U.S. Department
of Transportation

Pipeline and Hazardous Materials
Safety Administration

12300 W. Dakota Ave., Suite 110
Lakewood, CO 80228

NOTICE OF PROBABLE VIOLATION
and
PROPOSED CIVIL PENALTY

CERTIFIED MAIL - RETURN RECEIPT REQUESTED

February 12, 2018

Mr. Alan S. Armstrong
Chairman of the Board and Chief Executive Officer
Williams Partners Operating, LLC
One Williams Center
Suite 4900
Tulsa, OK 74172

CPF 5-2018-3001

Dear Mr. Armstrong:

On March 31, 2014, pursuant to 49 U.S.C. § 60117, representatives of the Pipeline and Hazardous Materials Safety Administration (PHMSA), Office of Pipeline Safety (OPS), responded to an incident that occurred at Williams Partners Operating LLC's (Williams) Plymouth Liquefied Natural Gas (LNG) Peak Shaving Plant (Plymouth Plant) near the Columbia River in Plymouth, Washington.[1] At approximately 8:19 a.m. PDT on March 31, 2014, the Plymouth Plant experienced a catastrophic failure, resulting in an explosion and fire on a portion of its LNG-1 Purification and Regeneration System (Incident). The LNG-1

[1] The Plymouth Plant is a storage facility in the middle of Williams' Northwest Pipeline System that takes gas from the pipeline system in the spring and summer months, liquefies it, stores it, and then vaporizes it during periods of high demand in the fall and winter months. The Plymouth Plant consists of two separate LNG plants, known generally as "LNG-1" and "LNG-2." LNG-1 was placed in operation in 1975 and LNG-2 was placed in operation in 1979. Both share the use of four vaporizers.

Purification and Regeneration System (P&R System) is a subsystem of the LNG process at the Plymouth Plant that removes water vapor and CO2 prior to the gas being liquefied.

Following the Incident, PHMSA initiated a joint investigation with the Washington Utilities and Transportation Commission (WUTC)[2] of the Incident and its causes. The investigation revealed that the Incident occurred during routine annual liquefaction startup operations. In preparation for the startup, a piece of equipment known as the Regeneration Salt Bath Heater D-40 (Salt Bath Heater) was started on March 30, 2014, and slowly brought to its process set point of 550°F. The following day, on March 31, Plymouth Plant personnel began taking steps to start up the P&R System. After reviewing the applicable procedure, Williams personnel took final steps for startup, which included bringing the system up to full operating pressure and starting the regeneration compressor D-70. Upon confirmation of these steps, the board operator gave a command via the distributed control system to align certain automated control valves and to permit normal gas flow through the system. As flow began, the flammable mixture of air and natural gas entered the Salt Bath Heater, where the mixture auto-ignited and resulted in a rolling detonation that went against the flow of gas in the direction of the Adsorber D-20A. The pressure wave generated by the detonation entered the Adsorber D-20A and failed the vessel catastrophically by rapid over-pressurization releasing natural gas into the atmosphere, producing additional deflagrations.

At 9:27 a.m. PDT, a Williams' representative called the National Response Center (Report Number 1078325), and reported that an explosion had occurred at a natural gas compressor station (storage for LNG). The representative reported that the cause of the explosion was unknown at that time, but believed it may have had been a heater blowing up. The representative also stated that there was an ongoing fire at the Plymouth Plant and that the plant had been evacuated. Furthermore, the representative reported that there was one known injury. Due to the 911 call, local fire departments, police agencies and county emergency services personnel were dispatched to the Plymouth Plant.

Seven employees were stationed within 150 feet of Adsorber D-20A when it exploded and caught fire. Five Williams employees were injured and treated on-site. One employee was flown to the hospital for additional treatment for burn injuries, admitted, and released several days later. The company conducted an emergency shutdown and evacuated all plant personnel. After emergency responders arrived on-site and talked with Williams' Plymouth Plant personnel, a decision was made to evacuate citizens from the unincorporated village of Plymouth and the surrounding area within a two-mile radius, due to concerns about gas vapors. Traffic on the Columbia River and Highway 14, as well the nearby Burlington Northern rail lines, were shut down.

