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# Review of Los Alamos National Laboratory's tritium venting reports – Volume 1 (November 2025) and Volume 2 (February 2026)

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This is a review of the two reports that Los Alamos National Laboratory (LANL) has published after the tritium venting operation from four Flanged Tritium Waste Containers (FTWCs) in September and October 2025. The reports are:

1. FTWC Radioactive Air Emissions Summary, Volume 1: Stack Emissions & Off-Site Dose Consequence, LA-UR: 25-31093, November 14, 2025; and
1. FTWC Radioactive Air Emissions Summary, Volume 2: Environmental Sampling & Expanded Plume Modeling, LA-UR: 26-20967, February 17, 2026.

The LANL reports are cited in the rest of this review by their report numbers with the respective years of publication (2025 for Vol. 1 and 2026 for Vol. 2). There were also four reports on the topic prepared for Tewa Women United and Communities for Clean Water related to the topic of the venting of the FTWCs – Franke (2024; Makhijani (2024; Rau and Winkler (2025); and Makhijani (2025).[2]

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[1] Arjun Makhijani is president of the Institute for Energy and Environmental Research (IEER).
[2] Bernd Franke (2024). Review of LANL radiation dose assessment for the Venting of Flanged Tritium Waste Containers (FTWCs) at TA-54 of Los Alamos National Laboratory, ifeu, September 14.
Arjun Makhijani (2024). Out of Order: An evaluation of the regulatory aspects of Los Alamos National Laboratory's proposal to vent tritium from waste containers, IEER, November.
Matthias Rau and Winkler (2025). Dispersion Concentration of Tritium in Rainwater and from Wet Deposition, released during the Venting of Tritium Waste Containers with Flange at TA-54 of LANL, Ingenieurbüro Rau, March 5.
Arjun Makhijani (2025). Interpretation of results of modeling of rainfall contamination due to Los Alamos National Laboratory's proposal to vent tritium waste containers, IEER, February.

## 1. Review summary

- **Emissions due to the venting operation**: The total tritium air emissions, as measured, were about 123 curies, with 88 percent being HT (tritiated hydrogen gas) and the rest HTO (tritiated water vapor). While there are some uncertainties (mainly due to conflicting data from two different measurement methods), the LANL data show that the vast majority of tritium – well over 99 percent) of the tritium – remained in the FTWCs, presumably within the specialized AL-M1 canisters placed inside the FTWCs.
- **Pressure buildup in the FTWCs**: LANL justified the venting on the basis of calculations that indicated a buildup of hydrogen-oxygen mixture created by radiolysis in the FTWC headspace, potentially to explosive levels. *However, no pressure increase was found in any of the FTWCs, indicating that there was no explosion risk.*
- **Radiation dose**: LANL's highest dose estimate for the whole operation was 0.0189 mrem to an adult and 0.063 millirem to an infant at a location in White Rock. While not verified in detail in this review, LANL's estimates are in general (order of magnitude) agreement with prior LANL and independently estimated dose factors (dose per curie emitted). Further, the estimated highest dose is so much below the regulatory limit that the conclusion that the exposure due the operation was well below that limit (10 mrem) would hold despite the measurement uncertainties.
- **Infant doses**: LANL has officially and formally acknowledged that infant doses from tritium venting were over three times higher than adult doses. This was the conclusion in Franke 2024, a report commissioned by Tewa Women United.
- **Use of adult dose for compliance**: Despite acknowledging that infant doses were more than three times that of adult doses in this case, LANL intends to continue compliance using dose estimates for adults; this has been EPA "standard practice" in enforcing the Clean Air Act 10 mrem limit.
- **Consideration of infant doses during permitting**: Had infant doses been considered during permitting, the operation would not have been allowed as planned, since infant doses under LANL's appropriately conservative source term assumption would have been more than the regulatory limit of 10 mrem. *This raises the question of whether EPA's "standard practice" of enforcement for adults only is providing equal protection under the law to infants and children when infant doses are estimated to exceed the regulatory limit of 10 mrem but adult doses do not. The fact that the actual venting resulted doses well below 10 mrem for infants is not relevant to the question of whether the permit was properly granted.*
- **The ALARA rule**: The primary reason given for venting was to mitigate a calculated explosion hazard. Since the modeled dose prior to venting was over 1 mrem, IEER's conclusion was that LANL should sample the headspace to determine whether an explosion risk existed. LANL did not do such sampling despite external suggestions that it do so (including a suggestive question from EPA Region 6). Since there was no pressure build up, the indicated ALARA requirement would have been no venting and zero emissions. By this analysis, the venting operation appears to have been in violation of DOE's ALARA rule.
- **Documentation of the contents of the FTWCs**: While LANL and NNSA have claimed that the contents of the four FTWCs are "well documented", the only real quantitative detail that has been provided is the tritium content of each FTWC. No detailed composition or quantitative

