

# ENGINEERING EVALUATION

**Ensign Sonoma Healthcare Center**  
**Application: 23483**  
**Plant: 20829**

1250 Broadway, Sonoma, CA 95476

## **BACKGROUND**

**Ensign Sonoma Healthcare Center** has applied to obtain an Authority to Construct (AC) for the following equipment:

**S-1 Emergency Standby Diesel Generator Set,  
John Deere, Model 606HF485, Model Year 2011  
315 BHP, 1.86 MMBTU/hr**

The Emergency Diesel Engine Generator Set (S-1) is equipped with the best available control technology (BACT) for minimizing the release of air borne criteria pollutants and harmful air toxins due to fuel combustion. The criteria pollutants are nitrogen oxides (NO<sub>x</sub>), carbon monoxide (CO), precursor organic compounds (POC) from unburned diesel fuel, sulfur dioxide (SO<sub>2</sub>) and particulate matter (PM<sub>10</sub>). POC is also denoted as NMHC (non-methane hydrocarbon). All of these pollutants are briefly discussed on the District's web site at [www.baaqmd.gov](http://www.baaqmd.gov).

The engine meets the Environmental Protection Agency and California Air Resources Board (EPA/CARB) Tier 3 Off-road standard. The engine will burn commercially available California low sulfur diesel fuel. The sulfur content of the diesel fuel will not exceed 0.0015% by weight.

## **EMISSIONS**

S-1 has been certified by EPA (Federal Environment Protection Agency) to be a cleaner burning engine (EPA Certification Number JDJ-NRCI-11-30). Except for SO<sub>2</sub>, the emission factors for these engines are from the EPA certificate. The SO<sub>2</sub> emissions were calculated based on the maximum allowable sulfur content (0.0015 wt% S) of the diesel fuel with assumption that all of the sulfur present will be converted to SO<sub>2</sub> during the combustion process.

### **Basis:**

315 hp output rating

13 hr/yr operation for testing and maintenance

13.6 gallons/hr max fuel use rate

NMHC + NO<sub>x</sub>, CO and PM<sub>10</sub> emission factors provided by EPA Certificate Data

SO<sub>2</sub> emissions are quantified based on the full conversion of 0.0015 wt% (~ 15 ppm) sulfur in the ULS diesel fuel.

The SO<sub>2</sub> emission factor was derived from EPA AP-42, Table 3.4-1.

### **Annual Emissions:**

Annual emissions are calculated based on the number of hours per year of operation for testing and maintenance.

### **Daily Emissions:**

Daily emissions are calculated to establish whether a source triggers the requirement for BACT (10 lb/highest day total source emissions for any class of pollutants). 24-hr/day of operation will be assumed since no daily limits are imposed on intermittent and unexpected operations.

Table 1

Pollutant	Emission Factor (g/kw-hr)	Emission Factor (g/hp-hr)	Annual Emissions (lb/yr)	Annual Emissions (TPY)	Max. Daily (lb/day)
NMHC+NOx	3.8	2.83			
NOx	3.70	2.76	24.90	0.0124	45.96
POC	0.10	0.07	0.67	0.0003	1.24
CO	0.7	0.52	4.71	0.0024	8.70
PM10	0.1	0.075	0.67	0.0003	1.24
SO2		0.001515	0.04	0.00002	0.07
		*lb SO2/MMBTU			

**PLANT CUMULATIVE INCREASE**

Table 2 summarizes the cumulative increase in criteria pollutant emissions that will result from the operation of S-1.

Table 2

Pollutant	Current Emissions (since April 5, 1991) (TPY)	Increase with this application (TPY)	Cumulative Emissions (Current + Increase) (TPY)
NOx	0.000	0.012	0.012
POC	0.000	0.000	0.000
CO	0.000	0.002	0.002
PM10	0.000	0.000	0.000
SO2	0.000	0.000	0.000

**TOXIC RISK SCREENING ANALYSIS**

This application required a Toxics Risk Screen because the diesel particulate emissions are greater than the toxic trigger level.

