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Ms. Annette L. Vietti-Cook
Secretary of the Commission
U. S. Nuclear Regulatory Commission
Washington, DC 20555-0001

Re: Comments on Draft NRC Regulatory Guide DG-1081, "Alternative Radiological Source Terms for Evaluating Design Basis Accidents at Nuclear Power Reactors," 64 Federal Register 71,990 (December 23, 1999)

Dear Ms. Vietti-Cook:

The Nuclear Utility Group on Equipment Qualification ("NUGEQ")[1] hereby submits the attached comment on the Nuclear Regulatory Commission's ("NRC") draft Regulatory Guide DG-1081, "Alternative Radiological Source Terms for Evaluating Design Basis Accidents at Nuclear Power Reactors." In the notice of final rulemaking for 10 C.F.R. § 50.67, "Accident Source Term," the NRC requested comments on the guidance document.[2] In addition to the specific comment attached, the NUGEQ has reviewed the comments developed by the Nuclear Energy Institute ("NEI"), and agrees with the comments, observations, and recommendations presented by NEI.

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1 The NUGEQ is comprised of 35 electric utilities in the United States and Canada, including NRC licensees authorized to operate over 100 nuclear power reactors. The NUGEQ was formed in 1981 to address and monitor topics and issues related to equipment qualification, particularly with respect to the environmental qualification of electrical equipment pursuant to 10 C.F.R. § 50.49.

2 64 Fed. Reg. 71,990 (December 23, 1999).

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SECY-02

We appreciate the opportunity to comment.

Respectfully submitted,

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cc: Mr. Richard J. Barrett, U.S. Nuclear Regulatory Commission
Mr. Mark F. Reinhart, U.S. Nuclear Regulatory Commission
Mr. Steve F. LaVie, U.S. Nuclear Regulatory Commission

Nuclear Utility Group on Equipment Qualification
Comment on Draft Regulatory Guide DG-1081, "Alternative Radiological Source Terms for Evaluating Design Basis Accidents at Nuclear Power Reactors"

I. NUGEQ Comment

The Nuclear Utility Group on Equipment Qualification strongly endorses the concept of establishing accident durations for equipment qualification (10 CFR § 50.49) purposes that are consistent with the accident durations utilized in accident radiological consequences analysis (*i.e.*, for site boundary and control room). Consistent with the provisions of 10 CFR Part 100, the equipment qualification ("EQ") accident duration for loss-of-coolant accident ("LOCA") events should be 30 days. This is termed the mitigation phase in the NEI comments. Issuance of DG-1081 is an opportunity for the NRC Staff to provide unifying guidance for the accident duration used for equipment qualification and radiological consequences purposes.

The specific rationale supporting the above comment is discussed in detail below.

II. Discussion of Rationale

A. Rationale for Consistent Regulatory Guidance

There are several compelling reasons for providing consistent regulatory guidance to the industry regarding 10 C.F.R. § 50.49 LOCA duration, including:

1. There is a logical relationship between 10 C.F.R. § 50.49 and 10 C.F.R. Part 100 with respect to accident duration assumptions that supports applying the same (*i.e.*, 30 days) accident duration.

2. Currently, there is no regulatory guidance on accident durations for qualification purposes. A consistent, technically-based LOCA accident duration could replace the wide ranging and somewhat arbitrary LOCA accident durations (30 days to 1 year) currently used by licensees for qualification.

3. Due to programmatic EQ conservatism, establishing qualification for a 30-day Design Basis Accident ("DBA") LOCA duration provides reasonable confidence that the equipment will be available for substantially longer durations for any actual events.

4. Based on risk-informed perspectives, there is little or no risk benefit from establishing long (i.e., > 30 day) LOCA accident durations for qualification purposes.

5. Response actions at Three Mile Island ("TMI") demonstrate that a wide range of recovery strategies, using alternative systems, repaired equipment, or new/modified systems, are available to provide decay heat removal after the 30-day period.

6. The vast majority of existing equipment qualification LOCA tests have a 30 day duration with analysis extending the results to longer durations. Licensee resources involved in such analyses would be better utilized elsewhere.

7. A 30-day LOCA accident duration is conservative with respect to the 14-day LOCA qualification test duration used in other countries, including France, Germany, and the United Kingdom ("UK").

