	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
83	SLCS PUMP	P208	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
84	RWCU SYSTEM RECIRC PUMP	P221	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
85	440V POWER RECEPTACLES	W201	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
85	440V POWER RECEPTACLES	W202																							
85	440V POWER RECEPTACLES	W205																							
86	440V POWER RECEPTACLES	W601	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
87	440V POWER RECEPTACLES	W206	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
88	MCC ANNUNCIATORS		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
89	TURB GEN TURNING GEAR PIGGYBCK MTR	S195	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	2	0	0
90	RHRSW CORROSION MONITORING	Y215	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	4kv BUS SUBTOTAL (kw)		2361	2130	2080	1830	1865	1741	2004	1996	2781	1935	1463	337	2574	2411	757	685	2781	1935	1463	337	2574	2411	767

LEGEND

(6) THE SPRAY POND PUMP STATION HEATING COILS ARE TRIPPED BY A LOCA SIGNAL

(7) ASSIGNMENT OF THE LOADING ON THE DIESEL GENERATORS IS SUCH THAT THE SITUATION OF A DBA ON ONE UNIT AND SPURIOUS LOCA ON THE OTHER UNIT DOES NOT PRECLUDE SAFE SHUTDOWN OF THE UNITS. A SPURIOUS LOCA IS DEFINED AS A LOCA FOR 0-10 MINUTES AND EMERGENCY SHUTDOWN FOR BEYOND 10 MINUTES.

(11) HEATING LOADS AND COOLING LOADS ARE NOT COINCIDENT. THE COINCIDENT COOLING LOAD IS LARGER THAN THE COINCIDENT HEATING LOAD, THEREFORE, THE COOLING LOADS ARE SHOWN ENERGIZED.

8.3.1.1.2 Class 1E AC Power System

The Class 1E ac power system is the portion of the onsite power system that is shown after the 4 kV nonsegregated bus in Drawings E-15 and E-16 at the incoming 4 kV breaker.

The Class 1E ac system distributes power at 4 kV, 440 V, and 208/120 V. The loads that are fed by this Class 1E ac system are divided into four divisions in each unit and are shown in Drawings E-15 and E-16. Each load division has its own distribution system and power supplies.

The 4 kV bus of each Class 1E load division is provided with connections to two offsite power sources, designated as preferred and alternate power supplies. In addition, provisions exist for connection to a third offsite power source through a spare transformer if there is a failure of one of the two offsite sources or either of the safeguard transformers. Diesel generators are provided as a standby power supply if there is a total loss of the preferred and alternate power supplies. Standby power supply is discussed in Section 8.3.1.1.3.

The Class 1E ac power system and its components, and the diesels and their auxiliaries, are located in seismic Category I structures that provide protection from the effects of tornadoes, tornado missiles, turbine missiles, and external floods. The Class 1E AC Power System and its components are designated Class 1E safety related, and the diesels and their required auxiliaries are designated safety related for procurement and quality assurance purposes and have been qualified for seismic and hydrodynamic loads as well as environmental conditions that they may experience during normal operation and postulated accidents.

None of the electrical equipment that is required to mitigate the effects of a design basis event will become submerged as a result of a LOCA. The only electrical equipment that may experience temporary submergence is penetration assembly JX230A, which becomes submerged during the pool-swell experienced during an SRV discharge. To ensure that suppression pool temperature indication which is monitored by this penetration is maintained during the pool-swell, the entire penetration is encased by an enclosure to a point above the maximum pool level, thereby assuring that the electrical portion of the penetration will not be affected by the pool-swell.

The following material describes the various features of the Class 1E ac power system.

