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February 4, 2015
L-15-018

10 CFR 50.90

ATTN: Document Control Desk
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

SUBJECT:
Perry Nuclear Power Plant
Docket No. 50-440, License No. NPF-58
Response to Request for Additional Information Regarding Request for Licensing Action on Alternative Accident Source Term Radiological Dose Calculations (TAC No. MF3197)

A request for licensing action to obtain Nuclear Regulatory Commission (NRC) approval of revisions to the Updated Safety Analysis Report and Technical Specifications to reflect updated alternative accident source term dose calculations was submitted by letter dated December 6, 2013 (Accession Number ML13343A013), and supplemented by letter dated July 22, 2014 (Accession Number ML14203A625). A public teleconference was held with the NRC staff on January 7, 2015, followed by a request for additional information dated January 15, 2015. The requested information is attached; including Attachment 3 containing an electronic file of meteorological data.

No changes were identified to the previously provided significant hazards consideration, and there are no regulatory commitments contained in this submittal. If there are any questions or if additional information is required, please contact Mr. Thomas A. Lentz, Manager – Fleet Licensing, at 330-315-6810.

I declare under penalty of perjury that the foregoing is true and correct. Executed on February 4, 2015.

Sincerely,

Ernest J. Harkness

Attachment 1: Response to Request for Additional Information on Dose Calculations
Attachment 2: Summary of Calculation Addendum - Technical Support Center X/Q and Dose
Attachment 3: Electronic File of Meteorological Data on Compact Disc

cc: NRC Region III Administrator (without Attachment 3)
NRC Resident Inspector (without Attachment 3)
NRC Project Manager (without Attachment 3)
State of Ohio (NRC Liaison) (without Attachment 3)
Utility Radiological Safety Board (without Attachment 3)

A001
NRR

FirstEnergy Nuclear Operating Company (FENOC) provided a request for licensing action (RLA) to obtain Nuclear Regulatory Commission (NRC) review and approval of revisions to the Perry Nuclear Power Plant (PNPP) Updated Safety Analysis Report (USAR) and Technical Specifications (TS) to reflect a full implementation of alternative accident source term (AST) radiological dose calculations in a letter dated December 6, 2013 (Accession Number ML13343A013), as supplemented in a letter dated July 22, 2014 (Accession Number ML14203A625). Additional information was also provided in letters dated February 27, 2014 (Accession Number ML14059A221) and October 8, 2014 (Accession Number ML14282A218). A public teleconference was held with the NRC staff on January 7, 2015. During the call, the NRC staff requested that additional information be submitted. The NRC staff docketed this request for additional information (RAI) in a letter dated January 15, 2015. The requested information is identified using bold text, followed by the FENOC response.

1. **In the December 6, 2013 submittal, FENOC (the licensee) proposes to update Table 15.6-13 of the Updated Safety Analysis Report (USAR) to reflect two corrections to the atmospheric dispersion value (X/Q) for the 24-96 hour X/Q and the 96-720 hour X/Q approved by the NRC staff in March 1999. The change to the 24-96 hour (1-4 day) X/Q is an order of magnitude increase (i.e., from E-5 to E-4).**

   a. **Address whether the original values are currently credited to determine Control Room (CR) dose in any affected accident scenario.**

      In Attachment 1 to the letter dated July 22, 2014, page 8 identifies that the changes marked on USAR Table 15.6-13 (page 15.6-63) for these two control room X/Q values are being made as part of this RLA to correct erroneous USAR information. Page 8 also lists the control room X/Q values that were utilized in the loss of coolant accident (LOCA) calculations (both the current licensing basis (CLB) calculation and the proposed licensing basis calculation use identical control room X/Q values). The other affected accident scenarios are the control rod drop accident (CRDA) and the main steam line break outside containment (MSLBOC), which are addressed on pages 11 and 13 of Attachment 1 to the letter dated July 22, 2014, respectively. Pages 11 and 13 document that control room dose calculations were not previously required to be performed for either of these two events, and these pages list the control room X/Q values that are utilized in the proposed licensing basis calculations. These X/Q values are identical to the LOCA control room X/Q values. Therefore, the 24-96 and 96-720 hour X/Q values typed in USAR Table 15.6-3 are not currently credited to determine control room dose in any affected accident scenario.

b. Address the application of these corrected values in determining the CR dose for any affected accident scenario.

As detailed in the letter dated July 22, 2014, the corrected control room X/Q values marked on USAR page 15.6-63 are used in determining the control room dose for each of the affected accident scenarios (LOCA, CRDA, and MSLBOC).

2. In the October 8, 2014, supplement, the licensee indicated that the onsite tracer gas study did not include sampling and estimation of X/Qs at the intakes to the building housing the onsite Technical Support Center (TSC) in its basement. The licensee discussed similarities in the exposures of the air intakes to the CR and the onsite TSC and how dispersion and dilution might be slightly different for the two receptor locations with the relative concentrations at the TSC expected to be somewhat lower. The short-term X/Qs for the onsite TSC, appear to apply scaling factors to the 0 to 8 hour X/Q value based on the Murphy-Campe dispersion model in order to account for the effects of varying wind direction on concentrations over the longer accident averaging time intervals.

a. Discuss why the proposed, scaled X/Q values for the onsite TSC were not adjusted to account for the same measurement uncertainties in the tracer gas study (as described in Subsection 15.6.5.5.1.10 of the USAR) as was the case for the design-basis CR X/Qs, along with the possible additional uncertainty of different dispersion conditions at the TSC air intakes which, as indicated in the October 8 supplement, are located at the corner of a structure (i.e., the Service Building), but whose dispersion effects do not otherwise appear to be addressed.