description of most of the other contents, such as free standing liquids and plastic bags has been provided. It should be.

- **Various omissions**: Various items should have been included in the close-out reports, especially given that the project had aroused much public concern. The following information/data was not included but should have been: (i) a detailed description each of the 53 alternatives LANL said it examined and why each option other than venting was rejected; (ii) the model inputs, model description, and detailed results that led LANL to the conclusion of a hydrogen-oxygen pressure buildup; (iii) an analysis of why pressure buildup modeling, central to the permitting process, was so off the mark; (iv) the gas composition in the headspace at the time of venting; (v) an explanation for the much higher concentrations of tritium in 2025 (before, during, and after the venting operation) at Airnet station 160 relative to nearby stations. Airnet station 160 is east-southeast of the venting point.

## 2. Background

In September 2025, LANL vented four FTWCs estimated to contain about 80,500 curies (a little over 8 grams) of tritium.[3] In the form of HTO, tritiated water, this tritium would be enough to contaminate over one trillion gallons of water to the U.S. drinking water limit of 20,000 picocuries per liter.

In 2018, LANL had asked EPA Region 6 for a permit to vent these containers because its modeling indicated that a hazardous condition might exist. The application was modified in 2019. In its review, the EPA described LANL's rationale as follows (italics added):

> As referenced above, the four FTWCs within Building 1028 at LANL's TA-54 contain tritium-contaminated metal parts and molecular sieve media, which is a pebble-like material used to absorb water vapor from exhaust air streams. This molecular sieve media inside the FTWCs is contained in metal canisters, along with some loose media material in bags. Over time, tritiated water vapor that had been adsorbed onto the media can become liberated into the FTWC headspace. Radiolysis can cause separation of the water vapor, *possibly resulting in a hazardous hydrogen-oxygen mixture within each of the four FTWCs*. According to the application, LANL has determined that continued tritium storage in these containers could pose an unsafe condition. To mitigate this hazard, LANL has decided that the FTWCs *be vented in-place to eliminate any build-up of pressure* so the material can be transported to another area at LANL for further processing.[4]

According to NNSA's 2025 review, "calculations indicate that the FTWCs contain a flammable hydrogen/oxygen mixture and that the headspace pressure is estimated to increase at a rate of ~5 psi per year."[5] An increase of 5 psi amounts to a little more than one-third of an atmosphere per year. At a similar rate, LANL's estimate indicates a pressure increase of several atmospheres over the 18 years

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[3] The operation continued into the first half of October, when the four containers were moved from Area G. No venting was involved during the moving.

[4] U.S. EPA (2020). Analysis of Application for Approval of Venting of Flanged Tritium Waste Containers at Los Alamos National Laboratory (LANL) under the Radionuclides NESHAP, July. p. 4.

[5] NNSA (2025). Flanged Tritium Waste Container Depressurization Independent Technical Report, August 12. p. 3.

from the time of FTWC loading in 2007 to the time of venting. The claim of a hazardous condition was made entirely on the basis of calculations. LANL made no measurements of the tritium or the pressure in the headspace. LANL's pressure calculations have not been made public. Nor did the NNSA state how it verified LANL's pressure modeling in its "independent" review.