D11

Date	W/O	Reason unsat.	Failure Mode	Resolution
2/20/1994	R0539829	D/G breaker did not close due to single use T.C. incorrect.	Coordination	Partial test completed later.
2/16/096	R0566534	1. Could not verify ESW pump start due to pump shutdown for MAT. 2. Time for EDGs to re-energize bus failed due to coordination. 3. 480V breaker could not be closed in to verify it shunt trips.	1. Coordination issue 2. Coordination issue 3. Shunt trip not able to be verified	1.TRE2 2. TRE1 3. Partial completed later
5/8/1998	R0757544	Breaker failed to shunt trip/faulty trip coil.	Shunt trip failure	Faulty coil/partial completed later
4/4/2000	R0922760	MCC D114-D-G breakers reclosed prior to shunt trips being verified.	Coordination	Partial test completed later.
3/13/2002	R0894957	Generator output breaker cell switch 152s-11507/a, didn't make up completely preventing the ESW pump start logic from actuationg via the generator breaker closure. The ESW pump brekaer closed via the EDG LSR logic. This prevented the ESW pump breaker closure from meeting the T.S. time limit. This occurred due to the cell switch linkage having been assembled improperly during maintenance. This would not have been identified during a routine surveillance test.	Maintenance induced (EDG output breaker)	Breaker replaced / partial performed later

D12

Date	W/O	Reason unsat.	Failure Mode	Resolution
2/26/1996	R0568320	Clearance prevented breaker from being tested.	Coordination	Partial completed later

D13

Date	W/O	Reason unsat.	Failure Mode	Resolution
2/8/1996	R0563678	Contacts on 105X-117 unable to be verified open per procedure due to HS-13-103A in PTL	Coordination	TRE

D14

Date	W/O	Reason unsat.	Failure Mode	Resolution
2/5/1994	R0272482	Test aborted due to auto raise adjustment on voltage regulator not functional. Related to PM work performed on voltage regulator previous day.	Maint. Induced (voltage regulator PM)	Partial completed later
2/23/1996	R0563847	D114-R-H-01 did not shunt trip.	Shunt trip failed	Fixed & Partial completed later
4/8/1998	R0661885	Fuel oil below T.S. level	Coordination	Filled tank, Partial completed later
9/25/2002	R0909040	Test aborted due to DIV 4 ground. Resulted from insulation on D.C. wires in mechanical governor having been worn away by governor linkage. This resulted in exposed wires coming into contact with governor linkage. This condition could have occurred during any surveillance test. None of the surveillance requirements were violated as a result of this event.	Governor shutdown solenoid wiring exposed causing ground	Governor shutdown solenoid and associated wiring replaced / test restarted

D21

Date	W/O	Reason unsat.	Failure Mode	Resolution
2/6/1995	R0501293	Test could not be copmleted due to system clearance. Marked unsat for schedule purposes.	Coordination	Partial completed later.
4/21/1999		RHR pump reject frequency exceeded T.S. value of 61.2 Hz (61.33)	D/G frequency during RHR pump load reject	Tuning, test reperformed.

D22

Date	W/O	Reason unsat.	Failure Mode	Resolution
2/12/1997	R0618474	1. Frequency exceeded T.S. value of 61.2 Hz (61.28 Hz) during RHR pump reject. 2. Breakers partialed out, therefore shunt trip could not be performed.	1. D/G frequency during RHR pump load reject 2. Coordination	1. Tuning/partial completed later 2. Partial copmleted later
5/11/1999	R0720509	The D224-24 MCC feeder breaker tripped open preventing shunt trips from being verified.	480V feeder breaker tripped open	Partial completed later
3/11/2003	R0923869	The spare contacts used to verify the EDG output breaker closure time did not make-up when the breaker closed. This was able to be verified using the recorder at the local engine panel.	coordination / spare contacts did not make-up	Alternate indication used

D23

Date	W/O	Reason unsat.	Failure Mode	Resolution
4/11/2001	R0798047	1. Volt meter in A.C. for resistance reading (verify needle deflects for relay actuation). 2. Recorder shut off prior to obtaining required 5 minute time period.	1. Coordination 2. Coordination	1. Partial completed later 2. Partial completed later

D24

Date	W/O	Reason unsat.	Failure Mode	Resolution
4/6/2001	R0837012	2DV512 exhaust fan did not auto start. Placed in run. Breaker deenergized preventing fan from auto starting.	Coordination	Partial completed later