Health Impact Assessment Recommendation for

Southern Area Fire Station Emergency Generator

By

Authors

For the

Air Quality Program

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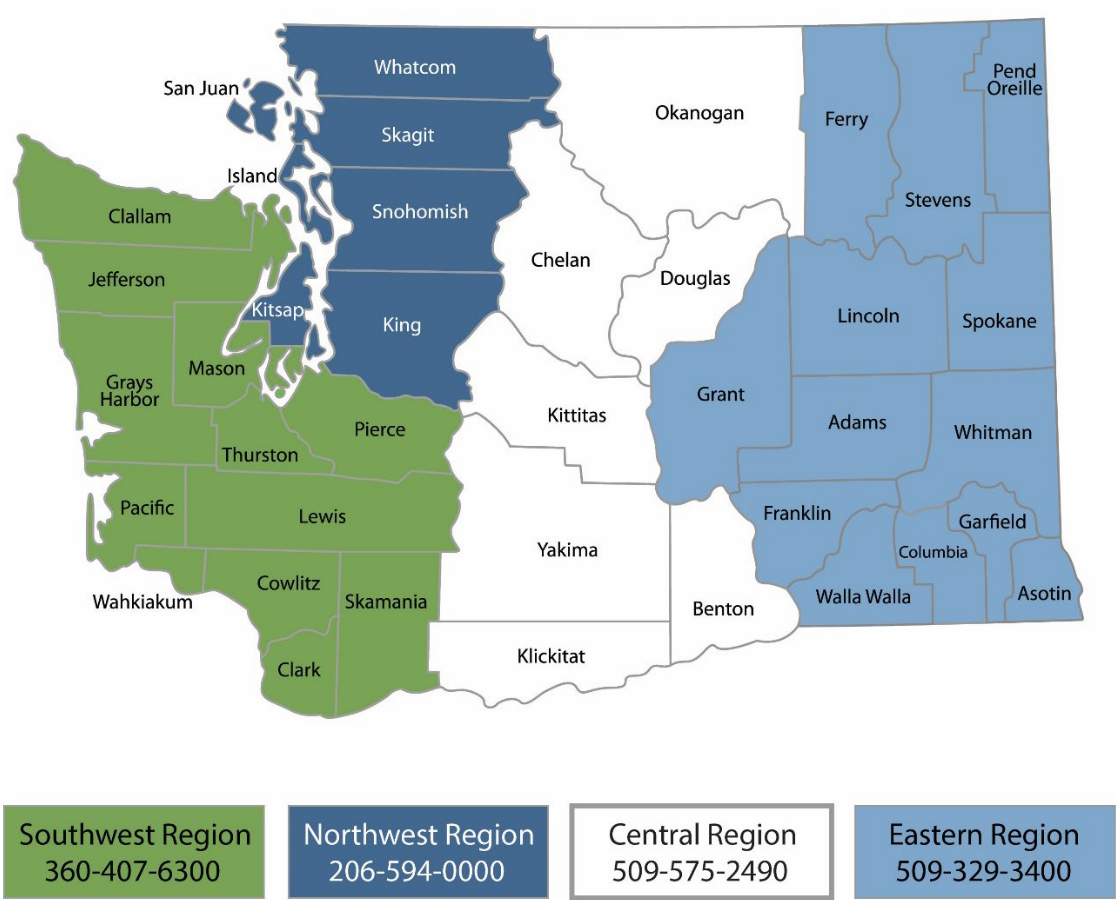

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DEPARTMENT OF ECOLOGY
State of Washington

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Executive Summary

This Health Impact Assessment (HIA) review evaluates and summarizes the health risks from air pollutants emitted by proposed Hanford Site Southern Area Fire Station Emergency Generator. In general, the toxic air pollutant impacts in the area will not result in excessive risks of short- or long- term health effects. Ecology concludes that the health risk is acceptable and recommends approval of the project.

The U.S. Department of Energy (DOE) is proposing to construct and operate a new diesel-fueled emergency generator to supply emergency backup power to a new Southern Area Fire Station near the eastern portion of the 400 Area Fast Flux Test Facility of the Hanford Site. As of September 2021, DOE had not decided what generator make and model they intend to use. The decision was pending review of proposals for construction of the Fire Station. The HIA is based on the assumption the electrical capacity of the generator installed will be no more than 750 kilowatts (kW). Diesel engines emit several toxic air pollutants (TAPs) including two: diesel particulate matter (DPM) and nitrogen dioxide (NO2) that pose higher health risks than the other TAPs that would be emitted by the model chosen for emissions calculations (a Caterpillar C18 750-kW emergency generator with a 1,112-brake horsepower diesel-fueled engine).

The proposed engine is not expected to operate frequently. Planned operation for routine testing, maintenance, and inspection purposes of the engine powering the generator is not expected to exceed to 500 hours per year, and annual emission calculations in this analysis are based on that interval. The engine may emit DPM and NO2 at rates requiring a HIA. The HIA submitted by DOE describes the increased health risks from exposure to TAPs from this new source.

DOE hired a consultant to prepare the HIA for this project.

Conclusions

- Potential for exposures:
  - Diesel engine exhaust contains chemicals in the gas phase, one of which is NO2. Short-term exposures to it can produce irritation of the airways, which can exacerbate respiratory diseases such as asthma and increase symptoms such as coughing, wheezing, and difficulty breathing.
  - The weather conditions conducive to poor dispersion may coincide with operation of the diesel engines sometimes causing higher concentrations of NO2. Meteorological data collected in the Hanford area indicate that poor dispersion conditions occur infrequently. Engine operations are expected to be infrequent, as well. Therefore, hazardous concentrations are rarely excepted and not likely to be sustained for long periods in such events. If the proposed engine had been in place and had run continuously from 2015 through 2019, the highest model-estimated NO2 concentration, would have been 514-µg/m3 in a single hour in that 5-year period. The model showed this highest concentration would have occurred at a point approximately 3-meters from the NE corner of

the proposed Fire Station. The fire station itself is about 250-meters west of the Fast Flux Test Facility. Exposure to 514-µg/m3 of NO2 for one hour is proportionate to a hazard quotient of 1.09 (from the generator itself). Adding that exposure to the exposures from existing background sources of NO2 is proportionate to a hazard quotient of 1.16.

  - Aside from the NO2, the other chemical constituents of diesel engines exhausts are unlikely to result in concentrations high enough to pose respiratory system or other health risks.

- Potential for effects from long-term exposures:
  - Diesel engine exhaust contains particles composed of complex mixtures of solid and liquid phase chemicals. The particles from the proposed engine could increase lifetime cancer risk in the worst-case by up to 5.7-in-one-million at a location near the emergency generator engine next to the Southern Area Fire Station. Worst-case increases lifetime cancer risks in residential areas and workplaces adjacent to the Hanford site are much less than 1-in-one-million.
  - In contrast, the worst-case lifetime cancer risk increase due to exposure to diesel particles from mobile engine sources in the area not part of this permit application may be up to 8.2 per million. The Washington Tracking Network reports the diesel pollution burden in the Hanford area is low.[2]

Ecology's recommendation

Ecology recommends approval of the Fire Station upgrades because:

- Ecology determined that the emission controls proposed for the new emission unit is the best available control technology for toxics (tBACT).
- The applicant demonstrated that the increase in emissions of TAPs is not likely to result in an increased cancer risk of more than one in one hundred thousand (10-in-one-million).
- Ecology determined that non-cancer hazards are acceptable.

