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Rules and Directives Branch
Office of Administration
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Subject: Comments on Draft Regulatory Guide, DG-1111, "Atmospheric Relative Concentrations for Control Room Radiological Habitability Assessments at Nuclear Power Plants" 66FR64893 dated December 14, 2001

Duke Energy offers the attached comments relative to the solicitation for public comments regarding Draft Regulatory Guide, DG-1111, "Atmospheric Relative Concentrations for Control Room Radiological Habitability Assessments at Nuclear Power Plants," as published in the Federal Register on December 14, 2001. Duke Energy also fully endorses the industry comments being provided by NEI regarding DG-1111.

Please address any questions to Lee Hentz at 704-382-8081.

Thank you for the opportunity to provide these comments.

Very truly yours,

K. S. Canady

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Template = ADM-013

E-RIDS = ADM-03
Add. = A. Beranek (AFB)
S. LaVie (SFL)

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	Page	Section, Paragraph	Comments	Recommend Revisions
1	2	A, 4th	Section A states that "this guide should be used in determining new or revised χ/Q values to be used in evaluations performed to demonstrate compliance with GDC-19 or 10CFR50.67...." This statement is more restrictive than that of Regulatory Position C.1 (page 4), which states that "licensees may also continue to use the licensing basis methodology for determining χ/Q values for newly identified source-receptor combinations or re-generating the approved χ/Q values using more recently collected meteorological data sets."	Revise Section A to be consistent with Regulatory Position C.1 and its allowance for continued use of the licensing basis methodology. One approach is as follows: 1) Delete the word "Although" to leave "Holders of operating…" 2) In the next phrase delete "the methodology described in", change the word "should" to "may", and begin the new sentence: "This guide may be used in determining …." 3) Add the following sentence to the end of this paragraph: "Licensees may also continue to use the licensing basis methodology for determining χ/Q values for newly identified source-receptor combinations or re-generating the approved χ/Q values using more recently collected meteorological data sets."
2	3	B,5th	The ARCON96 code is a general analytical tool, and the effectiveness of the code for a given application should be evaluated on a case basis. There are areas where the Staff concludes that the modeling or benchmarking is insufficient for licensing application. This more specific phrasing is recommended, rather than "not adequately addressed by ARCON96."	Replace the phrase "not adequately addressed by ARCON96." with "where the modeling in ARCON96 or the application of ARCON96 is considered insufficient for these licensing evaluations."
3	4	C.1, 2nd	In the phrase "…other models addressed in this guide may be used voluntarily", the word "voluntarily" should be assumed by the chosen language and may be deleted.	Remove the word 'voluntarily'
4	4-5	C.1, 4th	The (current) 2nd sentence states that the averaging periods for which control room χ/Q values "are generally determined" include 0-8 hours (or 0-2 hours and 2-8 hours), 8-24 hours, 24-96 hours, and 96-720 hours. Other averaging periods should be acceptable, if justified by the licensee.	Add the following after the (current) 2nd sentence of this paragraph: "Other similar time-averaging approaches may be justified by the licensee."
5	4-5	C.1, 4th	The discussion of applying the "limiting" χ/Q values to the limiting time window for release to the environment should be clarified. In addition to the recommended revisions, consider additional examples, especially to describe the treatment for the "sliding window" in either the 0-8 hour period, or in subsequent periods.	Move the 1st sentence of the 4th paragraph to precede the sentence that begins, "If the 0-2 hour …" to start a 5th paragraph concluding section C.1. To connect the example information to the proper place without breaking the track of the presentation, move the last 2 sentences to a note, at the end of "limiting portion of the release to the environment". For clarity, replace "start

