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1	*Non-conservative LPF Values*— The staff team was unable to analyze the post-seismic fire accident LPF values because the information LANL provided was incomplete and unclear.	As part of the TA-55 DSA Upgrade to DOE-STD-3009-2014, LANL has committed to provide a more comprehensive LPF analysis inclusive of post-seismic fires. Currently this analysis, which includes a special treatment of a seismic event in the CFD and MELCOR analyses, is in preparation.
2	*Non-conservative LPF Values*— The staff team found that the LPF_{95} referenced in the DSA ranges from the 31st to the 78th percentile based on the full set of LPF values.	LANL will propose a newer methodology to the NNSA field office (NA-LA) that will be based on MACCS Version 3.10 output from meteorological data generated by the CFD model for at least 48 wind speed – wind direction cases for each accident phenomenology. Safety software quality assurance protocols are in place for updated versions of software used in the LPF and DOE-STD-3009-2014 DSA. The 2016-2020 meteorological data from the TA-06 meteorological tower was used to establish representative stability classes. The matching will be exact as the 48 cases with representative stability class will be the input to the MACCS Version 3.10 runs. The methodology used to pair meteorological conditions with LPF and dispersion models for use in mitigated consequence calculations will be submitted to NA-LA prior to the DSA submittal.
3	*Non-conservative LPF Values*— The staff team found that the LPF_{Rep} values that LANL safety analysts used in the dose calculations in the DSA range from the 45th to the 97th percentile. From the accidents the staff team analyzed, it is possible that the dose consequences could increase by up to a factor of two or more, had the 95th percentile LPF been used.	LANL will propose a newer methodology to the NA-LA that will be based on MACCS Version 3.10 output from meteorological data generated by the CFD model for at least 48 wind speed – wind direction cases for each accident phenomenology. The 2016-2020 meteorological data from TA-06 was used to establish representative stability classes. The matching will be exact as the 48 cases with representative stability class will be the input to the MACCS Version 3.10 runs. The methodology used to pair meteorological conditions with LPF and dispersion models for use in mitigated consequence calculations will be submitted to NA-LA prior to the DSA submittal. The updated LPF will result in appropriate dose calculations in the PF-4 3009-2014 DSA.
4	*Non-conservative LPF Values*— The staff team also noted that the amount of rounding, or	The newer methodology based on MACCS Version 3.10 output from meteorological data generated by the CFD model for at least 48 wind

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	margin, applied to the LPF_{95} is inconsistent. The margin ranged from a factor of 1.03 to a factor of 4.17. Notably, of the sampling of accidents the staff review team analyzed, the smallest margins are applied to the post-seismic fire LPF values.	speed – wind direction cases for each accident phenomenology, with 2016-2020 meteorological data from TA-06 establishing representative stability classes will provide LPF values for the mitigated accident analysis. Applying additional margin may not be necessary and will be evaluated when the revised DSA accident analysis is developed.
5	*Non-conservative LPF Values*— The staff team identified two concerns with LANL's argument: (1) χ/Q and LPF do not depend on the same time-averaged weather data; and (2) LPF and χ/Q are not always inversely proportional based on LANL's model.	The newer methodology based on MACCS Version 3.10 output from meteorological data generated by the CFD model for at least 48 wind speed – wind direction cases for each accident phenomenology, with 2016-2020 meteorological data from the TA-06 meteorological tower to establish the representative stability classes will show a closer dependence of LPF and c/Q since they will both be calculated using the same CFD generated meteorological data. The methodology used to pair meteorological conditions with LPF and dispersion models for use in mitigated consequence calculations will be submitted to NA-LA prior to the DSA submittal.
6	*Time-Averaged Weather Data*—The staff team identified that the time-averaged weather data may vary significantly when evaluating χ/Q and LPF parameters… Because the LPF is dependent on shorter interval weather conditions, differences in the wind data between a 60-minute average and a shorter, five-minute average, may be significant and warrant separate analysis.	DOE-STD-3009-2014 Section 3.2.4.2 does not require accident analysis calculations to use meteorological data averaged to match the release duration. What is a common best practice is to input hourly-averaged meteorological data regardless of the release duration, except for a release of less than one-minute (puff) which may require a different Gaussian model treatment. Importantly, it should be emphasized that common DOE best practices for atmospheric dispersion modeling uses hourly-averaged meteorology for all MACCS c/Q calculations. This includes a 60-second spill release and a 20-minute fire release. The duration of the release is accounted for in the MACCS inputs (i.e., releases from 3-39 minutes in duration expand the horizontal diffusion magnitude through application of the time-based meander). The proposed methodology for calculating the paired LPF and c/Q will not use sampling of weather data, but will be driven by the wind direction and wind speed