The onsite TSC X/Q values established in 1988 based on the control room tracer study[1] were not adjusted in the 2013 or 2014 LOCA calculations to account for measurement uncertainties (as had been done for the control room X/Qs in 1998) because the onsite TSC study, performed only for internal licensee use prior to this RLA, was considered a realistic[2] rather than design-basis study. Documentation supporting the 1988 TSC X/Q values was judged as adequate to support continued use of those values. However, as a result of the public teleconference call with the NRC on January 7, 2015, FENOC has adjusted the onsite TSC X/Q values in a similar fashion as was done for the control room X/Q values in 1998, to make them more conservative. Details are provided in Attachment 2, which summarizes a LOCA calculation addendum that has been performed specifically to determine the revised X/Q values and the resultant onsite TSC dose. In summary, the resultant X/Qs are between the 1980 TSC values (determined using the Murphy-Campe dispersion model with three years of PNPP site meteorological data) and the 1988 TSC X/Q values (determined using tracer study results). The starting point in the calculation addendum for determining the more conservative X/Q values is the

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[1] See the study docketed as Attachment 5 of letter PY-CEI/NRR-2076L dated August 27, 1996.
[2] As described in Regulatory Guide 1.70, Revision 3, page 15-7.

1980 onsite TSC X/Q values determined for the design basis LOCA calculation. Similar to the conclusion in response to RAI 3.d for the control room, the onsite TSC dose results for the LOCA event are considered to be limiting. Because construction on Unit 2 had not yet been halted in 1980, these values were determined using the worst combination of the distances between the Unit 1 and Unit 2 containment/vent release points and the TSC air intake. The X/Q values based on this approach are now considered to be conservative since they included the shorter source to receptor distances for Unit 2, and Unit 2 is not operational.

The X/Q value for the first of four post-accident time periods of interest (3.6E-3 seconds/meter^3 (s/m^3)) was provided on page 5 of 6 of the attachment to the letter dated October 8, 2014. Because the control room tracer gas study X/Q values were based on seven years of meteorological data, which provides a reduction factor of 1.4 from the three year data, the 3.6E-3 s/m^3 TSC value is adjusted to account for the current licensing basis seven year meteorological data by dividing by 1.4, with a rounded-up result of 2.6E-3 s/m^3. The three subsequent time periods out to 30 days are then determined per Murphy-Campe by applying the wind speed and wind direction factors determined from the seven year joint frequency distributions for the sectors that could result in an exposure. As noted in NUREG/CR-2521, "Methods for Estimating Wake Flow and Effluent Dispersion Near Simple Block-Like Buildings," Murphy-Campe can be overly conservative by a factor of 10 to 100. Therefore, consistent with the method used to establish the control room X/Q values, the Murphy-Campe values for the four time periods are each reduced by a factor of 10, with an additional adjustment for the last (96-720 hour) period to increase that value by a factor of 2.5 (additional detail is in Attachment 2). This results in more conservative X/Q values for the onsite TSC than those submitted previously[3]; these more conservative values are considered adequate to account for the measurement uncertainties referred to in RAI 2a.

The resultant dose for the onsite TSC using these more conservative X/Q values is 2.1 rem total effective dose equivalent (TEDE) for the design basis LOCA, more than four times the 0.5 rem result in the letter dated July 22, 2014. This total dose remains less than the 5 rem regulatory guidance value.

Therefore, the TSC should remain habitable post-accident unless it is unavailable due to a separate reason. Section 7.1.1 of the PNPP emergency plan states that the offsite TSC located in the emergency operations facility (EOF) will be used if for any reason the onsite TSC is uninhabitable or inaccessible (for example, because the ventilation system is unavailable (it is not one of the three engineered safety feature (ESF) ventilation systems described in USAR sections 6.5.1 and 7.3, and, as identified in USAR section 1.10 and Table 8.3-1, TSC ventilation and heaters are powered from a non-safety related, manually connected Division 2 stub bus if offsite power is lost)). The offsite EOF/TSC is located more than 10 miles from the site, a location that would receive a dose much less than the 2.5 mile LPZ dose,

[3] The 2014 calculation revision was summarized in Attachment 2 to the letter dated July 22, 2014.

even without consideration of occupancy factors.

Attachment 2 to this current submittal contains a more detailed summary of the Addendum to the LOCA calculation that revises the onsite TSC X/Q's and dose.

b. As the resulting onsite TSC X/Q values were scaled from earlier Murphy-Campe modeling results, and the acknowledged limitation that the "testing may not have captured the full range of poor dispersion conditions," explain the rationale for the footnote on page 6 of the attachment to the October 8, 2014, supplement.

The footnote is no longer considered relevant due to FENOC's agreement to no longer use the tracer gas study-based TSC X/Q values, but instead use X/Qs adjusted to be more conservative, as was done for the control room X/Qs during the pilot plant application for alternative accident source terms. However, the footnote was intended to note that wind speed factors were not utilized in determining the 1986 control room tracer study X/Q values, which in turn were used in establishing the 1988 TSC X/Q values. The tracer study documented that the original control room X/Q values, determined in accordance with Murphy and Campe, utilized both time-dependent wind speed and wind direction factors. These factors can be multiplied to determine a combined reduction factor. However, in determining the X/Qs in the tracer study, only the set of factors with the smallest reductions were selected (only the wind direction factors were utilized/applied to the control room tracer results). Because the 1988 determination of the onsite TSC X/Qs was based on the control room tracer study, this use of only the direction factors carried over into the determination of the onsite TSC values. Again, as described above, this footnote was provided to support continued use of the previously proposed TSC X/Q values, which are now being made more conservative by adjusting them consistent with how the control room X/Q values were established.