<b><u>Toxic Pollutant Emitted</u></b>	<b><u>Emission Rate (lb/yr)</u></b>	<b><u>Risk Screening Trigger (lb/yr)</u></b>
PM10 (Diesel Particulate)	0.67	0.34

S-1 meets Best Available Control Technology for toxics (TBACT) since the diesel particulate emissions are less than 0.15 g/bhp-hr. For an engine that meets the TBACT requirement, it must also pass the toxic risk screening level of less than ten in a million. Estimates of residential risk assume exposure to annual average toxic air contaminant concentrations occur 24 hours per day, 350 days per year, for a 70-year lifetime. Risk estimates for offsite workers assume exposure occurs 8 hours per day, 245 days per year, for 40 years. Risk estimates for students assume a higher breathing rate, and exposure is assumed to occur 10 hours per day, 36 weeks per year, for 9 years.

Based on 13 hours per year of operation, the emergency generator passed the Health Risk Screening Analysis (HRSA) conducted on July 9th, 2011 by the District's Toxic Evaluation Section. The source poses no significant toxic risk, since the increased cancer risk to the maximally exposed receptor (Resident) is 9.53 in a million with a hazard index of 0.0033. The increased cancer risk to the workers near the project is 0.29 in a million with a hazard index of 0.00022. The increased cancer risk for students attending Adeve Harrison Middle School at 1150 Broadway, Sonoma and Sonoma Valley School at 20000 Broadway, Sonoma are insignificant, since the engine is not allowed to operate when the school is in session. In accordance with the District's Regulation 2, Rule 5, this risk level is considered acceptable, as it has been determined that S-5 meets the current TBACT standards.

**BACT**

In accordance with Regulation 2, Rule 2, Section 301, BACT is triggered for any new or modified source with the potential to emit 10 pounds or more per highest day of POC, NPOC, NOx, CO, SO<sub>2</sub> or PM<sub>10</sub>.

<b>Source:</b>	<i>IC Engine – Compression Ignition: Stationary Emergency, non-Agricultural, non-direct drive fire pump</i>	<b>Revision:</b>	7
		<b>Document #:</b>	96.1.3
<b>Class:</b>	> 50 BHP Output	<b>Date:</b>	12/22/2010

POLLUTANT	BACT		TYPICAL TECHNOLOGY
	1. Technologically Feasible/ Cost Effective 2. Achieved in Practice 3. TBACT		
POC	1. n/s <sup>c</sup> 2. CARB ATCM standard <sup>a</sup> for POC at applicable horsepower rating (see attached Table 1).		1. n/s <sup>c</sup> 2. Any engine certified or verified to achieve the applicable standard. <sup>a</sup>
NO <sub>x</sub>	1. n/s <sup>c</sup> 2. CARB ATCM standard <sup>a</sup> for NO <sub>x</sub> at applicable horsepower rating (see attached Table 1).		1. n/s <sup>c</sup> 2. Any engine certified or verified to achieve the applicable standard. <sup>a</sup>
SO <sub>2</sub>	1. n/s <sup>c</sup> 2. Fuel sulfur content not to exceed 0.0015% (wt) or 15 ppm (wt).		1. n/s <sup>c</sup> 2. CARB Diesel Fuel (Ultra Low Sulfur Diesel)
CO	1. n/s <sup>c</sup> 2. CARB ATCM standard <sup>a</sup> for CO at applicable horsepower rating (see attached Table 1).		1. n/s <sup>c</sup> 2. Any engine certified or verified to achieve the applicable standard. <sup>a</sup>
PM <sub>10</sub>	1. n/s <sup>c</sup> 2. 0.15 g/bhp-hr 3. 0.15 g/bhp-hr		1. n/s <sup>c</sup> 2. Any engine or technology demonstrated, certified or verified to achieve the applicable standard. 3. Any engine or technology demonstrated, certified or verified to achieve the applicable standard.
NPOC	1. n/s <sup>c</sup> 2. n/s		1. n/s <sup>c</sup> 2. n/s

**Reference:**

*a. ATCM standard (listed below): Where NMHC + NO<sub>x</sub> is listed (with no individual standards for NO<sub>x</sub> or NMHC) as the standard, the portions may be considered 95% NO<sub>x</sub> and 5% NMHC. For the purposes of determining BACT NMHC = POC. Any engine which has been certified or demonstrated to meet the current year tier standard may be considered compliant with the certified emission standard for that pollutant.*

*b. Deleted (no longer applies).*

*c. Cost effectiveness analysis must be based on lesser of 50 hr/yr or non-emergency operation as limited by District health risk screen analysis.*

