IEN Engineering

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Fairbanks Morse Owners' Group Comments
on
Draft Revision 4 of Reg Guide 1.9, DG-1172

The Fairbanks Morse Owners' Group consists of domestic United States nuclear power plant licensees who employ emergency diesel generators driven by Opposed Piston, Pielstick and SCAM-Wartsila engines as the onsite emergency AC power supply as well as the United States Coast. There are 15 nuclear licensees representing 21 nuclear power plants with 29 operating nuclear reactors and 68 installed emergency diesel generators represented in the Fairbanks Morse Owners' Group. The following licensees are members of the Fairbanks Morse Owners' Group (with plant sites in parenthesis):

Ameren Union Electric (Callaway)
AmerGen (Three Mile Island)
Constellation Nuclear (Calvert Cliffs)
Detroit Edison (Fermi)
Dominion (Millstone and North Anna)
Entergy (Arkansas Nuclear One and Vermont Yankee)
Exelon (Limerick and Peach Bottom)
First Energy Nuclear Operating Corporation (Beaver Valley)
Florida Power & Light (Duane Arnold and Seabrook)
Nuclear Management Company (Prairie Island)
Progress Energy (Crystal River and H. B. Robinson)
Public Service Electric & Gas (Hope Creek)
Southern Company (Farley and Hatch)
South Carolina Electric & Gas (V. C. Summer)
Wolf Creek Nuclear Operating Corporation (Wolf Creek)

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IEN Engineering is the technical consultant to and administrator of the Fairbanks Morse Owners' Group. On behalf of the Fairbanks Morse Owners' Group, IEN Engineering submits the attached comments to Draft Revision 4 of Regulatory Guide 1.9, DG-1172.

If you have any questions regarding the above or need additional information, please contact the undersigned (digitally).

Respectfully submitted
Harold E. Epstein
IEN Engineering
133 Sylvan Street
Danvers, MA 01923
(978) 777-9494 [Phone Number]
(978) 777-9457 [Fax Number]
ieneng@aol.com [E-Mail Address]

E-RIDS = ADM-03
Add = S. Aggarwal (SKA
S. O'Connor (SCO)
J. Budzely (JNR)
J. T. Yerokun (JTY)

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1. **Comments Submitted by Paul Roelant of Fermi Unit 2**
   a) Page 2 Part B 1st paragraph: how does a utility determine the period associated with "if an extended loss of offsite power occurs"? What defines this period? A clarification needs to be provided in DG-1172.

   b) Page 3, 2nd paragraph: how will we know if we meet "in about 1 second"? A clarification needs to be provided in DG-1172.

   c) Page 5 section 1.4: "will not decrease to less than 75 percent of nominal". This does not align with the "20-30 percent" stated on page 3 second paragraph. If we are allowed 20-30 percent, then the minimum should be 70 percent, not 75 percent.

   d) Bottom page 5, section 1.4: "speed of the diesel generator should not exceed the nominal speed plus 75 percent of the difference between nominal speed and the overspeed trip set point, or 115 percent of nominal (whichever is lower)." What value for overspeed trip set point do we use for this calculation? We have a specified band of 1035 - 1053 RPM? What if we test the overspeed trip and find it trips at 1020 RPM, do we have to change the maximum allowable EDG speed on largest single load reject based on an as-found trip set point? What if we decide to continue with the 1020 rpm set point for several months until the next planned outage?

   e) Page 6 step 1.9 part 2: Recommend specifying what reaction the operator is expected to take when the abnormal condition (associated with the bypassed trip) occurs. Is the action to trip the engine to protect it? A typical example is that low jacket coolant level is bypassed. If a flex hose or flex pipe coupling blew out, would an operator have time to address this before engine damage occurred? The design function of the EDGs is to operate (not shutdown). We are designed to have single failures. Therefore, recommend that item 2 be deleted.

   f) Page 7 section 2.1: Definitions of demands and failures is not very thorough. I recommend stating that failures identified during post maintenance testing (provided that the failure was caused during the maintenance period) should not count as a demand or a failure. Failures identified during PMT, but not attributed to the maintenance performed should be counted as a demand and a failure. Is this guidance consistent with the Maintenance Rule guidance for demands and failures?