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				at the start of the event" with "coincide with the start of the event". Start the next sentence with "If the limiting portion of the release occurs in the first 8 hour period, for example, the 2-8 hour χ/Q value…" Add a 3rd sentence to the note, such as: "However, the start of this period should be determined as a part of the analyses for each facility."
6	5 28	C.2.1, 1st Ref. 12	The reference for Regulatory Guide 1.23 as cited from 1972 should be called Safety Guide 23, which preceded Regulatory Guide 1.23. In reality, several nuclear plant licensees made commitments to various proposed versions of RG 1.23 (1980, 1986), which were never made final Regulatory Guides, or ANSI-ANS 2.5 (1984, expired), or ANS-ANSI 3.11 (2000). NUREG-0737 and RG 1.97 were also issued to address TMI issues, some of which relate to meteorological data collection. In general, there is no single document that contains the specific requirements of a meteorological monitoring system.	The reference to the guidance in Regulatory Guide 1.23 should be changed to Safety Guide 23. In addition, the discussion and references should be generalized to incorporate legitimate quality programs that have been built on a variety of regulatory guidance documents. Additional references to industry standards would be useful.
7	7	Table 1	"Hour of day of observation Military time, 0-23, with midnight=0 as an integer" is specified. However, <u>Military time</u> = Zulu = GMT. <u>Local time</u>, 0-23 hours is the more common reference approach.	Clarify the language to specify the timescale of choice.
8	6	C.2.2, 1st	The first two sentences state "A 95th percentile χ/Q value should be determined for each identified source-receptor combination. However, it may be possible to identify bounding combinations [of release and receptor locations] in order to reduce the calculational effort." These statements should not prohibit the calculation of a "composite value" of control room χ/Q associated with two or more release pathways from a single volume containing radioactivity. One example is containment bypass leakage, which can be released through several pathways.	A statement should be added to permit the calculation of a composite value of χ/Q for these types of applications, where the licensee has demonstrated an acceptable modeling approach. Specifically, add: "The calculation of a composite value of control room χ/Q associated with two or more release pathways from a single volume containing radioactivity is also permitted, where the licensee has demonstrated an acceptable modeling approach." The formulation presented in attached Note (1) is recommended.
9	6	C.2.2, 2nd	This statement may not be consistent with the provisions for a given accident sequence as prescribed in the UFSAR.	Add a phrase to specify consistency with the UFSAR provisions, "… and considerations of loss of offsite power, consistent with UFSAR accident

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				sequences and descriptions."
10	6	C.2.2.2	An acceptance for elevated releases of at least 2.5 times the height of adjacent solid structures is given here. In Regulatory Guide 1.111, Section C.2.b, there is other guidance for developing an elevated release model. RG 1.111 states "For effluents released from vents or other points at the level of or above adjacent solid structures, but lower than elevated release points, the effluent plume should be considered as an elevated release whenever the vertical exit velocity of the plume is at least five times the horizontal wind speed at the height of release."	It would be useful to clarify the differences in application, as identified in RG 1.111 (effluent releases). Refer to page D-6 of NEI 99-03, Section iii "Stack Release." Provide the basis for selecting the value of 2.5 and the appropriate references for this application.
11	8	C.2.2.2 3rd	Pertains to the discussion about control room intakes being located "close" to the base of a tall stack and subsequent under predictions of the code and flow reversal analysis. How close is "close"?	Additional guidance is recommended on treatment of geometry and on acceptable methods for the performance of flow reversal analysis.
12	9	C.2.2.4.4	It is not clear why these equations for initial diffusion coefficients sigma-y and sigma-z are preferred for diffuse area sources, rather than the formulas provided in the ARCON96 manual (NUREG/CR-6331).	Explain the basis/derivation of the initial diffusion coefficients sigma-y and sigma-z in equations (1) and (2).
13	10	C.2.2.4.6	In the 2nd sentence, replace "if" with "for time spans over which" to provide clear and consistent guidance. As revised, this sentence states "The diffuse area source model may be appropriate for time spans over which the [secondary containment or annulus] ventilation system is not capable of maintaining the requisite negative pressure differential specified in the technical specifications or in the FSAR."	Implement the recommended wording changes. If the annulus ventilation system can achieve the requisite negative pressure differential within one minute of the initiating event (drawdown time), then the diffuse area source model need not be used at all. This is consistent with the Staff expectation in Standard Review Plan (SRP) Section 6.2.3.
14	11	C.2.3.2	The criteria listed here will not be applicable to the licensing basis for every site. In addition, this section gives the impression that it is written to provide guidance to the design of future plants or for configuration additions or system modifications, rather than for the purpose of analyzing layouts. For example, the statement "The outside air intakes should be located with the intent of providing a low contamination intake regardless of wind direction". This type of statement more appropriately belongs in SRP 6.4 if it belongs in any form of regulatory guidance.	Rather than provide general guidance that may not be applicable to all plants, refer to the specific plant licensing basis. Assure that guidance for existing plants versus that for future plants is clear throughout the document. This paragraph should be restricted to examples or descriptions of the various configurations of intakes and the restraints imposed on each type for the purpose of analyses.
15	11	C.2.3.2	This section does not provide guidance for maintenance activities that may render one outside air intake initially unavailable for the design basis event, when that activity is not governed by TS	For many sites this issue will be addressed via TS Allowable Outage Time (AOT) considerations or other appropriate procedural controls. If not,