## 3. Venting operation: LANL data and estimates

The venting operation began on September 15, 2025, when preparations were made for the venting that began the next day. Two types of instruments were used to measure the tritium being vented. An ion chamber system sampled the air stream and provided real time measurements. A bubbler system was also used; those samples were sent to a laboratory for analysis. Results from both were reported in LA-UR: 25-31093 (2025). The venting operation was, broadly, in two steps. The first was to vent the FTWC, which was then pressurized with helium. The second was to bleed off the helium. Tritium emissions could occur in both the venting and helium evacuation steps.[6] The venting and helium evacuation steps were done on different days.

The following is a summary of data in LA-UR: 25-31093 (2025); page numbers are provided in the list below.

1. **FTWC 225**, containing the second largest inventory of tritium (29,379 curies, p. 4), was vented on September 16 and evacuated on September 17. "[N]o measurable pressure was noted on the vent rig gauges" (p. 9). Tritium emissions, made by the two measurement methods, were as follows (p. 14):
    a. Sept. 16, venting: Bubbler data: Zero HTO and 5.25 curies of HT gas. Ion chamber data: 5.5 curies combined HTO and HT.
    b. Sept. 17, evacuation: Bubbler data 12.2 curies of HTO[7] and 18.2 curies of HT gas. Ion chamber data: 14.4 curies combined HTO and HT.
2. **FTWC 229** (tritium inventory 12,285 curies, p. 4), was vented next. "…no pressure was measured within the FTWC headspace…" (p. 11). Tritium emissions were as follows (p. 14):
    a. Sept 18, venting: Bubbler data: 0.27 millicuries of HTO (0.00027 curies) and 34.4 millicuries (0.0344 curies) of HT gas. Ion chamber data: 0.13 curies combined HTO and HT.
    b. Sept 25, evacuation: Bubbler data: 68.9 millicuries (0.0689 curies) of HTO and 460 millicuries (0.460 curies) of HT gas. Ion chamber data: 1.5 curies combined HTO and HT.

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[6] LA-UR: 25-31093 (2024), p. 4.

[7] The 12.2 curies reported as bubbler data is partly an estimate. For some of the evacuation operation of September 17, 2025 "the vacuum pump discharge line was not fully connected to the pump; a portion of the pump exhaust was not being returned to the stack exhaust simply being discharged to the ambient air." LANL claims to have made a "[b]ounding" estimate by using the "[w]orst-case" concentration for the relevant period. LANL also assumed that this entire estimate amount was HTO, which delivers a somewhat higher dose per curie than HT. (LA-UR: 25-31093 (2024), pdf, p. 54). This appears to this reviewer to be a reasonable approach to address problem of estimation.

3. **FTWC 227** (tritium inventory 8,653 curies, p. 4) was vented next. "Once again, the vent rig gauges indicated no pressure buildup within the FTWC." (p. 11). Tritium emissions were as follows (p. 14):
    a. Sept. 21, venting: Bubbler data: 0.603 millicuries (0.000603 curies) HTO and 6.21 curies of HT gas. Ion chamber data: 5.35 curies combined HTO and HT.
    b. Sept. 29, evacuation: Bubbler data: 0.0842 curies of HTO and 28.6 curies of HT. Ion chamber data: 69.52 curies combined HTO and HT.
4. **FTWC 226** (tritium inventory 30,201 curies, p. 4) was the last to be vented. "Once again, the vent rig gauges indicated no pressure buildup within the FTWC." (p. 12) Tritium emissions were as follows (p. 14):
    a. Sept. 23, venting: Bubbler data: 6.18 millicuries (0.00618 curies) HTO and 0.225 curies HT gas. Ion chamber data: 0.23 curies combined HTO and HT.
    b. Sept. 24, evacuation: Bubbler data: 91.1 millicuries ( 0.0911 curies) HTO and 6.19 curies HT gas. Ion chamber data: 9.72 curies combined HTO and HT.

Table 1 below shows these release estimates as well as the estimates used by LANL for dose calculations. The overall release estimate of 123 curies (rounded) is less than 0.2 percent of the tritium inventory in the four FTWCs. Of this, LANL estimated that 110 curies was HT gas and the rest was HTO.

