REGION 6
DALLAS, TX 75270

July 31, 2025

Transmitted via Email

Stephen Dugat
Vice President and General Manager
Cheniere Energy, Inc.
9243 Gulf Beach Highway
Cameron, LA 70631
Stephen.Dugat@cheniere.com

RE: Alternative Monitoring Plan - 40 Code of Federal Regulations (CFR) Part 63, National Emission Standards for Hazardous Air Pollutants (NESHAPS)- Subpart YYYY-Stationary Combustion Turbines –Forty-four (44) Stationary Combustion Turbines without Catalyst at Cheniere Energy-Sabine Pass LNG Terminal-Cameron Parish, Louisiana

Dear Mr. Dugat:

This letter is in response to the Alternative Monitoring Plan (AMP) request to the Environmental Protection Agency (EPA) Region 6, dated February 9, 2023; and February 24, 2023, to petition the operating limitations that will be monitored to demonstrate compliance with the formaldehyde emission limitations for stationary turbines that are not equipped with an oxidation catalyst. Sabine Pass LNG Terminal (SPL) provided additional information on February 3, 2023; February 28, 2025; June 6, 2025; and July 15, 2025, in support of the original AMP request. Based on the EPA's review of the information provided, and as discussed in this response, EPA approves your request.

Sabine Pass Liquefaction LLC, a subsidiary of Cheniere Energy LLC, owns and operates a natural gas vaporization and liquefaction facility called SPL located in Cameron Parish, Louisiana. SPL owns and operates eight (8) General Electric (GE) LM2500+G4 Dry Low Emissions (DLE) natural gas stationary combustion turbines; and thirty-six (36) GE LM2500+G4 Single Annular Combustion (SAC) diffusion flame natural gas-fired stationary combustion turbines that are subject to 40 CFR 63, Subpart YYYY. The 44 turbines are not equipped with an oxidation catalyst; therefore, per 40 CFR §63.6120(e) SPL is required to submit an Operational Parameter Monitoring Petition to EPA for approval[1]. A summary of the EPA's analyses of the SPL Operational Parameter Monitoring Petition for each turbine type is included in Enclosure A and Enclosure B, respectively.

[1] Although the Louisiana Department of Environmental Quality (LDEQ) is delegated authority for NESHAP YYYY, EPA headquarters has determined that the Agency should approve operating parameter petitions to ensure consistency across all states and EPA Regions.

This response has been coordinated with EPA's Office of Air Quality Planning and Standards (OAQPS). A copy of the AMP and EPA's response will be sent to LDEQ to attach to the facility's air permit for federal enforceability. If representations made in the request or supporting information change, the rules changes, or process unit operations change, this determination may become void, and a new determination will be necessary. Please address questions or concerns about this determination to Cassandra Lowder of my staff at lowder.cassandra@epa.gov or at 214-665-8545.

Sincerely,

STEVEN THOMPSON
Digitally signed by STEVEN THOMPSON
Date: 2025.07.31 12:57:01 -05'00'

Steve Thompson
Manager
Air Enforcement Branch

Enclosure A – Eight Turbines with Dry Low Emission DLE Technology
Enclosure B - Thirty-Six turbines with SAC Technology

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Enclosure A
Eight Turbines with Dry Low Emission DLE Technology

SPL operates 8 turbines with Dry Low Emission (DLE) technology. Since these turbines are not equipped with an oxidation catalyst, SPL submitted a petition to approve operating parameters to monitor. The petition was submitted under 40 Code of Federal Regulations ("C.F.R.") § 63.6120(e) for justifying the required information under 40 C.F.R. § 63.6120(g)(1) through (7).

EPA Analysis

The petition addresses the required information described in 40 C.F.R. § 63.6120(g)(1) through (7). EPA determined that the facility is monitoring additional operating parameters; therefore, the petition must provide information under 40 C.F.R. § 63.6120(f)(1) through (5) instead of 40 C.F.R. § 63.6120(g)(1) through (7). EPA makes the following determinations regarding the lean premixed gas-fired combustion turbine under Subpart YYYY, which is operating without an oxidation catalyst, and is subject to emission and operating limitations.