**Table 1: BACT 2 Emission Limits based on CARB ATCM**

<b>Emissions Standards for Stationary Emergency Standby Diesel-Fueled CI Engines &gt;50 BHP g/Kw-hr (g/bhp-hr)</b>			
<b>Maximum Engine Power</b>	<b>PM</b>	<b>NMHC+NOx</b>	<b>CO</b>
37 < KW < 56 (50 < HP < 75)	0.20 (0.15)	4.7 (3.5)	5.0 (3.7)
56 < KW < 75 (75 < HP < 100)	0.20 (0.15)	4.7 (3.5)	5.0 (3.7)
75 < KW < 130 (100 < HP < 175)	0.20 (0.15)	4.0 (3.0)	5.0 (3.7)
130 < KW < 225 (175 < HP < 300)	0.20 (0.15)	4.0 (3.0)	3.5 (2.6)
225 < KW < 450 (300 < HP < 600)	0.20 (0.15)	4.0 (3.0)	3.5 (2.6)
450 < KW < 560 (600 < HP < 750)	0.20 (0.15)	4.0 (3.0)	3.5 (2.6)
KW > 560 (HP > 750)	0.20 (0.15)	6.4 (4.8)	3.5 (2.6)

BACT is triggered for NOx since the maximum daily emissions of NOx exceeds 10 lb/day. Please refer to the discussion on “Daily Emissions” in page 1 of this evaluation. BACT for this source is presented in the current BAAQMD BACT/TBACT Workbook for IC Engine – Compression Ignition: Stationary Emergency, non-Agricultural, non-direct drive fire pump, Document # 96.1.3, Revision 7 dated 12/22/2010.

For NOx, BACT(2) is 2.85 g/hp-hr. BACT(1) has not been determined. S-1 meets the current emissions standard since the NOx level is 2.76 g/hp-hr. .

**OFFSETS**

Offsets must be provided for any new or modified source at a facility that emits more than 10 tons/yr of POC or NOx per Regulation 2-2-302. Table 3 summarizes the increase in criteria pollutant emissions that will result from the operation of S-1.

**Table 3**

<b>Pollutant</b>	<b>Current plant emissions (TPY)</b>	<b>Increase in plant emissions associated with this application (TPY)</b>	<b>Cumulative emissions (Current + Increase) (TPY)</b>	<b>Regulation 2-2-302 and 2-2-303 Offset Triggers (TPY)</b>
NOx	0.000	0.0124	0.0124	> 10; < 35
POC	0.000	0.0003	0.0003	> 10; < 35
CO	0.000	0.0024	0.0024	NA
PM10	0.000	0.0003	0.0003	> 1*
SO2	0.000	0.00002	0.00002	> 1*

\*Applies to major facilities with a cumulative increase, minus contemporaneous emission reduction credits, in excess of 1 ton/year since April 5, 1991.

It can be seen from Table 3 above that S-1 does not trigger any offsets. Therefore, offsets are not warranted for any emission.

**NSPS**

The engine is subject to 40 CFR 60, Subpart IIII, Standards of Performance for Stationary Compression Ignition Internal Combustion Engines because it was manufactured after April 1, 2006, as required by Section 60.4200(a)(2)(i).

The engine has a total displacement of 6.8 liters and has 4 cylinders, so each cylinder has a volume of less than 10 liters. The engine is a 2011 model year engine and is not a fire pump. Section 60.4205(b) requires these engines to comply with the emission standards in Section 60.4202, which refers to 40CFR89.112 and 40CFR89.113 for all pollutants. For engines greater than 300 hp and smaller than 600 hp, these standards are:

NMHC+NO<sub>x</sub>: 3.0 g/hp-hr

CO: 2.6 g/hp-hr

PM: 0.15 g/hp-hr

20% opacity during acceleration mode

15% opacity during lugging mode

50% opacity during peaks in acceleration or lugging mode

According to EPA Certificate, the engine will comply with the standards.

Sections 60.4206 and 60.4211(a) require that the owner/operator operate and maintain the engine according to the manufacturer's written instructions or procedures developed by the owner or operator that are approved by the engine manufacturer, over the entire life of the engine. The owner/operator is expected to comply with this requirement.