Table 1: Tritium emissions by operation (venting or evacuation) and FTWC (rounded as shown) (Note 1)

| | in curies, bubbler data | | | | | Ion chamber data | Used for dose estimates |
|---|---|---|---|---|---|---|---|
| | HTO venting | HT venting | HTO evac. | HT evac. | Total | Total | Total |
| FTWC 225 | 0.0 | 5.25 | 12.2 | 18.2 | 35.65 | 19.9 | 35.65 |
| FTWC 229 | 0.0 | 0.034 | 0.069 | 0.46 | 0.564 | 1.6 | 1.53 |
| FTWC 227 | 0.001 | 6.21 | 0.084 | 28.6 | 34.895 | 74.9 | 75.72 |
| FTWC 226 | 0.006 | 2.25 | 0.091 | 6.91 | 9.257 | 9.95 | 9.95 |
| Total all FTWCs | 0.007 | 13.744 | 12.444 | 54.17 | 80.366 | 106.4 | 123 |

Note 1: A small amount of tritium, 0.00018 curies, possibly emitted on September 15 during pre-venting preparations, is not shown in this table (LA-UR: 25-31093, p. 9). "evac." stands for emissions during evacuation, the helium depressurization operation, carried out a day or more after the venting of a FTWC.

Source: LA-UR: 25-31093 (2025), p. 14 for details and p. 16 for emissions used to calculate doses.

LA-UR: 25-31093 (2025) also reported estimated radiation doses based on the measured tritium releases and the prevailing weather during the releases. LANL used the higher of the two measured values of tritium releases and the mix of HT and HTO for the calculations and the CAP-88 model to estimate the doses. The highest single estimated dose was 0.012 millirem on September 29, 2025 in the southeast direction at a White Rock residence on "Karen Circle", 2.3 kilometers southeast of the Area G venting location; the total dose over all days of the operation at this location was 0.0123 millirem (p. 16).

A recalculation of the dose was reported in LA-UR: 26-20967 (2026). It used weather data for all the days that operations took place, including the nights when the fans were off. This method resulted in an estimated maximum dose at the same location of 0.0189 millirem (pp. 9-10). The larger dose estimate was mainly due to the larger weather dataset, with winds being more towards the southeast. Both dose estimates are less than 0.2 percent of the Clean Air Act, Subpart H limit of 10 mrem/year (at 40 CFR 61.92).

LA-UR: 26-20967 (2026) also presented dose estimates for individuals of different ages at the White Rock location of highest dose. This is the first LANL publication to explicitly acknowledge that infant doses from the venting operation would be higher than adult doses (though a verbal acknowledgement was made during a 2025 public meeting). Specifically, the LANL estimates, reproduced below as Table 2, show that infant doses were 3.32 times higher than adult doses; the exposure of a one-year old would be 3.16 times that of an adult. These are almost the same factors (3.2 and 3.01, respectively) as those calculated in the report commissioned by Tewa Women United; see Franke (2024), Table 4.1.

Table 2: Cumulative dose at the highest exposure point in White Rock for people of various ages

| Scenario | CAP88 Age Group | CAP88 Dose (mrem) | Ratio to Adult dose |
|---|---|---|---|
| FTWC_Adult | Adult | 0.0189 mrem | 100% |
| | | | |
| FTWC_Infant | Infant | 0.0630 mrem | 3.32x higher than adult |
| FTWC_Age01 | Age 1 | 0.0600 mrem | 3.16x higher |
| FTWC_Age05 | Age 5 | 0.0320 mrem | 1.68x higher |
| FTWC_Age10 | Age 10 | 0.0250 mrem | 1.32x higher |
| FTWC_Age15 | Age 15 | 0.0200 mrem | 1.05x higher |
| | | | |
| Composite NM | 75% Adult, 25% Infant | 0.0299 mrem | 1.58x higher |

Source: Reproduced from LA-UR: 26-20967, Table 4, p. 12.