[2] https://fortress.wa.gov/doh/wtn/WTNIBL/ accessed Feb.11, 2021

Second Tier Review Processing and Approval Criteria

DOE and their consultant for this project completed and submitted the documents and related information required for Ecology to conduct a Second Tier Review process and to confirm approval criteria under Chapter 173-460 WAC. Ecology is responsible for reviewing Second Tier Review petitions.

Second tier review processing requirements

In order for Ecology to review the Second Tier Petition, each of the following regulatory requirements under Chapter 173-460-090 WAC must be satisfied:

(a) The permitting authority has determined that other conditions for processing the NOC Order of Approval (NOC) have been met, and has issued a preliminary approval order.

(b) Emission controls contained in the preliminary NOC approval order represent at least best available control technology for toxics (tBACT).

(c) The applicant has developed an HIA Protocol that has been approved by Ecology.

(d) The ambient impact of the emissions increase of each toxic air pollutant (TAP) that exceed ASILs has been quantified using refined air dispersion modeling techniques as approved in the HIA protocol.

(e) The second tier review petition contains an HIA conducted in accordance with the approved HIA protocol.

Acting as the permitting authority for this project, Ecology's project permit engineer satisfied item (a)[3] and verified item (b) above on February 22, 2022.[4] Ecology approved the HIA Protocol (item (c)) on June 15, 2021.[5] Ecology confirmed that refined modeling (item (d)) was conducted appropriately,[6] and Ecology Richland Field Office received a HIA (item (e)) on September 30, 2021, then forwarded it to the reviewing Toxicologist and Modeler on January 11, 2022, who

[3] State of Washington Department of Ecology, Notice of Construction Approval Order In the matter of approving a new air contaminant source for Southern Area Fire Station at the Hanford Site. Approval Order No. DE21NWP-001

[4] Technical Support Document, Notice of Construction Approval Order No. DE21NWP-001 for United States Department of Energy – Richland Operations Office (DOE-RL) Hanford Site Richland, WA, Prepared by: John Pulsipher, Professional Engineer, Washington State Department of Ecology, February 22, 2022

[5] From Matthew Kadlec, To Tanya Williams, Subject: [EXTERNAL]RE: Hanford Site - Fire Station HIA Protocol - for your review and approval, Sent: December 15, 2021

[6] From: Beth Friedman, To: Matthew Kadlec, Subject: [EXTERNAL]RE: Hanford Site - Fire Station HIA Protocol - for your review and approval, Sent: January 24, 2022

then determined it had been conducted in accordance with the approved HIA on January 28, 2022.[7]

All five processing requirements above are satisfied.

Second Tier review approval criteria

As specified in Ch. 173-460-090(7) WAC, Ecology may recommend approval of a project that is likely to cause an exceedance of ASILs for one or more TAPs only if it:

(a) Determines that the emission controls for the new and modified emission units represent tBACT.

(b) The applicant demonstrates that the increase in emissions of TAPs is not likely to result in an increased cancer risk of more than one in one hundred thousand.

(c) Ecology determines that the non-cancer hazard is acceptable.

tBACT determination

Ecology's permit engineer determined that the proposed diesel engine meets BACT and tBACT requirements for diesel engines powering backup generators. tBACT control technology requirements are to be met by using an engine compliant with applicable 40 CFR 60 Standards of Performance for New Stationary Sources, Subpart IIII Standards of Performance for Stationary Compression Ignition Internal Combustion Engines, Tier 2 emission standards and compliance with its applicable emergency engine operation and maintenance requirements.

40 CFR 60 Subpart IIII requires that the affected emergency engines burn only ultra-low sulfur diesel (ULSD) having a sulfur content equal to or less than 15 parts per million (ppm) by weight; that the permitted install a no resettable hour meter, and operate the engine according to emergency provisions (i.e., no limit to emergency operation, and 100 hours per year of non-emergency operation, 50 of which can be non-emergency, non-maintenance, and/or non-testing operation); and purchase a certified engine that has a permanent label demonstrating it meets the emission limits in 40 CFR 89.112 and 40 CFR 89.113 applicable for its model year and power rating.

Health Impact Assessment Review

Chapter 173-460-090 WAC requires permit applicants to prepare a HIA. Then an Ecology engineer, toxicologist, and modeler review it to determine if the methods and assumptions are appropriate for assessing and quantifying risks to the surrounding community from a new project.

[7] From: Beth Friedman, To: Matthew Kadlec, Subject: [EXTERNAL]RE: Hanford Site - Fire Station HIA Protocol - for your review and approval, Sent: January 28, 2022

The proposed Hanford Site Southern Area Fire Station Emergency Generator to be located near the 400 Area of the Hanford Site. An aerial photo of the 400 Area and the proposed location of the fire station and its emergency generator are shown in Figure 1. The blue-shaded buildings are ones included in the dispersion model inputs.[8]

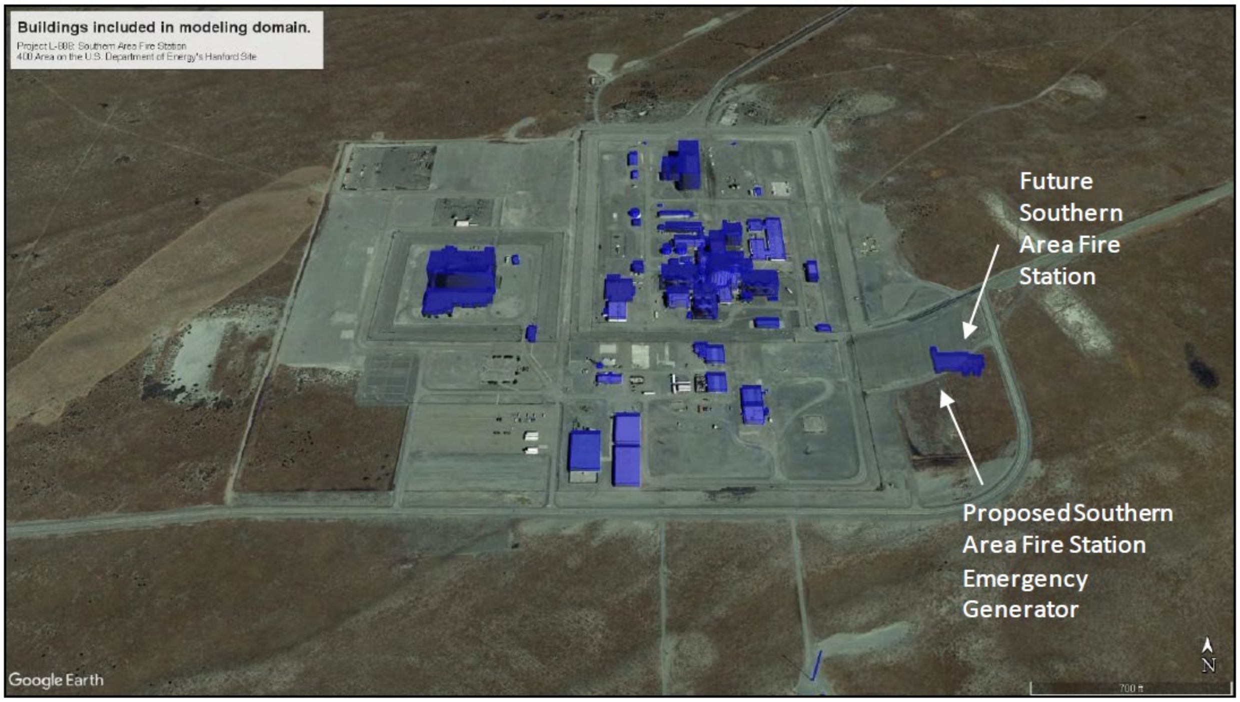

Figure 1: Existing structures and proposed locations of the fire station and its emergency generator in the 400 Area of the Hanford Site

The proposed emergency generator may emit 19 of the TAPs (see Table 1) listed in Ch. 173-460-150 TAPs. Of these, 13 may be emitted at rates at or below their respective de minimis levels. Therefore they are exempt from further First Tier review under Ch. 173-460-080 WAC. Emission rates of the others (Acrolein, Benzene, Carbon monoxide, DPM, Naphthalene, and NO2) may exceed their de minimis levels, therefore a tBACT analysis was conducted. Based on the tBACT accepted by Ecology, the emission rates were quantified then compared to their Small Quantity Emission Rate (SQER) values.