   g) Page 9 last paragraph of section 2.1: Past inoperability should apply to this also. If during a maintenance outage (EDG already inoperable) we find something that

would have caused the EDG to not perform its required design function (past inoperability), this also should be counted as a demand and failure.

h) Page 10 table 1: change "System operation tests: shutdown/refueling" to "System operation tests: once per operating cycle". If the plant design and operation conditions force these tests into a refueling outage, then that is when they will be performed. If they can be done with the plant on-line, this must be allowed.

i) Page 10 table 1: Have all monthly and 6 month tests gone away? Why are these columns blank?

j) Page 11 step 2.2.7: "while operating at largest load power factor" is unclear. What if you are not shedding the largest load, but rather doing a full load reject? How close do you need to be to the power factor of this load?

k) Page 12 step 2.2.9: Load tables are naturally very conservative, loading to above them is unnecessary and may be harmful to the EDG. If we have a < 10 minute load value and a > 10 minute load value, which would we use as the load value for the first 2 hours? I assume that meter tolerances do not need to be factored into these values.

l) Page 12 step 2.2.11: Recommend deleting last sentence. EDG safety function is to run, not trip. We should not be mandated to test that essential trips work.

2. Comments Submitted by Steve Loeper of Calvert Cliffs Units 1&2

a) Clause 1.9 of DG-1172 requires that it be ensured accident loading remains below continuous rating plus 10 to 15% margin during design stage. This clause seems to ignore the 2000 hour rating concept of diesel generators. A clarification should be added to this clause concerning a diesel generator's 2000 hour rating.

b) Clause 1.4 of DG-1172 contains a response requirement for disconnection of the single largest load of recovery of the frequency to within 2 percent of nominal within less than 80% of sequencer interval. What is the basis of this requirement?

c) Clause 1.8 of DG-1172 identifies additional engine status indication requirements in terms of a surveillance system in the Control Room. The form of acceptability of this remote indication should be clarified in this clause. For example, a combination of indicator lights, computer screen indication, annunciation, etc.

d) Clause 1.9 of DG-1172 identifies two or more measurements for each protective trip. Protective relay logic, protective relaying other than generator differential, at existing nuclear power station may not have two or more measurements. Protective relay trips should be identified as an exception in this clause.

3. Comments Submitted by William McFarland of Exelon

Clause 2.2.3 of DG-1172 states *This test involves demonstrating 90-100 percent of the continuous rating or worst case design-basis event loads (whichever is higher) of the emergency diesel generator for an interval of not less than 1 hour and until attainment of temperature equilibrium. This test may be accomplished by synchronizing the generator with offsite power. The loading and unloading of an emergency diesel generator during this test should be gradual and based on a prescribed schedule that is selected to minimize stress and wear on the diesel generator.* The words *or worst case design-basis event loads (whichever is higher)* should be removed from this clause.

The NRC recommended that the emergency diesel generator be loaded in accordance with vendor's recommendations "...for all test purposes other than the refueling outage LOOP tests." in NUREG 1366, "Improvements to Technical Specification Requirements" published in December, 1992. Fairbanks Morse Engine's recommendations for the monthly test were provided in their 1985-1986 letters which recommend that the emergency diesel generator be loaded to between 60% and 100% of their continuous ratings. Further, the Commission approved Technical Specification changes on the North Anna docket in 1985 [Docket No. 50-339, Amendment 48] in response to GL 84-15 to address routine emergency diesel generator overloading by stating in their Safety Evaluation report (pg 16): "*We* [USNRC] *believe that the monthly test should exercise the EDG, confirm its operability, and detect degradation before a second failure* [sic] *is likely to occur. During the 18-month testing, the test loads envelope the calculated accident loads. It is our* [USNRC] *position that it is not necessary to envelope the design basis accident loads, which might occur once in 10,000 years, by a test that is repeated 12 times each year....*" [Emphasis added].

The industry and the Commission's collective efforts over the last 20 years has resulted in dramatic improvements in EDG performance and reliability. One of the key components of this effort has been the reduction in overly harsh testing regimens that were prevalent in the 1970's and 1980's, while still maintaining an appropriate balance to nuclear safety. The Commission should not foster regression of these gains through the re-imposition of unnecessary testing requirements.