EPA received the following documents from SPL during the review process to complete the technical review:

- SPL 40 C.F.R. 63, Subpart YYYY Petition
- Initial Stack Test and Annual Performance Test
- Monitoring Parameters – *"DLE Package Operations,"* Revision 3 (Document Code SOK2312851)[2]
- YYYY Alarm Notification & Response Process[2]

63.6120(f)(1) Identification of the specific parameters SPL proposes to use as additional operating limitations.

SPL's petition proposes monitoring the Lean Premix (LPM) operation to meet the requirements for ensuring compliance with the formaldehyde emission standards in 40 CFR 63, Subpart YYYY. Baker Hughes is the original equipment manufacturer (OEM) for the 8 GE LM2500+G4 DLE stationary turbines and uses the term DLE synonymously with LPM. The turbine DLE system stages a specific air-to-fuel ratio into a turbine's three burner rings (labelled A, B, C) that have a specific configuration. The air-to-fuel ratio is automatically adjusted, and a suitable burner configuration mode is selected to ensure proper operation of the DLE system, combustion efficiency, and acoustic vibrations. The DLE system and manufacturer-defined parameters are explained further in the OEM document titled, "*Monitoring Parameters – DLE Package Operations," Revision 3 (Document Code SOK2312851)*.

63.6120(f)(2) A discussion of the relationship between the monitored parameters and hazardous air pollutant (HAP) emissions, identifying how HAP emission rates change with changes in the operating parameters, and how limitations on these operating parameters will serve to limit HAP emissions of formaldehyde.

[2] Turbine specific operating parameters and other representations in the company's petition and supporting information were claimed as Confidential Business Information and as such are not directly incorporated into EPA's response.

SPL states that DLE technology emits low emissions of nitrogen oxides (NOx) and products of incomplete combustion, including formaldehyde. A gas turbine which operates with lean premix does not guarantee that emissions will be below the formaldehyde standard of 91 parts per billion by volume, dry basis (ppbvd) at 15 percent (%) oxygen (O_2). However, SPL conducted initial emissions testing from August 4, 2022, through September 4, 2022, which showed compliance with the NESHAP YYYY formaldehyde emission limit for six (6) out of the 8 turbines. Turbines EQT0006 and EQT0120 did not demonstrate compliance with the formaldhyde emission standards during the first initial performance test. SPL conducted maintenance activity to EQT0006 and demonstrated compliance with the formaldehyde emission limit by retesting on September 19, 2022. EQT0120 was remapped and retested on December 16, 2022, demonstrating compliance with the emission standard. The results from the initial and annual formaldhyde performance testing are summarized in Table 1.

Table 1: Initial and Annual Formaldhyde Performance Test Results

Unit Name	Unit ID	Test Results (ppbvd at 15% O2)			
		Initial Test Date	Initial Test	2023 Test	2024 Test
GTG (A) - Natural Gas-Fired Generator Turbine No. 1	EQT0003	09/04/2022	41	69	65
GTG (B) - Natural Gas-Fired Generator Turbine No. 2	EQT0004	09/04/2022	60	29	20
GTG (C) - Natural Gas-Fired Generator Turbine No. 3	EQT0005	08/04/2022	32	20	45
GTG (D) - Natural Gas-Fired Generator Turbine No. 4	EQT0006	09/19/2022	46[3]	73	38
GTG (E) - Natural Gas-Fired Generator Turbine No. 5	EQT0084	08/02/2022	51	65	5
GTG (F) - Natural Gas-Fired Generator Turbine No. 6	EQT0085	08/03/2022	52	61	73
GTG (G) - Natural Gas-Fired Generator Turbine No. 7	EQT0119	09/03/2022	90	28	48
GTG (H) - Natural Gas-Fired Generator Turbine No. 8	EQT0120	12/16/2022	33[3]	73	7

63.6120(f)(3) A discussion of how you will establish the upper and/or lower values for these parameters which will establish the limits on these parameters in the operating limitations.

a. During the initial commissioning of the turbines, and as needed thereafter, the DLE system of each turbine will be manually adjusted by OEM called “mapping.” The mapping procedure is a detailed, lengthy process requiring accurate measurement of gas turbine engine operating parameters and corresponding NOx and carbon monoxide (CO) emission rates, as well as combustion dynamics monitored through acoustic vibrations. Operating parameters and resultant emission rates are measured and recorded across all operating conditions and combustion modes. These operating