Table 1: Fire station TAP emissions estimates

TAP Common Name	CAS	Avg. Period	Project Emissions Estimate (lbs./avg. period)	*De Minimis* (lb./avg. period)	Exceeds *De Minimis*	SQER (lb./avg. period)	Exceeds SQER
Acetaldehyde	75-07-0	year	9.28E-02	3.00E+00	No	6.00E+01	No
Acrolein	107-02-8	24-hr	1.39E-03	1.30E-03	Yes	2.60E-02	No

[8] Figure 6 of 003138_Attachment_5.pdf (Attachment 5, 21-ECD-003138, DOE/RL-2021-33 Revision 0, Health Impact Assessment for Southern Area Fire Station Emergency, Generator Notice of Construction Application Technical Information)

TAP Common Name	CAS	Avg. Period	Project Emissions Estimate (lbs./avg. period)	*De Minimis* (lb./avg. period)	Exceeds *De Minimis*	SQER (lb./avg. period)	Exceeds SQER
Benz[a]anthracene	56-55-3	year	2.29E-03	4.50E-02	No	8.90E-01	No
Benzene	71-43-2	year	2.86E+00	1.00E+00	Yes	2.10E+01	No
Benzo[a]pyrene	50-32-8	year	9.46E-04	8.20E-03	No	1.60E-01	No
Benzo[b]fluoranthene	205-99-2	year	4.09E-03	4.50E-02	No	8.90E-01	No
Benzo[k]fluoranthene	207-08-9	year	8.03E-04	4.50E-02	No	8.90E-01	No
Carbon monoxide	630-08-0	1-hr	4.73E+00	1.10E+00	Yes	4.30E+01	No
Chrysene	218-01-9	year	5.63E-03	4.50E-01	No	8.90E+00	No
Dibenz[a,h]anthracene	53-70-3	year	1.27E-03	4.10E-03	No	8.20E-02	No
DPM	-	year	1.59E+02	2.70E-02	Yes	5.40E-01	Yes
Formaldehyde	50-00-0	year	2.91E-01	1.40E+00	No	2.70E+01	No
Indeno[1,2,3-cd]pyrene	193-39-5	year	1.52E-03	4.50E-02	No	8.90E-01	No
Naphthalene	91-20-3	year	4.79E-01	2.40E-01	Yes	4.80E+00	No
NO_2	10102-44-0	1-hr	1.43E+01	4.60E-01	Yes	8.70E-01	Yes
o-Xylene	95-47-6	24-hr	3.41E-02	8.20E-01	No	1.60E+01	No
Propylene	115-07-1	24-hr	4.93E-01	1.10E+01	No	2.20E+02	No
Sulfur Dioxide	7446-09-5	1-hr	1.17E-02	4.60E-01	No	1.20E+00	No
Toluene	108-88-3	24-hr	4.97E-02	1.90E+01	No	3.70E+02	No

The maximum modeled concentrations were estimated by air dispersion modeling for TAPs that could be emitted at rates greater than their SQERs (DPM and NO2). This suggested concentrations of both could exceed their ASILs (Table 2). Therefore a Second Tier Analysis Health Impact Assessment to assess potential health hazards and limit public health risks was required under Ch. 173-460-090 WAC.

Table 2: Modeled Fire station TAP concentrations

TAP	Avg. Period	ASIL (µg/m^3)	Maximum Ambient Concentration (µg/m^3 per avg. period)	Exceeds ASIL
DPM	1-year	3.30E-03	2.31E-01	Yes
NO_2	1-hour	4.70E+02	5.14E+02	Yes

DOE’s consultant for this project quantified potential inhalation exposures to DPM and NO2 to evaluate their potentials health risks. Emission rates of the other TAPs were so low no health risk assessment of them was necessary.

Health Effects Summary

The HIA prepared by DOE’s consultant for this project quantifies the non-cancer hazards and increased cancer risks attributable to DPM and NO2 emissions from the proposed Southern Area Fire Station Emergency Generator.

Diesel Particulate Matter health effects summary

Diesel engines emit particles less than 2.5 micrometers (µm) in diameter, which when inhaled deposit in the bronchi and pulmonary regions in the lung. A range of mild to life-threatening effects has been associated with exposure for different durations to various concentrations of DPM.[9] Exposure to DPM in controlled laboratory animal studies has demonstrated its carcinogenicity. Epidemiological evidence among occupationally exposed people, although lacking in well-quantified exposure levels, suggests diesel exhaust may cause lung and bladder cancer. The International Agency for Research on Cancer (IARC) designated DPM as a probable (Group 2A) carcinogen in humans based on sufficient evidence in experimental animals and limited evidence in humans.[10] In the Health Assessment Document for Diesel Engine Exhaust, US EPA Office of Research and Development states that diesel exhaust is a probable human carcinogen.[11] At exposure levels significantly higher than those that may cause cancer, DPM can cause a range of other toxic effects including respiratory illnesses, reproductive, developmental, and immune system impairments. Specifically:

- Eye, nose, and throat irritation along with coughing, labored breathing, chest tightness, and wheezing associated with inflammation and irritation
- Worsening of allergic reactions to inhaled allergens
- Increased likelihood of respiratory infections
- Asthma attacks and worsening of asthma symptoms
- Decreased lung function
- Impaired lung growth in children
- Heart attack and stroke in people with existing heart disease
- Male infertility
- Birth defects

Nitrogen dioxide health effects summary

NO_2 is present in diesel exhaust. It forms when nitrogen, in diesel fuel and air, combines with oxygen. Exposure to NO_2 can cause both long-term (chronic) and short-term (acute) health effects.

Long-term exposure to NO_2 can lead to chronic respiratory illness such as bronchitis and increase the frequency of respiratory illness due to respiratory infections.

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[9] Washington Dept. of Ecology. 2008. *Concerns about Adverse Health Effects of Diesel Engine Emissions.* https://apps.ecology.wa.gov/publications/documents/0802032.pdf, accessed on February 23, 2021

[10] International Agency for Research on Cancer. 1989. *Diesel and Gasoline Engine Exhausts and some Nitroarenes*, IARC Monographs on the Evaluation of Carcinogenic Risks to Humans: Vol 46, World Health Organization, Lyon, France

[11] U.S. Environmental Protection Agency Office of Research and Development. 2002. *Health Assessment Document for Diesel Engine Exhaust.* National Center for Environmental Assessment, Washington, D.C., EPA/600/8- 90/057F, 2002, http://cfpub.epa.gov/ncea/cfm/recordisplay.cfm?deid=29060, accessed on February 23, 2021

Short-term exposure to extremely high concentrations (> 180,000 µg/m³) of NO_2 may result in serious effects including death (National Research Council, 2012).[12] Moderate levels (~ 30,000 µg/m³) may severely irritate the eyes, nose, throat, and respiratory tract, and cause shortness of breath and extreme discomfort. Lower level NO_2 exposure (< 1,000 µg/m³), such as that experienced near major roadways, or perhaps downwind from stationary sources of NO_2, may cause increased bronchial reactivity in some people with asthma, decreased lung function in patients with chronic obstructive pulmonary disease, and increased risk of respiratory infections, especially in young children.