The explosion caused extensive physical damage to Plymouth Plant buildings and electrical equipment. Debris from Adsorber D-20A and the associated piping were thrown through the air, causing extensive damage to the surrounding plant facilities, including the air scrubber on the Saturn Turbine compressor, above-ground gas transmission piping at the compression

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[2] The Plymouth Plant is an interstate LNG facility under PHMSA jurisdiction. The WUTC, however, has assumed inspection and oversight authority for interstate natural gas and hazardous liquid pipelines in the State of Washington pursuant to an "interstate agent" agreement under 49 U.S.C. § 60106.

station, the LNG-1 refrigerant tower, the regeneration compressor and cooler, the "boil-off" compressor, various plant communication systems and cables, the backup generator, the surrounding buildings and structures (including the control room), and the Burlington Northern railroad tracks located outside the plant grounds. Debris also penetrated the outer shell of the large LNG-1 storage tank and dented the inner shell of the tank. This penetration of the outer shell caused the Perlite insulation that filled the annulus between the inner and outer tanks to be compromised, thus allowing LNG "boil off" gas to escape into the atmosphere. In addition, a protrusion on the half-inch-diameter instrumentation pipe located near the bottom of the LNG-1 tank was damaged, allowing additional LNG to escape in a spray and then vaporize. The release continued for approximately 25 hours and caused roughly 9.3 barrels of LNG to escape per hour, for a total of 234 barrels released. The resulting costs of the Incident, which included the damage to and repair of the Plymouth Plant, damage to the adjacent rail lines, and Williams' emergency response, totaled $45,749,300.00.[3]

The joint investigation resulted in the publication of a failure investigation report (FIR) issued by PHMSA on April 28, 2016.[4] The FIR found that the primary cause of the Incident was a substandard purge performed after leaving the LNG-1 purification loop open to the atmosphere from November 1, 2013, to March 18, 2014. A flammable gas-air mixture remained in the system, which then entered the Salt Bath Heater and auto-ignited during start-up.[5] Specifically, the FIR found that Williams failed to have detailed procedures to ensure that the plant's LNG-1 purification loop, which had been vented to the atmosphere during maintenance activities, was adequately and safely purged prior to startup. The valve alignment prescribed by the procedure left large volumes of gas against the closed Hot Valve D400, which created a dead-leg.[6] As a result, a flammable gas-air mixture remained in the system and then entered the Salt Bath Heater and auto-ignited during startup.[7]

The FIR also identified four other contributory causes:

1. The start-up sequence in the written procedure contributed to the event. The start-up of the Salt Bath Heater combined with the rapid pressurization of

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3 https://www.phmsa.dot.gov/sites/phmsa.dot.gov/files/docs/FIR_and_APPENDICES_PHMSA_WUTC_Williams_Plymouth_2016_04_28_REDACTED.pdf, Failure Investigation Report (FIR), (April 28, 2016) at 1 and Williams' Incident Report – Liquefied Natural Gas (LNG) Facilities, (March 25, 2016) at 2-3. *See also* Pipeline Safety Violation Report (February 12, 2018) (on file with PHMSA), Exhibits C and D.

4 FIR at 1.

5 *Id.* at 11.

6 A "dead-leg" is an area of an internal pipeline with no flow, low flow, or intermittent or occasional flow and is often a line that is closed by weld caps, flanges, valves, or other fittings. A dead-leg can affect the integrity of the pipeline by making it more susceptible to contamination or corrosion.

7 FIR at 11.

the gas-air mixture in the system from 53 psig to 685 psig allowed conditions to exist that were within the temperature and pressure range for auto-ignition to occur.

2. The purge and pack procedure utilized by the employees on March 18, 2014, did not provide a sufficient amount of detail to assure successful and repeatable results.
3. Previous purge and pack operations may have at times utilized additional purge points at or near the adsorbers.
4. The low toughness of the adsorber metal allowed it to fail in a brittle manner causing fragmentation.[8]

As a result of the joint investigation, PHMSA believes that Williams has committed probable violations of the Pipeline Safety Regulations, Title 49, Code of Federal Regulations, Part 193, as follows:

1. **§ 193.2517 Purging.**
   When necessary for safety, components that could accumulate significant amounts of combustible mixtures must be purged in accordance with a procedure which meets the provisions of the AGA "Purging Principles and Practices" after being taking out of service and before being returned to service.[9]

Williams failed to purge its P&R System in accordance with a procedure that met the provisions of American Gas Association's (AGA) *Purging Principles and Practices*, after being taken out of service and before being returned to service.

On November 1, 2013, Williams removed three manual valves from the P&R System for maintenance after the plant was taken offline and blown down. Once the valves were removed, the open flanges were covered with Visqueen plastic and taped shut to protect them from the elements. Nevertheless, air containing 20.9% oxygen was allowed to enter into the normally closed P&R System.

On March 18, 2014, Williams installed three new valves and purged the P&R System in preparation for the annual startup of the liquefaction process. To purge the system, Williams personnel followed the steps in its *Regeneration Compressor and Purification Adsorber –*

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[8] *Id.* Williams also provided a summary of its incident analysis and recommendations in Section 4 of its Root Cause Failure Analysis, dated October 29, 2015, at 9. In particular, action items number 1 and 2 of Williams' incident analysis and recommendation are reflected in the PHMSA-identified contributory causes.