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		used in the CFD model, thus the correlation between average wind data over different measurement times will not be a factor.
7	*Time-Averaged Weather Data*—The staff team estimated how well fifteen-minute and 60-minute wind data compared over the five-year period between 2003 and 2007. The team obtained 15-minute average wind data, as it was the shortest averaged data available from LANL. The staff team then computed 30- and 60-minute average wind data from the 15-minute wind data.	The common DOE best practices for atmospheric dispersion modeling uses hourly-averaged meteorology for all MACCS c/Q calculations. This includes a 60-second spill release and a 20-minute fire release. The duration of the release is accounted for in the MACCS inputs (i.e., releases from 3-39 minutes in duration expand the horizontal diffusion magnitude through application of the time-based meander). The proposed methodology for calculating the paired LPF and c/Q will not use sampling of weather data, but will be driven by the wind direction and wind speed used in the CFD model, thus the correlation between average wind data over different measurement times will not be a factor.
8	*Time-Averaged Weather Data*—The staff team's analysis shows that fifteen-minute and 60-minute data differ significantly… the staff team concludes that the 60-minute average wind speed and direction values are not appropriate representations of the five-minute LPF phenomenon.	The common DOE best practices for atmospheric dispersion modeling uses hourly-averaged meteorology for all MACCS c/Q calculations. This includes a 60-second spill release and a 20-minute fire release. The duration of the release is accounted for in the MACCS inputs (i.e., releases from 3-39 minutes in duration expand the vertical diffusion magnitude). The proposed methodology for calculating the paired LPF and c/Q will not use sampling of weather data, but will be driven by the wind direction and speed used in the CFD model, thus the correlation between average wind data over different measurement times will not be a factor.
9	*Non-physical Behavior in LPF Arrays*—The staff team identified instances where the LPF arrays provided by LANL exhibited seemingly non-conservative or non-physical behavior. Although wind speed and LPF are expected to be correlated, the staff team identified instances where the LPF did not increase with wind speed.	LANL will propose to a newer methodology to NA-LA that will be based on MACCS Version 3.10 output from meteorological data generated by the CFD model for at least 48 wind speed – wind direction cases for each accident phenomenology. The 2016-2020 meteorological data from the TA-06 meteorological tower was used to establish representative stability classes. The matching will be exact as the 48 cases with representative stability class will be the input to the MACCS Version 3.10 runs. The methodology used to pair meteorological conditions with LPF and

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		dispersion models for use in mitigated consequence calculations will be submitted to NA-LA prior to the DSA submittal.
10	*Non-physical Behavior in LPF Arrays*—The staff team's discovery that the LANL calculations in some cases yield decreasing LPF values with increasing wind speeds reveals two potential non-conservative aspects in the calculations. LANL personnel stated that using LPF values in high percentiles in combination with the 95th percentile of χ/Q is non-physical and overly conservative because LPF values and χ/Q values are inversely proportional. However, if the LPF decreases with increasing wind speed, then χ/Q and LPF are not always inversely proportional and higher percentile LPF, and χ/Q values may simultaneously exist for the same weather data. Therefore, it may not be overly conservative to use LPF values in higher percentiles with the 95th percentile of χ/Q. LANL personnel stated that one of the additional conservatisms in the statistical methodology is that hourly wind speed values are rounded up to the next highest wind speed in the LPF array when interpolating LPF values. For instance, if a given hourly wind speed was 3 meters per second (m/s), then the LPF selected for that hour would correspond to the LPF array at 5 m/s. Since there are cases where LPF values decrease with increasing wind speed, then rounding up to the next highest wind speed is not always conservative.	The newer methodology based on MACCS Version 3.10 output from meteorological data generated by the CFD model for at least 48 wind speed – wind direction cases for each accident phenomenology, with 2016-2020 meteorological data from TA-06 establishing representative stability classes will show a closer dependence of LPF and c/Q since they will both be calculated using the CFD generated meteorological data.

