Michigan Public Service Commission

Staff Investigation Report

Consumers Energy Company - Ray Compressor Station Fire

69333 Omo Road, Armada Township

Incident Date: January 30, 2019

Case: 00003091

Report Date: January 31, 2020

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[1] Consumers' original report to PHMSA dated March 1, 2019. PHMSA and Staff requested updates to this report on several occasions. Consumers' latest response on January 16, 2020, stated that they intend to update and submit a final version on February 17, 2020.

Case Information

Principal Investigator	Kyle Friske
Program Manager	David Chislea
Date of Report	January 31, 2020
Subject	Staff Investigation Report – Consumers Energy Company – Ray Compressor Station Fire
Case	00003091

Operator, Location, & Consequences

Date of Failure	January 30, 2019
Commodity Released	Natural Gas
Volume Released	3.274 MMcf
City/County & State	Armada Township/Macomb County, Michigan
OpID & Operator Name	2748, Consumers Energy Company
Unit Name	Consumers Energy Company
Milepost / Location	69333 Omo Road/Ray Compressor Station
Type of Failure	Equipment Failure – Compressor or Compressor-Related Equipment
Fatalities	0
Injuries	0
Description of Area Impacted	Plant 2 and 3 Blowdown Silencers and Plant 2 Dehydration System; Gas Supply Curtailments; Entire Customer Base Demand Response Request
Property Damage	$18,017,151

Executive Summary

On January 30, 2019, Consumers Energy Company (Consumers) notified the Michigan Public Service Commission Staff (Staff) of a fire at their Ray Compressor Station in Armada Township. This fire initiated from the ignition of gas that was venting from a localized shutdown of Plant 3. The gas from Plant 3 vented out of the blowdown silencers and then ignited when the wind blew the gas towards Plant 2's thermal oxidizer. Upon recognizing the fire, Consumers initiated an emergency shutdown (ESD) of the entire station, increasing the amount of gas venting from the blowdown silencers for Plants 2 and 3, which ultimately added additional fuel to the existing fire.

Staff determines that the root cause of the Consumers' Ray Compressor Station Fire that occurred on January 30, 2019, was interference from the domestic water well pump at the station, which caused a voltage spike in the grounding system of the communications system of the Plant 3 controls. This caused the system to lose communication and go into "fault mode," resulting in a Plant 3 ESD.

System Details

Ray Compressor Station consists of three compressor systems; Plants 1, 2, and 3. The compressor station compresses gas into and out of Ray Storage Field, which is one of the largest storage fields in the state.[2] Plant 1 no longer contained compression equipment (these were retired in 2016) but still contained headers and processing equipment. Plant 2, constructed in 1966, consisted of three compressor units with a maximum allowable operating pressure (MAOP) of 1,800 pounds per square inch gauge (psig). Plant 2 had modifications made in 2005 to its dehydration system that included the installation of a thermal oxidizer. The thermal oxidizer is responsible for combusting volatile organic compounds and other waste removed from the gas stream when withdrawn from storage fields. Plant 3, placed into service in 2013, consists of five compressor units with an MAOP of 1,800 psig. Plant 3's blowdown silencers were located approximately 135 feet southwest of Plant 2's thermal oxidizer. Refer to Consumers' Root Cause Analysis (RCA) Presentation (Appendix A) for a detailed site layout.

Events Leading up to the Failure

Gas was free-flowing (or floating) from Ray Compressor Station to market prior to the incident. Due to the high operating pressure of the storage fields associated with Ray Compressor Station (1170 psig), Consumers was able to float pressure from the storage fields to market (without utilizing compression) much later in the withdrawal season than other storage fields it owns.

The ambient temperature was -8°F with wind blowing at 20 miles per hour with gusts up to 28 mph in a northeasterly direction. Consumers was planning on delivering gas at a rate of 1.8 billion cubic feet (Bcf) per day for 12 hours from this station to accommodate the extreme weather conditions. According to Consumers' first response to Commission Order in Docket

[2] 65.4 Bcf total storage volume. 17.3 Bcf base volume with 48.1 Bcf working volume.

No. U-20463 (refer to Appendix I), such a delivery rate would have set a record for total day and peak hour demand deliveries.