[9] This was the version of § 193.2517 in effect at the time the alleged violation occurred. The current version of § 193.2517, updated on January 5, 2015 (80 FR 183), reads as follows:

> *Purging.* When necessary for safety, components that could accumulate significant amounts of combustible mixtures must be purged in accordance with a procedure which meets the provisions of the "Purging Principles and Practices (incorporated by reference, *see* § 193.2013)" after being taking out of service and before being returned to service.

LNG I; Remote Start-up and Shutdown procedure.[10] Adhering to these steps, Williams' personnel performing the purge pressurized the P&R System up to 100 pounds per square inch (psig) using natural gas, and then depressurized or "blew down" the system to approximately 5 psig through the blowdown valve downstream of the regeneration gas compressor. This process was repeated three times and then the P&R System was subsequently closed, with 5 psig of natural gas pressure left on the system.

Williams' procedure did not specify a blowdown pressure and since the blowdowns for each pressured purge were done to approximately 5 psig, instead of the industry-recognized practice of 0-1 psig,[11] oxygen remained in the P&R System. During the start-up of the Salt Bath Heater on March 31, 2014, the rapid pressurization of the gas-air mixture in the system allowed conditions to exist that were within the temperature and pressure range for auto-ignition to occur, which led to the Incident.

The AGA *Purging Principles and Practices* document notes the many different aspects of a system to be considered when designing purge procedures. The document discusses the difficulties in designing a general purge procedure for the various systems in place and the necessity of looking at individual systems and to design a procedure that takes into account the unique characteristics of the system to be purged. Specifically, paragraph 6.4(a*), "PLANT PIPING AND PROCESS EQUIPMENT*," which would be applicable to Williams' Plymouth Plant P&R System, states in relevant part:

> "**A detailed purge procedure should be prepared for each purge project.** All personnel involved in the project should be familiar with the procedure and the hazards of oxygen deficiency, fire and explosion." (emphasis added)

Here, Williams failed to prepare a detailed purge procedure for the purge conducted on March 18, 2014. Instead, it used a general purge procedure that failed to take into account all of the various aspects of its P&R System, including vessel size, piping configuration, molecular sieve materials, valves, filters, and other obstructions that could cause an incomplete purge. The valve configuration specified in Section C.3, "PURGE AND PRESSURIZE," of Williams' *Regeneration Compressor and Purification Adsorber – LNG I; Remote Start-up and Shutdown* procedure, required that the "Hot Valve D400" be left in the closed position during the purge.

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[10] Document 41.04.133LNG, issue number 1, and issuance date 10/31/2013. *See* Violation Report, Exhibit A.

[11] AGA *Purging Principles and Practices* provides sample procedures for purging a CO2 adsorbing tower, which include a provision to open the vent and reduce pressure to ~ 0.5 psig. (*See* paragraph 6.4(e)(2)(7)). AGA *Purging Principles and Practices* also provides another sample procedure for purging an expander to include opening vents and reducing pressure to 0.5 psig. (*See* paragraph 6.4(d)(2)(6))

However, implementation of this procedure, along with a lack of procedural specificity for a blow-down pressure and therefore only blowing down to 5 psig, created a low flow or "dead-leg" segment of pipeline on either side of the valve that could not be properly purged of a combustible air/gas mixture. This incomplete purge created an explosive oxygen and natural gas mixture that was present immediately prior to the startup and resulted in the auto-initiation.

2. § 193.2017 Plans and procedures.
(a) . . .
(c) Each operator must review and update the plans and procedures required by this part –
(1) When a component is changed significantly or a new component is installed; . . .

Williams violated § 193.2017 by failing to review and update its plans and procedures when new components were installed at the Plymouth Plant. Specifically, Williams installed three new manual valves in its P&R System on March 18, 2014. During PHMSA and WUTC's joint investigation, investigators reviewed numerous written procedures, required records, and interviewed all but one of the employees who were on site the day of the Incident. In their review, the investigators found that none of the documentation provided by Williams demonstrated the company's compliance with 49 CFR § 193.2017(c)(1) when it installed the three new manual valves in the purification-loop piping system on March 18, 2014. In accordance with § 193.2017(c)(1), a LNG operator must review its plans and procedures any time a component[12] is "changed significantly" or a new component is installed because the operator needs to evaluate and determine whether modifications to its operating plans or procedures are needed.

