NuScale Power

RAIO-0817-55640

August 24, 2017

Docket: PROJ0769

U.S. Nuclear Regulatory Commission
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SUBJECT: NuScale Power, LLC Response to NRC Request for Additional Information No. 8881 (eRAI No. 8881) on the NuScale Topical Report, "Accident Source Term Methodology," TR-0915-17565, Revision 1

REFERENCES:
1. U.S. Nuclear Regulatory Commission, "Request for Additional Information No. 8881 (eRAI No. 8881)," dated July 25, 2017
2. NuScale Topical Report, "Accident Source Term Methodology," TR-0915-17565, Revision 1, dated April 2016

The purpose of this letter is to provide the NuScale Power, LLC (NuScale) response to the referenced NRC Request for Additional Information (RAI).

The Enclosures to this letter contain NuScale's response to the following RAI Question from NRC eRAI No. 8881:

- 02.03.04-2

Enclosure 1 is the proprietary version of the NuScale Response to NRC RAI No. 8881 (eRAI No. 8881). NuScale requests that the proprietary version be withheld from public disclosure in accordance with the requirements of 10 CFR § 2.390. The enclosed affidavit (Enclosure 3) supports this request. Enclosure 2 is the nonproprietary version of the NuScale response.

This letter and the enclosed responses make no new regulatory commitments and no revisions to any existing regulatory commitments.

If you have any questions on this response, please contact Darrell Gardner at 980-349-4829 or at dgardner@nuscalepower.com.

Sincerely,

Zackary W. Rad
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Enclosure 1: NuScale Response to NRC Request for Additional Information eRAI No. 8881, proprietary

Enclosure 2: NuScale Response to NRC Request for Additional Information eRAI No. 8881, nonproprietary

Enclosure 3: Affidavit of Zackary W. Rad, AF-0817-55644

Enclosure 1:

NuScale Response to NRC Request for Additional Information eRAI No. 8881, proprietary

Enclosure 2:

NuScale Response to NRC Request for Additional Information eRAI No. 8881, nonproprietary

Response to Request for Additional Information
Docket: PROJ0769

eRAI No.: 8881
Date of RAI Issue: 07/25/2017

NRC Question No.: 02.03.04-2

Regulatory Background

10 CFR 52.47(a)(1) requires a DC applicant to provide site parameters postulated for the design and an analysis and evaluation of the design in terms of those site parameters. 10 CFR 52.47(a)(2)(iv) requires a DC applicant to perform an assessment of the plant design features intended to mitigate the radiological consequences of accidents, which includes consideration of postulated site meteorology, to evaluate the offsite radiological consequences at the exclusion area boundary (EAB) and outer boundary of the low population zone (LPZ). Regulatory Guide (RG) 1.145, "Atmospheric Dispersion Models for Potential Accident Consequence Assessments at Nuclear Power Plants," presents criteria for characterizing atmospheric dispersion conditions for evaluating the consequences of radiological releases to the EAB and outer boundary of the LPZ.

Information Request Background

One of the positions that NuScale is seeking approval for in TR-0915-17565-P is the use of the ARCON96 methodology for the calculation of offsite atmospheric dispersion factors (or X/Q values). ARCON96 has typically been used to calculate X/Q values for the control room based on guidance provided in RG 1.194, “Atmospheric Relative Concentrations for Control Room Radiological Habitability Assessments at Nuclear Power Plants.” Section 4.1.6 of TR-0915-17565-P describes the methodology to be used in utilizing ARCON96 in performing offsite atmospheric dispersion calculations.

Supplemental to RAI 8691, Question 02.03.04-1

In RAI 8691, Question 02.03.04-1, the NRC staff asked why it is acceptable for the NuScale design-basis accident offsite atmospheric dispersion methodology to (1) use the 95th percentile X/Q value as the maximum sector X/Q value instead of a 99.5 percentile X/Q value as suggested by RG 1.145 and (2) {{

}}[2(a),(c)] as suggested by RG 1.145.

In response to RAI 8691, Question 02.03.04-1, the applicant stated that it is acceptable to utilize the 95th percentile X/Q value as the maximum sector X/Q because RG 1.194 directs that the 95th percentile X/Q value should be determined for control room related atmospheric dispersion analyses. According to the applicant, the use of ARCON96 (RG 1.194) methodology versus the PAVAN (RG 1.145) methodology creates non-analogous situations when trying to combine guidance from both RG 1.194 and RG 1.145 or compare NuScale's methodology to these regulatory guides in calculating offsite X/Q values.

The applicant also stated that {{

}}[2(a),(c)]

In response to the applicant's statements, the NRC staff finds {{ }}[2(a),(c)] of RG 1.145 for the EAB and outer boundary of the LPZ and the 95 percentile X/Q approach of RG 1.194 for the control room to be analogous. Both approaches state that the X/Q value that is not exceeded by more than 5 percent of the X/Q values generated with all the meteorological observations should be used to estimate doses to the appropriate receptor.