4. Comments Submitted by Harold E. Epstein of IEN Engineering

a) Comment on Clause 1.4 of DG-1172

Clause 1.4 of DG-1172 states in part "*During recovery from transients caused by a disconnection of the largest single load, the speed of the diesel generator should not exceed the nominal speed plus 75 percent of the difference between nominal speed and the overspeed trip set point, or 115 percent of nominal (whichever is lower).*

Comment

Initially Fairbanks Morse Engine, the vendor of the Opposed Piston and Pielstick engines within the Fairbanks Morse Owners' Group, recommended the overspeed trip setpoint of these engines be set in the range of 112% to 115% of nominal speed. Fairbanks Morse later revised their position concerning the overspeed setpoint to 115% to 117% of the engine's nominal speed. The nominal speed of Opposed Piston engines is 900 rpm and the nominal speed of Pielstick engines is 514 rpm. *75 percent of the difference between nominal speed and the overspeed trip set point* will always be lower than *115 percent of nominal.*

b) Comment on Table 1 of DG-1172

Table 1 of DG-1172 identifies a number of *system operation tests: shutdown/refueling*. It should be clarified that not all these tests are required to be performed with the unit in shutdown/refueling mode. There are a number of these tests which can be performed with the unit at 100% power without presenting a challenge to the operating unit. For example; (i) largest load rejection, (ii) design load rejection, (iii) endurance and load margin, and (iv) hot restart. Flexibility should be provided to the licensee to perform these test with the unit at 100% power. It is recommended a clarification be provided to allow licensees to perform tests on a refuel cycle periodicity versus with the unit in shutdown or refuel mode.

c) Comment on Clause 1.9 of DG-1172

Trips associated with electrical protective relaying should be excluded from this clause. Protective relay trips may be implemented with a single measurement and may not provide the operator with sufficient time to react to an abnormal condition. For example, a generator ground.

d) Comment on Definitions of DG-1172

The definition of "*load run demands*" should be deleted from DG-1172 and replaced with a reference to the proper regulatory document which contains these requirements.

e) Comment on Clause 2.2.3 of DG-1172

In the section associated with test descriptions, clause 2.2.3, "Load Run (Load Acceptance) Test", identifies the following:

This test involves demonstrating 90-100 percent of the continuous rating or worst case design-basis event loads (whichever is higher) of the emergency diesel generator for an interval of not less than 1 hour and until attainment of temperature equilibrium. This test may be accomplished by synchronizing the generator with offsite power. The loading and unloading of an emergency diesel generator during this test should be gradual and based on a prescribed schedule that is selected to minimize stress and wear on the diesel generator.

Comment

The load run is currently performed on approximately a monthly basis on existing emergency diesel generators at existing domestic nuclear power stations. Generally the emergency diesel generators are loaded to a kW value equal to or less than the continuous rating of the machine. This is done to minimize stress and wear on the emergency diesel generator. However, draft revision 4 of Regulatory Guide 1.9 would require the emergency diesel generator to load the machine to *90-100 percent of the continuous rating or worst case design-basis event loads (whichever is higher).* In some existing domestic nuclear power stations the worse case design-basis event loads may be higher than the continuous ratings of the emergency diesel generators. To account for this possibility, manufacturers have provided standby diesel generators with short term ratings such as recommended in Safety Guide 9, issued in 1971. For example, ratings such as continuous, 2000 hour, 7 day and 30 minute can be found on a number of emergency diesel generators. Others may have different short term ratings. With engines built by Fairbanks Morse Engine there is a general rule of thumb concerning operation of emergency diesel generators within these ratings and de-energizing these machines for overhaul and inspection when operating at the short term ratings between normally scheduled overhauls. This rule of thumb can be characterizing as follows:

When the following equation is equal to or greater than 1.0, the diesel generator should be shutdown to undergo a major inspection and overhaul:

$$\frac{N_1}{R_1} + \frac{N_2}{R_2} + \frac{N_3}{R_3} + \frac{N_4}{R_4} =$$

Where N equals the number of hours of operation of the emergency diesel generator at R rating. For an emergency diesel generator with the following ratings, the equation would be as noted below:

2600 kW continuous (8760 hours)
3000 kW 2000 hours
3100 kW 168 hours
3250 kW 30 minutes

$$\frac{N_1}{8760} + \frac{N_2}{2000} + \frac{N_3}{168} + \frac{N_4}{0.5} =$$

As can be seen by the above equation, if the worst case design basis event loads on an emergency diesel generator were above the machines 7 day rating and below the machine's 30 day rating, the licensee would load the emergency diesel generator to within its 30 minute rating each month and be required to perform a major inspection and overhaul each month if following the guidance as currently depicted in clause 2.2.3 of DG-1172.