3. Figure 1 of Attachment 6 to the December 6, 2013, submittal illustrates that the assumed direct release to atmosphere for this accident scenario is from the Auxiliary Building. Assuming a release location for the main steam line break outside containment (MSLBOC) accident that is different from the design-basis loss of coolant accident (LOCA) release location (i.e., from the outer edge of the Containment Building as indicated in Subsection 2.3.4.2 of the USAR), discuss the following:

a. Whether the distances to the exclusion area boundary and the low population zone receptors from the potential MSLBOC release point are less than the distances implied by assuming that the same X/Q values for the design-basis accident apply for the MSLBOC release scenario and either justify their applicability and use or revise as necessary;

The original pre-licensing exclusion area boundary (EAB) and low population

zone (LPZ) X/Q values utilized in the MSLBOC calculation were based on three years of meteorological data. The EAB/LPZ X/Q values utilized in the new MSLBOC calculation were updated in 1988 based on seven years of meteorological data and are consistent with the values in USAR Table 15.6-13 (which lists the meteorological data used in the LOCA dose calculation) and Table 2.3-24 "PNPP Short Term (Accident) X/Q Values at the Exclusion Area Boundary (EAB) and the Low Population Zone (LPZ) Based on Seven Site Years." From USAR 2.3.4.2, the X/Q values applicable for releases less than or equal to two hours were calculated at the established EAB and LPZ using the joint frequency distributions of wind speed and wind direction by atmospheric stability class. The established licensing basis EAB and LPZ distances for each unit are 863 meters and 4,002 meters, respectively, defined by circles about each of Units 1 and 2 and measured from the outer edge of the reactor containment building.

These EAB and LPZ distances are determined based on a design basis LOCA event, as required by the siting requirements in 10 CFR 100.11, which required that a plant's EAB be of such size that an individual located at any point on its boundary for two hours immediately following onset of the postulated fission product release would not receive a total radiation dose to the whole body in excess of 25 rem or a total radiation dose in excess of 300 rem to the thyroid from iodine exposure. Similar words also apply to the LPZ. A footnote indicates that

> The fission product release assumed for these calculations should be based upon a major accident, hypothesized for purposes of site analysis or postulated from considerations of possible accidental events, that would result in potential hazards not exceeded by those from any accident considered credible. Such accidents have generally been assumed to result in substantial meltdown of the core with subsequent release of appreciable quantities of fission products.

This is descriptive of a design-basis LOCA dose calculation rather than a main steam line break dose calculation (for which no fuel failures are postulated).

Measuring these EAB and LPZ distances from the reactor/containment rather than from varying release points for different events is consistent with long-standing NRC guidance for determination of these distances. For example, Standard Review Plan (SRP) Section 15.4.9, "Radiological Consequences of Control Rod Drop Accident (BWR)" (an event that releases dose from downstream of the outboard main steam line isolation valves) specifies that the X/Q values are the same as those used in the calculation of doses from a loss-of-coolant accident. Regulatory Guide 1.5 "Assumptions used for evaluating the potential radiological consequences of a steam line break accident for boiling water reactors," states that "The following specific assumptions are used: (1) The dose at any distance **from the reactor** is calculated...." and "In the case of beta radiation, the receptor is assumed to be exposed to an infinite cloud at that distance **from the reactor**." There is no requirement or guidance that different EAB and LPZ boundaries must be established for different events. The current licensing basis EAB/LPZ distances

(and therefore the resulting X/Q values) for the LOCA are appropriate to apply to the MSLBOC, as further supported below.

While it could be argued that the distance to the licensing basis EAB and LPZ boundaries shown in the USAR would be slightly less for a release location from the auxiliary building steam tunnel or the turbine building for some of the wind rose sectors, the reduction in distance would mostly occur north and west of the plant. The north and west directions consist of Lake Erie sectors with the exception of the north-northeast and northeast (land) sectors in which the distances would be reduced by only a small amount. USAR Figure 2.1-15 shows that the 2010 permanent resident population in the west thru north-northeast sectors is zero out to 10 miles from the plant. It is judged that a different release point (from the auxiliary building steam tunnel or the turbine building rather than the containment) would decrease the dose for populated areas to the south of the plant due to the slightly increased distance to the current EAB and LPZ for the majority of the wind rose sectors. Additionally, re-drawing the established EAB/LPZ boundaries due to the minor difference in release point assumed for the MSLBOC would not change the dose calculations for the EAB. This is because an 863 meter circle around the end of the main steam lines would still be well within the Owner Controlled Area (plant site boundary) fence line that is enforced by site security[4], so the calculation of the X/Q values would still utilize that established 863 meter value. Therefore, the resulting EAB X/Q values would remain unchanged. Also, the LPZ calculation would continue to use the established 4002 meter (approximately 2.5 miles) distance, because, as detailed in 10 CFR 100.11, the LPZ is simply an arbitrarily established distance rather than a fixed topographical feature. Finally, the NRC has previously accepted use of the current licensing basis EAB/LPZ boundary distances for leakage from the main steam lines, as shown in the Safety Evaluation for Amendment 103 (pilot plant AST), in which page 15 accepts the 863/4002 meter EAB/LPZ distances while also identifying in Table 1 (on page 19) that the vast majority of the total event dose is from the main steam line leakage pathway.