One of the differences between the RG 1.145 (PAVAN) and RG 1.194 (ARCON96) applications is the nature of the receptors. Each ARCON96 run simulates a release to a single receptor point, such as an air intake or infiltration pathway. In contrast, each PAVAN run simulates a release to a boundary such as the EAB and/or the outer boundary of the LPZ. 10 CFR 52.47(a)(2)(iv) states that the contents of applications for standard design certifications should contain an evaluation and analysis of a postulated fission product release demonstrating that an individual located at any point on the boundary of the EAB for any 2-hour period and an individual located at any point of the outer boundary of the LPZ during the entire period of plume passage would not receive a radiation dose in excess of 25 rem total effective dose equivalent (TEDE). {{ }}[2(a),(c)] of the EAB and LPZ boundaries for the duration of the dose assessment. Therefore, the staff's suggestion {{ }}[2(a),(c)] for the EAB and outer boundary of the LPZ is reasonable and consistent with current regulatory guidance.

RG 1.145 also implements a direction-dependent methodology as described in NUREG/CR-2260. The RG 1.145 direction-dependent methodology considers the directional variability of diffusion conditions and boundary distances by dividing the 360-degree EAB and outer boundary of the LPZ into sixteen 22.5-degree sectors. If atmospheric dispersion conditions and boundary distances are identical in each of the sixteen 22.5-degree wind direction sectors, then the calculated direction-independent 5 percent X/Q value would be exceeded approximately 0.31 percent of the time in each of the 22.5-degree downwind sectors (5% times 22.5°/360°). After a parametric study of dispersion conditions at a number of sites, NUREG/CR-2260 concludes that the 0.5 percent level for the direction-dependent methodology would be reasonably consistent with the direction-independent 5 percent approach.

NuScale suggests that a 95th percentile X/Q value be calculated for each of sixteen 90-degee sectors and the maximum 95th percentile X/Q concentration out of all 16 sectors be selected. If atmospheric dispersion conditions and boundary distances are identical in each of the sixteen 90-degree wind direction sectors, then the calculated direction-independent 5 percent X/Q value would be exceeded approximately 1.25 percent of the time in each of the 90-degree downwind sectors (5% times 90°/360°). Therefore, NuScale's suggested use of the 5 percent X/Q value for the 90-degree sector X/Q is less conservative than the 1.25 percent 90-degree sector X/Q value implied by the NUREG/CR-2260 methodology.

Given the above discussion, the applicant should provide additional justification for deviating from RG 1.145 guidance regarding why it is acceptable to (1) use the 95th percentile 90- degree X/Q value as the maximum sector X/Q value instead of the 99.5 percentile 22.5- degree X/Q value and (2) {{ }}2(a),(c) Alternatively, as discussed during the closed meeting on May 23, 2017, {{ }}2(a),(c)

NuScale Response:

The offsite atmospheric dispersion methodology is modified to {{ }}2(a),(c)

A markup of TR-0915-17565 is provided to show this methodology change.

Impact on Topical Report:
Topical Report TR-0915-17565, Accident Source Term Methodology, has been revised as described in the response above and as shown in the markup provided in this response.

3.1 Software

3.1.1 SCALE 6.1/TRITON/ORIGEN-S

SCALE 6.1 modular code package, developed by Oak Ridge National Laboratory, is used for development of reactor core and primary coolant fission product source terms. Specifically, the TRITON and ORIGEN-ARP analysis sequences of the SCALE 6.1 modular code package, and ORIGEN-S, run as a standalone module, are used to generate radiation source terms for the NuScale fuel assemblies and primary coolant (Reference 7.2.25). The aforementioned software has been used in the evaluation of operating large LWRs. The operating environment, nuclear fuel and structural materials in the NuScale design are expected to be similar to, or bounded by, that in large pressurized water reactors (PWR).

3.1.1.1 TRITON

As described in the SCALE manual (Reference 7.2.25), the TRITON sequence of the SCALE code package is a multipurpose control module for nuclide transport and depletion, including sensitivity and uncertainty analysis. TRITON can be used to generate problem- and exposure-dependent cross sections as well as perform multi-group transport calculations in one-dimensional, two-dimensional, or three-dimensional geometries. The ability of TRITON to model complex fuel assembly designs improves transport modeling accuracy in problems that have a spatial dependence on the neutron flux. In this case, TRITON is used to generate burnup-dependent cross sections for NuScale fuel assemblies for subsequent use in the ORIGEN-ARP depletion module.

3.1.1.2 ORIGEN (ORIGEN-ARP and ORIGEN-S)

Reference 7.2.25 describes ORIGEN-ARP as a SCALE depletion analysis sequence used to perform point-depletion and decay calculations with the ORIGEN-S module using problem- and burnup-dependent cross sections. ORIGEN-S nuclear data libraries containing these cross sections are prepared by the ARP module using interpolation in enrichment and burnup between pre-generated nuclear data libraries containing cross section data that span the desired range of fuel properties and operating conditions. The ORIGEN-ARP sequence produces calculations with accuracy comparable to that of the TRITON sequence with a savings in problem setup and computational time as compared to repeated use of TRITON. Many variations in fuel assembly irradiation history can be modeled. For depletion calculations involving NuScale fuel assemblies, the ORIGEN-S nuclear data libraries are generated by the TRITON sequence, as described in the previous Section 3.1.1.1.