Finally, the air concentrations of tritium during the week of venting operations were generally consistent with annual averages. The highest concentrations, roughly two orders of magnitude higher than other stations near the venting location,  were at the Airnet station 160, east-southeast of the venting location. No explanation for these high levels at a single station, even relative to others in the same area was given in LA-UR: 26-20967 (2026).[8]

## 4. Review comments: technical issues

### i. Lack of pressure-buildup

The tritium absorbed on the molecular sieves was stored in specialized canisters, called AL-M1s; there were four to five in each FTWC. The venting and evacuation data indicate that there was only a small amount of tritium in the head space. About 0.15 percent (less than 13 milligrams) of the total inventory of more than 8 grams in the four FTWCs was vented or evacuated (with the helium). The LANL data

[8] See Table 2 and Appendix 1 of LA-UR: 26-20967 (2026) for tritium data during the venting operations and for all of 2025. Some measurements, prior to the venting, in July and August 2025, at Airnet station 160 were well over 1,000 pCi/m$^3$. LA-UR: 26-20967 (2026), p. 21. Locations of the Airnet stations near the venting location are shown in LA-UR: 26-20967 (2026), Figure 1, p. 4.

indicates that the AL-M1s performed the design objective of storing the tritium very well: almost all the tritium absorbed on the molecular sieves and stored in the AL-M1 canisters stayed there.

LANL's application for venting was based on calculations of buildup of hydrogen and oxygen due to the radiolysis of the moisture that had been absorbed in the molecular sieves used to trap tritium. An annual pressure increase of 5 psi was estimated, implying a pressure buildup of several atmospheres since the time of FTWC loading in 2007. *Since there was no pressure buildup in the headspace of any of the FTWCs, there would have been no explosion risk in transporting them without venting. This is not acknowledged LANL reports being reviewed here.*

The venting could have been avoided if LANL had sampled the headspace of each FTWC as a separate and prior step before deciding which, if any, FTWCs posed a transportation hazard. This was repeatedly recommended by IEER, including in the report prepared for Tewa Women United and Communities for Clean Water (Makhijani 2024), as well as verbally during meetings. LANL did not do so.

### ii. Quantity and composition of the releases and dose estimates

About 88 percent of the estimated 123-curie release was in the form of tritiated hydrogen gas, HT; the rest was tritiated water vapor (HTO). The modeling assumption made by LANL and in the four independent reports was that all the tritium would be released. As a result, the impacts of the venting would be far lower than those modeled. The predominance of HT gas reduces the local environmental impact of tritium (notably as regards any local rainout), since it takes time for the HT to be oxidized into HTO, which causes more harm than HT per curie released. No increase in soil tritium was detected, according to measurements reported in LA-UR: 26-20967 (2026).

It is important to note that while there was rough agreement between the two methods of measurement in the initial days of the operation, they diverged later (see Table 1 above). LANL used the higher values for its dose calculations.

No verification calculations for the venting calculations were performed as part of this review; none appear to be necessary. Given the release estimates, LANL's dose estimates are consistent on an order of magnitude basis with what could be expected from use of the CAP-88 model with Area G weather data. As was the case for both LANL modeling and that done independently, the highest dose would be expected to be in the White Rock area.

LANL's highest dose estimate in the White Rock area was 0.0189 mrem; the infant dose was estimated to be as 0.063 millirem.[9] Given that the estimated doses are less than 0.2 percent of the Subpart H regulatory limit of 10 mrem, any uncertainties in emissions are unlikely to impact the dose materially so far as a comparison with the Subpart H limit is concerned.

[9] LA-UR: 26-20967 (2026) Table 4

## 5. Review comments: regulatory issues

### i. The 10 mrem dose limit in 40 CFR 61, Subpart H

In his 2024 report on compliance with Subpart H, Arjun Makhijani stated that the proposed operation, as described in LANL's permit application to EPA Region 6, would exceed the 10 mrem dose limit if infants were included as members of the public. This was based on the infant dose estimates in Franke 2024 (Table 4.1). As noted above, LA-UR: 26-20967 (2026) states that infant doses were 3.32 times the adult dose.