It is not prudent to operate the emergency diesel generators above their continuous ratings during the monthly load run test. The machine may experience unnecessary and excessive wear and stress if operated above its continuous ratings will on a monthly basis. The purpose of the monthly load test is to verify operability of the emergency diesel generator to start and load, not to demonstrate its ability to meet worst case design basis event loads each month. This is the purpose of the LOOP and SIAS tests performed during unit outages. The Staff has previously demonstrated an understanding of the affects of excessive wear and stress on emergency diesel generators. Previous industry operating experience has demonstrated advanced wear on emergency diesel generators when performing monthly fast starts and loads. To avoid excessive wear on these machines, the NRC gave relief to the industry to perform fast start tests every six months versus monthly.

It is recommended the requirement for load run testing of emergency diesel generators at the worst case design basis event load be removed from this clause of DG-1172 and clause 2.2.3 be revised to read as follows:

This test involves demonstrating 90-100 percent of the continuous rating ~~or worst case design basis event loads (whichever is higher)~~ of the emergency diesel generator for an interval of not less than 1 hour and until attainment of temperature equilibrium. This test may be accomplished by synchronizing the

generator with offsite power. The loading and unloading of an emergency diesel generator during this test should be gradual and based on a prescribed schedule that is selected to minimize stress and wear on the diesel generator.

f) Comment on Clause 2.2.9 of DG-1172

In the section associated with test descriptions, clause 2.2.9, "Endurance and Load Margin Test", identifies the following:

This test involves demonstrating the full load-carrying capability at a worst case design load power factor for an interval of not less than 24 hours. Of this period, 2 hours are at a load equal to 105-110 percent of the continuous rating or design-basis load with a margin of 5-10 percent (whichever is higher) of the emergency diesel generator, and 22 hours are at a load equal to 90-100 percent of the generator's continuous rating. The test process should verify that frequency and voltage requirements are maintained.

Comment

The endurance test is generally performed on a refuel cycle periodicity at domestic nuclear power stations that perform this test. It is not necessary to perform this test on a unit outage and there is no reason why the endurance test cannot be performed when the unit is at 100% power. This clause of DG-1172 requires the test to be performed for a period of *2 hours are at a load equal to 105-110 percent of the continuous rating or design-basis load with a margin of 5-10 percent (whichever is higher) of the emergency diesel generator, and 22 hours are at a load equal to 90-100 percent of the generator's continuous rating.* Existing domestic nuclear power stations have mature emergency diesel generator load profiles with little expected load growth on these machines. It is not necessary nor is it prudent to load the emergency diesel generator for 2 hours at the design basis load with an additional margin of 5-10 percent if this equivalent load level is greater than 105-110 percent of the machine's continuous rating. This will only burden the machine with unnecessary additional wear and stress. Rather, to ensure the emergency diesel generator will not experience unnecessary wear and stress during the endurance run, the load level of machines at existing domestic nuclear power stations with mature load profiles should be equal to "105-110 percent of the continuous rating or the worst case steady state design-basis load, whichever is lower" 2 hours and at their continuous rating for 22 hours.

Further, it is not necessary for the emergency diesel generator to run at the worst case load power factor for a period of 24 hours. The power factor of the generator load should be allowed to vary between 80-90 percent during the period of the test

with the generator load power factor approaching expected design-basis load power factor where feasible.

It is recommended the requirement for endurance testing of emergency diesel generators, clause the DG-1172 and clause 2.2.9, be revised to read as follows:

This test involves demonstrating the full load-carrying capability at a ~~worst case design load~~ power factor **between 80-90 percent during the period of the test** *for an interval of not less than 24 hours. Of this period, 2 hours are at a load equal to 105-110 percent of the continuous rating or* ***worst case steady state*** *design-basis load ~~with a margin of 5-10 percent~~ (whichever is ~~higher~~* **lower***) of the emergency diesel generator, and 22 hours are at a load equal to 90-100 percent of the generator's continuous rating. The test process should verify that frequency and voltage requirements are maintained.*