3.1.2 ~~ARCON96~~NARCON

The calculation of both onsite and offsite atmospheric dispersion factors for design basis accidents is performed with NARCON~~96 (Reference 7.2.24)~~. NARCON is the NuScale version of ARCON96 (Reference 7.2.24). NARCON is equivalent to ARCON96 with the exceptions of input/output edit differences {{

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{{

}}2(a),(c)~~only~~. ~~The program~~ARCON96 implements the guidance provided in RG 1.194 (Reference 7.2.8). The code implements a building wake dispersion algorithm; an assessment of ground level, building vent, elevated and diffuse source release modes; use of hour-by-hour meteorological observations; sector averaging and directional dependence of dispersion conditions. The code also implements a Gaussian diffusion model for the 0 to 8 hour period.

NuScale uses ARCON96 for various time periods at the EAB and the outer boundary of the LPZ as well as the control room and technical support center. Justification for utilizing ARCON96 for offsite locations, as opposed to PAVAN, is provided in Section 4.1.

3.1.3 RADTRAD

RADTRAD is used to estimate radionuclide transport and removal of radionuclides and dose at selected receptors for the various DBAs (Reference 7.2.31). Given the radionuclide inventory, release fractions and timing, RADTRAD estimates doses at offsite locations, i.e., the EAB and LPZ, and inside the control room and technical support center. As material is transported through the containment, the user can account for natural deposition that may reduce the quantity of radioactive material. Material can flow between buildings, from buildings to the environment, or into the control rooms through filters, piping or other connectors. An accounting of the amount of radioactive material retained due to these pathways is maintained. Decay and in-growth of daughters can be calculated over time as material is transported.

3.1.4 MELCOR

MELCOR is used to model the progression of severe accidents through modeling the major systems of the plant and their generally coupled interactions (Reference 7.2.13). Specific use relevant to the application of DBST includes the following:

- thermal-hydraulic response of the primary coolant system and containment vessel
- core uncovering, fuel heatup, cladding oxidation, fuel degradation and core material melting and relocation
- aerosol generation
- in-vessel and ex-vessel hydrogen production and transport
- fission product release (aerosol and vapor) and transport
- and impact of engineered safety features on thermal-hydraulic and radionuclide behavior

3.1.5 NRELAP5

NRELAP5 is NuScale’s proprietary system thermal-hydraulic computer code used in engineering design and analysis. It has been developed for best-estimate transient simulation of LWR coolant systems during postulated accidents. The code models the

[Note: The $M_{ij}(x)\ \sigma_{yj}(x)$ term from Eq 4-3 is redefined in Eq 4-4 for downwind distances greater than 800 meters. For downwind distances less than 800 meters, Eq 4-4 is not used.]

$\sigma_{yj}(800)$ = lateral dispersion of plume at 800 meters

Two-hour relative concentrations are calculated for EAB and LPZ distances for each hour of data by assuming meteorological data representing 1-hour averages are applicable to the 2-hour period. An annual average is also calculated for each sector at the LPZ distance and is used in combination with the two-hour relative concentration in order to determine relative concentrations for various intermediate time periods.

Position two: Using relative concentrations calculated for each hour of data, a cumulative probability distribution of relative concentrations is constructed for each of the 16 sectors. A plot of relative concentration versus probability of being exceeded is made for each sector and a smooth curve is drawn to form an upper bound of the computed points. For each of the 16 curves, the relative concentration that is exceeded 0.5 percent of the total number of hours in the data set should be selected. The highest of the 16 sector values is defined as the maximum sector *X/Q*. Maximum sector relative concentrations are calculated for the 0 to 2 hour time period for the EAB. Maximum sector relative concentration for the 0 to 2 hour time period and the intermediate time periods are calculated for the LPZ.

Position three: Using relative concentrations calculated for each hour of data, an overall cumulative probability distribution for all directions combined is constructed. A plot of relative concentration versus probability of being exceeded is made, and an upper bound curve is drawn. The two-hour relative concentration that is exceeded five percent of the time should be selected from this curve. In addition, for the LPZ distance, the maximum of the 16 annual average relative concentrations should be used along with the five percent two-hour relative concentration to determine relative concentrations for the intermediate time periods.

Position four: The relative concentration for EAB or LPZ distances should be the maximum sector *X/Q* (position two) or the 5 percent ~~over~~overall site *X/Q* (position three), whichever is higher.

4.1.2 ARCON96

Detailed information regarding ARCON96 methodology and a description of the technical basis for the code is provided in Reference 7.2.24. The following paragraphs provide a brief summary of relevant sections of this technical basis and information from RG 1.194 (Reference 7.2.8).

The meteorological data needed for relative concentration calculations include hourly data of wind speed, wind direction, and a measure of atmospheric stability for one year. A consecutive 24-month period of onsite meteorological data is expected to be included in an ESP or COL application that does not reference an early site permit per SRP

Section 2.3.3 and RG 1.23. Relative concentrations are calculated for each hour through use of Eq 4-5 and Eq 4-6. ARCON96 estimates diffusion in building wakes by replacing the σ_y and σ_z terms in Eq 4-5 with the Σ_y and Σ_z terms in Eq 4-6.