LA-UR: 26-20967 (2026) goes on to state:

> In summary, even if we were required to apply the 3.32x multiplier for infants, all doses from FTWC operations were very low. Applying that 3.32x factor to all of the dose scenarios shown in Table 3 still results in a public dose consequence of less than 0.1 millirem for all modeling scenarios.
>
> The question about using age-dependent dose factors was raised during the public meetings. There has been no requirement for using age-dependent analyses for regulatory compliance purposes. Moving forward, the RAEM team will continue to evaluate new projects and report annual doses using the adult dose conversion factors, in accordance with EPA standard practice.[10]

LA-UR: 26-20967 (2026) is silent on what the factor of more than 3 for infant doses relative adult doses means for the permit application, However, it is easy to calculate that this factor, when applied to the LANL adult dose estimate in its permit application, would cause the infant dose estimate to exceed 10 mrem. Specifically, LANL's adult dose estimate based on annual weather data was 5.64 millirem. Using the factor of 3.32, the infant dose would be 18.7 mrem, well over the Subpart H limit. The dose to a one-year old would have been about 17 mrem. Subpart H of the Clean Air act (at 40 CFR 61.92) requires doses from radionuclide emissions to the atmosphere to "any member of the public" to be at most 10 millirem per year:

> Emissions of radionuclides to the ambient air from Department of Energy facilities shall not exceed those amounts that would cause any member of the public to receive in any year an effective dose equivalent of 10 mrem/yr.[11]

By limiting enforcement to adults, the EPA "standard practice" has been to exclude children from the group it considers to be members of the public for regulatory compliance purposes. It is important to note that not only are doses to infants and one-year olds much higher (in this case) than to adults, the cancer risks are also much higher. The cancer risk per unit of exposure to infants is about 4 times higher than to adult (male-female average risk in both cases). *Therefore the EPA "standard practice" in enforcing 40 CFR 61.92 (in Subpart H of Clean Air Act regulations) in this case has been to allow a 14 times higher cancer risk to infants than to adults.* LANL has followed the EPA's "standard practice." As noted above, it intends to continue this practice.

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[10] LA-UR: 26-20967, p. 10.

[11] EPA National Emission Standards for Hazardous Air Pollutants, Subpart H, at 40 CFR 61.92.

The equal protection clause of the U.S. Constitution reads in part:

> No State shall make or enforce any law which shall abridge the privileges or immunities of citizens of the United States; nor shall any State deprive any person of life, liberty, or property, without due process of law; nor deny to any person within its jurisdiction the equal protection of the laws.

One is therefore left to ponder how the U.S. EPA (and LANL) can limit the definition of "any member of the public" for the legal purposes of the Clean Air Act to infants when that results in unequal protection of infants and children. In the specific instance at hand, equal protection would seem to require that a permit to vent should demonstrate that doses to all people, regardless of age should be below the legal limit. Had doses to infants been considered in the permit application, they would have been over the legal limit; yet the permit was approved.[12] The technical conclusion in this specific instance is that unequal protection prevailed.

*The fact that the actual venting resulted in doses to infants far below 10 mrem is not relevant to the question of whether the permit was properly granted.* Subpart H at 40 CFR61.92 has an absolute limit of 10 mrem; no member of the public can be exposed to more than that. The permit applicant, not knowing the source term, as was the case here, is obliged to make a worst-case assumption for modeling. If that modeling does not show compliance, a permit should not be granted.

Finally, the modeling in Franke (2024), using conservative daily weather and humidity data, indicated that adult dose may also be over the 10 mrem limit. Neither LA-UR: 25-31093 (2025) nor LA-UR: 26-20967 (2026) made a comment on the permitting process other than implicitly, by stating that LANL would continue to use the "standard practice" of using adult doses for compliance.