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			Allowable Outage Time (AOT) considerations or other appropriate procedural controls. Furthermore, for outside air intakes with automatic selection controls, valid failure modes could cause an outside air intake to close inadvertently. In either case, a facility with two outside air intakes might be in the limiting single intake configuration at least in the initial phase of a design basis event. Additional positions pertaining to the assumed availability of both outside air intakes in a dual intake configuration may be warranted. A failure analysis should be performed on the dual intake configuration to verify that no valid failure can cause the inadvertent closure of one intake. If any such failure modes are identified, one intake only should be assumed to be open at the initiation of an event. For calculations of post accident radiation doses to the control room operators in which it is assumed that one intake of a dual intake configuration is closed, it may be desirable to show that the closed intake is opened after a time. In this case, the steps to detect a closed outside air intake and open it should be addressed in procedures and operator training. Opening a closed outside air intake during a design basis event is a safety related operator action and as such should conform to the positions of ANSI/ANS 58.8-1994, R.G. 1.97, and Generic Letter 91-18 pertaining to safety related operator actions.	the following guidance is recommended: One approach would be to specify that credit may be allowed for a dual intake configuration, provided that administrative controls are in place as follows: The time span for which one intake may be closed (for maintenance activity) shall not exceed 24 hours. In this case, it is acceptable to assume that both intakes of a dual intake configuration perform their safety function as designed. This position is consistent with action statements in some plant technical specification pertaining to breach of control room pressure boundaries. Alternatively, the time span for which one intake may be closed (for maintenance activities) shall not exceed 7 days. In this case, in calculation of radiation doses to the control room operators for design basis events, a scenario should be considered for which one intake is closed at least initially but the event includes no failures. This is consistent with the single train action statement for technical specification pertaining to control room ventilation systems.
16	11	C.2.3.2	The discussion regarding the placement of control room dual intakes seems to be providing guidance or emphasis on system design rather than analysis. The examples in Figure 2 focus only on one release point. Other release points (e.g., fuel building in sites A, B, and C) could result in similar impacts. Also, note that, depending on the location details and sizes of the on-site structures, it is likely that there will be some pathway of release that for some wind direction would place both intakes downwind of the source. However, this can be accommodated by determining an applicable χ/Q from a composite of the individually determined χ/Q s for each intake / receptor pair.	(1) For design purposes it would be better to provide clear guidance specifying a preference for intake locations such that one is always "clean" (outside the 90 degree window) when release is from, e.g., the reactor building or unit vent. (2) Guidance on how to weight individual χ/Q s in dose projections should be given when this condition is not met for other source-receptor pairs. The statement here appears to limit or disallow the use of ARCON96 under this condition, although this is inconsistent with other guidance. Please clarify the language or its intent. See the recommendations in the following comment for the formulation of an approach that should be acceptable