[3] Initial and/or annual performance testing was retested due to failing a previous performance test formaldehyde standards and corrective action were executed to get the turbines back into compliance.

parameters are used to define the upper and lower operational boundaries that meet the prescribed emission limits and acoustic vibration targets. These operational boundaries are then converted into a final combustion "map" or control scheme and programmed into each gas turbine's digital controller. Each engine is then only able to operate within the combustion map of operational boundaries programmed into its respective digital controller. More detailed information can be located in Revision 3 (Document Code SOK2312851) of the document titled, *"Monitoring Parameters – DLE Package Operations*;" and outlined in the procedures entitled, "*YYYY Alarm Notification and Response Process*."

b. Only qualified OEM personnel are able to modify or change the control logic. Specialized classroom and field training is required by the OEM to become qualified to properly map a particular gas turbine engine model.

c. SPL proposes to monitor specific parameters that were provided in the Revision 3 (Document Code SOK2312851) *"Monitoring Parameters – DLE Package Operations"* document. SPL performance testing has demonstrated that all 8 turbines at the SPL facility are below the 91 ppbvd at 15 % O_2 formaldehyde limit while operating in DLE mode. Since the algorithms utilized by the process logic controller (PLC) to maintain DLE operation of the turbines are extremely complex and require a myriad of measured and calculated inputs, it is impractical to monitor formaldehyde emissions performance parametrically through any subset of parameters. As discussed in Section 1 of the referenced OEM document, ideal operation of the turbine in any given mode is multivariate and not subject to any simple upper and/or lower value for a given operating condition. Even if certain parameters were identified for manual monitoring, the PLC, with the benefit of computer processing, would detect, analyze, and react to any anomalous data quicker than any human operator could.

   While the DLE control philosophy ensures low CO, NOx, and hazardous air pollutant (HAP) emissions during normal operation, the transitory operation of the turbine during startup and shutdown may result in a different emission profile of these pollutants. SPL duration of turbine startup is subject to the limits specified in the definition of startup in 40 CFR § 63.6175.

   In accordance with SPL's Louisiana Title V Air Permit 0560-00214-V8, maintenance, startups, and shutdowns are limited to the hourly and yearly emission limits represented in the application dated March 13, 2025. Additionally, the period of time for turbine startup is subject to the limits specified in the definition of startup in § 63.6175.

63.6120(f)(4) A discussion identifying the methods SPL will use to measure and the instruments SPL will use to monitor the proposed parameters, as well as the relative accuracy and precision of these methods and instruments.

a. SPL will use the turbines' inherent PLC system to continuously monitor the specific parameters of the Revision 3 referenced OEM document utilizing indicators. If the PLC detects an exceedance of the operational parameters or improper combustion, then the PLC will make automatic adjustments to return the affected turbines back to optimal DLE operations. In the event the PLC

cannot return a turbine back within its operational limits or proper combustion then it will automatically shut down the affected turbine. Additionally, each of the monitored parameters has an alarm installed with an established set point.

b. SPL cannot make any adjustments or conduct mapping to the PLC - only OEM technicians can do so. SPL and OEM will respond to an alarm notification as outlined in the procedures titled, *"YYYY Alarm Notification and Response Process."*

c. SPL has a list of specific monitored parameters, and the alarm set points in the Revision 3 referenced OEM document. SPL also provided for EPA review the copies of indicators and manufacturer specifications outlined in Revision 5 (Document Code SOM6769252) of the document titled, *"Instrument Data Sheets."*

63.6120(f)(5) A discussion identifying the frequency and methods for recalibrating the instruments SPL will use for monitoring the selected parameters.

SPL will have the OEM install, calibrate, and maintain the 8 turbines at the frequency indicated in Revision 3 (Document Code SOK2312851) of the document titled, *"Monitoring Parameters – DLE Package Operations."*

Enclosure B
Thirty-Six turbines with SAC Technology

SPL operates 36 turbines with Single Annular Combustion (SAC) equipped with water injection system. Since the turbines are not equipped with an oxidation catalyst, SPL submitted a petition to approve operating monitoring to monitor. The petition was submitted under 40 Code of Federal Regulations ("C.F.R.") § 63.6120(e) for justifying the required information under 40 C.F.R. § 63.6120(f)(1) through (5). Below is SPL's list of GE LM2500+G4 SAC diffusion flame natural gas-fired stationary combustion turbines that are not equipped with an oxidation catalyst.