### ii. The venting operation and DOE's ALARA rule

Makhijani 2024 (Section 6) analyzed the relevance of DOE Order 458.1, which requires Department of Energy facilities to keep radiation exposures and environmental damage "as low as reasonably achievable." This is known as the "ALARA" rule. ALARA requires DOE facilities to go beyond regulatory limits, such as the 10 mrem limit of Subpart H (at 40 CFR 61.92), when it is feasible and reasonable to do so. When estimated doses are over 1 mrem (as they were in this case) a quantitative analysis is required to examine, among other things, how low doses can be kept.

As noted above, the primary reason for that LANL sought a permit for venting was the risk of an explosion during transport of the FTWCs from Area G to another LANL facility, known as WETF ("Weapons Engineering Tritium Facility") a few miles away. This risk was hypothesized because radiolysis of moisture over the years could have resulted in a buildup of a hydrogen and oxygen mixture sufficient to trigger a hydrogen explosion in case of a transportation accident.

The first and most important step in evaluating alternatives to lower estimated doses would have been to determine whether, in fact, any FTWC had sufficient concentrations of hydrogen and oxygen to pose an explosion risk.  Makhijani 2024 recommended that step because, as noted there, "The ALARA option

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[12] A permit amendment in 2020 changed the venting process so that it would be stopped when the real-time dose estimate reached 8 rem. This also would result in infant doses well over 10 mrem. Makhijani (2024), p. 16.

for any FTWC that does not pose an explosion risk is simple: it can be transported without venting." (Makhijani (2024), p. 26).

Sampling the headspace was also verbally suggested to LANL during meetings. Finally, EPA Region 6 suggested it in the form of a question in 2023:

> [EPA question] *Can sampling be performed to characterize the headspace gas to inform option selection?*
>
> [LANL reply] o Sampling is included in the operational plan and procedures, throughout all operational phases. Opening the FTWCs for headspace sampling requires the same level of ventilation, emissions monitoring, and regulatory permitting/approval that is needed for full venting.
>
> [EPA question] *If sampling confirms that an explosive mixture is not a concern, what transportation restrictions apply to the containers due to the contents and pressure?*
>
> [LANL reply] o The primary objective of the field operations will be to meet DOT and worker safety requirements by resolving the pressure hazard. The controlled venting operation is designed to mitigate the pressure in the containers. Once accomplished, all additional processing will occur at the LANL Tritium Facility.[13]

As events have shown, sampling the headspace prior to deciding on venting would have revealed that there was no pressure hazard. The alternative under ALARA would have been to move the FTWCs without venting. In other words, conformity with ALARA would have meant zero emissions and zero radiation dose. The venting operation therefore appears to have violated ALARA even though the estimated maximum dose was far below the regulatory limit of 10 mrem because it was above zero.

## 6. Gaps in the reports

The following items are of note because of their absence in the final reports that LANL has issued on the venting project:

- LANL has claimed that 53 alternatives were examined and shared with the EPA. But a detailed list has never been made public, much less the analysis of each that led LANL to reject all but the venting option.
- LANL and NNSA have claimed that "[t]he contents [of the FTWCs] are well documented" (NNSA 2025, p. 3). However, apart from a detailed inventory of the tritium in each FTWC, no documents detailing the types and quantities of other materials in the FTWCs have been published. Qualitative descriptions have been provided, such as "…paint cans, and plastic bags; potential free-standing liquids; and lead styphnate contaminated squib valves (expended)" (NNSA 2025, p. 3).

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[13] Frank A. Rose, NNSA to Earthea Nance, EPA (2023). DOE/NNSA response to July 27, 2023, letter from EPA Region 6 (Dr. Earthea Nance) to NNSA Los Alamos Field Office (Theodore A Wyka), with cover letter, October 12, p. 2.

- Despite the centrality to the permit application of the modeling that estimated that a mixture of hydrogen and oxygen would buildup in the FTWC headspace, no details of the input data, the model, or the results of the pressure analysis have been published.
- No data on the composition of the vented gas, other than the tritium quantities, has been published.
- No analysis of why the model results indicating a considerable build of up pressure was so off the mark has been published.
- No explanation for the consistently far higher tritium concentrations at Airnet station 160 east-southeast of the venting location relative to other nearby stations has been provided.