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				for cases where two control room intakes are in the same wind direction window.
17	11-12	C.2.3.2.1	The position in this section is overly conservative. Allowing no dilution credit for dual intakes when the second intake is impacted, is unnecessarily conservative, especially in the case where the second impacted intake is at a much greater distance from the source than the first impacted intake. An appropriate control room χ/Q may be calculated to serve as an upper bound to capture the effect of both outside air intakes of the Control Room Ventilation System being in the same wind direction window as described in Note (1).	The formulation presented in attached Note (2) is recommended. This approach derives conservative methods to calculate the appropriate χ/Q for this configuration. The method also demonstrates consistent results in the derivation of limiting cases.
18	12	C.2.3.2.2	Equation 5 in DG-1111 does not converge to taking half of the upper bound control room χ/Q in the limiting case, where the airflows in the two Control Room Ventilation System outside air intakes are balanced. See Note (2).	The formulation presented in attached Note (3) is recommended. This approach derives conservative methods to calculate the appropriate χ/Q for this configuration. The method also demonstrates consistent results in the derivation of limiting cases.
19	12-13	C.2.3.2.3 C.2.3.2.4	The basis for reducing a single intake control room χ/Q by 4 for two intakes with manual selection controls and by 10 for two intakes with automatic selection controls is incomplete. What happens if both intakes are in the same wind direction window or if the airflow in the intakes is not balanced?	Consider documentation or references that will provide additional supporting information for the rationale to limit the credit for manual and automatic selection controls to 4 and 10, respectively.
20	13	C.2.3.3, 1st	The position presented in this section goes beyond current requirements for several existing facilities and systems. In addition, at least one portion appears to require clarification and reinforcement. 1. The last sentence is "The situation can be further compounded if the χ/Q for the unfiltered pathway is more limiting than that for the control room outside air intake." The idea behind this statement is underdeveloped. A position should be included in the regulatory guide to state that control room χ/Q's for unfiltered inleakage are unnecessary if an evaluation demonstrates that all of them are bounded by the control room χ/Q values for the outside air intakes. This position could be coupled with the mathematical identity (6), so that if either the identity (6) is not met or if an evaluation cannot show that control room χ/Q's for the outside air intakes are bounding, then the "95th percentile χ/Q values for each infiltration path needs to be determined." See also, comments	Drop second paragraph and the bulleted list. This information is not appropriate for DG-1111. Rather, this information appears to be more suitable for discussion in DG-1114 or DG-1115.

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			on Equation (6) below. 2. With the possible exceptions of some control room doors, the items on the list of "infiltration pathways" are not true points of entry of unfiltered inleakage into the plant. All of them may be paths of unfiltered inleakage into the control room but not into the plant. Rather, these "infiltration pathways" are likely to be contained within completely enclosed safety-related Seismic Category I structures (e.g., the Auxiliary Building). More likely, points of entry for unfiltered inleakage include the control room doors, doorways to service buildings and turbine buildings, for example. This guidance is better suited for other DGs in this series.	
21	14	C.2.4, 2nd	The specification that "source-to-receptor distance is the shortest horizontal distance between the release point and the intake" is too prescriptive without a basis (or bases). It should be acceptable to use the horizontal distance around the building, when it is longer than the horizontal distance over the building (and/or in cases where the effluent would be unlikely to go over the building).	Specify the criteria for determining if the effluent could go over the building and to the control room intakes.
22	16	C.3.4.1 1st	The mechanics of the analysis discussed in Section C.3.4 is confusing. As an example, one meteorologist is concerned by the following interpretation of and comments on the application process: "The correction to the wind speed is counter-intuitive and makes the χ/Q values more conservative than needed. Wind speed (U) is expected to increase above the 5th percentile wind speed with time. Thus, in reality, the χ/Q s for longer time intervals should decrease based on larger values of U (i.e. χ/Q proportional to 1/U). " Another meteorologist has concluded that the guidance is consistent, but that the correction factor application could be confusing.	Clarify the mechanics of the approach outlined and provide clear examples of the intent and process of these correction factors. The current guidance can be misinterpreted and, therefore, could be misapplied. Is the correction to the wind speed actually intended, or is the intent to apply a correction factor to the short-term χ/Q to determine χ/Q values for longer time periods? Please clarify the intent within the guidance document. It is recommended that a note be included to clarify that Column 1 of Table 2 should be applied to the χ/Q values and not to the wind speed.
23	17	C.3.4.1 Table 2	Wind Speed Correction: Guidance is needed on how to determine corresponding wind speed percentiles for non-standard time intervals (e.g. 0-2 hours, 2-8 hours, 0-4 hours, 4-8 hours, 8-10 hours, and 10-24 hours).	Provide requested guidance and the basis for the wind speed percentiles listed in Table 2.
24	17 18	C.3.4.1	Wind Direction Correction: Guidance is requested to clarify the application of the wind direction	Provide requested clarifications, guidance, and the corresponding bases or references.