In the public teleconference on January 7, 2015, a follow-up question was raised regarding emergency planning requirements for lake traffic during an accident. USAR 2.1.2 indicates that "Authority to control all activities in the Lake Erie portion of the exclusion area is provided by the United States Coast Guard." USAR section 2.1.2.2 also notes that "A public address system has been installed for plant communication to individuals in areas within the exclusion boundary including the beach and Lake Erie... The number and volume of speakers used will be sufficient to immediately warn individuals on the lake within the exclusion boundary in an emergency." During an accident, as part of the initial notifications to the state and county emergency management agencies (EMAs), possible protective action recommendations (PARs) are made by FENOC, which may range from no action necessary, to the evacuation of the entire 10-mile emergency planning zone (EPZ).

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[4] As can be seen by examination of USAR Figure 2.1-4.

Site procedures define that Lake Erie is considered a subarea in and of itself. Since this Lake Erie subarea is within two miles of PNPP, the default PAR includes an evacuation of Lake Erie. The lake is always evacuated out to 10 miles. In addition, sheltering is not recommended for the lake. The PNPP emergency plan Section 6.1.2 also states: "Boaters on Lake Erie will be notified by either the United States Coast Guard (USCG), Ohio Department of Natural Resources (ODNR), Ohio Department of Transportation (ODOT), or National Oceanic and Atmospheric Administration (NOAA) in accordance with the appropriate State and local county response plans."

The Ohio Radiological Emergency Preparedness (REP) Operations Manual, page 20, provides guidance in the event of an Alert as follows:

ACTION	RESPONSE AGENCY
If decision is made to clear waterways:	Ohio EMA Radiological Assessment Branch
a. Contact USCG Operations Center, Cleveland, and request they broadcast message to mariners and provide resources for waterway notification.	Ohio EMA County EMA
b. Dispatch state agency watercraft as necessary to clear waterways. Coordinate with USCG to assist clearing waterways.	ODNR

Additionally, page 38 of this manual provides the following information under notification methods and procedures:

For notifying boating traffic within the affected area on Lake Erie, recreational boaters and mariners will be directed to –

i. Return to their port, marina or harbor from which they launched and evacuate by automobile or other transportation.
ii. Seek safe harbors outside the 10-mile EPZ by following traffic control directions from responding watercraft officers.
iii. U.S. Coast Guard (USCG) shall broadcast a "Notice to Mariners" utilizing standard USCG broadcast procedures.
iv. National Oceanic and Atmospheric Administration (NOAA) shall broadcast instructions to the public to refer to an EAS station for emergency information. NOAA may also directly broadcast emergency information to the public, if possible.
v. Surface responders shall read pre-scripted boating advisories over public address systems.

b. The release elevation for the MSLBOC, its orientation (relative to True North) with respect to the CR air intake locations, and its distance to those intakes;

The MSLBOC release is conservatively considered to be a ground level release with no credit taken for the building structure(s). Ground level is considered to be 620 feet above sea level. The outboard main steam isolation valve centerlines are approximately at elevation 632'. The control room intakes are at elevation 687'-8". The release did not credit any holdup, filtration, or dilution due to the building and could be released at any point downstream of the outboard main steam isolation valves. The direction from the closest MSLBOC release point (auxiliary building steam tunnel) to the nearest control room intake is approximately 50 degrees east from plant north (~30 degrees east of true north/Ohio Grid North) and the release point would be due north (plant north) of the containment building. The closest point of the auxiliary building steam tunnel to the control room intakes is approximately 1.6 times the distance from the Unit 1 containment source point to the control room intakes. This is based on scaling a plant layout drawing distance from the Unit 1 containment building to the closest control room air intake (approximately 190 feet) and the distance from the same air intake to the closest point of the auxiliary building steam tunnel (approximately 303 feet). While not credited, the plume would also need to exit the buildings and go over and around plant buildings before reaching the control room intakes. Refer to Figure 3-2 (page 46 of 167) of the tracer study for building layout.

c. Given any differences and/or uncertainties noted previously for the onsite tracer study and its results (especially if source-receptor distances are less and/or orientations are different), address the use of the same adjusted CR X/Q values for the LOCA release scenario; and,

While control room dispersion factors for the MSLBOC were not separately determined for an auxiliary building release location, the dispersion factors are expected to be enveloped by those used in the LOCA calculation since the north-northeast (NNE) wind direction needed to reach the control room is less likely to occur than for the LOCA, which would need a wind from the northeast (NE) or east-northeast (ENE) to reach the control room. This is based on a review of the wind rose information in USAR Figures 2.3-3 through 2.3-6. Per USAR section 2.3, the prevailing winds at both the 10 meter and 60 meter levels usually blow from the southeast through northwest directions. Additionally, as noted above, the distance to the control room intakes from the closest point in the auxiliary building steam tunnel (approximately 303 feet) is greater than the distance from the containment to the control room (approximately 190 feet). Given the above, use of the LOCA control room dispersion factors in the MSLBOC calculation is deemed appropriate.

d. Confirm that the LOCA release still represents the controlling accident scenario for the CR.