Table 1: List of SAC Stationary Turbines equipped with water injection system.

SPL Turbine IDs		
EQT0052	EQT0068	EQT0103
EQT0053	EQT0069	EQT0104
EQT0054	EQT0070	EQT0105
EQT0056	EQT0072	EQT0107
EQT0058	EQT0074	EQT0109
EQT0059	EQT0075	EQT0110
EQT0060	EQT0076	EQT0111
EQT0061	EQT0076	EQT0112
EQT0062	EQT0078	EQT0113
EQT0064	EQT0080	EQT0115
EQT0066	EQT0082	EQT0117
EQT0067	EQT0083	EQT0118

EPA Analysis

The petition stated that it addresses the required information described for 40 C.F.R. § 63.6120(f)(1) through (5). EPA made the following determinations under 40 C.F.R. 63, Subpart YYYY regarding the SAC turbines operating without an oxidation catalyst which have a water injection system, and outlines the following emission and operating limitations based on representations made in SPL's petition.

EPA received the following documents from SPL during the review process to ensure it was complete:

- SPL 40 C.F.R. 63, Subpart YYYY Petition
- Initial Performance Test and Annual Performance Test
- Refrigeration Compressor Turbine (RCT) Parametric Monitoring Plan, Revision 3 (Document Code SPL-0000-OML-10-ENA-PLN-000004)[2]
- Monitoring Parameters – *"Monitoring Parameters Support Document,"* Revision 7 (Document Code SOM6928996)[2]
- YYYY Alarm Notification & Response Process[2]

63.6120(f)(1) Identification of the specific parameters SPL proposes to use as additional operating limitations.

SPL's petition proposes monitoring of water injection and water demand rates to meet the requirements for ensuring compliance with the formaldehyde standards in 40 CFR 63, Subpart YYYY. Baker Hughes is the original equipment manufacturer (OEM) for the 36 GE LM2500+G4 SAC diffusion flame natural gas-fired stationary turbines. SPL established the water injection control parameters when demonstrating compliance with NOx emission controls required by 40 C.F.R. Part 60 Subpart KKKK (NSPS KKKK). The water injection system defined parameters are explained further in the OEM document titled, *"Monitoring Parameters – Monitoring Parameters Support Document," Revision 7 (Document Code SOK2312851*);" and *"RCT Parametric Monitoring Plan, Revision 3 (Document Code SPL-0000-OML-10-ENA-PLN-000004)."*

63.6120(f)(2) A discussion of the relationship between the monitored parameters and hazardous air pollutant (HAP) emissions, identifying how HAP emission rates change with changes in the operating parameters, and how limitations on these operating parameters will serve to limit HAP emissions of formaldehyde.

SPL states that water injection technology is used to control NOx emissions; however, this control method exhibits an inverse relationship with uncombusted hydrocarbons, CO, and formaldehyde. SPL indicated that the PLC determines how much water must be injected to ensure emissions of NOx, CO, hydrocarbons, and HAPs are minimized over a wide load range while satisfying other design requirements, including high combustion efficiency. Use of a water injection system does not guarantee that formaldehyde emissions will be below the Subpart YYYY limit standard of 91 parts per billion by volume, dry basis (ppbvd) at 15 percent oxygen (O_2). However, SPL conducted initial performance emissions testing in August and September 2022, and 10 out of 36 turbines showed compliance with the Subpart YYYY formaldehyde emission limit standard. SPL initiated a Subpart YYYY re-testing campaign to get the remaining 26 turbines in compliance. SPL and the OEM investigated and/or used specific actions listed in the Subpart YYYY Notice of Compliance Status report dated March 2, 2023, to achieve compliance demonstration. All 36 turbines subsequently tested were below the Subpart YYYY formldehyde standard by May 2023 and continued to demonstrate compliance in the annual testing conducted in 2024.