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			correction in Table 4 to the calculation of χ/Q values. Add clarifications to indicate that the final χ/Q can be multiplied by the wind direction correction factor to allow for the variability of the wind direction with time. Thus, χ/Q s for longer time periods are less (i.e. only a fraction of the short-term χ/Q value).	
25	18	C.3.5	The presentation of the exponential term in Equation (10) is incorrect. The general form of the correct solution for this application is shown to the right.	The exponential term in Equation 10 is in error (Reference, for example, Section 1 of Appendix B to RG 1.78 Rev. 0). It should read: $\exp\left[-\frac{1}{2}\left(\frac{x^2}{\sigma_x^2+\sigma_I^2}+\frac{z^2}{\sigma_z^2+\sigma_I^2}\right)\right]$
26	19	C.3.5, 3rd	The phrase "solving Equation 10 *reiteratively* for the release activity...during *individual* one-second time steps." is not the most accurate description of the solution process.	Recommended wording is: "solving Equation 10 repeatedly for the release activity...during sequential one-second time steps."
27	20	C.5	In addition to site-specific site environs testing, the application of wind tunnel testing should be included as an option to derive (or to contribute to the derivation of) site-specific χ/Q values. Wind tunnel testing is a widely used and accepted approach in a number of industrial applications. Wind tunnel test results have also been use to benchmark the adequacy of ARCON96.	Change the 4th sentence in the first paragraph to add the bolded phrase: "Licensees may opt to propose alternative methods and parameters that are based in part on data obtained from site-specific experimental field **and/or wind tunnel** measurements."
28	31	Table A-1	Average Sector Width Constant: "Although the default value is 4, a value of 4.3 is preferred."	Clarify why "4.3" is the preferred value for the averaging sector width constant.

Note (1):

This pertains to Section 2.2. The basis for calculating composite control room χ/Q values is derived for transport of radioactivity from multiple release points associated with a region of release points to the Control Room (CR) Ventilation System outside air intakes. The basis for calculating composite control room χ/Q values for transport of radioactivity to two CR Ventilation System outside air intakes is then developed. Transport of radioactivity to two intakes either in the same wind direction window or different windows is developed together with the effect of asymmetric airflow split in the two intakes.

Multiple Release Points from One Region

Consider a set of J release points associated with the one region R. Each release point j is associated with a release time constant $\nu_j(t)$ and a control room atmospheric dispersion factor $(\chi/Q)_j(t)$. These releases all contribute to the specific activity arriving at the CR Ventilation System outside air intake as governed by (1.1)

$$a_{OA}(t) = \sum_j \left(\chi/Q\right)_j (t)\nu_j(t)A(t).$$

By defining (1.2)

$$\left(\chi/Q\right)_J(t) = \sum_j \frac{\nu_j(t)}{\nu_J(t)}\left(\chi/Q\right)_j(t)$$

in which (1.3)

$$\nu_J(t) = \sum_j \nu_j(t),$$

Equation (1.1) may be rewritten as (1.4)

$$a_{OA}(t) = \left(\chi/Q\right)_J(t)\nu_J(t)A(t).$$

Since all releases are associated with the same volume, they are associated with the same inventory (volume, mass). The time constant $\nu_j(t)$ for each release path j is proportional to the flow rate in that release path with the inventory behind each set of release points being the same for all release points. As these flow rates add to the total flow rate from the region, then one can define a fractional flow rate $r_j(t)$ so that $\Sigma\, r_j(t) = 1$ and (1.5)

$$\left(\chi/Q\right)_J(t) = \sum_j r_j(t)\left(\chi/Q\right)_j(t).$$

Note (2):

This pertains to Section 2.3.2.1. The position in this section is unnecessarily conservative. A composite control room χ/Q may be calculated to serve as an upper bound to the effect of both outside air intakes of the Control Room (CR) Ventilation System being in the same wind direction window as follows (2.1):

$$\overline{\left(\chi/Q\right)} = \frac{\max(F_1, F_2)\max\left(\left(\chi/Q\right)_1, \left(\chi/Q\right)_2\right) + \min(F_1, F_2)\min\left(\left(\chi/Q\right)_1, \left(\chi/Q\right)_2\right)}{F_1 + F_2}.$$

In (2.1), all variables are as defined in Section 2.3.2.2 of DG-1111. In addition,

$\max(x,y) = x$ if $x \geq y$ and y if $x < y$.