Review of the calculation results indicate that the LOCA dose consequences are limiting for the control room. The limiting dose results for the control room are as follows:

- *LOCA: 3.0 Rem* [letter dated July 22, 2014]
- *MSLBOC: 6.22E-1 Rem (@ 4 μCi/gm)* [letter dated December 6, 2013]
- *CRDA: 2.63E-1 Rem (scenario 1)* [letter dated December 6, 2013)]
- *Fuel Handling Accident (FHA): 2.78 Rem (scenario 3)* The FHA was previously reviewed and approved by the NRC utilizing Regulatory Guide 1.183 guidance, and was updated for the new fuel under the provisions of 10 CFR 50.59.

4. In support of the NRC's staff confirmatory analysis of the estimated onsite TSC X/Q values, and for the MSLBOC accident, provide and discuss the following analysis inputs:

a. Sequential, hourly onsite meteorological data for a representative period of record (POR), including upper and lower measurement heights and units of measure (NOTE: previous confirmatory modeling analyses by the NRC were based on a five-year POR from 1993 to 1997);

Meteorological data for 1993 through 1999 is provided in Attachment 3, for information and potential use in NRC confirmatory calculations. Additionally, the licensing basis seven year PNPP meteorological data base joint frequency distributions (JFDs) (5/1/72 - 4/30/74; 9/1/77 - 8/31/82) that have been utilized are contained in the tracer study (pages 12 through 16 of 167), and also in Appendix 2B of the PNPP USAR. Additionally, wind rose information is provided in USAR Figures 2.3-3, 2.3-4, 2.3-5, and 2.3-6.

b. Scaled drawings showing the locations and heights of the release points for the LOCA and for the MSLBOC accident, the TSC and CR intake locations and heights, distances between the release points (sources) and receptors, and orientations relative to True North from the receptors to the sources, and from which building heights and dimensions can be determined; and

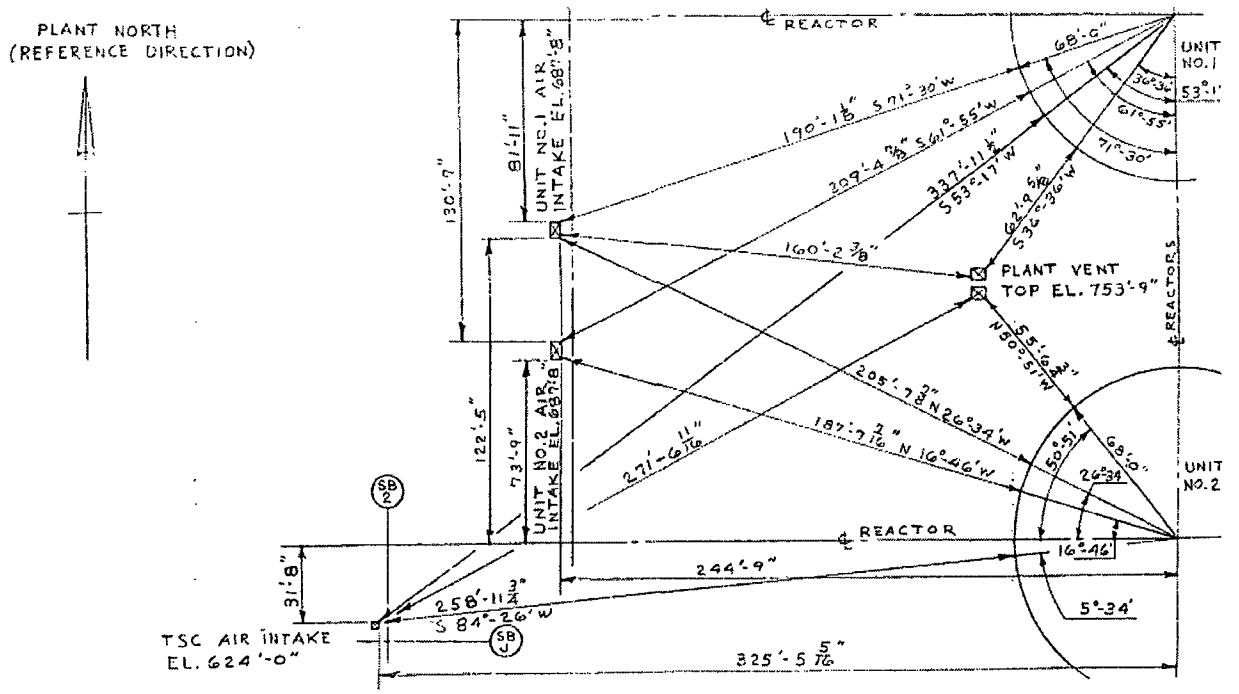
Refer to the following figures:

Tracer Study Figure Number	Current USAR Figure Number
Figure 2-2 (page 20)	Figure 1.2-2 Final Plant Layout, Plot Plan, Plant Area (shows the difference between plant north and true north (true north is 20 degrees east of plant north)
Figure 2-3 (page 21)	Figure 12.3-8 Radiation Zone, Plan H Roof Plan
Figure 2-4 (page 22)	Figure 12.3-11 Radiation Zone, Section C-C