Toxicity Reference Values

Agencies develop toxicity values for evaluating exposures and characterizing risks from chemicals in the environment. As part of the HIA, DOE's consultant for this project identified appropriate toxicity values for DPM and NO_2.

DPM toxicity values

Toxicity values for DPM are available from the US EPA,[13] and from the California EPA Office of Environmental Health Hazard Assessment (OEHHA).[14]

These toxicity values were derived from studies of animals exposed to known amounts of DPM, and epidemiological studies of occupationally exposed humans. They are estimates of exposure levels at or below which adverse non-cancer health effects are not expected, and of a metric by which to quantify increased risk from exposure to a carcinogen. Table 1 shows the appropriate DPM non-cancer and cancer toxicity values used by DOE's consultant for this project.

US EPA's reference concentration (RfC) and OEHHA's reference exposure level (REL) for diesel engine exhaust (measured as DPM) was derived from dose-response data on inflammation and changes in the lung from rat inhalation studies. Each agency established a level of 5 µg/m³ as

[12] National Research Council: Committee on Acute Exposure Guideline Levels; Committee on Toxicology; Board on Environmental Studies and Toxicology; Division on Earth and Life Studies (2012), The National Advisory Committee for the Development of Acute Exposure Guideline Levels for Hazardous Substances (AEGL Committee), Acute Exposure Guideline Levels for Selected Airborne Chemicals: Volume 11 <http://www.epa.gov/sites/production/files/2015-09/documents/nitrogen_oxides_volume_11_1.pdf>

[13] United States Environmental Protection Agency, Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part F, Supplemental Guidance for Inhalation Risk Assessment), January 2009 <https://www.epa.gov/sites/production/files/2015-09/documents/partf_200901_final.pdf>

United States Environmental Protection Agency, 2014 National Air Toxics Assessment, Released to the Public on August 22, 2018 < https://www.epa.gov/national-air-toxics-assessment >

[14] California Environmental Protection Agency, Office of Environmental Health Hazard Assessment, Air Toxicology and Epidemiology Section. For the "Proposed Identification of Diesel Exhaust as a Toxic Air Contaminant" Part B: Health Risk Assessment for Diesel Exhaust. May, 1998 <https://oehha.ca.gov/media/downloads/air/document/partb.pdf >

the concentration of DPM in air at which long-term exposure is not expected to cause adverse non-cancer health effects.

OEHHA derived a unit risk factor (URF) for estimating cancer risk from exposure to DPM. The URF is based on a meta-analysis of several epidemiological studies of humans occupationally exposed to DPM. In these studies, DPM exposure was estimated from measurements of filterable fractions of elemental carbon and respirable particulate in diesel exhaust. Therefore, some condensable particulate matter may have been excluded when assessing health risks; however, the OEHHA URF is based on the most commonly used measure of the atmospheric concentration of particles: The mass of particles collected on a filter per volume of the air that flowed through the filter. This exhaust fraction contains filterable solid and condensed liquids. Concentrations DPM defined this way was considered when determining the Fire Station Upgrade application NOC's compliance with the National Ambient Air Quality Standards and in the HIA.

The URF is expressed as the upper-bound probability of developing cancer, assuming continuous lifetime exposure to a substance at a concentration of one microgram per cubic meter (1 $\mu g/m^3$), and are expressed in units of inverse concentration [*i.e.,* ($\mu g/m^3$)-1]. OEHHA's URF for DPM is 0.0003 per $\mu g/m^3$ meaning that a lifetime of exposure to 1 $\mu g/m^3$ of DPM could increase an average person's risk of developing cancer by 0.03 percent, or cause 300 cancer cases per million people exposed.

NO_2 toxicity values

OEHHA developed an acute REL for NO_2 based on studies its effects on humans.[15] These studies found that some people with asthma experienced increased airway reactivity following inhalation of about 0.25 ppm of NO_2 (470 $\mu g/m^3$, 1-hour average).

The US EPA has promulgated annual and 1-hour National Ambient Air Quality Standards (NAAQS) for NO_2, 53 and 100 ppb respectively (equivalent to 102 and 192 $\mu g/m^3$ at 20°C, 1-atmosphere). Modeling was performed for the NOC Application for compliance with WAC 173-400-113(3), in order to determine if operation of the emergency generator would cause or contribute to a violation of NAAQS for NO_2 due to pollutant exceedance of the WAC 173-400-110(5) exemption thresholds. The predicted modeled concentrations for comparison to the NAAQS showed that the project would not cause or contribute to a violation of the NAAQS Compliance with these NAAQS was demonstrated as part of the NOC application process for the Hanford Site Southern Area Fire Station Emergency Generator.[16]

[15] California Environmental Protection Agency, Office of Environmental Health Hazard Assessment, Technical Support Document for Noncancer RELs Appendix D2: Acute RELs and toxicity summaries using the previous version of the Hot Spots Risk Assessment guidelines. December 2008 <https://oehha.ca.gov/media/downloads/crnr/appendixd2final.pdf>

[16] Technical Support Document, Notice of Construction Approval Order No. DE21NWP-001 for United States Department of Energy – Richland Operations Office (DOE-RL) Hanford Site Richland, WA, Prepared by: John Pulsipher, Professional Engineer, Washington State Department of Ecology, February 22, 2022

The Washington State Department of Labor and Industries has established a Permissible Exposure Level - Short-term exposure limit for workers of 1-ppm or 1880-µg/m^3 NO_2 for fifteen-minute exposure periods (WAC 296-841-20025). This is noteworthy but not intended for protection of the general public.

Community receptors

DOE's consultant for this project assessed appropriate receptors and locations where the highest exposures to the emitted air pollutants could occur near the proposed Southern Area Fire Station Emergency Generator.

Aside from DOE-operated facilities, no commercial buildings are within the modeled ASIL exceedance areas. Likewise, no existing residential buildings or residential land-use zones are within the modeled ASIL exceedance areas. Table 3 notes the nearest habitable areas to the proposed Southern Area Fire Station. The Station is located outside the Hanford Federal Reserve ambient air boundary.

Table 3: Nearest habitable areas to the proposed Southern Area Fire Station

Distance to proposed generator (Km)	Location
3.3	The Kootenai building, the nearest building in the Columbia Generation complex, operated by Energy Northwest
4.5	The closest point of the LIGO facility, operated by Caltech and MIT
5.7	A currently undeveloped area within a Benton County light industrial land use zone
7.3	The closest shore of the Columbia River
7.5	The closest point on Highway 240
7.5	The closest point of Horn Rapids County Park (Benton Co.)
7.6	A Benton County RL-5 land use zone

Sources: Benton County land use zoning and Google Maps

Typically, HIAs evaluate maximally-impacted boundary receptor (MIBR) locations where the highest concentration of TAPs of interest could occur near an ambient air perimeter boundary to publicly-accessible land. In this case, the proposed generator set will be outside of the ambient air boundary so DOE's consultant for this project evaluated short-duration periodic exposures at the maximally-impacted receptor (MIR). DOE employees or contractors are more likely than members of the public are to ever be present at the MIR.