The subscript y indicates horizontal direction and the subscript z indicates the vertical direction.

> *Δσ1*: (the low wind speed increment) is the factor that accounts for plume meander.
>
> *Δσ2*: (the high wind speed increment) is the factor that accounts for building wake effects, and σ is the normal diffusion coefficient.
>
> y is the distance from the center of the plume

$$\frac{\chi}{Q'} = \frac{1}{\pi\sigma_y\sigma_z U} exp\left[-0.5\left(\frac{y}{\sigma_y}\right)^2\right] \qquad \text{Eq 4-5}$$

$$\Sigma_y = \sqrt{\sigma_y^2 + \sigma_{y1}^2 + \sigma_{y2}^2}$$
$$\Sigma_z = \sqrt{\sigma_z^2 + \sigma_{z1}^2 + \sigma_{z2}^2} \qquad \text{Eq 4-6}$$

Intermediate time periods are calculated using different averages of each hourly relative concentration. A cumulative frequency distribution is constructed for each averaging period, and the 95th percentile relative concentration is selected from each, using linear interpolation. These relative concentrations are used to calculate the 95th percentile relative concentration for each standard averaging interval.

4.1.3 Major Differences

The following list summarizes the key differences between PAVAN and ARCON96 program methodology, using the information described in Sections 4.1.1 and 4.1.2 of this report.

- Generally, PAVAN uses a JFD of hourly wind speed, wind direction, and a measurement of stability class, while ARCON96 uses hourly data.
- PAVAN relies upon selective use of three different equations to account for plume meander and building wake effects, while ARCON96 relies upon one equation that accounts for both factors as a function of wind speed.
- PAVAN calculates a 99.5th percentile relative concentration for each sector and a 95th percentile relative concentration for the site limit, while ARCON96 only calculates a 95th percentile relative concentration. {{

}}2(a),(c)

- PAVAN calculates a relative concentration for each of the 16 direction sectors with only one execution of the code, while ARCON96 calculates a relative concentration for one specified direction sector per code execution. The direction sector can be specified in any direction from the intake to the source when executing ARCON96. NuScale utilizes 16 different 22.5 degree direction sectors for ARCON96 to be consistent with PAVAN, which utilizes 16 direction sectors that are each 22.5 degrees.
- PAVAN assumes a default direction window of 22.5 degrees, while ARCON96 allows a custom input direction window. ~~The default direction window input for ARCON96 is 90 degrees;~~ NuScale's methodology is to utilize ~~this default 90 degree~~{{

}}2(a),(c).

As stated above, ARCON96 calculates relative concentrations in one of 16 possible direction sectors at a time, while PAVAN calculates relative concentrations for all 16 direction sectors. Therefore, in order to use ARCON96 for offsite purposes, 16 executions of the code must be performed (one for each direction sector). The NuScale methodology for the use of ARCON96 for offsite purposes assumes a uniform circle where each of the 16 direction sectors is of equal length. {{

}}2(a),(c)

~~Reference 7.2.24 shows that, during the code's calculation process, ARCON96 compares the wind direction found in the hourly meteorological data to the wind direction window that contains the wind directions assumed to carry the effluent from the release point to the receptor. If the wind direction does not fall within the direction window, the X/Qs are set to zero. A smaller direction window inherently produces more zero values, which effectively lowers the final 95th percentile X/Q since ARCON96 includes these zeroes in the hourly averaging period calculations which are used in calculating the 95th percentile X/Q. Therefore, using a larger direction window results in more non-zero~~

~~X/Qs in the hourly averaging periods, and thus a larger (more conservative) final 95th percentile relative concentration.~~

4.1.4 Atmospheric Dispersion Estimates in the Vicinity of Buildings

Reference 7.2.23 describes revisions made to the 1995 standard methodology used for estimating relative concentrations in the vicinity of buildings. The revised model later became the industry standard model, and its methodology was used to create ARCON96. The revised model includes corrections to the diffusion coefficients specifically implemented to improve model performance at low wind speeds, where meander and possibly uneven heating of building surfaces may be responsible for increased diffusion and at high wind speeds where turbulence from wakes dominates. This reference contains a section that validates the revised model through comparison of calculated relative concentrations and observed relative concentrations as illustrated in Figure 4-1. The methodology from RG 1.145 is included in this figure for comparison.