8. The use of a 30-day LOCA accident duration effectively resolves the low risk significant Cesium Generic Safety Issue ("GSI") question.

B. Relationship Between 10 C.F.R. § 50.49 and 10 C.F.R. Part 100

10 CFR § 50.49 provides specific qualification requirements for satisfying the provisions of General Design Criterion ("GDC") 4 as they apply to certain items of electrical equipment, including LOCA mitigating equipment. For equipment subjected to accident environmental conditions, qualification demonstrates that the specified equipment safety functions are achieved in accordance with the plant safety analyses. Inside containment equipment is qualified for applicable design basis LOCA containment environmental conditions derived from Safety Analysis Report Chapter 15 accident assumptions and analyses. Acceptance criteria for these system and equipment safety functions are fundamentally based on the ability of the integrated plant design to maintain radiological consequences within the provisions of 10 CFR Part 100. Because the Part 100 calculations form the basis for establishing public safety and acceptable plant response, the 30 day duration specified by Part 100 is both a reasonable and conservative accident duration for establishing LOCA qualification of equipment. This relationship between Part 100 durations and equipment qualification is reinforced by the safety-related equipment scope of 10 CFR 50.49 which involves equipment with "*the capability to prevent or mitigate the consequences of accidents that could result in potential offsite exposures comparable to the 10 CFR 100 guidelines*".

C. Lack of Regulatory Guidance and Wide Ranging Accident Durations

For EQ purposes, the NRC staff has accepted a wide range of LOCA accident durations, ranging from 30 days to 1 year, for similar plant designs. This range of accident durations exists, in part, because neither the EQ rule (10 CFR § 50.49) nor NRC guidance documents (e.g., Reg. Guide 1.89, Rev. 1) specifically address accident durations. The EQ rule is silent on accident durations. Regulatory Guide 1.89, Rev. 1 states (at p. 1.89-2) that: "*It is essential that safety-related electric equipment be qualified to demonstrate that it can perform its safety function under the environmental service conditions in which it will be*

required to function and for the length of time its function is required"[emphasis added]. . . . However, no additional guidance on accident durations is provided in this or other NRC guidance documents.

The LOCA *accident duration* defined by licensee EQ programs range from 30 days to one year or longer. Once defined this accident duration is used to establish qualification for a number of EQ devices, including those needed for long-term core cooling and post-accident monitoring. To achieve EQ program simplification, other devices with shorter operating time requirements are also qualified to this accident duration. These licensee-defined accident durations were qualitatively established based on various considerations, including prior commitments, IEEE standards, regulatory practice, and in some cases post-LOCA equipment access. Often, plants with virtually identical safety-systems and accident response scenarios have significantly different accident durations (e.g., 30 days and 1 year) in their EQ programs. Typically, the older vintage plants tend to use a 30-day LOCA accident duration with the newer plants committed to longer operating times. To our knowledge, the NRC Staff has accepted all licensee LOCA accident durations that are at least 30 days. The NRC EQ Staff has accepted accident duration differences among quite similar plants and expects each licensee to establish qualification to their "self-imposed" accident duration.

We believe licensees and the NRC have implicitly reconciled these accident duration differences based on several considerations. First, virtually all the critical safety functions are performed during the first few days of the accident. Successful mitigation of both design basis and severe events typically involves maintaining stable, coolable core geometries and containment integrity for a few days. Subsequent actions were appropriately viewed as recovery activities.

Secondly, as discussed further below, establishing equipment qualification for a long-term post-accident recovery period is simply not risk-significant. Accident mitigation occurs within the first few hours or days of the accident. Subsequently, plant conditions change slowly, permitting a range of accident management scenarios. This capability was dramatically demonstrated at TMI.

Thirdly, there is recognition that establishing qualification, using the strict criteria of 10 CFR 50.49 and related guidance documents, for a somewhat arbitrary DBA LOCA accident duration (e.g., 30 days) provides reasonable assurance that the equipment will be available for substantially longer periods under actual post-accident conditions. The overall conservatism in EQ programs, which includes test environments more severe than anticipated actual plant conditions, provides reasonable assurance that equipment will, in fact, remain operable even after the 30-day period. Simply stated, any equipment design capable of being qualified to the DBA LOCA radiation, steam, temperature and pressure inside containment conditions for a 30 day duration is sufficiently robust in design to continue operating during subsequent accident recovery phases.