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11	*Non-physical Behavior in LPF Arrays*—The staff team identified instances where the LPF arrays exhibited potentially non-physical behavior, which casts doubt on the validity of the LPF values used in the DSA… The staff team concludes that the erratic behavior of the LPF arrays indicates weaknesses or inaccuracies in the MELCOR and CFD modeling, and that such inaccuracies indicate that the LPF values may not be defensible.	The newer methodology based on MACCS Version 3.10 output from meteorological data generated by the CFD model for at least 48 wind speed – wind direction cases for each accident phenomenology, with 2016-2020 meteorological data from the TA-06 meteorological tower to establish the representative stability classes will show a closer dependence of LPF and c/Q since they will both be calculated using the same CFD generated meteorological data. The updated analysis, will not need to round up to the next highest wind speed.
12	*Inadequate Documentation*- Documentation describing the contents of LPF arrays and calculations substantiating the values reported in the DSA were unavailable. The staff team submitted multiple document requests and held multiple teleconferences with LANL personnel to obtain and interpret information.	LANL commits to appropriately documenting all supporting calculations associated with the LPF that will be discussed in the revised TA-55 DSA. It will do so by improving its configuration management system relative to this project.
13	*Records Availability* - The staff team noted the following deficiencies in records availability: • LANL could not provide sufficient documentation explaining how MELCOR output files corresponded to input files for specific accident scenarios. • LANL could not provide the documentation for resolving local facility and global geographic coordinates. • Information referenced in the PF-4 safety basis was not traceable to the cited document	LANL commits to appropriately documenting all supporting calculations and other documentation associated with the LPF that will be discussed in the revised TA-55 DSA. It will do so by improving its configuration management system relative to this project.

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	or the cited document was inaccurately referenced.	
14	*Quality Assurance* - The staff team concluded that the records and application of quality assurance with respect to the LPF calculation were inconsistent with the requirements of Subpart A of DOE's regulation, *Nuclear Safety Management*, 10 Code of Federal Regulations (CFR) 830.	LANL commits to meet its internal quality assurance requirements in PD-330, appropriately documenting all supporting calculations and other documentation associated with the LPF that will be discussed in the revised TA-55 DSA. This includes preparing all necessary documentation associated with the CFAST, MELCOR, PATHFINDER, ANSYS ALION and MACCS codes. It will do so by complying with the current quality assurance management system.
15	*NA-LA Review* - It is not apparent to the staff team that NNSA fully reviewed the technical basis for the PF-4 LPF prior to approving the recently submitted DSA	As part of NA-LA's overall safety basis review plan for the PF-4 3009-2014 DSA, with the support of NA-ESH, NA-LA secured the services of a renown LPF expert to independently evaluate the LANL LPF calculations. This work is being executed under an approved safety basis review plan for the LPF calculation. To support NA-LA, LANL commits to: (1) appropriately documenting all supporting calculations associated with the LPF; (2) appropriately documenting all supporting calculations and other documentation associated with the LPF that will be discussed in the revised TA-55 DSA; and (3) preparing all necessary documentation associated with CFAST, MELCOR, PATHFINDER, ANSYS ALION and MACCS codes.
16	*Conclusions* – The staff team concludes that the approved PF-4 safety basis does not appropriately analyze the post-seismic fire accident scenario at PF-4.	As part of the TA-55 DSA Upgrade to DOE-STD-3009-2014, (LANL has committed to provide a more comprehensive LPF analysis inclusive of post-seismic fires. Currently this analysis, which includes a special treatment of a seismic event in the CFD and MELCOR analyses, is in preparation.
17	*Conclusions* – The staff team concludes that inadequate documentation and quality assurance regarding the derivation of LPF values used in the DSA challenge the efficacy of the	LANL will propose a newer methodology based on MACCS Version 3.10 output from meteorological data generated by the CFD model for at least 48 wind speed – wind direction cases for each accident phenomenology, with 2016-2020 meteorological data from TA-06 establishing

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	primary control that is credited to protect the public from the consequences of a seismic event (i.e., confinement by the building structure) … LANL plans to follow the same statistical methodology for calculating the 95th percentile LPF … LANL needs to address the concerns with the statistical methodology to ensure the identified controls adequately address the hazard.	representative stability classes will show a closer dependence of LPF and c/Q since they will both be calculated using the same CFD generated meteorological data. This will result in the calculation of LPF values that will ensure the identified controls adequately address the hazard with respect to all evaluation basis accident sequences.