Section 60.4207(a) requires that by October 1, 2007, the owner/operator must use fuel that complies with 40 CFR 80.510(a). This means that the fuel must have a sulfur content of 500 parts per million (ppm) maximum, a cetane index of 40 or a maximum aromatic content of 35 volume percent. The owner/operator is expected to comply with this requirement because CARB diesel is required to be used in California.

Section 60.4207(b) requires that by October 1, 2010, the owner/operator must use fuel that complies with 40 CFR 80.510(b). This means that the fuel must have a sulfur content of 15 parts per million (ppm) maximum, and the same cetane index or aromatic content as above. The owner/operator is expected to comply with this requirement because CARB diesel is required to be used in California.

Section 60.4209(a) requires a non-resettable hour meter. This requirement is already in the standard permit conditions.

The engine will comply with the requirements of Section 60.4211(c) because it has been certified in accordance with 40 CFR Part 89.

The engine will comply with the requirement in Section 60.4211(e) to run for less than 50 hours per year for maintenance checks and readiness testing, and the prohibition of running for any reason other than emergency operation, maintenance, and testing because they are limited by permit condition to 13 hours per year for reliability testing and otherwise may only operate for emergencies.

The owner/operator is not required to perform tests in accordance with Section 60.4212 or 60.4213.

Section 60.4214 states that owner/operators do not have to submit an initial notification to EPA for emergency engines.

Because the engine does not have a diesel particulate filter, the owner/operator is not subject to Section 60.4214(c).

The owner/operator is required to comply with certain sections of 40 CFR 60, Subpart A, General Provisions. The owner/operator is expected to comply with this requirement.

**NESHAP**

This engine is not subject to the emission or operating limitations in 40 CFR 63, Subpart ZZZZ, National Emission Standards for Hazardous Air Pollutants for Stationary Reciprocating Internal Combustion Engines, because it is an emergency stationary reciprocating internal combustion engine (40 CFR 63.6600(c)).

**CARB STATIONARY DIESEL ENGINE ATCM**

The State Office of Administrative Law approved the Airborne Toxic Control Measure (ATCM) on November 8, 2004. State law requires the local Air Districts to implement and enforce the requirements of the ATCM. Effective January 1, 2005, there is a prohibition on the operation of new diesel emergency standby engines greater than 50 bhp unless the following operating requirements and emission standards are met:

“Stationary Diesel Engine ATCM” section 93115.6 (3)(A), title 17, CA Code of Regulations, Amended May 2011.

1. New stationary emergency standby diesel-fueled engines (>50 bhp) shall:
  - a. meet the applicable emission standards for all pollutants for the same model year and maximum horsepower rating as specified in the following Table Emission Standards for New Stationary Emergency Standby Diesel-Fueled CI Engines, in effect on the date of acquisition or submittal, and
  - b. after December 31, 2008, be certified to the new nonroad compression-ignition (CI) engine emission standards for all pollutants for 2007 and later model year engines as specified in 40 CFR, PART 60, Subpart III-Standards of Performance for Stationary Compression Ignition Internal Combustion Engines(2006); and
  - c. not operate more than 50 hours per year for maintenance and testing purposes.
  
2. The District may allow a new stationary emergency standby diesel-fueled CI engine (> 50 hp) to operate up to 100 hours per year for maintenance and testing purposes on a site-specific basis, provided the diesel PM emission rate is less than or equal to 0.01 g/bhp-hr.

<b>Emission Standards for New Stationary Emergency Standby Diesel-Fueled CI Engine g/bhp-hr (g/kW-hr)</b>				
<b>Maximum Engine Power</b>	<b>Model Year</b>	<b>PM</b>	<b>NHMC+NO<sub>x</sub></b>	<b>CO</b>
50 ≤ HP < 75 (37 ≤ kW < 56)	2007	0.15 (0.20)	5.6 (7.5)	3.7 (5.0)
	2008+		3.5 (4.7)	
75 ≤ HP < 100 (56 ≤ kW < 75)	2007	0.15 (0.20)	5.6 (7.5)	3.7 (5.0)
	2008+		3.5 (4.7)	
100 ≤ HP < 175 (75 ≤ kW < 130)	2007	0.15 (0.20)	3.0 (4.0)	3.7 (5.0)
	2008+			
175 ≤ HP < 300 (130 ≤ kW < 225)	2007	0.15 (0.20)	3.0 (4.0)	2.6 (3.5)
	2008+			
300 ≤ HP < 600 (225 ≤ kW < 450)	2007	0.15 (0.20)	3.0 (4.0)	2.6 (3.5)
	2008+			
600 ≤ HP < 750 (450 ≤ kW < 560)	2007	0.15 (0.20)	3.0 (4.0)	2.6 (3.5)
	2008+			
HP > 750 (kW > 560)	2007	0.15 (0.20)	4.8 (6.4)	2.6 (3.5)
	2008+			