At approximately 10:26 a.m., Consumers personnel working in the onsite headquarters building[3] observed a fire near the Plant 2 dehydration equipment and proceeded to activate the entire Plant 3 ESD system to vent the gas away from the fire. Station personnel then went outside to activate the Plants 1 and 2 ESD systems at approximately 10:28 a.m., since these systems were not activatable from the headquarters building. The venting gas from the Plants 2 and 3 blowdown silencers ignited immediately after exiting the silencer, due to the proximity to the existing fire.

Emergency Response

Consumers notified the Armada Township Fire Department (Fire Department) at 10:29 a.m., who arrived by 10:38 a.m. The firefighters were instructed to wait in the headquarters building until the gas was fully evacuated from the station piping. Consumers initiated two incident command structures (ICS); the first to control the event until a cause could be determined and the second to manage the gas delivery demand to the market (as previously mentioned, the demand called for record-setting gas deliveries). Consumers' first response to Commission Order in Docket No. U-20463 (refer to Appendix I) includes more detail on the ICS and the gas supply and curtailment events. The gas took approximately five hours to fully evacuate the piping due to Consumers' personnel remotely closing the Plant 2 regulation run control valves (R4 and R8). Consumers stated that the controls valves were closed to limit the fuel being added to the existing fire. These control valves isolated a portion of the Plant 2 headers, preventing a complete Plant 2 blowdown. However, these control valves did not create a gas-tight seal, allowing gas to slowly fuel the existing fire.

All ESD block valves activated as designed. The fire decreased in intensity by 10:33 a.m. after most of the gas was vented. The remaining gas restricted behind the Plant 2 regulation run was slowly leaking by, allowing a slow flare of gas through the Plant 2 blowdown silencer. Consumers decided to reroute the restricted gas (between ESD Block Valve 608 and R4/R8) through the Plant 1 blowdown silencer (ESD Blowdown Valve 609). Refer to Consumers' Ray Emergency Plan (Appendix B) for a schematic of the station, valve locations, and notes elaborating on where the isolated gas in Plant 2 was located.

The fire, isolated to the Plants 2 and 3 blowdown area, essentially extinguished itself by approximately 3:34 p.m. when the venting gas from the blowdown silencers was completely exhausted. The onsite Fire Department proceeded to enter the affected area to hose down any remaining fires and cleared the site.

Staff was notified of the incident at 11:23 a.m. and arrived onsite at 1:21 p.m. to perform an investigation. This incident was reported to the National Response Center at 11:35 a.m. on

[3] Consumers' personnel onsite used the term "Control Room." Consumers' RCA Presentation used the term "Main Building." Consumers' Compressor Station Emergency Plan Schematic used the term "Headquarters Building." Consumers' Third-Party Vendor Root Cause Analysis Report used the terms "Main Building" and "Control Room." Consumers' Communications System Vendor Apparent Cause Investigation used the term "Headquarters Building." All these terms are referring to the same location that Staff is using the term "Headquarters Building" to refer to.

January 30, 2019, due to the estimate that damages would exceed $50,000 and the volume of gas loss would exceed 3 million cubic feet (MMcf) (Refer to Appendix C).

Summary of Return-to-Service

The ESD for Ray Compressor Station shut down all gas and non-emergency electrical service to the station. Pressures and flow on the pipelines and storage fields were being monitored by Consumers' control room in Jackson, MI. Consumers estimated that if the station were to remain out of service past 6:00 p.m. on January 30, 2019, there was the potential of customer outages. After the fire was extinguished, Consumers immediately began inspecting the station to determine the cause of the incident, what equipment or piping was potentially compromised, and which sections of piping could be returned to service in order to avoid customer outages.

Due to the potential of widespread customer outages and the need to preserve as much gas on the system as possible, Consumers began notifying industrial customers about the need to reduce gas utilization. As the day progressed, formal curtailment was conducted for all non-residential customers having commercial gas requirements of at least 1,250 Mcf/month. Consumers was actively monitoring their "line pack" (how much natural gas is on their transmission system available for utilization) and comparing the line pack depletion rate to the rate at which gas was entering their system from other sources. Additionally, during the evening of January 30, as part of coordination between Consumers and the Governor's office, a text message was sent to Michigan citizens requesting that they reduce their natural gas usage by turning down their thermostats to maintain as much reserve line pack as possible. It was forecasted that the temperatures would hit -14°F before the morning of January 31.

By 10:15 p.m., Consumers had completed the inspection of Plant 1 piping and determined that it was safe to return to service. Plant 1 was returned to full service by approximately 10:40 p.m. on January 30, 2019.