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A	The LPF analysis relies heavily on how long the confinement doors are assumed to be open during an evacuation. Previously, in the MELCOR model, LANL assumed that the PF-4 confinement doors would only be open for five minutes. For the updated LPF analysis, Triad personnel plan to use the software package PathFinder to develop an evacuation model of PF-4. This model will estimate the time required for personnel to evacuate the facility such that the confinement doors can close. DOE Standard 3009-2014 requires that assumptions made when defining a meaningful accident scenario be protected at a level commensurate with their importance. In this case, the staff finds that there are no viable controls to ensure the confinement doors will be	The PATHFINDER model is currently evaluating a set of 8 exit strategies and 6 occupancy levels for emergency egress. TA-55 Facility Operations via TA55-AERI-001-R32. *TA-55 Alarm/Emergency Response Instruction, Revision 32,* instruct personnel on evacuation procedure depending on the type of emergency condition. The PATHFINDER model simulates those conditions which include various confinement door conditions. The TA-55 Facility Emergency Plan (TA55-PLAN-007) states “The reentry and recovery phases in emergency response are the responsibility of the IC and must be carefully planned. Planning is essential to ensure that actions during or after the incident do not make the situation worse and/or injure additional people.” Thus, additional controls, besides the automatic door closure already in place and personnel emergency plan training may need to be considered in the new DSA.

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	closed shortly after the accident initiates or that the confinement doors will remain closed, given that emergency responders will need to enter the facility to engage in firefighting or rescue operations.	
B	Further, Triad plans to continue to use a statistical methodology that couples χ/Q (the atmospheric dispersion factor) with LPF. In the previous analysis, LANL calculated LPF values corresponding to six wind speeds and eight wind directions to form an array of 48 LPF values for each accident scenario in the safety basis. Next, LANL used hourly wind speed and direction data to interpolate within the computed LPF array. This allowed LANL to generate a distribution of LPF values for each hour based on a five-year period of meteorological data for each accident scenario. Then, LANL multiplied the hourly LPF values by the hourly χ/Q values to obtain a distribution of the product of LPF and χ/Q. LANL ordered these paired parameters from low to high values and determined the 95th percentile of the product of χ/Q and LPF. Finally, LANL divided the 95th percentile of the product of χ/Q and LPF by the 95th percentile of χ/Q to obtain the LPF value for each accident scenario. This approach will result in less conservative dose consequence estimates than if each parameter were derived independently and may be	LANL plans to discontinue its current LPF-c/Q pairing methodology and propose to NA-LA an alternate pairing technique. This technique will be based on MACCS Version 3.10 output from meteorological data generated by the CFD model for at least 48 wind speed – wind direction cases for each accident phenomenology. The 2016-2020 meteorological data from the TA-06 meteorological tower was used to establish representative stability classes. The matching will be exact as the 48 cases with representative stability class will be the input to the MACCS Version 3.10 runs. This will ensure that the future LPF values in the DSA will be reasonably conservative. With respect to the unmitigated CW dose calculation, the cross-sectional building area of PF-4 is greater than 360 square meters and the value of 3.5 E-3 seconds per cubic meter from that report applies.

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	inappropriate for calculating co-located worker dose consequences.	
C	Quality of the Analyses Needs Improvement—DOE has established expectations for the justification, documentation, and traceability of safety basis information. DOE Standard 3009-2014 states that "Calculations shall be made based on technically-justified input parameters and underlying assumptions such that the overall consequence calculation is conservative." Some input parameters and assumptions may be based on the existing facility design. These design inputs must be controlled by a formal configuration control process consistent with LANL's approved quality assurance program [16] as required by Title 10 Code of Federal Regulations (CFR) 830, Subpart A, Quality Assurance Requirements [17].	LANL is ensuring the updated analyses are documented and maintained under configuration management to ensure traceability and repeatability of the calculations. Analytical inputs tied to facility design are verified and traced to the design document from which the information was taken. Changes to these design documents are reviewed for impacts on the inputs to the analyses. MELCOR input files under source control using a software configuration management system. There are multiple branches, where "main" is the designated baseline version that is kept up-to-date.
D	Additionally, consistent with DOE guidance, certain inputs and assumptions may need to be protected by safety controls. The final LPF analysis must clearly justify and document all relevant inputs and assumptions and provide a list of approved design documents associated with these inputs. Failure to provide justification for the technical validity of inputs and assumptions would prevent an appropriate independent verification from being performed as required by Title 10 CFR 830, Subpart A.	The accident analysis is currently being revised as part of the DOE-STD-3009-2014 DSA upgrade. The inputs used, and assumptions made will be documented and protected at a level commensurate with their importance.