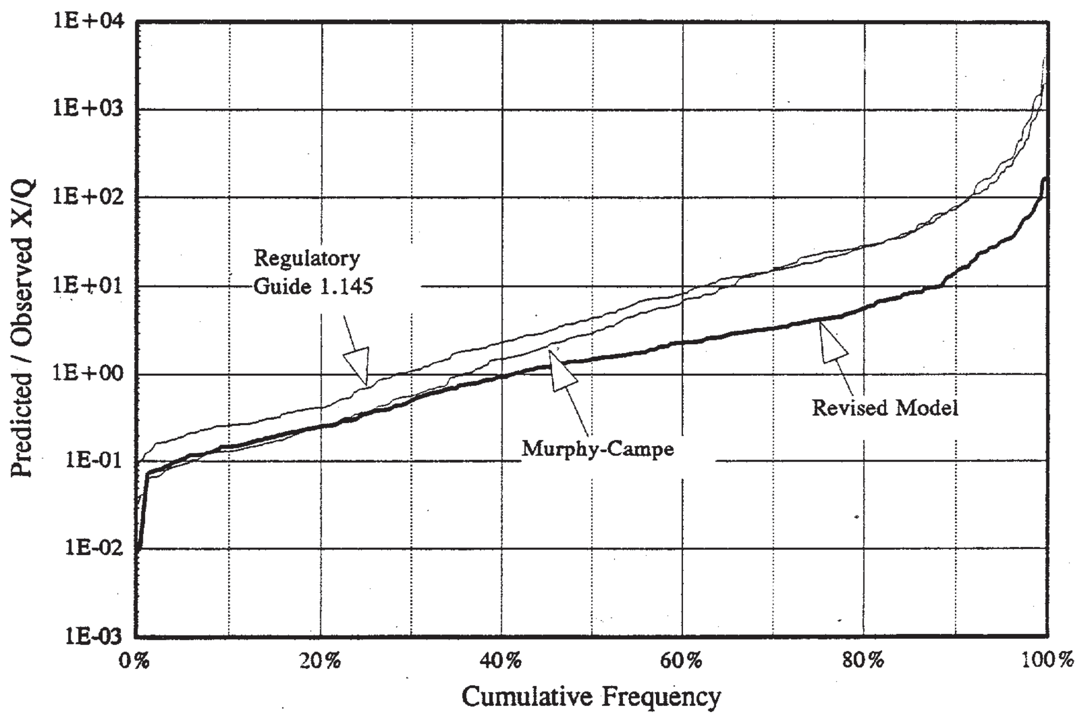

Figure 4-1. Cumulative frequency distributions of predicted to observed concentration ratios for the Murphy-Campe (RG 1.145), and revised models (Reference 7.2.23)

Figure 4-1 shows that compared with other NRC models, the revised model has less tendency to over-predict relative concentrations, especially at cumulative frequencies above 40 percent. At ratio cumulative frequencies of 95 percent and greater, as shown in Figure 4-1, RG 1.145 methodology over-predicts relative concentrations by two to three

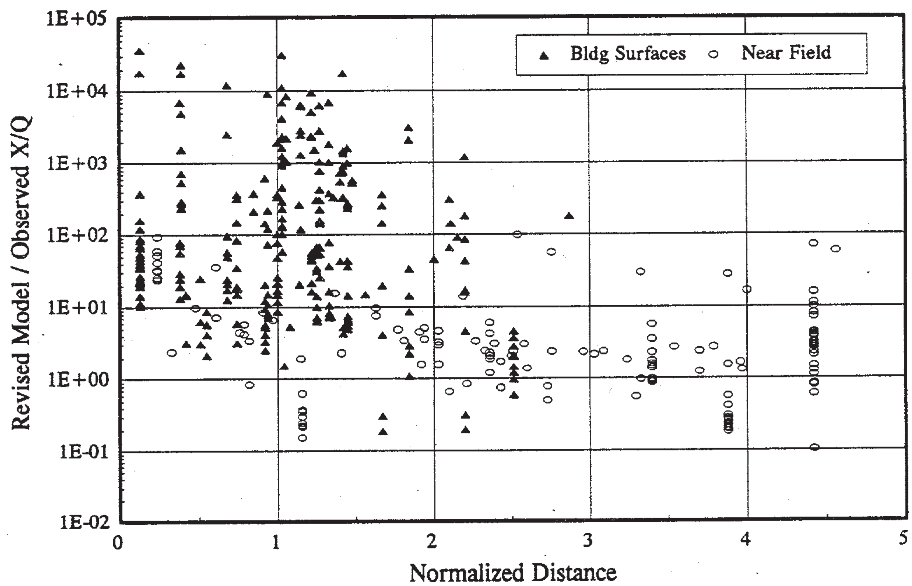

Figure 4-6. Ratios of predicted to observed concentrations for ARCON96 (Reference 7.2.23)

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}}2(a),(c)

4.1.5.2 Test Case Two: Distance Comparison

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}}2(a),(c)

Figure 4-10. Ratio of PAVAN to ARCON96 versus distance (data from Figure 4-9)

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}}2(a),(c)

{{

}}2(a),(c)

Table 4-3. Site meteorological statistics

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}}2(a),(c)

4.1.6 Application

In order to utilize ARCON96 for offsite atmospheric dispersion calculations, the following methodology is utilized. ~~{{~~

- For each possible measured wind direction sector available in the input meteorological data (typically 16 sectors), {{

}}2(a),(c)

- Ground level release (no credit taken for possible elevated release)
- {{

}}2(a),(c)

- {{

}}2(a),(c)

5.0 Example Calculation Results

Example calculation analyses and results are presented in this section to demonstrate the application of the methodology described in this report. These results are for illustrative purposes. Final~~NuScale plans to provide the final~~ design values are provided as part of~~in~~ the design certification application. Examples are provided in this section for offsite and onsite atmospheric dispersion factors, severe accident event selection, example severe accident analysis, containment aerosol removal, Category 1 and 2 radiological consequences, and post-accident pH_T. All examples provided in Section 5 are based on a superseded preliminary version of the NuScale design. Since the purpose of these example results is illustrative and the changes in results would not be large enough to provide new insights into the application of the methodologies, the example results are not updated as methodology changes and revisions to this report occur. Differences in the methodologies originally utilized to create these example results and the methodologies stated in the current revision of this report are noted in the associated Section 5 subsections as appropriate.