Consumers assembled a root cause analysis (RCA) team on January 31, 2019. The RCA team ruled out any Plant 3 damage outside of the damage to the blowdown silencers and began to formulate a plan to return Plant 3 to gas service. Consumers' third response to the Commission Order in Docket No. U-20463 (Refer to Appendix M) included a detailed proposed schedule for returning the station to service. The timeline started with the completion of the facility damage assessment and repair prioritization on February 8, 2019. This assessment consisted of prioritization "in such a way as to minimize their impact on system operations, meet peak summertime injection demand, and ensure that the natural gas storage field can be filled to capacity by October 31, 2019, prior to the start of the 2019-2020 heating season." Plant 3 was returned to injection service on May 16, 2019. Consumers' fifth response to Commission Order in Docket No. U-20463 (Refer to Appendix O) included an updated schedule for returning the station to service. Plant 2 was returned to injection service on August 16, 2019. Plant 3 was returned to withdrawal service on October 8, 2019. Plant 2 was returned to withdrawal service on December 30, 2019.

Investigation Details

January 30, 2019

Staff arrived onsite to perform an investigation at 1:21 p.m. on January 30, 2019. The fire was still burning and appeared to be in the area of the Plant 2 dehydration equipment as observed from the headquarters building. Firefighters were onsite and waiting for the gas flow to stop before they were cleared to extinguish what remained of the fire. The fire was being fueled with the natural gas venting from the compressor station piping as a result of the ESD activation, and Consumers had been unable to get close enough to determine the actual failure location. Consumers stated that gas was continuing to enter the system and vent out the blowdown silencers, fueling the fire.

Consumers was working towards returning Plant 1 to service by 6:00 p.m., contingent on an inspection of the piping and equipment to determine that it had not been compromised. At this time, Plant 2 was to remain shut down due to the obvious damage to its facilities and Plant 3 was to remain shut down pending an inspection of its facilities. Refer to Figure 1 for a visual of where the fire damage was in relation to Plant 2's equipment. The fire caused heat damage and scorching to equipment and electronics.

Figure 1: Fire Above Plant 2 Dehydration System

Consumers was able to fully shut down the station and extinguish the fire by approximately 3:34 p.m. An observation of the failure location did not yield an obvious cause or ignition source. There were several locations with evident scorching and melted equipment in the area of the Plant 2 dehydration equipment, including two buildings. The station supervisor stated that there was a big fireball and a gas-fed fire at this location prior to the ESD being activated. The supervisor stated that the venting gas ignited at the Plant 3 blowdown silencers at the southwest corner of the site at 10:26:10 a.m. Staff reviewed security footage and there appeared to be a large gas release at 10:26:06 a.m. (per the video timestamp) prior to ignition. Consumers planned to initiate an investigation the following morning to determine the cause and source of the release. Plant 1 was returned to full service at 10:40 p.m. on January 30, 2019.

January 31, 2019

Staff arrived onsite to continue the investigation on January 31, 2019. Michigan State Police (MSP) and fire investigators from the Federal Bureau of Alcohol, Tobacco, and Firearms (ATF) were onsite to assist with the investigation. Staff returned to the area of the Plant 2 dehydration equipment to walk through the incident with the fire investigators. Staff then reviewed video footage of the incident from Consumers' security cameras and compared the event timelines between milestones in the camera footage, communications system historical database (Historian) data, and the headquarters building event logs from the Human-Machine Interface (HMI). At the end of January 31, 2019, there was still no definitive cause of the incident due to timeline discrepancies between the Plant 3 ESD in the Historian data and the HMI event logs in relation to the ignition observed in the surveillance video system. It was unknown if the large gas release precipitated an automatic-activation of the ESD or if other equipment was releasing gas. There were also discrepancies with the HMI event logs and the Historian data detailing pertinent information on valve positions and alarms.

The MSP investigator indicated that their onsite investigation was completed and that the cause of this fire will be classified as undetermined. Refer to MSP Fire Investigation Report (Appendix E) for additional details.

Plants 2 and 3 were planned to remain shut down until Consumers' root cause analysis was completed. It should be noted that the extreme weather events that were placing an unprecedented stress on Consumers' natural gas system had lifted, and these two Plants were not needed to avoid curtailments with the resumption of more typical weather.