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E	Modeling Simplifications: The current working versions of the CFD and MELCOR models contain simplifications that may strongly influence the results. They should be evaluated for conservatism and model sensitivity (e.g., non-seismically qualified building collapse height and topography, number of room stratifications). Triad personnel noted that the model simplifications followed commonly used approaches in the field and were needed to reduce the computational demands of the model.	Model simplifications are, and will continue, to be evaluated for their impact on the overall results. If simplifications are adopted, the basis for their degree of conservatism will documented.
F	Modeling Simplifications: The current working version of the CFD model validation approach seems to validate the software (i.e., Ansys Fluent), rather than the model of PF-4. Triad personnel noted that their validation approach was driven by a lack of available data needed for a direct comparison and that it was similar to the approach used for the original LPF analysis.	As part of the software acquisition plan, the software QA inherent in the ANSYS Fluent software approach was evaluated and accepted per LANL policy for acquired commercially available software. Per the LANL SQA requirements, Verification and Validation (V&V) of ANSYS Fluent was performed and documented. The Verification of ANSYS Fluent was performed by running all the Theoretical Solutions Test Cases developed from the ANSYS Fluid Dynamics Testing Package. To properly validate/benchmark ANSYS Fluent, LANL sampled turbulent test cases that best represented the main features of the theoretical models used for LPF analysis. . .
G	Modeling Simplifications: For the MELCOR model, Triad personnel noted that additional time is needed to develop, evaluate, and document assumptions and limitations.	Sufficient schedule time will be accounted for to ensure proper documentation is developed and reviewed both internally and by NNSA.
H	Fire Modeling Assumptions and Combustible Controls: the combustible loading assumed in the LPF fire methodology is based on a snapshot	The assumptions in the fire analysis for fuel packages are being updated based on walkdowns and plausible process upsets. Over the last several years the facility has conducted an extensive program aimed at a

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	in time and may not bound all conditions. Because the assumed combustible loading is not protected in the current combustible control program, operators may introduce combustibles that exceed the amounts assumed in the LPF analysis and invalidate the results.	significant decrease of combustible loading. As an example, all computer desks were replaced with non-combustible metal desks. Also, the clustering concept was applied when fuel packages were separated from each other with significant distance to avoid an ignition of a neighboring fuel package due to potential heat flux. That separation distance is numerically calculated for a biggest combustible cluster in each room in PF-4. For each analyzed room, a conclusion is drawn if a "flash point" is possible using a conservative assumption for flash point condition of 450C. To make combustible loading analysis very conservative, the analysis use 150% heat release rate (HRR) for each analyzed combustible package.
I	Fire Modeling Assumptions and Combustible Controls: The assumptions and inputs for the CFAST calculation are not associated with the combustible loading program at PF-4. As a result, changes can be made to items in the room, consistent with TA55-AP-090, TA-55 Transient Combustible Program [18], leading to combustibles with heat loading greater than what is considered in the updated LPF fire methodology and with different separation criteria (required to ensure that flashover does not occur resulting in a larger fire). TA55-AP-090 provides instructions for personnel on the control of transient combustible materials and "verifies area conditions against the current Base Line Fixed Combustible Loading Surveys." As part of the implementation of this program, combustible loading permits are assigned for	The updated fire analysis that is ongoing will review and align with the combustible loading permits. The fire analysis results supporting the LPF are conservative based not only on the assumed fuel package loading and spacing but also the use of an exaggerated heat release rate, a conservative assumption for the flashover temperature and incident heat flux upon an adjacent fuel package from a burning fuel package.

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	every room in the facility. The combustible loading permits for the subject rooms currently allow different items to be placed into the rooms and at greater quantities than what is considered in the updated LPF fire methodology.	
J	Fire Modeling Assumptions and Combustible Controls: The staff found that operators may change the combustible loading in a room without a review by a person knowledgeable about the CFAST inputs (i.e., a fire protection engineer or safety basis analyst), as long as the change is within room permit limits.	The room combustible permit is reviewed by knowledgeable staff and establishes the proper bounds for each room. Thus, changes within the permit are authorized and bounded by previous reviewed configuration.
K	Fire Modeling Assumptions and Combustible Controls: Given the sensitivity of the LPF results to fire intensity, combustible loading inputs should be considered initial conditions in the documented safety analysis that may need to be protected by a specific administrative control consistent with the guidelines established in DOE Standard 3009-2014, Preparation of Nonreactor Nuclear Facility Documented Safety Analysis [1]. The Board's staff concludes that these input parameters and the spreadsheet should be maintained through a formal configuration control process consistent with LANL's approved quality assurance program [16] as required by Title 10 Code of Federal Regulations 830, Subpart A, Quality Assurance Requirements [17].	The calculated LPF is for mitigated analysis to demonstrate the effectiveness of controls on reducing the unmitigated consequences. As a mitigated analysis, reasonably conservative assumptions on the performance of safety systems and facility configuration are appropriate. These assumptions for the mitigated analysis are reviewed for inclusion in performance criteria or administrative controls as appropriate and commensurate with their importance. Fire analysis tools such as CFAST are in compliance with the LANL software QA program. Pre and post processing tools are documented in the analysis calculation so that all inputs and outputs are traceable and repeatable.