5.1 Atmospheric Dispersion Factors

~~{{~~ A COL applicant that implements this methodology is expected to use site-specific atmospheric dispersion factors calculated from qualified site-specific meteorological data obtained from a site specific RG 1.23 compliant meteorological monitoring program. In order to demonstrate the application of this methodology, this report assumed a three year data span for Sacramento, California from 1984 to 1986 in example calculations, described in Section 5.2 and Section 5.3. This representative site is assumed to occur on flat ground with nominal surface features (i.e., default surface roughness). A COL applicant who utilizes this methodology is expected to evaluate the applicability of the atmospheric dispersion modeling methodology for any significant site-specific geographical features. The example site information evaluated in this section is a representative example and is intended to illustrate how dispersion factors are calculated utilizing the methodology from Section 4.1 (with the exceptions of {{

}}$^{2(a),(c)}$) as applied to a set of U.S. meteorological data.

~~In order to utilize appropriate dispersion factors for design certification,~~In order to establish an appropriate site and associated meteorological dataset that could be used to develop atmospheric dispersion factors in a design certification, the methodology from Section 4.1 (with the exceptions of {{

}}$^{2(a),(c)}$) is applied to a set of U.S. meteorological data from 241 sites across the U.S. from which a site representative of an 80-90th percentile U.S. site was selected; as recommended in the advanced light water reactor (ALWR) utility requirements document (URD), Reference 7.2.42 (which specifically recommended 80-90th percentile). The selected site meteorological data is then used in example calculations of offsite and control room atmospheric relative concentration values.

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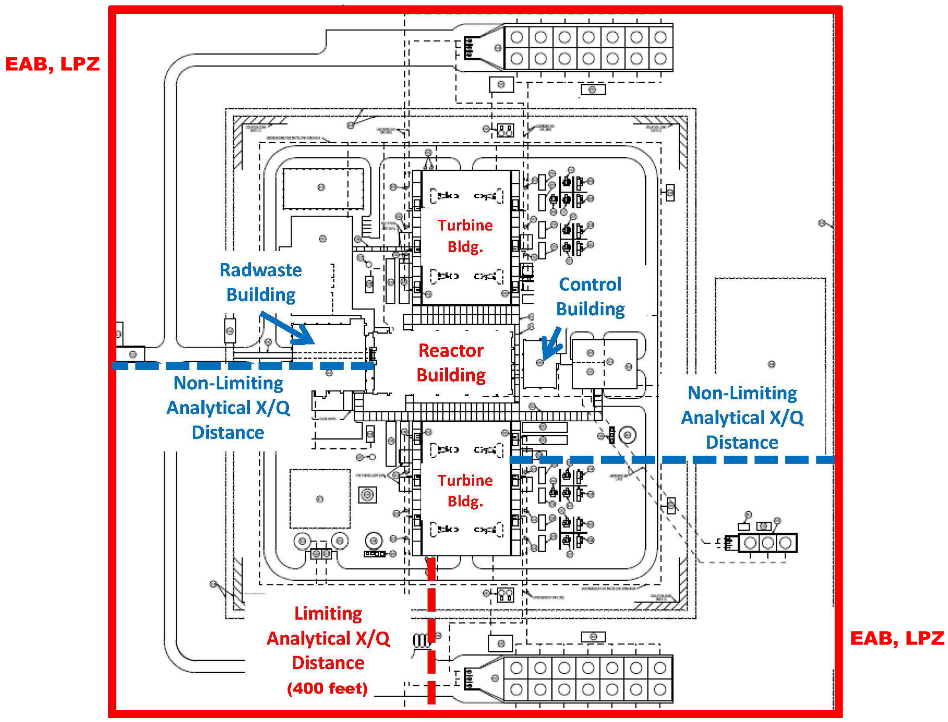

}}2(a),(c)

Figure 5-2. Markup of site layout with analytical offsite distances overlaid

{{ The example analysis assumed a conservative cross sectional building area of 0.01 square meters, since smaller cross sectional building areas have been observed to produce larger relative concentrations. Note that ARCON96 has only one input for cross sectional building area and therefore this input accounts for the effect of all buildings between the source and receptor. All source geometries were assumed to be from a ground-level point source; no elevated, vent, heated, or diffuse sources were considered. The site terrain elevation differences were assumed to be zero.