DOE's consultant for this project also evaluated the maximally-impacted angler receptors (MIAR) to account for potential exposures to people fishing in the Columbia River. Specifically those participating in the Pikeminnow Sport Reward Fishery Program, which is funded by the Bonneville Power Administration and administered by the Pacific States Marine Fisheries Commission. The Program pays anglers for each Northern Pikeminnow caught.

DOE's consultant for this project also evaluated project-attributable exposures that could occur at places children or elderly people or people with respiratory illnesses are likely to be. No daycares, preschools, K-12 schools, convalescent homes, or hospitals are located less than 12-kilometers from the proposed generator in any direction.

Exposure assessment

DOE's consultant for this project evaluated prolonged and frequent project-attributable pollutant exposure times. The durations and age group sensitivity factors (Table 3) they used to evaluate cancer risks are sufficient for estimating the most extreme residential, commercial, angler, and MIR exposure scenarios.[17]

Table 4: Parameters to calculate exposures for cancer risk assessments

Exposure Parameter	Resident (MIRR)			Commercial (MICR)	Angler (MIAR)	Maximum (MIR)	School (MISR)	LIGO Student (MILR)	Hospital (MIHR)	Long-Term Care (MILCR)	Daycare (MIDR)	
	Adult	Child 0-2	Child 2-16								Child 0-2	Child 2-6
ET (hours per day)	24	24	24	8	4	2	8	4	4	24	8	8
EF (days per year)	350	350	350	250	180	250	180	30	250	350	250	250
ED (years)	54	2	14	40	30	30	15	15	40	10	2	4
AT (hours; 70 years x 365 days/year x 24 hrs/day)	613,200	613,200	613,200	613,200	613,200	613,200	613,200	613,200	613,200	613,200	613,200	613,200
Age Sensitivity Factor	1	10	3	1	1	1	3	3	1	1	10	3
Fraction of 70-Year Continuous Exposure	0.740	0.274	0.575	0.130	0.035	0.024	0.106	0.009	0.130	0.137	0.065	0.039

AT = averaging time
ED = exposure duration
EF = exposure frequency
ET = exposure time
MIAR = maximally-impacted angler receptor
MICR = maximally-impacted commercial receptor
MIDR = maximally-impacted daycare receptor
MIHR = maximally-impacted hospital receptor
MILR = maximally-impacted LIGO receptor
MILCR = maximally-impacted long-term care receptor
MIR = maximally-impacted receptor
MIRR = maximally-impacted residential receptor
MISR = maximally-impacted school receptor

[17] Table 17 of 003138_Attachment_5.pdf (Attachment 5, 21-ECD-003138, DOE/RL-2021-33 Revision 0, Health Impact Assessment for Southern Area Fire Station Emergency, Generator Notice of Construction Application Technical Information)

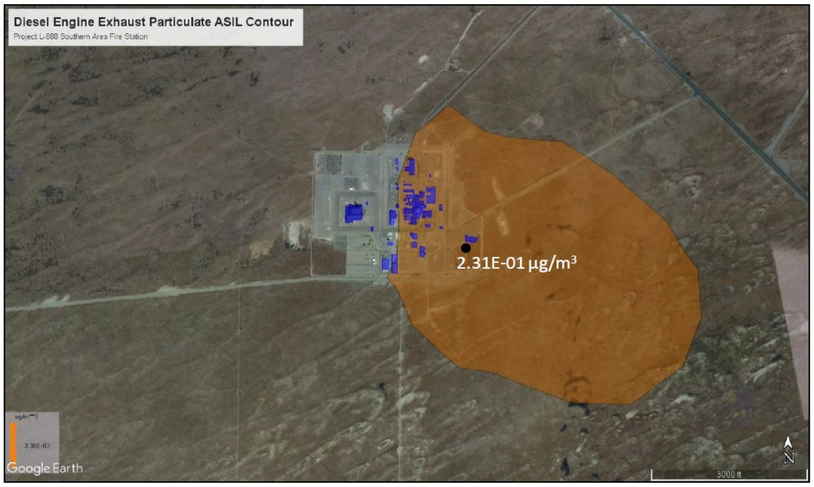

Figure 2: Modeled DPM greater-than-ASIL impact area near Southern Area Fire Station Emergency Generator

Highest annual average: (2015) 2.31E-01-µg/m^3.[18]

Figure 3: Modeled NO_2 greater-than-ASIL impact area near Southern Area Fire Station Emergency Generator

Highest 1-hour average: (an hour sometime in 2019) 514-µg/m^3.[19]

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[18] Figure 3 of 003138_Attachment_5.pdf (Attachment 5, 21-ECD-003138, DOE/RL-2021-33 Revision 0, Health Impact Assessment for Southern Area Fire Station Emergency, Generator Notice of Construction Application Technical Information)

[19] Figure 4 of 003138_Attachment_5.pdf (Attachment 5, 21-ECD-003138, DOE/RL-2021-33 Revision 0, Health Impact Assessment for Southern Area Fire Station Emergency, Generator Notice of Construction Application Technical Information)

Figures 2 and 3 show the greatest DPM and NO_2 impact areas adjacent to the proposed Fire Station emergency generator that could result from its diesel engines. The greater-than-ASIL impact area of DPM is about 2.9-km^2. Only one receptor point exceeded the NO_2 ASIL.

Health Risks

DOE's consultant for this project assessed the increased lifetime risk of cancer from exposure to DPM emitted from the Fire Station emergency generator engine, and the cumulative risks posed by it together with the existing levels of DPM from other sources in the region. They also assessed the non-cancer health hazards posed by exposure to NO2 and of DPM from the engine, and cumulative risks posed by them with the existing NO2 and DPM from other sources in the region.

For these risk characterizations, the results of the exposure and toxicity assessments were integrated into quantitative estimates. DOE's consultant made quantified estimates of cancer risk and non-cancer hazard for the MICR, MIR, and the other receptor scenarios listed in Table 3.

Increased risks of cancer attributable to the Southern Area Fire Station Emergency Generator and existing sources

Cancer risks were estimated in a manner consistent with US EPA guidance for inhalation risk assessment[20] using the following equations:

Risk Increase = IUR x EC

Where: IUR = Inhalation Unit Risk (Unit Risk Factor) (µg/m3)-1

EC = exposure concentration (µg/m3)

EC = (CA x ET x EF x ED) ∕ AT

Where: CA = contaminant concentration in air (µg/m3)

ET = exposure time (hours/day)

EF = exposure frequency (days/year)

ED = exposure duration (years)

AT = 70 (average lifetime years)

The MICR assumes an 8-hour workday, 250 days per year for 40 years.

The MIR assumes the highest concentration receptor near the engine with no facility fence line. The MIR is assumed at the highest receptor for 2 hours per day, 250 days per year for 30 years.

[20] United States Environmental Protection Agency, Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part F, Supplemental Guidance for Inhalation Risk Assessment), January 2009, <https://www.epa.gov/sites/production/files/2015-09/documents/partf_200901_final.pdf>

The duration of exposure was set to account for any uncertainty in the future 400 area Hanford Site usage.

By applying the available URFs noted in the Toxicity Reference Values section of this review, DOE's consultant for this project estimated the increases in cancer risks that could result from emissions by the proposed Fire Station Emergency Generator diesel engine. They also obtained estimates of increased cancer risks from existing diesel engines in the Hanford area using data from the latest US EPA *National Ambient Toxics Assessment* (NATA)[21][22] and evaluated overall cancer risks attributable to both the Fire Station emergency generator and the background DPM concentration in the appropriate census tract.