February 2, 2019

Staff arrived onsite to continue the investigation on February 2, 2019. Staff focused on aligning the timelines between the video surveillance system, the HMI event logs, and the Historian database. A comparison between the Plant 2 ESD activation event from the HMI event log; Historian Database alarm; and the visible gas beginning to vent from the Plant 2 blowdown silencers on the video system indicated that the HMI time log lagged approximately five minutes behind the video system timestamp and the Historian time was approximately one minute ahead. This time difference was confirmed by manually sending a signal to the HMI while simultaneously looking at the video system timestamp in real time. This produced a time difference of 4 minutes and 22 seconds. The Historian time was determined to be 50 seconds ahead of the video timestamp using a similar method. It also appeared that the video system was close to actual real time by comparing to a cellular phone clock. The conclusions are summarized as follows:

- Video footage timestamp is real time.
- Historian timestamp is real time plus 50 seconds.

- HMI timestamp is real time minus 4 minutes and 22 seconds.

Staff presented these findings and requested that Consumers verify the time differences from a software level to determine the actual time differences based on source coding of the systems. Consumers responded on February 8, 2019:

> The camera footage was calibrated/sync to the world clock EST and determined to be the "real time" - The RCA spent approximately three days working through the time-line, reviewing camera footage as real time and then comparing the camera footage to Historian and the HMI times. Once the team determine[d] the difference between real time and Historian and HMI, the times were validated by checking and comparing Historian and HMI times throughout the day to confirm the information below.
>
> a. Camera Footage - Video footage is our "real time"
> b. Historian - Historian = (real time - 0:50 sec)
> c. HMI - HMI = (real time + 4min 22 sec)

This conclusion appeared to reflect the same process that Staff took to determine the time differences, except that the mathematical equations appeared to be reversed. Upon further conversations with Consumers, they agreed with Staff's original conclusions; however, their formatting as mathematical equations was mistakenly misrepresented. Staff again requested that Consumers provide evidence from a software programming level that confirmed the timeline, but Consumers stated that they were comfortable with the methods used and that delving into the software was not necessary.

Staff proceeded with the timeline validation by comparing events that should have been detectable in each of the three data sources:

- A Plant 2 ESD Alarm from the HMI occurred at 10:23:36, correlating to 10:27:58 real time.
- The first Plant 2 ESD blowdown valves began to move (Valves 610 and 612) in Historian at 10:29:30, correlating to 10:28:40 real time.
- Plant 2 venting was observed in the video at 10:29:30 real time.

While there are unknowns between when signals were sent or received in relation to when valves begin to or completed operating, this timeline appears to be valid from a sequencing standpoint.

However, comparable results were not achieved when Staff attempted to perform the same validation using Plant 3's events:

- Plant 3 ESD system alarms from the HMI (potential trigger for automatic activation of Plant 3 ESD prior to fire) began at 10:18:49, correlating to 10:23:11 real time. Consumers stated that these alarms were unfamiliar to them and were not identified as indications that Plant 3 was shutting down.

- Plant 3's first ESD bypass valve (Valve 702) began to actuate in Historian at 10:25:23, correlating to 10:24:33 real time.
- The first small flame was observed in the video at 10:25:51 real time.
- The second small flame was observed in the video at 10:26:07 real time.
- Full ignition and flames travel back to Plant 3's blowdown silencers in the video at 10:26:20 real time.
- Plant 3's first ESD blowdown valves (Valves 722 and 724) began to actuate in Historian at 10:27:43, correlating to 10:26:53 real time. This would have been the first moment that gas could have been present at the Plant 3 blowdown silencers.
- Plant 3's ESD Alarm from the HMI (manual activation) was 10:22:46, correlating to 10:27:08 real time.

Staff requested that Consumers investigate how gas was venting from Plant 3's blowdown silencers via the video surveillance footage before indications that Blowdown Valves 722 and 724 began to actuate in Historian.

<u>February 4, 2019</u>

Staff received an update from Consumers via a conference call on February 4, 2019. The time discrepancy for the Plant 3 valve indications in Historian could likely be attributed to a delay in when the valves actually began to move versus when the movement sensor was triggered. Consumers stated that a more reliable indicator would be pressure data showing the line was blowing down prior to when the valve data indicated movement. Staff requested to review this pressure data.

Additionally, Consumers communicated that they had retained a third-party vendor to perform an independent investigation into the root cause of the incident. Consumers also indicated that they were looking into a possible malfunction of the Plant 3 control system due to identifying several malfunction and error messages.