ARCON96 was executed using data from each of the geographical sites in the selected meteorological database and executed 16 times for each site; once for each direction sector. The sectors are centered at ~22.5 degree intervals~~,~~ {{

}}2(a),(c) and each is 90 degrees in width, {{

}}2(a),(c). The maximum relative concentrations were selected for each site at each time period and distance. A set of 80th percentile relative concentrations and a set of 90th percentile relative concentrations were established by ordering the data from least to greatest and selecting the 80th and 90th percentile data points for each distance and each time period. Selection of an 80-90th percentile site is based on establishing a site whose relative concentrations typically fall between the 80th and 90th percentile relative concentration data sets. }}2(a),(c)

{{ Table 5-2 presents the ratio of the selected relative concentration to the true 90th percentile relative concentration in the dataset. Though not all values represent the 80-90th percentile of the dataset, all of them are reasonably close in magnitude. There are five values below the 90th percentile of the dataset, but all of them are close to the 90th percentile in magnitude. Considering this relationship, and the fact that many of the selected concentrations are well above the 90th percentile, the selected site is justified for use as the 80-90th percentile of the dataset. ~~}}$^{2(a),(c)}$~~

Table 5-2. Ratio of selected relative concentration to true 90th percentile

{{

Downwind Distance (m)	0-2 hour	2-8 hour	8-24 hour	1-4 day	4-30 day
33	1.00	1.02	0.88	0.98	1.08
66	1.01	0.99	0.88	0.98	1.07
122	1.00	1.01	0.88	0.99	1.08
201	1.00	1.02	0.88	0.99	1.06
402	1.01	1.00	0.92	0.96	1.03
805	0.99	0.93	1.15	1.06	1.06
1609	0.90	0.96	1.25	1.08	1.13

Using the methodology specified in Section 4.1 of this report (with the exceptions of {{

}}$^{2(a),(c)}$, offsite atmospheric relative concentration values for the site located in Sacramento, California for the data span of three years (1984 to 1986) were calculated. These relative concentrations (shown in Table 5-4) are used in example dose calculations in this report. A COL applicant is expected to use site-specific atmospheric dispersion factors calculated from qualified site-specific meteorological data obtained from a site specific RG 1.23 compliant meteorological monitoring program. Use of NWS data is only for the purpose of illustrating the derivation of reasonable atmospheric relative concentration values for the NuScale design certification application and example calculations in this report. ~~}}$^{2(a),(c)}$~~

Table 5-3. Selected meteorological data

{{

WBAN	Location	Number of Years	Span of Years
23232	Sacramento, California	3	1984-1986

The calculated offsite dispersion factors are presented in Table 3-2. ~~}}$^{2(a),(c)}$~~

Table 5-4. Example offsite atmospheric relative concentration (X/Q) values

{{

Distance (feet)	Distance (meters)	0-2 hour (s/m^3)	2-8 hour (s/m^3)	8-24 hour (s/m^3)	1-4 day (s/m^3)	4-30 day (s/m^3)
400	121.9	5.72E-04	4.85E-04	2.14E-04	2.15E-04	1.95E-04

}}2(a),(c)

5.1.2 Control Room and Technical Support Center Dispersion Factors

{{ Possible reactor or turbine building source locations, including doors, heating, ventilation, and air conditioning (HVAC) inlets and outlets, and penetrations, were examined for determining the limiting source locations. For the control room envelope and technical support center, personnel access doors and HVAC inlets were examined as possible receptor locations. In these example calculations, the control room ventilation air exhaust was not included as a control room receptor, because it was assumed that the control room emergency air will be continuously discharged through this location.

Utilizing the three dimensional coordinates provided by building drawings, the total and horizontal distances between source and receptor were calculated for each source-receptor combination. The total "taut-string" distance was considered as a vector length, therefore the standard equation for calculating vector lengths was utilized. The resultant control room atmospheric dispersion factors are presented in Table 5-5 for the limiting control room source-receptor distance. }}2(a),(c)

Table 5-5. Example control room atmospheric dispersion factors

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Distance (feet)	Distance (meters)	0-2 hour (s/m^3)	2-8 hour (s/m^3)	8-24 hour (s/m^3)	1-4 day (s/m^3)	4-30 day (s/m^3)
111.78	34.1	6.27E-03	5.37E-03	2.31E-03	2.35E-03	2.13E-03

}}2(a),(c)

5.2 Category 1 Events

{{ Example dose results from the Category 1 events described in Section 3.2 of this report are shown in Table 5-6. The acceptance criteria in Table 5-6 are taken from SRP Section 15.0.3. These example calculations utilized the dispersion factors associated with the limiting 80th-90th percentile site described in Section 5.1, and the general methodologies described in Section 3.3 (with the exception of the method utilized to calculate the iodine decontamination factor for the pool during a fuel handling accident), as applied to the example design assumed in these evaluations. For this example, the smallest margin between calculated and acceptance criteria dose is a factor of 7 smaller between the 5 Roentgen equivalent man (rem) control room dose acceptance criteria and the 0.72 rem calculated value.