The NATA estimate of the annual average concentration of DPM is 0.104-µg/m3 in the census tract covering the Fire Station Emergency Generator engine's MIR and MICR.[23]

Table 5: DPM concentrations modeled in the 2014 NATA and with AERMOD for the proposed engine emissions

	Location	DPM µg/m^3, annual Time-Weighted Average (TWA)
Project AERMOD	MIR	2.31E-01
	MICR	1.61E-02
NATA	Nearest grid point to the MIR	1.04E-01
	Nearest grid point to the MICR	1.04E-01

The cancer risk attributable to the background DPM concentration was added to the calculated cumulative cancer risk increases attributable to the project emissions.[24] The MIR and MICR were the only places with maximal impacts of the Fire Station Emergency Generator diesel engine where its DPM emissions would increase cancer risk by more than one-in-one-million

[21] United States Environmental Protection Agency, 2014 National Air Toxics Assessment. Released to the Public on August 22, 2018. < https://www.epa.gov/national-air-toxics-assessment >

[22] "Background Concentrations for Exposure" section 6.2.3 of 003138_Attachment_5.pdf (Attachment 5, 21-ECD-003138, DOE/RL-2021-33 Revision 0, Health Impact Assessment for Southern Area Fire Station Emergency, Generator Notice of Construction Application Technical Information)

[23] Adapted from Table 18 of 003138_Attachment_5.pdf (Attachment 5, 21-ECD-003138, DOE/RL-2021-33 Revision 0, Health Impact Assessment for Southern Area Fire Station Emergency, Generator Notice of Construction Application Technical Information)

[24] "Risk Characterization" section 8 of 003138_Attachment_5.pdf (Attachment 5, 21-ECD-003138, DOE/RL-2021-33 Revision 0, Health Impact Assessment for Southern Area Fire Station Emergency, Generator Notice of Construction Application Technical Information)

(1E-06). The estimated increase in lifetime cancer risks at those locations are shown in Table 5.[25]

Table 6: Estimated increase in lifetime cancer risks at locations where modeled DPM concentrations are greater than the ASIL

DPM	Project		Project + Background	
	US EPA	OEHHA	US EPA	OEHHA
Maximum impact receptor	5.7E-08 to 5.7E-06	1.7E-06	8.2E-08 to 8.2E-06	2.5E-06
Maximum impact commercial receptor	2.1E-08 to 2.1E-06	6.3E-07	1.6E-07 to 1.6E-05	4.7E-06

At the MIR, approximately 69% of diesel engine emissions cancer risk will be from the Hanford Site Southern Area Fire Station Emergency Generator engine, with the remainder from existing diesel engines' emissions. Likewise, at the MICR, 13% of diesel emissions cancer risk will be from the Emergency Generator engine, the remainder from other existing DPM sources in the area.

The highest possible increase in cancer risk attributable to the Fire Station Emergency Generator engine emissions is less than six per million at the MIR point (see Figure 1) which is less than Ecology's project approval threshold of 1E-05.[26] The project's attributable cancer risk is less than 1% at all other receptors. Cancer risk increases for the other exposure scenarios are all predicted to be no more than 2.1E-06. Benzene and naphthalene likely to be emitted by the engine may add at most 0.22% to the cancer risk relative to risk from the DPM.

Increased risk of non-cancer health impacts attributable to Southern Area Fire Station Emergency Generator and existing sources

DOE's consultant for this project assessed the non-cancer health hazards from exposure to TAPs emitted from the Fire Station emergency generator engine. They also assessed the cumulative hazards posed by them together with existing levels of these TAPs from other sources in the area. They integrated acute and chronic exposures to NO2 and DPM with toxicity assessments to derive quantitative estimates of potential health hazards for the MIR, MICR, and other

[25] Adapted from Table 22 in "Background Concentrations for Exposure" section 6.2.3 of 003138_Attachment_5.pdf (Attachment 5, 21-ECD-003138, DOE/RL-2021-33 Revision 0, Health Impact Assessment for Southern Area Fire Station Emergency, Generator Notice of Construction Application Technical Information)

[26] 1E-5 is an upper-bound theoretical estimate of the number of excess cancers that might result in an exposed population of one hundred thousand people compared to an unexposed population of the same size. Alternatively, an average person's increase in risk of one in one hundred thousand means their lifetime chance of getting cancer increases by one in one in one hundred thousand (0.001 percent).

exposure scenarios.[27] They quantified the hazards in a way consistent with US EPA guidance for inhalation risk assessment[28] using the following equation:

HQ = EC ⁄ Toxicity Value

Where: HQ = hazard quotient (unitless)

EC = exposure concentration (the contaminant concentration in air) (µg/m^3)

Toxicity Value = Inhalation toxicity value (e.g., RfC, REL) for the exposure scenario (acute or chronic) (µg/m^3)

By applying the OEHHA REL and US EPA RfC values noted in the Toxicity Reference Values section to the highest modeled concentration estimates, DOE's consultant project estimated the increases in health hazards that could result from the Fire Station Emergency Generator engine. As noted in Table 6, the maximum 1-hour average concentration of NO_2 (514-µg/m^3) exceeded its ASIL in only one location: The MIR. The highest concentration at the next most impacted receptor location, the MICR, did not exceed the ASIL.

Table 7: NO_2 as modeled by NW Air Quest and with AERMOD for the proposed generator emission[29]

	Location	**NO_2 µg/m^3, 1-hr TWA**
Project AERMOD	MIR	5.14E+02
	MICR	4.09E+02
NW Air Quest	Nearest grid point to MIR	3.08E+01
	Nearest grid point to MICR	3.08E+01

[27] Risk Characterization section of 003138_Attachment_5.pdf (Attachment 5, 21-ECD-003138, DOE/RL-2021-33 Revision 0, Health Impact Assessment for Southern Area Fire Station Emergency, Generator Notice of Construction Application Technical Information).

[28] United States Environmental Protection Agency, Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part F, Supplemental Guidance for Inhalation Risk Assessment), January 2009. <https://www.epa.gov/sites/production/files/2015-09/documents/partf_200901_final.pdf>

[29] Adapted from Table 18 of 003138_Attachment_5.pdf (Attachment 5, 21-ECD-003138, DOE/RL-2021-33 Revision 0, Health Impact Assessment for Southern Area Fire Station Emergency, Generator Notice of Construction Application Technical Information)

Table 8: Non-cancer hazards quotients of the worst-case 1-hour exposures at the outdoor maximum impact receptor and maximum impact commercial impact receptor

DPM		Project		Project + Background	
		US EPA	OEHHA	US EPA	OEHHA
Maximum impact receptor	**NO_2, 1-hr**	-	1.09E+00	-	1.16E+00
	DPM, annual	3.21E-03	3.21E-03	2.41E-02	2.41E-02
Maximum impact commercial receptor	**NO2, 1-hr**	-	8.69E-01	-	9.35E-01
	DPM, annual	1.06E-04	1.06E-04	2.78E-02	2.78E-02

The calculated acute (1-hour) HQ attributable to Fire Station Emergency Generator engine emissions is 1.09 for the MIR, and 1.16 (6% more) with the additional NO2 from background sources. HQ values greater than one indicate potential hazard: In this case, respiratory system effects from short-term exposure to the emissions. The acute HQ exceedance is at a single receptor in close proximity to the engine. It is possible people with heightened sensitivity to NO2 - such as some people with asthma - could suffer short high exposures near the proposed engine during calm wind conditions with poor dispersion. They occur 3.1% of the time in the Hanford area as shown in Figure 4.[30] However, the engine is in a remote location and not expected to operate frequently. The combined probability of engine operation during calm conditions when a NO_2-sensitive person present is very low.