Table 2: Initial and Annual Formaldhyde Performance Test Results

Unit ID	Unit ID	Test Results (ppbvd at 15% O2)			
		Initial Test Date	Initial Test	2023 Test	2024 Test
Refrigeration Compressor Turbine No. 1 (11TC-1411)	EQT0052	11/15/22	44[3]	42	39
Refrigeration Compressor Turbine No. 2 (11TC-1421)	EQT0053	08/14/22	61	41	50

Table 2: Initial and Annual Formaldhyde Performance Test Results

Unit ID	Unit ID	Test Results (ppbvd at 15% O2)			
		Initial Test Date	Initial Test	2023 Test	2024 Test
RCT Refrigeration Compressor Turbine No. 3 (11TC-1511)	EQT0054	09/15/22	38[3]	66	75
RCT Refrigeration Compressor Turbine No. 4 (11TC-1521)	EQT0056	08/05/22	63[3]	70	38
RCT Refrigeration Compressor Turbine No. 5 (11TC-1611)	EQT0058	01/11/23	90.57[3]	57	59
RCT Refrigeration Compressor Turbine No. 6 (11TC-1621)	EQT0059	08/08/22	57	31	71
RCT Refrigeration Compressor Turbine No. 7 (12TC-1411)	EQT0060	08/17/22	66	20	33
RCT Refrigeration Compressor Turbine No. 8 (12TC-1421)	EQT0061	12/08/22	20[3]	24	66
RCT Refrigeration Compressor Turbine No. 9 (12TC-1511)	EQT0062	12/07/22	43[3]	51	30
RCT Refrigeration Compressor Turbine No. 10 (12TC-1521)	EQT0064	08/24/22	63	53	68
Refrigeration Compressor Turbine No. 11 (12TC-1611)	EQT0066	12/06/22	16[3]	39	69
Refrigeration Compressor Turbine No. 12 (12TC-1621)	EQT0067	09/20/22	61[3]	79	88
Refrigeration Compressor Turbine No. 13 (23TC-1411)	EQT0068	12/02/22	21[3]	44	33
Refrigeration Compressor Turbine No. 14 (23TC-1421)	EQT0069	11/30/22	22[3]	83	40
Refrigeration Compressor Turbine No. 15 (23TC-1511)	EQT0070	09/29/22	48[3]	70	68
Refrigeration Compressor Turbine No. 16 (23TC-1521)	EQT0072	07/17/23	23[3]		28
Refrigeration Compressor Turbine No. 17 (23TC-1611)	EQT0074	11/21/22	68[3]	55	82
Refrigeration Compressor Turbine No. 18 (23TC-1621)	EQT0075	09/27/22	60[3]	36	28
Refrigeration Compressor Turbine No. 19 (24TC-1411)	EQT0076	08/30/22	84	40	59
Refrigeration Compressor Turbine No. 20 (24TC-1421)	EQT0077	05/11/23	20[3]		64
Refrigeration Compressor Turbine No. 21 (24TC-1511)	EQT0078	01/27/23	24[3]	13	27

Table 2: Initial and Annual Formaldhyde Performance Test Results

Unit ID	Unit ID	Test Results (ppbvd at 15% O2)			
		Initial Test Date	Initial Test	2023 Test	2024 Test
Refrigeration Compressor Turbine No. 22 (24TC-1521)	EQT0080	10/03/22	19[3]	55	69
Refrigeration Compressor Turbine No. 23 (24TC-1611)	EQT0082	08/29/22	78	63	27
Refrigeration Compressor Turbine No. 24 (24TC-1621)	EQT0083	01/28/23	39[3]	86	53
Refrigeration Compressor Turbine No. 25 (35TC-1411)	EQT0103	01/18/23	67[3]	2	26
Refrigeration Compressor Turbine No. 26 (35TC-1421)	EQT0104	03/22/23	72[3]		57
Refrigeration Compressor Turbine No. 27 (35TC-1511)	EQT0105	09/01/22	76	3	46
Refrigeration Compressor Turbine No. 28 (35TC-1521)	EQT0107	09/01/22	84	71	27
Refrigeration Compressor Turbine No. 29 (35TC-1611)	EQT0109	08/31/22 – 09/01/22	71	13	20
Refrigeration Compressor Turbine No. 30 (35TC-1621)	EQT0110	05/03/23	35[3]		51
Refrigeration Compressor Turbine No. 31 (46TC-1411)	EQT0111	10/20/22	24[3]	31	46
Refrigeration Compressor Turbine No. 32 (46TC-1421)	EQT0112	10/20/22	29[3]	16	57
Refrigeration Compressor Turbine No. 33 (46TC-1511)	EQT0113	10/19/22	21[3]	45[3]	38
Refrigeration Compressor Turbine No. 34 (46TC-1521)	EQT0115	10/13/22	54[3]	59	40
Refrigeration Compressor Turbine No. 35 (46TC-1611)	EQT0117	10/12/22	52[3]	58	38
Refrigeration Compressor Turbine No. 36 (46TC-1621)	EQT0118	10/13/22	30[3]	29	27