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L	Complex Application of Boundary Conditions: The results from the CFD model will be used as boundary conditions in MELCOR. Triad personnel indicated that they would apply different configurations of boundary conditions in MELCOR depending on the wind direction. This approach introduces additional complexity and will require careful application.	Each CFD wind case (direction and speed) were evaluated in the analysis reflected in the current DSA. Using this approach is a method to ensure a reasonably conservative LPF value for various accident types and accident locations within the facility. A suite of parametric runs will be completed to demonstrate the sensitivity of the results to the CFD boundary conditions.

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I	Non-conservative Post-seismic Fire Accident Progression—The accident progression postulated in the safety basis for the post-seismic fire accident scenario does not consider spilled MAR being impacted by seismically unqualified equipment. Currently, about 75 percent of the gloveboxes in the facility either do not meet their seismic criteria or have not yet been analyzed to demonstrate they will not topple in a seismic event. There are also large pieces of equipment and shielding that could create such impacts. Based on the analysis in Appendix A, the staff team found that including an additional insult where MAR is impacted by falling equipment in the quantitative accident analysis would increase the source term and result in mitigated dose consequences to the	The ARFxRF value mentioned in this comment (2E-3) is discussed in the DOE HDBK, section 4.4.3.3.2, "Large Falling Object Impact or Induced Air Turbulence." Thus, there are two phenomena grouped together but the HDBK considers them separately with respect to that ARFxRF value (use of "or" in the HDBK). The two phenomena are: large falling objects that cause vibration of the substrate supporting the oxide powder, or induced air turbulence from large objects falling. The first paragraph of that section states: "Under some circumstances (e.g., seismic events) substantial portions of structural features and equipment may fall into radionuclide-bearing-powders released from confinement. If the fall of the objects generates a substantial air movement, the powder impacted may be suspended by the aerodynamic stress imposed." The HDBK discusses these equipment/structure objects as being large parts of the structure itself (this not applicable to PF-4, due to the structure's credited seismic

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	public that exceed the DOE Evaluation Guideline. This is because the bounding airborne release fraction (ARF) and respirable fraction (RF) values for the fraction of plutonium powder that is aerosolized by an impact (2.0×10-3) is greater than the fraction of plutonium powder aerosolized for a spill (6.0×10-4) and fire (6.0×10-5) by one to two orders of magnitude. As shown in Table 2, the mitigated dose consequences for the post-seismic fire accident scenario increase such that the Evaluation Guideline could be exceeded by a factor of about three when considering this additional insult. Further, the Evaluation Guideline is exceeded by a factor of about 1.35 when considering this additional insult and the new first floor MAR limit.	rating) or heavy pieces of equipment falling that could generate significant amounts of air currents. It is important to maintain consistency with the methodology described in DOE-STD-3009-94, section 3.4.2, and again in DOE-STD-3009-2014, section A.3, where it is stated that facilities are “analyzed as they exist … when quantifying meaningful release mechanisms.” The PF-4 structure is credited to survive PC-3 level seismic events and there are no “substantial portions of structural features” postulated to fall during a seismic event that would cause either vibration of the substrate or air currents/turbulence. The only heavy equipment components postulated to fall within PF-4 are water-filled piping, and those are not large enough to cause “substantial air movement.” Lighter equipment such as ductwork may collapse, but these are not heavy enough to cause the vibration/shock or air movement from “substantive portions of structural features” identified in the HDBK associated with this ARFxRF. Furthermore, with respect to water-filled piping or any other heavy equipment, the concrete floor of PF-4 would not react to such impacts in the same way as the testing apparatus and setup used to derive the bounding combined value of 2E-3. As stated in the HDBK, the tests were performed on surrogate materials that were free flowing (i.e., having no cohesion, unlike plutonium oxide, which does exhibit significant cohesion if it is fine powder). The experimental setup involved “powder on a plywood sheet (called the “impact area”) or held in a can in a vented metal box placed on the impact area.” By far the highest ARF values were associated with the pad (plywood) as opposed to the quart can placed on the metal box, indicating the important contribution of