<u>February 7, 2019</u>

On February 7, 2019, the Michigan Public Service Commission (Commission) ordered Consumers to file a report by April 7, 2019, addressing the following (Refer to Appendix H):

1. The origin of the fire;
2. How Consumers responded to the fire, both at the site and at its corporate office;
3. The company's implementation of gas curtailment procedures;
4. Whether there is evidence of a failure on the part of Consumers to properly maintain its equipment or any non-compliance with Commission rules;
5. Whether the company properly responded to the natural gas shortage;
6. Estimated reductions in natural gas usage from large customer curtailments and residential conservation over time during the emergency with corresponding timeframes of actions (e.g., public appeals, emergency alerts) by Consumers and the State of Michigan;

7. Consumers' coordination and communication with State of Michigan officials and local emergency response agencies;
8. Actions directed toward physical security and cybersecurity before, during, and after the event; and
9. The total cost of the incident, including gas lost on site, emergency natural gas purchases, estimates of customer curtailment impacts, and repair of the facility.

Staff was ordered to file a response to this report by May 8, 2019, addressing Consumers' filings, outlining the process and anticipated timeline for the subsequent RCA Report that the Commission's Gas Operations Section would provide, and recommending potential changes to utility operations or procedures, if identified. Stakeholders were also invited to file input by this date. Additionally, Consumers was invited to file a reply to Staff's response and stakeholder input by May 30, 2019.

<u>February 19, 2019</u>

Staff arrived onsite to investigate another unintended gas release at Ray Compressor Station on February 19, 2019. This incident involved a relief valve blowing on a recently installed filter/separator. This incident appeared to have been caused by liquids in the pilot sensing line freezing and were unrelated to the subject incident of this report.

However, while onsite, Staff requested to review additional records pertaining to the January 30, 2019 incident. Staff reviewed piping drawings for the blowdown lines and confirmed that Blowdown Valves 722 and 724 were the only valves connected to these lines. Staff reviewed the pressure data that Consumers used as an indicator that these valves had begun to actuate. Consumers reiterated that, depending on where the valve sensor indicators are located, they do not necessarily indicate the actual position status of the valves. The pressure data indicated that pressures began dropping at 10:26:23 in Historian, correlating to 10:25:33 real time. Using the pressure data to determine when valves began to actuate validates the time normalizing methodology previously developed.

Consumers also iterated that their RCA team was not intending to determine the cause of the ESD; rather only the cause of the ignition and how to prevent recurrence in the event of future ESD's. The task of determining the cause of this specific ESD was given to operations employees and was still underway. Consumers' RCA Presentation (Refer to Appendix A) and their third-party vendor RCA (Refer to Appendix F) focused on the cause of the ignition. It was stated that they were most concerned by the ignition because, while an ESD could be triggered by anything, the significance of this incident was a result of the ignition. Staff stated that it intended to stay involved with the root cause investigation of the ESD because an increased frequency of ESD's increases the likelihood of a potential ignition.

<u>March 4, 2019</u>

On March 4, 2019, Staff received Consumers' Third-Party Vendor RCA (Refer to Appendix F) and Consumers' RCA Presentation (Refer to Appendix A). These documents conclude that the source of the gas was from the Plant 3 ESD blowdown silencer. The gas migrated towards Plant 2's thermal oxidizer and ignited due to the temperature of the exhaust exceeding the auto-ignition temperature range of natural gas. Per thermocouple historian data at the time of ignition, the Plant 2 Thermal Oxidizer exit temperature was 1506°F. Per the National Fire Protection Association (NFPA) 921 Guide for Fire & Explosion Investigations, the auto ignition temperature of natural gas ranges from 900°F to 1170°F. As previously mentioned, the root cause of the incident (the initial Plant 3 ESD) was not fully investigated in either of these RCA documents. Consumers appeared satisfied by this conclusion and proceeded with their plans of returning the station to service as detailed in the "Summary of Return-to-Service" section of this report. Included in these plans were modifications to the Plant 3 blowdown vents to replace the silencers with straight vent piping and to repair the damaged facilities. The new configuration would allow for increased velocity of venting gas, reducing the likelihood of a gas plume contacting any existing station equipment that may be a source of ignition.