A sensitivity study was performed for the SGTF and MSLB events assuming the liquid secondary coolant in the steam generator was at the primary coolant design basis limit concentration. This study resulted in an EAB dose increase of 1.4E-03 rem TEDE, as compared to the acceptance criteria of 2.5 rem or 25 rem, depending on the iodine

6.1.1 Criteria for Atmospheric Dispersion Factors

1. {{
2. }}2(a),(c)
3. Ground level release.
4. {{
5.
6. }}2(a),(c)

6.1.2 Criteria for Core Radionuclide Inventory

1. {{
2.
3.
4.
5. }}2(a),(c)

6.1.3 Criteria for Control Room Modeling

1. {{
2. }}2(a),(c)

Enclosure 3:

Affidavit of Zackary W. Rad, AF-0817-55644

NuScale Power, LLC

AFFIDAVIT of Zackary W. Rad

I, Zackary W. Rad, state as follows:

1. I am the Director, Regulatory Affairs of NuScale Power, LLC (NuScale), and as such, I have been specifically delegated the function of reviewing the information described in this Affidavit that NuScale seeks to have withheld from public disclosure, and am authorized to apply for its withholding on behalf of NuScale.
2. I am knowledgeable of the criteria and procedures used by NuScale in designating information as a trade secret, privileged, or as confidential commercial or financial information. This request to withhold information from public disclosure is driven by one or more of the following:
    a. The information requested to be withheld reveals distinguishing aspects of a process (or component, structure, tool, method, etc.) whose use by NuScale competitors, without a license from NuScale, would constitute a competitive economic disadvantage to NuScale.
    b. The information requested to be withheld consists of supporting data, including test data, relative to a process (or component, structure, tool, method, etc.), and the application of the data secures a competitive economic advantage, as described more fully in paragraph 3 of this Affidavit.
    c. Use by a competitor of the information requested to be withheld would reduce the competitor's expenditure of resources, or improve its competitive position, in the design, manufacture, shipment, installation, assurance of quality, or licensing of a similar product.
    d. The information requested to be withheld reveals cost or price information, production capabilities, budget levels, or commercial strategies of NuScale.
    e. The information requested to be withheld consists of patentable ideas.
3. Public disclosure of the information sought to be withheld is likely to cause substantial harm to NuScale's competitive position and foreclose or reduce the availability of profit-making opportunities. The accompanying Request for Additional Information response reveals distinguishing aspects about the methodology by which NuScale develops its accident source term.

    NuScale has performed significant research and evaluation to develop a basis for this methodology and has invested significant resources, including the expenditure of a considerable sum of money.

    The precise financial value of the information is difficult to quantify, but it is a key element of the design basis for a NuScale plant and, therefore, has substantial value to NuScale.

    If the information were disclosed to the public, NuScale's competitors would have access to the information without purchasing the right to use it or having been required to undertake a similar expenditure of resources. Such disclosure would constitute a misappropriation of NuScale's intellectual property, and would deprive NuScale of the opportunity to exercise its competitive advantage to seek an adequate return on its investment.

4. The information sought to be withheld is in the enclosed Request for Additional Information No. 8881, eRAI 8881. The enclosure contains the designation "Proprietary" at the top of each page containing proprietary information. The information considered by NuScale to be proprietary is identified within double braces, "{{ }}" in the document.
5. The basis for proposing that the information be withheld is that NuScale treats the information as a trade secret, privileged, or as confidential commercial or financial information. NuScale relies upon the exemption from disclosure set forth in the Freedom of Information Act ("FOIA"), 5 USC § 552(b)(4), as well as exemptions applicable to the NRC under 10 CFR §§ 2.390(a)(4) and 9.17(a)(4).
6. Pursuant to the provisions set forth in 10 CFR § 2.390(b)(4), the following is provided for consideration by the Commission in determining whether the information sought to be withheld from public disclosure should be withheld:
    a. The information sought to be withheld is owned and has been held in confidence by NuScale.
    b. The information is of a sort customarily held in confidence by NuScale and, to the best of my knowledge and belief, consistently has been held in confidence by NuScale. The procedure for approval of external release of such information typically requires review by the staff manager, project manager, chief technology officer or other equivalent authority, or the manager of the cognizant marketing function (or his delegate), for technical content, competitive effect, and determination of the accuracy of the proprietary designation. Disclosures outside NuScale are limited to regulatory bodies, customers and potential customers and their agents, suppliers, licensees, and others with a legitimate need for the information, and then only in accordance with appropriate regulatory provisions or contractual agreements to maintain confidentiality.
    c. The information is being transmitted to and received by the NRC in confidence.
    d. No public disclosure of the information has been made, and it is not available in public sources. All disclosures to third parties, including any required transmittals to NRC, have been made, or must be made, pursuant to regulatory provisions or contractual agreements that provide for maintenance of the information in confidence.
    e. Public disclosure of the information is likely to cause substantial harm to the competitive position of NuScale, taking into account the value of the information to NuScale, the amount of effort and money expended by NuScale in developing the information, and the difficulty others would have in acquiring or duplicating the information. The information sought to be withheld is part of NuScale's technology that provides NuScale with a competitive advantage over other firms in the industry. NuScale has invested significant human and financial capital in developing this technology and NuScale believes it would be difficult for others to duplicate the technology without access to the information sought to be withheld.

I declare under penalty of perjury that the foregoing is true and correct. Executed on 8/24/2017.

Zackary W. Rad