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		continued vibration of the substrate on the aerosolization of the powder. The concrete floor of PF-4 would not exhibit a post-impact vibration tendency like a plywood board or a metal box floor, indicating that the phenomena associated with the ARFxRF value of 2E-3 is not physically representative of PF-4. LANL will examine the seismic event again for the revised DSA for DOE-STD-3009-2014. During that effort, LANL will use DOE-HDBK-3010 appropriately.
II	Non-conservative Leak Path Factor	**See above**
III	Inappropriate Dose Conversion Factors for Heat Source Plutonium Oxides—For the purposes of calculating dose consequences, radiological material is classified as Type S (slow), Type M (moderate), and Type F (fast), which correspond to how quickly inhaled, aerosolized material is absorbed into the bloodstream. A faster rate of absorption corresponds to a higher dose conversion factor, which results in higher dose consequences. This is important for heat source plutonium because the dose conversion factor for Type M is approximately three times greater than Type S. The PF-4 safety basis applies a Type S dose conversion factor to heat source plutonium oxides (i.e., fine powders and granules) that have been heated above 800°C for at least two hours. For heat source plutonium	LANL revised (Revision 2) the ESS associated with this issue in the year 2019 to improve the detailed discussion. The revised ESS provides a defensible technical basis for the intermediate Type S and Type M dose conversion factor, using LANL health physics expertise, including a member of the ICRP. The LANL health physicists provided review and concurrence with the technical basis in the ESS. As part of the efforts in developing the original ESS, communication was provided form the LANL health physics SME that is relevant, and is reproduced as follows: “In my professional opinion, the intention of paragraph 264 of ICRP Publication 71 is not to make a statement about the relative hazard of 238Pu-oxides compared to 239Pu-oxides. The paragraph points out that 238Pu-oxides generally have relatively higher lung solubility due to particle fragmentation. However, it does not state that these compounds are more dangerous as a result. The reason is that the high specific activity of 238Pu compared to 239Pu, which leads to higher solubility, may also lead differences in lung deposition and mechanical transport. As a result, the intention of the paragraph was to point out

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	oxides that have not been heat treated at 800°C, the PF-4 safety basis applies a LANL-derived intermediate dose conversion factor (between Types S and M). Based on the analysis in Appendix B, the staff team concludes that the intermediate dose conversion factor is not technically defensible and is incorrectly applied to certain forms of heat source plutonium. This results in underestimated dose consequences to the public and workers.	the need to develop new deposition and retention models for these compounds. Such models have indeed been developed by the ICRP in the years since Publication 71 was released and are expected to be published in 2019. It may be worth noting that the dose coefficients (dose per unit activity of intake) for 238Pu-oxide compounds in the upcoming ICRP radiation protection guidelines (the 130 series of publication) are about 1/3 the dose coefficient associated with the ICRP 60 series type M 238Pu. Regarding paragraph 58 of Publication 71, this states that, for unspecified radionuclides released into the environment, Type M is a good assumption because it leads to an intermediate dose coefficient (between the dose coefficients of Type F and Type S). However, that is not the case for 238Pu, where solubility Type M actually leads to the largest dose coefficient. Therefore, the reasoning in that paragraph does not apply to 238Pu. Paragraph 58 also states that "exceptions [to the assumption of Type M] are made in those cases… where experimental data indicate that many of the principal forms of the element likely to be encountered exhibit behavior characteristic of Types F or S." This again suggests that an intermediate risk assumption should be chosen unless there is experimental data to suggest that an extreme assumption is more appropriate. In the case of oxides of 238Pu we have a large amount of experimental data which suggests that an intermediate assumption is, in fact, appropriate. While we have observed 238Puoxides exhibiting excretion patterns consistent with Type M solubility, we have not observed this more or less frequently than a range of other excretion patterns. The range of different solubility types observed in oxides of 238Pu should not be confused for uncertainty as to the true solubility of the materials. Instead, it implies that we know that a wide range of solubility characteristics actually