Also, $\min(x,y) = x$ if $x \leq y$ and y if $x > y$.

Eq (1) is based on the assumption that there is an imbalance in airflow into the two CR Ventilation System outside air intakes, and that this imbalance can shift between the two intakes. If it can be demonstrated that an imbalance in airflow into the CR Ventilation System outside air intakes does not shift between the intakes, then the analyst should be able to use (2.2):

$$\overline{\left(\chi/Q\right)} = \frac{F_1\left(\chi/Q\right)_1 + F_2\left(\chi/Q\right)_2}{F_1 + F_2}.$$

Both (1) and (2) follow from the time-dependent Murphy-Campe equation modified to account for transport of radioactivity to both CR Ventilation System outside air intakes. It is assumed that the control room χ/Q for transport of radioactivity to each outside air intake has been calculated separately pursuant to the positions in this guide. Then (2.1) or as appropriate (2.2) provide an upper bound to the composite control room χ/Q for transport of radioactivity to two CR Ventilation System outside air intakes in the same wind direction window. Finally, if the airflows in the two outside air intakes are balanced, then (2.1) and (2.2) both reduce to (2.3):

$$\overline{\left(\chi/Q\right)} = \frac{1}{2}\left[\left(\chi/Q\right)_1 + \left(\chi/Q\right)_2\right].$$

Note (3):

This pertains to Section 2.3.2.2. The position in this section is not internally consistent. Specifically, Equation 5 in DG-1111 does not converge to taking half of the upper bound room χ/Q in the limiting case in which the airflows in the two CR Ventilation System outside air intakes are balanced. Equation 5 is more appropriate for *both* outside air intakes in the same wind direction and no shift in the imbalance in airflow in the intakes. It is the same as Equation (2.2) of these review remarks.

If only one air intake is in any wind direction window for a given release point and the potential for imbalance in airflow in the intake and shifts in that imbalance are to be taken into account, then (2.1) reduces to (3.1)

$$\overline{\left(\chi/Q\right)} = \frac{\max(F_1, F_2)\max\left(\left(\chi/Q\right)_1, \left(\chi/Q\right)_2\right)}{F_1 + F_2}.$$

If it can be demonstrated that the imbalance in airflow does not shift between the outside air intakes, then (2.2) reduces to (3.2)

$$\overline{\left(\chi/Q\right)} = \frac{\max\left(F_1\left(\chi/Q\right)_1, F_2\left(\chi/Q\right)_2\right)}{F_1 + F_2}.$$

The analyst may use (3.2) for cases of no shift in the imbalance of airflow in the two outside air intakes. Finally, if the airflows in the two outside air intakes are the same, then (3.1) and (3.2) reduce to (3.3)

$$\overline{\left(\chi/Q\right)} = \frac{1}{2}\max\left(\left(\chi/Q\right)_1, \left(\chi/Q\right)_2\right).$$

which is the standard position pertaining to a composite control room χ/Q for transport of radioactivity to two open outside air intakes with balanced airflow and only one intake being in any wind direction window.

Please note that (2.3), representing a composite control room χ/Q for two outside air intakes in the same wind direction window with balanced airflow, also converges to (3.3). In summary, (2.1), (2.2), (2.3), (3.1), (3.2), and (3.3) are internally consistent and ultimately yield the standard position concerning flow to an outside air intake. In addition, (3.1) and (3.2) are based on the assumption behind (3.3) - a Staff position - that the outside air intake outside the wind direction windows is "clean." Equation 5 of DG-1111 is not consistent with that assumption.