Here, the investigation found that Williams' purge procedure in effect at the time of the Incident did not specify the blowdown pressure. The valve configuration outlined in Williams' procedure did not account for the nested piping configuration around the adsorbers, which further made the industry-recognized blowdown to 0-1 psig essential. The investigation also revealed that the purging process used by Williams' personnel during previous successful restarts also deviated from this written procedure. Therefore, had Williams reviewed and updated its procedure when it installed the manual valves on March 18, 2014, it should have determined that its procedures failed to adequately describe the purging process previously employed during successful startups, as well as account for the various design aspects of its P&R System, including piping and valve configuration. As such, Williams violated § 193.2017 by failing to review and update its plans and procedures when it installed three new manual valves on March 18, 2014, thereby allowing employees to perform an insufficient purge on the LNG-1 P&R System, which was a contributory cause of the Incident.

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[12] The pipeline regulations define the term "*Component*" to mean "any part, or system of parts functioning as a unit, including, but not limited to, piping, processing equipment, containers, control devices, impounding systems, lighting, security devices, fire control equipment, and communication equipment, whose integrity or reliability is necessary to maintain safety in controlling, processing, or containing a hazardous fluid." (49 CFR 193.2007).

3. **§ 193.2503 Operating procedures.**
Each operator shall follow one or more manuals of written procedures to provide safety in normal operation and in responding to an abnormal operation that would affect safety. The procedures must include provisions for: . . .
(f) In the case of liquefaction, maintaining temperatures, pressures, pressure differentials and flow rates, as applicable, within their design limits for: . . .
(4) Purification and regeneration equipment; . . . .

Williams failed to have procedures in place to provide safety during the start-up process. Specifically, Williams' operating procedures failed to identify that its purification and regeneration equipment would result in being operated beyond its design limits in accordance with § 193.2503(f)(4). The start-up sequence in Williams' *Regeneration Compressor and Purification Adsorber – LNG I; Remote Start-up and Shutdown* procedure failed to provide safety in normal operation by instructing Williams personnel to start the Salt Bath Heater prior to pressurization.[13] Section C.2 of its procedure indicated that the startup of the heating process through completion of the Regeneration Salt Bath Heater procedures was required prior to starting the regeneration process.[14]

Following this procedure, Williams personnel, on the day before the Incident, started the Salt Bath Heater and slowly brought up to its full operating temperature. The start-up of the Salt Bath Heater on March 30, 2014, combined with the rapid pressurization of the gas-air mixture in the P&R System, allowed for conditions to exist that were within the temperature and pressure range for auto-ignition. Williams' operating procedure failed to take into account that the purification and regeneration equipment would result in being operated beyond its design limits in accordance with § 193.2503(f)(4), and the failure to have a start-up procedure that provided safety during normal operations contributed to the cause of the Incident on March 31, 2014.[15]

Proposed Civil Penalty

Under 49 U.S.C. § 60122 and 49 CFR § 190.223, you are subject to a civil penalty not to exceed $209,002 per violation per day the violation persists, up to a maximum of $2,090,022 for a related series of violations. For violations occurring prior to November 2, 2015, the maximum penalty may not exceed $200,000 per violation per day, with a maximum penalty not to exceed $2,000,000 for a related series of violations. Also, for LNG facilities, an additional penalty of not more than $76,352 for each violation may be imposed. The Compliance Officer has reviewed the circumstances and supporting documentation involved in the above probable violation(s) and has recommended that you be preliminarily assessed a civil penalty of $864,000 as follows:

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[13] Document 41.04.133LNG, issue number 1, and issuance date 10/31/2013.

[14] *Id.* at 1.

[15] *See* Failure Investigation Report at 11 and Williams' Root Cause Failure Analysis at Section 4.

Item number	PENALTY
1	$288,000
2	$288,000
3	$288,000

Response to this Notice

Enclosed as part of this Notice is a document entitled *Response Options for Pipeline Operators in Compliance Proceedings*. Please refer to this document and note the response options. All material submit in response to this enforcement action may be made publicly available. If you believe that any portion of your responsive material qualifies for confidential treatment under 5 U.S.C. 552(b), along with the complete original document you must provide a second copy of the document with the portions you believe qualify for confidential treatment redacted and an explanation of why you believe the redacted information qualifies for confidential treatment under 5 U.S.C. 552(b). If you do not respond within 30 days of receipt of this Notice, this constitutes a waiver of your right to contest the allegations in this Notice and authorizes the Associate Administrator for Pipeline Safety to find facts as alleged in this Notice without further notice to you and to issue a Final Order.

In your correspondence on this matter, please refer to **CPF 5-2018-3001** and for each document you submit, please provide a copy in electronic format whenever possible.

Sincerely,

Kim West
Acting Director, Western Region
Pipeline and Hazardous Materials Safety Administration

Enclosure: *Response Options for Pipeline Operators in Compliance Proceedings*

cc: PHP-60 Compliance Registry
PHP-500 P. Katchmar (#149816)