D. Risk-Informed Perspectives

Critical to establishing the proper framework for considering the question of a LOCA accident duration for EQ purposes is a recognition that EQ issues related to long-term equipment performance are simply not risk significant. Probabilistic risk assessments ("PRAs") typically only model the first few day or less of an accident sequence based principally on PRA analysts views that both core damage frequency ("CDF") and risk are dominated by the first few days following accident initiation. After this initial period, as decay heat productions rates decline, operators have a significantly longer time to respond to equipment failures and can implement other core cooling strategies. Because of these accident management options and modeling complexities, most PRAs conclude that the risk of further radiation release during subsequent periods is insignificant. Consequently, CDF contributions from equipment failures several days after accident initiation are generally neglected. Based on this risk perspective, qualification only needs to be demonstrated for several days or possibly weeks. From this point of view, even a 30 day LOCA accident duration is quite conservative. Demonstrating qualification for even longer times is clearly not relevant to overall accident risk.

This question of EQ accident duration was specifically addressed in NUREG/CR-5313, "Equipment Qualification (EQ) - Risk Scoping Study," (January 1989), which provides important risk-based insight into EQ requirements and practices. The risk-based conclusions in this Sandia report are significant since many of these "*historical EQ issues*" were technical questions initially raised by Sandia. A portion of the report's *Technical Summary* is titled, *Risk Significant Accident Time Durations* (at p.2). Here, the document recognizes the difference between PRAs which *"only model plant accident response for the first 24 to 48 hours"* and EQ programs which deterministically *"qualify some equipment for very long post-accident time periods (up to one year)"*. In question was an analytical practice used to establish qualification for accident durations that were longer than equipment qualification test durations. The EQ Risk Scoping Study concluded that; *"From a PRA perspective and given NRC inspection philosophy, this EQ issue of whether correct accident acceleration techniques have been used is not risk significant."* It reached similar conclusions regarding a lack of risk significance for several other technical questions related to long term operability.

The EQ Risk Scoping Study Preface, signed by NRC Moni Day and Thomas King, states in part:

> *"The study concluded that several historical EQ issues lack risk significance as a result of conservatisms embedded in NRC's EQ regulations that provide defense in depth considerations of equipment performance. . . . Therefore, this report is being published for information and for use by the industry and*

the NRC, as appropriate, in assessing EQ issues associated with individual plants."

E. A Wide Range of Accident Recovery Strategies are Available

As discussed in the NEI industry comments on the AST, response actions at TMI demonstrate that a wide range of recovery strategies, using alternative systems, repaired equipment, or new/modified systems, are available to provide decay heat removal during or subsequent to the 30 day period. This flexibility forms the basis for the view that equipment qualification for the recovery period is not a risk significant concern.

As decay heat productions rates decline, operators have significantly longer windows of opportunity to respond to equipment failures by initiating other, possibly innovative, core cooling techniques. As noted in NUREG/CR-5313 if core cooling should fail a week after accident initiation, plant personnel would have a day or more to initiate alternative core cooling techniques. Within one month after accident initiation even longer time frames are available to implement alternative strategies because decay heat rates will have decreased by a factor of 75. For these LOCA events virtually all the "qualified" decay heat removal equipment and associated piping is located outside containment. If the need arose, this equipment would be made accessible for repair, replacement, or implementation of alternative cooling strategies. In addition, it is our opinion that any EQ equipment qualified for a 30-day LOCA duration would continue to be operable after the 30-day period (as discussed above in Section II.C).

F. Thirty-Day Qualification Test Durations and Supplemental Analysis

Equipment manufacturers and licensees have established LOCA steam (temperature, pressure, moisture) qualification for the vast majority of inside containment cables and other electrical devices that is based on 30 day LOCA steam qualification tests. Although not universal, the use of a 30 day qualification test duration has a long standing historical basis that is apparently rooted in TID-14844 radiological consequence analyses. Some examples of widely used 30 day qualification tests include those for Limitorque motorized valve actuators, NAMCO limit switches, Raychem heat shrink splice materials, ASCO solenoid-operated valves, Rosemount electronic transmitters, and numerous cable styles including Brand-Rex, Rockbestos, Anaconda, and Samuel Moore.