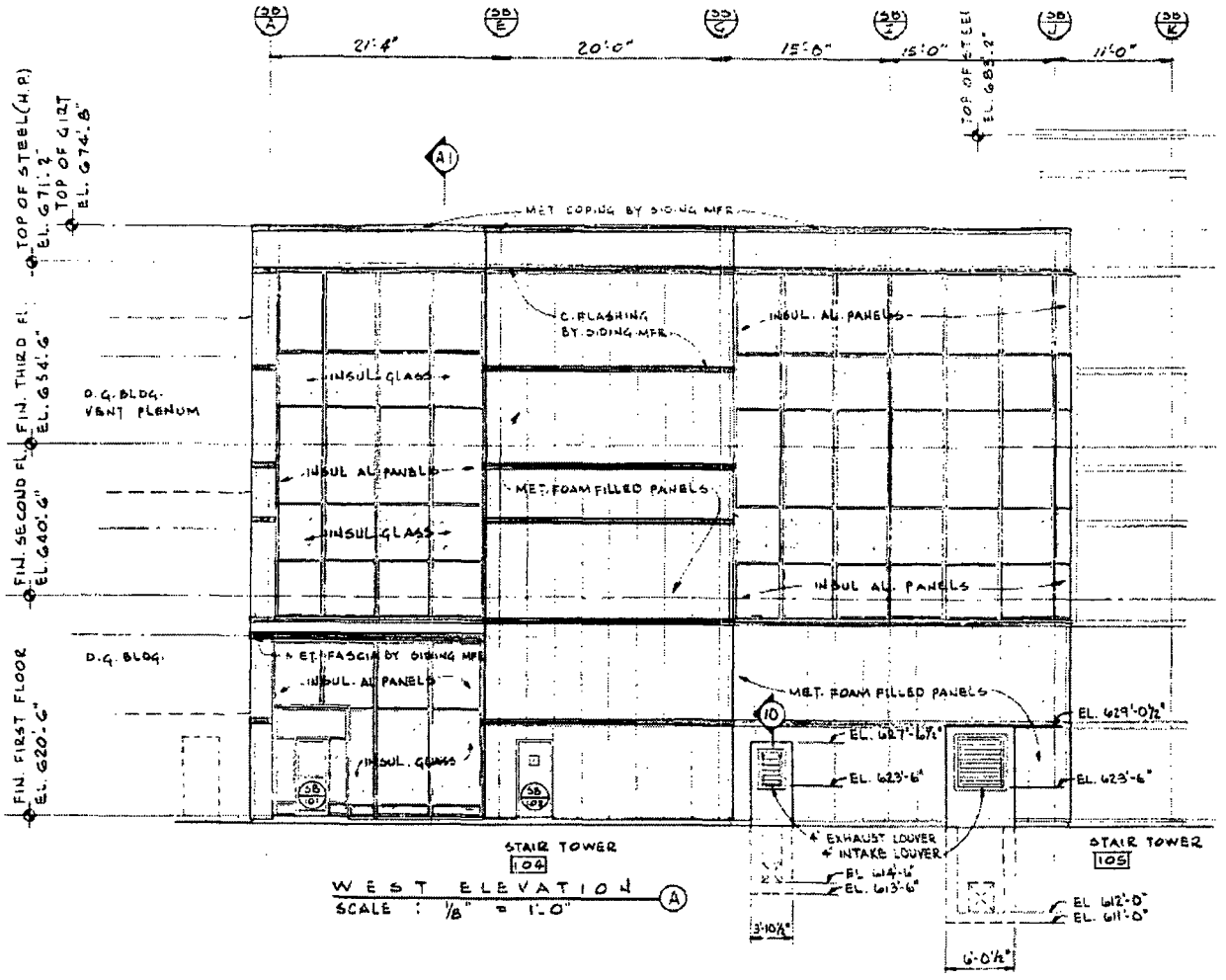
Figure 3-2 (page 46)	Figure 12.3-8 Radiation Zone, Plan H Roof Plan
Figure 3-3 (page 47)	Figure 12.3-11 Radiation Zone, Section C-C

Also see USAR Figure 12.3-9 Radiation Zone, Section A-A, and the following two sketches:

1. Various horizontal distances to the onsite TSC air intake are provided in the following sketch:



The intake serving the onsite TSC ventilation system is shown in the lower right corner of the following sketch showing the west face of the service building:



c. Release characteristics for each source, as applicable, including vertical velocity, flow rate, stack radius (and associated units of measure).

Location	Velocity (feet/minute)	Size (inches)	Flowrate (cubic feet/minute)
Plant Vent	4,100	48 x 90	30,700 / 700*
Turbine Building/ Heater Bay Vent	4,000	120 x 120	325,000 / 198,000**

* Unit 1 plant vent / Unit 2 plant vent flow rates. Actual flow rates post-accident would depend on what is running. Fuel handling area exhaust subsystems (2 of 3 fans) and the annulus exhaust gas treatment system would operate post-accident. Other ventilation systems supplying the plant vents are not required post-accident.

**Summer / winter flow rates. The heater bay exhaust fans are non-safety/non-seismic components and are not required to function post-accident.

None of the above information is utilized in the dose calculations.

As a result of the public teleconference call on January 7, 2015, the NRC requested confirmation that the releases were ground level releases versus stack releases. The calculations considered the releases to be ground level releases:

- For the CRDA calculation; "The X/Q values, based on a ground level release, are given below" (reference Addendum 5 to the letter dated December 6, 2013, page 3)
- For the MSLBOC calculation; "The X/Q values, based on a ground level release, are given below" (reference Addendum 6 to the letter dated December 6, 2013, page 7)
- For the LOCA calculation; "The X/Q values, based on a ground level release, are given below" (reference Attachment 2 to the letter dated July 22, 2014, page 11)

Summary of Calculation Addendum - Technical Support Center X/Q and Dose

The following five pages provide a summary of an Addendum to the loss of coolant accident radiological dose calculation regarding changes to the onsite technical support center (TSC) atmospheric dispersion (X/Q) values, and the revised dose that resulted from application of the revised X/Qs.