This emergency standby diesel engine (S-1) is in compliance with the above ATCM requirements. The diesel engine will operate for no more than 50 hours per year for maintenance and reliability testing. This engine is subject to the Current off-road CI engine standards for HC, NO<sub>x</sub>, NMHC+NO<sub>x</sub> and CO. As shown in the Table 4, the engine meets these requirements.

Table 4. ATCM Emission Standard Compliance

	EPA Certified g/bhp-hr	ATCM Standards g/bhp-hr
NMHC+NO <sub>x</sub>	2.83	3.0
NO <sub>x</sub>	N/A	N/A
NMHC (POC)	N/A	N/A
CO	0.52	2.6
PM	0.075	0.15

**STATEMENT OF COMPLIANCE**

Source S-1 is subject to and expected to be in compliance with the requirements of District Regulation 1-301 (*Public Nuisance*), Regulation 6-1-303 (*Ringelmann No. 2 Limitation*), Regulation 9-1 (*Sulfur Dioxide*) and Regulation 9-8 (*NO<sub>x</sub> and CO from Stationary Internal Combustion Engines*). In order to ensure compliance with the requirements of these regulations, the facility will be conditionally permitted to meet the requirements.

From Regulation 1-301, no person shall discharge from any source whatsoever such quantities of air contaminants or other material which cause injury, detriment, nuisance or annoyance to any considerable number of persons or the public; or which endangers the comfort, repose, health or safety of any such persons or the public, or which causes, or has a natural tendency to cause, injury or damage to business or property. For purposes of this section, three or more violation notices validly issued in a 30 day period to a facility for public nuisance shall give rise to a rebuttable presumption that the violations resulted from negligent conduct.

S-1 is subject to the limitations of Regulation 6-1-303 (*Ringelmann No. 2 Limitation*). Regulation 6, Rule 1, Section 303 states that a person shall not emit for a period or periods aggregating more than three minutes in any hour, a visible emission that is as dark or darker than No. 2 on the Ringelmann Chart, or of such opacity as to obscure an observer’s view to an equivalent or greater degree, nor shall said emission, as perceived by an opacity sensing device in good working order, where such device is required by District Regulations, be equal to or greater than 40% opacity. This low PM10 emitting engine is not expected to produce visible emissions or fallout in violation of this regulation, and it will be assumed to be in compliance with Regulation 6 pending a regular inspection

S-1 is also subject to the SO<sub>2</sub> limitations of Regulation 9-1-301 (*Limitation on Ground Level Concentrations of Sulfur Dioxide*), Regulation 9-1-302 (*General Emission Limitation*) and 9-1-304 (*Fuel Burning*). From Regulation 9-1-301, the ground level concentrations of SO<sub>2</sub> will not exceed 0.5 ppm continuously for 3 consecutive minutes or 0.25 ppm averaged over 60 consecutive minutes, or 0.05 ppm averaged over 24 hours. Per Regulation 9, Rule 1, Section 302, a person shall not emit from any source a gas stream containing sulfur dioxide in excess of 300 ppm (dry). And Regulation 9, Rule 1, Section 304, states that a person shall not burn any liquid fuel having sulfur content in excess of 0.5% by weight. Compliance with both Regulations 9-1-302 and 9-1-304 is likely since California law mandates using diesel fuel with a 0.015% by weight sulfur.

Regulation 9-8 “NO<sub>x</sub> and CO from Stationary Internal Combustion Engines.” From Regulation 9-8-110.5, this source is not subject to the requirements of Regulations 9-8-301 (*Emission Limits on Fossil Derived Fuel Gas*), 9-8-302 (*Emission Limits on Waster Derived Fuel Gas*), 9-8-304 (*Emission Limits on Compression Ignited Engines*), 9-8-501 (*Initial Demonstration of Compliance*), 9-8-502 (*Record Keeping*), and 9-8-503 (*Quarterly Demonstration of Compliance*).