The highest calculated chronic (annual) HQ attributable to Fire Station Emergency Generator DPM engine emissions for any exposure scenario is 3.21E-03. This is much less than one indicating very little health risk potential itself. It adds at most 0.321% to the respiratory effects of the separately quantified acute hazard from NO_2.

[30] Figure 5 of 003138_Attachment_5.pdf (Attachment 5, 21-ECD-003138, DOE/RL-2021-33 Revision 0, Health Impact Assessment for Southern Area Fire Station Emergency, Generator Notice of Construction Application Technical Information)

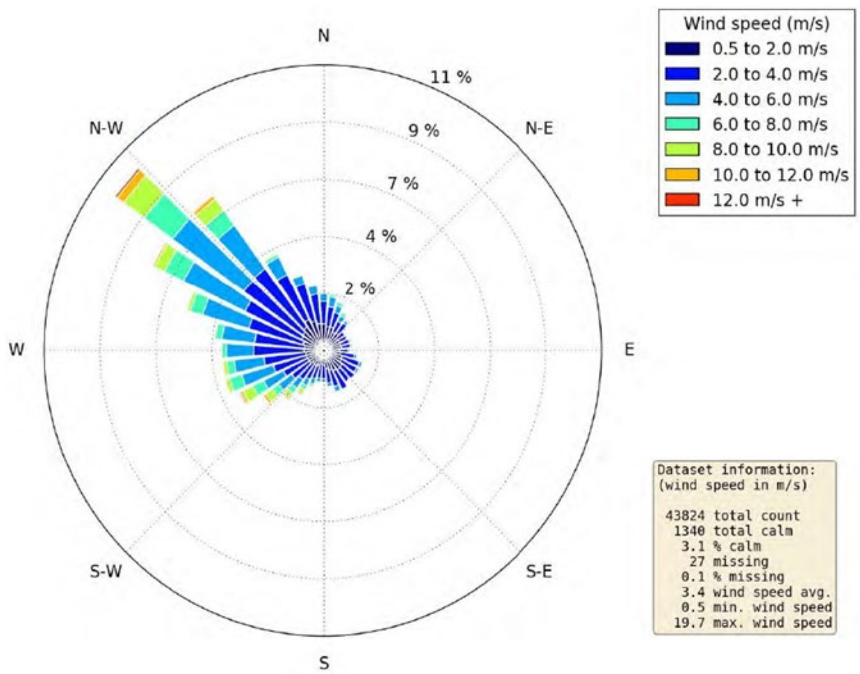

Figure 4: Hanford Meteorological Station wind rose for 2015 through 2019

Aside from NO2, DPM and the other TAPs emitted by the proposed generator engine will not add to the respiratory hazard measurably. The potential of Hanford Site Southern Area Fire Station Emergency Generator emissions to cause non-cancer health effects at its maximally impacted receptors is predicted to be acceptable everywhere except right next to the Fire Station nearly all of the time. If people happen to be exposed to concentrations greater than 470-µg/m3 for an hour or more, those with existing respiratory illnesses may experience temporary chest tightness or labored breathing during physical exertion.

Uncertainty

Uncertainty may be defined as imperfect knowledge concerning the present and future conditions of a system under consideration. In risk assessments undertaken in support of regulatory decisions, there are many uncertainties. Careful consideration of them allows us to assess the dependability of risk decisions.

Evaluating potential impacts of the Hanford Site Southern Area Fire Station Emergency Generator engine involves elements including pollutant emissions rates, air dispersion modeling, and resulting ambient concentrations and exposures, as well as exposure-response relationships to estimate the possibilities of different types of health impacts. Each of these elements is encumbered by uncertain science and measurement variability that prevents absolute confidence in predictions about adverse health impacts of this project.

To the extent that people may be exposed to emissions of TAPs from the proposed Emergency Generator engine, and despite the uncertainties in concentration estimates, exposure estimates, cancer potency estimates, and respiratory hazards, the potential health risks appear to be acceptable. Quantitative assessments of the effects of the emissions impacts on human health cannot be made with greater confidence. The uncertainties are summarized in Table 9.

Table 9: Qualitative summary of how uncertainties affect the estimated risks and hazards

Source of Uncertainty	Effects on estimated risks and hazards
Emissions estimates	Likely to overestimate risks initially but to underestimate risk in coming decades
Concentration modeling	Possible underestimate of long-term risks and possible overestimate of acute risks
Exposure assumptions	Likely to slightly overestimate risks
Toxicity of emissions	Possible overestimate of cancer risk, and possible underestimate of non-cancer hazards for extremely sensitive people

Emissions uncertainty

Emissions uncertainty includes measurement uncertainty and process variability. The emissions factors used to estimate emission rates from the proposed new diesel engine generator are estimates of central tendency of measured emissions from comparable diesel engines.

DOE's consultant for this project calculated emissions using data provided in the engine manufacturer's specifications and the US EPA AP-42[31] guidance for large internal combustion diesel engines, Tier 2 average emission limits, as emission factors for DPM and NO2. These emission factors are just as likely to underestimate as to overestimate emissions. No quantitative description of uncertainty and variability consistent with available data is available.

The consultant also accounted for uncertainties in the variation of engine operating loads. It is not operationally feasible to run an engine a full hour at 10% load, the high for diesel engine exhaust particulate, and at 100% load, the high for nitrogen dioxide. They calculated worst-case emissions applying the maximum emission rate of each tested pollutant across all the loads. The cumulative emissions by this method are likely to be an overestimate. It is expected the engine will be actually be operated at loads greater than 30% in most instances.

Further uncertainty in the diesel generator emissions estimates comes from the increasing possibility of emergency operation of the generators as increasing regional electricity

[31] U S. Environmental Protection Agency. 1996. AP-42, Volume I, Chapter 3.4

demand[32][33][34] coincides with increasingly uncertain generation capacity from diminishing stream flows resulting from climate change.[35] Consistent hydroelectric power production over the next century in eastern Washington is uncertain. According to a study[36] by UW scientists:

> ". . . *substantial changes in the amount and seasonality of energy supply and demand in the PNW are likely to occur over the next century in response to warming, precipitation changes, and population growth. For the 2020s, regional hydropower production increases by 0.5-4% in winter, decreases by 9-11% in summer, with annual reductions of 1-4%. Slightly larger increases in winter, and summer decreases, are projected for the 2040s and 2080s*."

In general, it appears that the overall risk of emergency generator operation is low now but that it will increase over time

Concentration modeling uncertainty

TAP concentration modeling uncertainty results from uncertainties about future meteorology, and the measurement variability and applicability of past meteorological conditions of the air data used for the current analyses. Additionally, TAP concentrations uncertainty arises from uncertainty in the precision and accuracy of the air quality dispersion model used: The US EPA AERMOD and its pre- and post-processors. The models are frequently updated as techniques that are more accurate become known, but are written to avoid underestimating the modeled impacts. Even if all of the input parameters to an air dispersion model were known precisely, random fluctuations in the atmosphere would continue to induce some uncertainty.

AERMOD has a tendency to over predict in low wind conditions for some source types. It may slightly overestimate high end 1-hour average impacts and somewhat underestimate the annual concentrations, as is typical of other steady-state Gaussian dispersion models.

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[32] In May 2001, the Bonneville Power Administration asked ten aluminum smelters in the Pacific Northwest to close for two years, to reduce electricity consumption in the area. Reported in *The Outlook, WALL ST. J Online*, and May 21, 2001.