When licensee EQ programs specify longer accident durations, licensees typically analyze the available test data (e.g. 30 day test duration) and demonstrate that the shorter duration, more severe, test conditions adequately simulate the longer duration, less severe plant conditions. Simply stated, separate licensees with different accident durations (*e.g.*, whether 30 days or 1 year) are often using the same 30 day duration qualification test reports to establish qualification with supplemental analysis used to justify longer accident durations. We note that although these analyses have been technically justified, both the industry and

the NRC have consumed resources evaluating the acceptability of the most commonly used methods.

Further, licensees with accident durations longer that the qualification test durations continue to expend resources justifying these unnecessarily long durations whenever revised/refined containment analyses are issued. In hindsight, these efforts to establish qualification for longer post-accident recovery periods have provided little, if any, safety benefit. These licensee resources could have been better utilized in more productive ways. Better utilization of resources was discussed in a paper, SAND-88-2171C, presented during an international EQ conference by the EQ Risk Scoping Study authors. In that paper they make the following recommendation at p. 7: *"The U.S. nuclear industry practice of specifying long duration equipment mission times during harsh accident conditions might be reduced when appropriate so that test resources focus on assuring equipment operability for the first few days of an accident exposure."*

G. International Practices

We believe considerations similar to those discussed above (i.e., lack of risk significance, reasonable confidence regarding longer-term equipment performance, and availability of alternative decay heat removal strategies), prompted other countries whose EQ practices are not directly patterned after US practices (e.g., France, Germany, and the UK), to limit their equipment qualification post-accident test durations.

The most severe French qualification category, "K1", applies to inside containment equipment which must function under accident conditions. The K1 qualification standard specifies qualification parameters, including aging and accident conditions. The required LOCA steam simulation test duration is limited to 14 days (4-day accident and 10-day post-accident) for all devices, including long-term core cooling and accident monitoring equipment. In Germany, qualification is based on the appropriate KTA and Seimens KWU standards. For inside containment equipment the LOCA simulation test is typically limited to 24 hours with a 12-day steam or water-immersion post-accident test used to simulate long-term performance. An overview of other European qualification practices is contained in *A Comparison of European Practices for the Qualification of Electrical and I&C Equipment Important to Safety for LWR Nuclear Power Plant;* Commission of the European Communities Qualification Benchmark Group, December 15, 1992. That report indicates that for the Sizewell B UK design, the standardized LOCA test profile is also limited to only 14 days.

H. Cesium GSI Resolution Bases

Defining a 30 day LOCA accident duration for EQ purposes establishes a basis to reconcile differences between TID-14844 and the AST for long-term equipment integrated doses during the post-30-day period. For the reasons cited above, we maintain that these post-30

day differences are not risk significant. In addition, current EQ radiation qualification testing practices contain sufficient conservatism to justify these differences.

Studies performed to determine the adequacy of isotopic gamma radiation sources (e.g., ^{60}Co) to simulate the combined beta-gamma radiation environment accompanying a LOCA concluded that current EQ testing practices overstress cable jacket and insulating materials by a factor of two to five. As part of the Sandia National Labs ("SNL") equipment qualification research program, joint U.S./French efforts investigated the damage from beta and gamma radiation on cable insulating and jacketing materials. Several interim reports were issued with the final results and conclusions presented in *Cobalt-60 Simulation of LOCA Radiation Effects*, NUREG/CR-5231 (1989). The study results concluded that beta- and gamma-induced damage could be related on the basis of average absorbed radiation dose. Based on this analysis, cables with EPR insulation and Hypalon jackets irradiated with conventional ^{60}Co simulators overstress the cable jacket and insulation materials by factors of two and five, respectively. Consequently, it follows that such testing conservatisms, coupled with the reasons discussed above, provide a reasoned basis for concluding that AST predictions of greater Cesium exposure compared to the TID-14844 predictions are not risk-significant.

III. Conclusion

We appreciate the opportunity to comment. We believe that the above comment reflects a reasoned approach to consideration of accident durations times that, if adopted, would establish a consistent regulatory approach and would be consistent with NRC initiatives to incorporate risk-informed perspectives in its regulatory scheme.

NUGEQ
Comment on NRC Draft Regulatory Guide
DG-1081
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