S-1 is exempt from Regulation 9-8-502 however; it is subject to the monitoring and record keeping procedures described in Regulation 9-8-530 (*Emergency Standby Engines, Monitoring and Recordkeeping*). The requirements of this Regulation are included in the permit conditions

This application is considered to be ministerial under the District's proposed CEQA guidelines, Regulation 2-1-311 (*Ministerial Projects*) and therefore is not subject to CEQA review. The engineering review for this project requires

only the application of standard permit conditions and standard emission factors in accordance with Permit Handbook Chapter 2.3.

This facility is within 1,000 feet from the nearest school and therefore is not subject to the public notification requirements of Regulation 2-1-412. A public notice was prepared and sent to all addresses within 1000 feet of the diesel generator set and parents and guardians of students of the following school:

Adele Harrison Middle School

1150 Broadway Ave  
Sonoma, CA 95476

Sonoma Valley High School / Creekside High School

20000 Broadway Ave  
Sonoma, CA 95476

PSD is not triggered.

**PERMIT CONDITIONS**

COND# 22813 -----

1. The owner/operator shall not exceed 13 hours per year per engine for reliability-related testing.  
[Basis: "Stationary Diesel Engine ATCM" section 93115, title 17, CA Code of Regulations, subsection (e)(2)(A)(3) or (e)(2)(B)(3)]
2. The owner/operator shall operate each emergency standby engine only for the following purposes: to mitigate emergency conditions, for emission testing to demonstrate compliance with a District, State or Federal emission limit, or for reliability-related activities (maintenance and other testing, but excluding emission testing). Operating while mitigating emergency conditions or while emission testing to show compliance with District, State or Federal emission limits is not limited.  
[Basis: "Stationary Diesel Engine ATCM" section 93115, title 17, CA Code of Regulations, subsection (e)(2)(A)(3) or (e)(2)(B)(3)]
3. The owner/operator shall operate each emergency standby engine only when a non-resettable totalizing meter (with a minimum display capability of 9,999 hours) that measures the hours of operation for the engine is installed, operated and properly maintained.  
[Basis: "Stationary Diesel Engine ATCM" section 93115, title 17, CA Code of Regulations, subsection(e)(4)(G)(1)]
4. Records: The owner/operator shall maintain the following monthly records in a District-approved log for at least 36 months from the date of entry (60 months if the facility has been issued a Title V Major Facility Review Permit or a Synthetic Minor Operating Permit). Log entries shall be retained on-site, either at a central location or at the engine's location, and made immediately available to the District staff upon request.
  - a. Hours of operation for reliability-related activities (maintenance and testing).
  - b. Hours of operation for emission testing to show compliance with emission limits.
  - c. Hours of operation (emergency).
  - d. For each emergency, the nature of the emergency condition.
  - e. Fuel usage for each engine(s).

[Basis: "Stationary Diesel Engine ATCM" section 93115, title 17, CA Code of Regulations, subsection e)(4)(I), (or, Regulation 2-6-501)]

5. At School and Near-School Operation:  
If the emergency standby engine is located on school grounds or within 500 feet of any school grounds, the



following requirements shall apply: The owner/operator shall not operate each stationary emergency standby diesel-fueled engine for non-emergency use, including maintenance and testing, during the following periods:

- a. Whenever there is a school sponsored activity (if the engine is located on school grounds)
- b. Between 7:30 a.m. and 3:30 p.m. on days when school is in session. "School" or "School Grounds" means any public or private school used for the purposes of the education of more than 12 children in kindergarten or any of grades 1 to 12, inclusive, but does not include any private school in which education is primarily conducted in a private home(s). "School" or "School Grounds" includes any building or structure, playground, athletic field, or other areas of school property but does not include unimproved school property.

[Basis: "Stationary Diesel Engine ATCM" section 93115, title 17, CA Code of Regulations, subsection (e)(2)(A)(1)] or (e)(2)(B)(2)]

### **RECOMMENDATION**

Issue an Authority to Construct **Ensign Sonoma Healthcare Center** for:

- S-1      Emergency Standby Diesel Generator Set,  
            John Deere, Model 606HF485, Model Year 2011  
            315 BHP, 1.86 MMBTU/hr**

---

Yu Zhang Liu  
Air Quality Engineering Intern  
Engineering Division