[33] http://openjurist.org/126/f3d/1158/association-of-public-agency-customers-inc-v-bonneville-poweradministration-and-utility-reform-proj

[34] Effects of projected climate change on energy supply and demand in the Pacific Northwest and Washington State Hamlet, A.F., S.Y. Lee, K.E.B. Mickelson, and M.M. Elsner, 2009, Effects of projected climate change on energy supply and demand in the Pacific Northwest and Washington State, Chapter 4 in *The Washington Climate Change Impacts Assessment: Evaluating Washington's Future in a Changing Climate*. Climate Impacts Group, University of Washington, Seattle, Washington < http://www.cses.washington.edu/db/pdf/wacciach4energy647.pdf >

[35] *Ibid*

[36] *Ibid*

Additional uncertainty arises in our estimate of NOx to NO2 conversion in the atmosphere.[37] DOE's consultant for this project used an "ambient ratio method" input to AERMOD for estimating NO2 concentrations. They applied a NOx: NO2 conversion ratio of 0.2211 based on information appropriate for standby generators from a US EPA database of in-stack testing of NOx speciation results.

Natural variation in meteorological conditions year-to-year will also effect the concentrations of the emitted TAPs. Given this natural variation a 70-year average concentration estimate, as would be ideal for cancer risk assessment, would be of uncertain reliability. To minimize the chance of under estimating cancer risk, DOE's consultant evaluated the highest concentration impact year among the five modeled years: 2015 to 2019.

Exposure uncertainty

Exposure uncertainty results from potential inaccuracies of assumptions about the time people will spend in various locations. The one location that could be affected by the Hanford Site Southern Area Fire Station Emergency Generator engine emissions at toxicologically relevant concentrations is the MIR. DOE's consultant for this project evaluated an extremely high exposure scenario for people entering this location. This ensured that uncertainty and variability are accounted for as much as possible and that maximal exposures are not underestimated, but it is likely to have overestimated the extent of exposures that will actually occur.

Toxicity uncertainty

Toxicity uncertainty results from potential inaccuracies in the RBCs used in a risk assessment. RBCs are based on inherently variable experimental toxicology and observational epidemiological studies. Further, the methods and sources US EPA and OEHHA used to develop the DPM and NO2 RfCs and RELs differ. The contractor dealt with these differences adequately by carrying all these values through the risk characterization.

To avoid underestimating the true cancer potency of DPM, OEHHA based the URF on upper confidence limits of response data. In this way, they attempted to ensure that uncertainty and variability were addressed and to avoid underestimating actual risks. Thus, the cancer risks quantified in this technical analysis are theoretical estimates of the highest possible risks.[38]

Although the US EPA classifies DPM as probably carcinogenic to humans, they have not established a URF for quantifying cancer risk. In their Health Assessment Document for Diesel Exhaust, they determined that "human exposure-response data are too uncertain to derive a confident quantitative estimate of cancer unit risk based on existing studies." However, they

[37] Most of the NO_X emitted from diesel engines is nitric oxide, which is not currently a listed TAP in Chapter 173-460-150 WAC.

[38] A URF is the upper-bound of a confidence interval around, most typically, a mean of expected carcinogenic response at a given concentration. The 95 percent confidence interval for a mean is the range of values that will contain the true population mean 95 percent of the time.

suggested that a URF based on existing DPM toxicity studies would range from 1E-05 to 1E-03 per µg/m^3. OEHHA's DPM URF (3E-04 per µg/m^3) falls within that range.

Lastly, other sources of uncertainty cited in the US EPA Health Assessment Document for Diesel Exhaust are the lack of knowledge about the underlying mechanisms of its toxicity, and the question of whether the studies of emissions from engines of older designs are relevant to emissions from current-technology engines.

Conclusions and Recommendation

The project review team has reviewed the HIA and determined that:

(a) The TAP emissions estimates presented by DOE for this project are reasonable estimates of the Southern Area Fire Station emergency generator engine emissions.

(b) Emission controls for the new emission unit meets the tBACT requirement.

(c) The ambient impact of the emissions increase of each TAP that exceeds ASILs has been quantified using appropriate refined air dispersion modeling techniques.

(d) The HIA submitted by DOE adequately assesses project-related increased health risks attributable to TAP emissions.

In the HIA, DOE's consultant estimated lifetime increased cancer risks attributable to DPM and other TAP emissions from the Fire Station emergency generator engine. The engine emissions resulted in a worst-case increase cancer risk of about 5.7-in-one-million at the Maximum impact receptor.

DOE's consultant for this project assessed the cumulative health risk by adding estimated concentrations attributable to the emergency generator engine emissions to an estimated background DPM concentration. The maximum cumulative cancer risk from exposure to DPM in the vicinity of the proposed Fire Station is approximately 8-in-one-million.

DOE's consultant also assessed chronic and acute non-cancer hazards attributable to the project emissions and determined that long-term adverse non-cancer health effects are not likely to occur. However, acute respiratory hazards, are possible when the engine is in use during unfavorable pollutant dispersion conditions. This impact may affect some people who have existing respiratory conditions such as asthma resulting in chest tightness or labored breathing with exercise. In some cases, healthy people may also experience adverse effects such as headaches. Symptoms related to high exposure episodes would resolve once cleaner air conditions resume. Because poor-dispersion weather conditions are not expected to occur frequently and because the generator will be used mainly during emergencies, high concentrations that could produce these hazards are expected to occur only rarely and are unlikely to be sustained for long periods. The non-cancer hazard from exposure to project emission together with existing background levels of the TAPs is about 6% greater than the hazard of the project emissions alone.

Finally, the project review team concludes that the HIA represents an appropriate estimate of potential increased health risks posed by TAP emissions. The risk manager may recommend approval of the permit because:

- The cancer risk from toxic air pollutant emissions is less than the maximum risk (10 in one million) allowed by a Second Tier review.
- Long-term non-cancer hazards are very low, and short-term non-cancer hazards, although possible, are not likely to occur frequently, but likely to be mild in terms of illness severity when they do occur.

Acronyms

AERMOD	American Meteorological Society/Environmental Protection Agency Regulatory modeling system
ASIL	acceptable source impact level
AT	averaging time
CAS	Chemical Abstract Service number
DOE	U.S. Department of Energy
EC	exposure concentration
ED	exposure duration
EF	exposure frequency
ET	exposure time
HIA	Health Impact Assessment
HQ	hazard quotient
kW	kilowatt
LIGO	Laser Interferometer Gravitational-Wave Observatory
MIAR	maximally-impacted angler receptor
MIBR	maximally-impacted boundary receptor
MICR	maximally-impacted commercial receptor
MIDR	maximally-impacted daycare receptor
MIHR	maximally-impacted hospital receptor
MILCR	maximally-impacted long-term care receptor
MILR	maximally-impacted LIGO receptor
MIR	maximally-impacted receptor
MIRR	maximally-impacted residential receptor

MISR	maximally-impacted school receptor
NAAQS	National Ambient Air Quality Standards
NATA	National-Scale Air Toxics Assessment
NOC	Notice of Construction
NW	Northwest
OEHHA	California Office of Environmental Health Hazard Assessment
PAH	polycyclic aromatic hydrocarbon
PM	particulate matter
ppm	parts per million
REL	reference exposure level
RfC	reference concentration
SQER	small quantity emission rate
TAP	toxic air pollutant
TWA	Time-Weighted Average
tBACT	Best Available Control Technology for toxics
ULSD	ultra-low sulfur diesel
US EPA	Environmental Protection Agency
WAC	Washington Administrative Code