CALCULATION ADDENDUM

TITLE/SUBJECT: (MUST MATCH ORIGINAL CALCULATION TITLE (SUBJECT))	Page 1 of 5
Design Basis LOCA Dose Evaluation using Alternative Source Terms	

OBJECTIVE OR PURPOSE OF ADDENDUM:

The purpose of this addendum is to determine new Atmospheric Dispersion factors (X/Qs) for the Technical Support Center (TSC) and use these X/Qs to determine the impact on post-LOCA dose in the TSC.

SCOPE OF ADDENDUM:

The scope is limited to determining the TSC X/Qs and the post-LOCA dose in the Technical Support Center.

LIST NEW DOCUMENTS TO BE ADDED TO THE DOCUMENT INDEX (DIN).

DIN No.	Document Number/Title	Revision, Edition, Date	Reference	Input	Output
57	PY-NUS/GAI-156; Technical Support Center X/Q Values	3/20/1980	☐	☒	☐
58	NUS-4794, Results of the Atmospheric Tracer Study within the Building Complex at the Perry Nuclear Power Plant.	March 1986	☐	☒	☐
59	NUREG/CR-2521, "Method for Estimating Wake Flow and Effluent Dispersion Near Simple Block-Like Buildings."	June 1982	☐	☒	☐
60	Letter L-13-306; Request for Licensing Action Pursuant to 10 CFR50.59, 50.67, and 50.90: Full Implementation of Alternative Accident Source Term Design Basis Accident Analysis, and an associated Technical Specification Change.	12-6-2013	☒	☐	☐
61	Letter R-15-010; Request for Additional Information concerning Alternative Accident Source Term Design Bases	1-15-2015	☒	☐	☐

CALCULATION ADDENDUM

SUMMARY OF RESULTS/CONCLUSIONS OF ADDENDUM:

This evaluation determined that the revised Technical Support Center X/Q values are as follows:

Time (hours)	New TSC X/Q (sec/m^3)
0-8	2.6E-4
8-24	1.6E-4
24-96	8.1E-5
96-720	4.25E-5

Utilizing these X/Q values results in a conservative dose of 2.1 Rem TEDE to the TSC personnel.

LIMITATIONS OR RESTRICTIONS CREATED BY ADDENDUM:

None

IMPACT OF ADDENDUM ON OUTPUT DOCUMENTS:

None

DESCRIBE WHERE THE ADDENDUM WILL BE EVALUATED FOR 10CFR50.59 APPLICABILITY:

Similar to Revision 1 of this calculation, this addendum supports a License Amendment Request. RAD 13-02880 applies.

LIST SUPPORTING DOCUMENTS: (Include total number of pages)

Design Verification Record; 1 page

Calculation Review Checklist; 5 pages AW 1-21-15

Design Interface Summary; 8 pages

LIST ATTACHMENTS: (Include total number of pages)

Attachment 1 PNPP LOCA TSC.out 42 pgs.

Attachment 2 PNPP ESF TSC.out 27 pgs.

CALCULATION ADDENDUM

Background:

The USNRC expressed concerns with the way Perry's Technical Support Center (TSC) X/Qs were developed and used in the Request for Licensing Action ~~Request~~ for the full implementation alternative Accident Source Term using GNF2 fuel as submitted in December 2013 (DIN 60). In a subsequent conference call, the NRC in DIN 61 asked why Perry didn't adjust the TSC X/Q values in a similar fashion to what had been done for the Control Room X/Q values in 1998 when Perry applied for a license amendment using the Revised Accident Source Term for the design basis LOCA calculation. The NRC requested that Perry provide new TSC X/Q values, identify the conservatism in the new values, and perform a dose analysis for the Technical Support Center using the new TSC X/Qs.

AW 1-21-15

The TSC X/Q values utilized in Calculation 3.2.15.16, Revision 1, and the December 2013 submittal, equaled the three year Murphy and Campe results reduced by a factor of 71 (similar to the Control Room X/Q's determined from the tracer gas study (DIN 49)). The X/Q values used in Revision 1 are provided in the following table:

Time (hours)	TSC X/Q (s/m^3)
0-8	5.1E-5
8-24	4.1E-5
24-96	3.1E-5
96-720	1.1E-5

Analysis:

In determining the basis for new TSC X/Q values, an approach similar to that taken in Telephone and Conference Memorandum DES-98-0845, dated 12-2-98, (DIN 10) for the control room X/Q will be used.

Perry's original TSC X/Q values utilized 3-year data (5/1/1972 through 4/30/1974, and 9/1/1977 through 8/31/1978) and the methodology of Murphy and Campe (DIN 57). The values represent the worst case of those comprised of the combination of Units 1 and 2 containments and vents with the Technical Support Center air intake. The values from PY-NUS/GAI-156, dated 3/20/1980, (DIN 57) are as follows:

Time (hours)	X/Q (s/m^3)
0-8	3.6E-3
8-24	2.1E-3
24-96	1.1E-3
96-720	2.1E-4

CALCULATION ADDENDUM

It is noted that because Unit 2 is not operational, the values above are considered conservative in that they consider the Unit 2 containment which would have a greater impact on the X/Q due to it being closer to the TSC intake.