63.6120(f)(3) A discussion of how you will establish the upper and/or lower values for these parameters which will establish the limits on these parameters in the operating limitations.

a. During the initial commissioning of the turbines, and as needed thereafter, the water injection system of each turbine will be manually adjusted by the OEM using a “mapping” procedure. The mapping procedure is a detailed, lengthy process requiring accurate measurement of gas turbine engine operating parameters, and corresponding NOx and carbon monoxide (CO) emission rates, as

well as water injection rates. The process logic controller (PLC) determines how much water must be injected in order to conform to the conditions set during the mapping process that were programmed into each turbine's digital controller. More detailed information regarding mapping can be located in Revision 7 (Document Code SOM6928996) of the document titled, "*Monitoring Parameters Support Document*."

b. Only qualified OEM personnel are able to modify or change the controller logic. Specialized classroom and field training is required by the OEM to become qualified to properly map a particular gas turbine engine model.

c. SPL proposes to monitor specific parameters that were provided in Revision 7 (Document Code SOM6928996) of the document titled, "*Monitoring Parameters Support Document.*" SPL performance testing has demonstrated that all 36 turbines at Sabine Pass are below the Subpart YYYY formaldehyde emission limit standard using water injection controls.

d. In accordance with SPL's Louisiana Title V Air Permit 0560-00214-V8, maintenance, startups, and shutdowns are limited to the hourly and yearly emission limits under the application dated March 13, 2025. Additionally, the period of time for turbine startup is subject to the limits specified in the definition of startup in § 63.6175.

63.6120(f)(4) A discussion identifying the methods SPL will use to measure and the instruments SPL will use to monitor the proposed parameters, as well as the relative accuracy and precision of these methods and instruments.

a. SPL will use the turbines' PLC system to continuously monitor specific parameters to ensure the appropriate amount of water injection is utilized to control the emissions. SPL strategically included instrumentation redundancies to ensure proper measurement within the turbines. SPL states that if a monitoring device is experiencing a malfunction or breakdown then it will be replaced at next available shutdown; however, due to monitoring redundancies SPL will be able to use other similar instruments to monitor the specified parameters.

b. The water injection supply flow meters are accurate to plus or minus 5% and correspond with the monitoring requirements in NSPS KKKK.

c. SPL cannot make any adjustments or conduct mapping to the PLC - only OEM technicians can do so. SPL and OEM will respond to an alarm notification as outlined in the procedures titled, *"YYYY Alarm Notification and Response Process;"* and Revision 7 (Document Code SOM6928996) of the document titled, *"Monitoring Parameters Support Document."*

d. SPL has a list of specific monitored parameters with an alarm and a notification system that are discussed in Revision 7 (Document Code SOM6928996) of the document titled, *"Monitoring Parameters Support Document."* Furthermore, SPL provided copies of transmitter manufacturer specifications outlined in Revision 2 (Document Code SOM990550768), and Revision 7 (Document Code SOM6928996) of the document titled, *"Instrument Data Sheets."*

63.6120(f)(5) A discussion identifying the frequency and methods for recalibrating the instruments SPL will use for monitoring the selected parameters.

SPL will have the OEM install, calibrate, and maintain the 36 SAC turbines at the frequency indicated in Revision 7 (Document Code SOM6928996) of the document titled, *"Monitoring Parameters Support Document."*