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		exists across the range of all 238Pu-oxides. The solubility characteristics of a mixture of these oxide compounds would be a weighted average of the solubility characteristics of the constituents, as would the dose coefficient. I believe that the assumption that all oxides of 238Pu have the dose coefficient associated with the ICRP 60 series "Type M" solubility type is unwarranted and overly conservative. Assuming an even mixture of Type S and Type M for oxides of 238Pu is justified by the data and would seem to be more appropriate in the spirit of this recommendation." (LANL memorandum RP-SVS-18:011, Nov-20-2018)
IV	Non-conservative Confinement Doors Assumption—The PF-4 DSA [5] assumes that the confinement doors (i.e., exits for evacuation) are open for only five minutes following a seismic event. The five-minute assumption is based on timed evacuations of personnel during drills. This assumption has a major impact on the LPF calculation, given that the doors are unfiltered release points from the facility. This assumption is not protected in practice, as the doors are not	The five-minute assumption is based on timed evacuations of personnel during drills. The PATHFINDER model is evaluating a set of 8 exit strategies and 6 occupancy levels for emergency egress. TA-55 Facility Operations via TA55-AERI-001-R32. *TA-55 Alarm/Emergency Response Instruction, Revision 32,* instruct personnel on evacuation procedure depending on the type of emergency condition. The PATHFINDER model simulates those conditions which include various confinement door conditions. The confinement doors are designed to close automatically so it is a conservative assumption for the doors to not remain open longer that the maximum egress time of personnel.
V	LANL does not analyze post-seismic fires in laboratory rooms that have pyrophoric materials because it assumes these would be low energy events and the resulting fire would not grow sufficiently within the first five minutes of the accident to impact the dose consequences.	The hazards of pyrophoric materials are identified and analyzed in the current DSA and will also be identified and analyzed in the new DSA as appropriate. LANL analyzes a post seismic room event fire based on the combination of a statistical analysis that considers real world data on post-seismic fires, and a deterministic analysis that includes rooms that house molten Pu metal, the most highly pyrophoric material present at TA-55. LANL chose the worst case with respect to the highest ST and

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		dose consequences given the condition of the facility at the time (i.e., some furnace GBs still had non-seismically qualified GB stands), and the probability of a randomly occurring room fire due to an electrical fault or similar ignition source and combustible materials. Since that time, all furnace GBs that house molten Pu have seismically qualified stands such that the GBs would not be expected to topple over, spilling molten Pu metal that could initiate and propagate to a fully developed room fire. Therefore, only one random fire is postulated and is placed in the room associated with the largest ST. LANL will re-evaluate the seismic event and post-seismic event fire to provide a bounding and representative accident analysis compliant with DOE-STD-3009-2014.
VI	LANL did not select the more conservative bounding ARF and RF values for boiling aqueous solutions when under thermal stress for the post-seismic fire accident because it assumes that five minutes would not be enough time for the aqueous solutions to boil.	The accident analysis is currently being revised as part of the DOE-STD-3009-2014 DSA upgrade. Appropriate bounding ARFxRF values from DOE-HDBK-3010-94 will be selected based on the accident scenario.
VII	LANL did not select the more conservative bounding ARF and RF values for aqueous and organic solutions being burned to complete dryness when under thermal stress for the post-seismic fire accident because it assumes that five minutes would not be enough time for the solutions to be burned to complete dryness.	The accident analysis is currently being revised as part of the DOE-STD-3009-2014 DSA upgrade. Appropriate bounding ARFxRF values from DOE-HDBK-3010-94 will be selected based on the accident scenario.
VIII	Inappropriate Compensatory Measures for Deficient Systems—The PF-4 DSA [5] identifies deficiencies in several safety systems that are	NNSA continues to invest in the TA-55 facilities and several upgrades have been completed since 2019, including seismic qualification of glovebox stands. Additional upgrades are ongoing. As appropriate, LANL

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	part of the post-seismic fire control strategy, including the fire suppression system, glovebox system, and components of the active confinement ventilation system. For each deficiency, the safety basis lists a compensatory measure. However, based on the analysis in Appendix C, the staff team found that the compensatory measures do not always ensure that the systems would be able to perform their intended safety function or that the hazards they are credited to protect would be prevented or mitigated. Therefore, the overall safety control strategy may not provide adequate protection to the public or workers. As discussed above, LANL has submitted plans to address these deficiencies. While LANL completed some of the upgrades identified in the PES, upgrade projects related to several of the key credited safety systems continue to be delayed.	has, and will continue, to seek equivalences or exceptions for SSCs that may not fully meet current design standards.