It had been shown that, for the Control Room X/Q values, a reduction factor of 1.4 is obtained by comparing the Murphy and Campe methodology results using 7-year meteorology with Murphy Campe results using 3-years of meteorological data for the 0-8 hour time period (ref. PY-NUS/CEI- 1474 attached to DIR 5.7.1.2, DIN 49). Therefore, a reduction factor of 1.4 is applied to the TSC 0-8 hour X/Q based on a 3-year meteorological data set to take credit for the reduction that would be obtained using a 7-year meteorological data set. The use of this reduction factor to obtain a 0-8 hour TSC X/Q representing 7 years of meteorological data is appropriate because the reduction in the Control Room X/Q value for the 7-year data set considered only additional meteorological data. The use of additional data would have the same impact on the TSC X/Q value.

For the remaining time steps, in accordance with Murphy and Campe, wind speed and wind direction factors that were determined for the 7-year Joint Frequency Distribution on the basis of observations may be applied to the 0-8 hour x/Q to obtain values for time periods out to 30 days. This is done by multiplying the Wind Speed and Wind Direction factor to obtain a combined factor for each subsequent time step and then multiplying this product to the initial time step. For example, for the 8-24 hour time step the wind speed and wind direction factors are 0.73 and 0.80 respectively. The combined factor is 0.584. Multiplying the combined factor by the X/Q for the 0 – 8 hour time step results in a X/Q of 1.52E-3 and is rounded to 1.6E-3.

Time step (hours)	Expected 7-yr X/Q (s/m^3)	Wind Speed x Wind Direction*	Expected X/Q 7-Year (s/m^3)
0-8	3.6E-3 / 1.4 = 2.6E-3		2.6E-3
8-24		0.73 x 0.80 = 0.584	1.6E-3
24-96		0.51 x 0.61 = 0.311	8.1E-4
96-720		0.31 x 0.21 = 0.0651	1.7E-4

*7-year Wind Speed and Wind Direction factors taken from NUS-4792, dated March 1986, p. 1-5 (DIN 58)

In determining Perry's current Licensing Basis Control Room X/Q values per DIN 10, Perry proposed that the Control Room X/Q values be based on the existing Murphy and Campe values (7-yr) reduced by a factor of 10. This reduction was consistent with NUREG/CR-2521 (DIN 59) which noted on page 49 that the Murphy and Campe methodology may provide results for a given application that are overly conservative by a factor of 10 to 100. The NRC review of the proposed Control Room X/Q methodology indicated that the approach was reasonable for the first three time steps; however, the NRC suggested that if Perry were to increase the X/Q value for the last step by a factor of 2.5, then the proposed approach would be considered acceptable. It was concluded that the new Control Room X/Q values would be a modified version of the X/Q values originally developed using the Murphy and Campe methodology from 7-years of site meteorological data. This approach in modifying the Control Room X/Q was agreed to by Perry and the NRC.

CALCULATION ADDENDUM

In keeping with the logic used to determine the Control Room X/Q values, the new X/Q values to be utilized for the Technical Support Center are as follows:

Time (hours)	TSC X/Q for Murphy & Campe (7 yr. data)	New TSC X/Q values (sec/m^3)
0-8	2.6E-3 x 0.1	2.6E-4
8-24	1.6E-3 x 0.1	1.6E-4
24-96	8.1E-4 x 0.1	8.1E-5
96-720	1.7E-4 x 0.1 x 2.5	4.25E-5

The following table shows the increase between the original TSC X/Qs and the New TSC X/Q values by taking the new TSC X/Qs and dividing it by the original proposed X/Q used in Revision 1 of this calculation.

Time (hours)	Current TSC X/Q (s/m^3)	New TSC X/Q (sec/m^3)	Factor increase (New / Original proposed)
0-8	5.1E-5	2.6E-4	5.1
8-24	4.1E-5	1.6E-4	3.9
24-96	3.1E-5	8.1E-5	2.6
96-720	1.1E-5	4.25E-5	3.9

Impact to TSC dose consequences:

Revision 1 of Calculation 3.2.15.16 provided the TSC dose results in Attachment 3 (p. 42) and Attachment 4 (p. 26). Revised TSC doses calculated with RADTRAD using the new TSC X/Qs are attached. The only change to the RADTRAD input files for these cases was the TSC X/Qs. The resulting doses are given below with the previous TSC doses for comparison.

	TSC Dose (rem TEDE)	
Pathway	**From Revision 1**	**Using New X/Qs**
Containment & MSIV Leakage	0.36	1.8
ECCS Leakage	0.05	0.2
Shine Dose	0.132*	0.132*
Total	0.5	2.1
Regulatory Limit	5	5

*Assumed to be the same as the Control Room

Electronic File of Meteorological Data on Compact Disc

A compact disc (CD) is attached for NRC information, containing meteorological data files entitled "Perry-Met-7 years.txt" and "Perry-Met-7 years.zip."

The meteorological data on the CD is for seven site years from 1993 to 1999. Although this is not the same seven year period as was used in determining the licensing basis atmospheric dispersion values described in Updated Safety Analysis Report Sections 2.3.2.1 and 2.3.2.1.1, this meteorological data may be useful to the Nuclear Regulatory Commission staff in performance of confirmatory calculations.

Also provided on the CD are meteorological data input files for ARCON96 for each of the years 1993 to 1999, entitled:

1. 1993.MET
2. 1994.MET
3. 1995.MET
4. 1996.MET
5. 1997.MET
6. 1998.MET
7. 1999.MET