<u>April 5, 2019</u>

On April 5, 2019, Consumers filed a report to Docket No. U-20463 in response to the Commission's Order (Refer to Appendix I). Regarding the origin of the fire, Consumers reiterated the findings from their RCA reports, stating that the control system was involved in the cause of the ESD but did not elaborate on how the ESD was initiated prior to the ignition. Regarding their response to the fire, Consumers elaborated on their ICS processes which "enabled fast, complete and transparent engagement with the MPSC, State Emergency Operations Center (SEOC) and the Governor's office throughout the event." Regarding whether there was evidence of a failure on their part to properly maintain its equipment or any non-compliance with Commission rules, Consumers stated "there was no evidence of a failure to properly maintain equipment."

<u>May 8, 2019</u>

On May 8, 2019, Staff filed a response to Consumers' report (dated April 5, 2019) to Docket No. U-20463 (Refer to Appendix J). Relevant excerpts from this response are as follows:

The Origin of the Fire:

- Page 2 of Consumers' report states in part that "On Jan. 30, Plant 3 at the Ray Compressor station detected an abnormal operating condition in the Det-Tronics control system."

  Staff's Response – It does not appear that Consumers included an investigation into the abnormal operating condition in the Det-Tronics control system in its report. Staff will include a further analysis of this failure in its subsequent RCA report.

- Page 3 of Consumers' report states in part that "For Ray Plant 3, the natural gas is typically routed through a silencer which reduces the noise produced by the blow down to a level that is less disruptive to the surrounding community than traditional straight pipe high velocity vents. This is accomplished by reducing the velocity as the natural gas is discharged. With the slow exit velocity, the gas flow is more sensitive to the wind which can enhance the mixing of the natural gas with the surrounding air."

Staff's Response – Consumers does not discuss whether the silencer design and/or location contributed to the incident. It appears that this incident could have been avoided if the silencer had a different design or was installed in a different location. Staff will include a further analysis of the adequacy of the design of the blowdown piping in its subsequent RCA report.

- Page 5 of Consumers' report states in part that "On the morning of Jan. 30 at 10:23:10 a.m. (Times have been normalized to align with the security camera timestamps), the Ray Compressor Station lost the pilot air pressure signal for the Plant 3 fire-gate system. As designed, this triggered Plant 3's process equipment emergency shutdown. The plant experienced a priority 1 fire-gate alarm at 10:25:20 a.m. and the station was blown down at 10:25:33 a.m."

  Staff's Response – Staff was unfamiliar with the pilot air pressure data point. Staff was originally provided with the 10:25:33 a.m. data point as the first data point indicating the activation of the emergency shutdown system. However, Staff was unable to see any significance to the 10:25:33 a.m. time in the data provided. As part of the RCA, Staff will work with Consumers to understand the timeline in relation to the data originally provided.

- Page 6 of Consumers' report states in part that "Personnel at the Ray Plant manually fire-gated Plant 1 and Plant 2, as part of our standard safety protocols, at 10:27:58 a.m. and 10:28:22 a.m., respectively."

  Staff's Response – Staff's investigation identified that Plant 2 actually fire-gated at 10:27:58. Staff was unable to verify the Plant 1 fire-gate time due to that event not being recorded electronically. As part of the RCA, Staff will work with Consumers to understand the timeline in relation to the data originally provided.

How Consumers Responded to the Fire

- Page 7 of Consumers' report states in part that "It also enabled fast, complete and transparent engagement with the Commission, State Emergency Operations Center (SEOC) and the Governor's office throughout the event."

  Staff's Response – Missing from this assertion is the fact that communication between Consumers and other utilities within the state appears to have been poor. During Staff's investigation of the event, other utilities indicated that Consumers failed to notify them of the seriousness of the situation, in addition to not being provided any advance notice that there was going to be an emergency plea issued to residents within the State, many of whom did not have Consumers as a natural gas provider. Staff recommends to the Commission that this issue be addressed in the Statewide Energy Assessment report (SEA) in Docket U-20464.

Evidence of a Failure on the Part of Consumers to Properly Maintain its Equipment or any Non-Compliance with Commission Rules

- Page 10 of Consumers' report states in part that "The current installation meets requirements of Michigan's gas regulations."

  Staff's Response – Considering the origin of the fire (Page 6 of Consumers' report states in part that "[t]he blowdown gas vented through the silencers located at the southwest corner of the station property. This blowdown gas ignited. The wind pushed the flames north eastward. The first visible sign of fire was observed near the Plant 2 thermal oxidizer stack at 10:25:51 am. The fire increased in size and reached the top of the Plant 3 blowdown silencer by 10:26:22 a.m."), it appears that the design does not meet the requirements of 49 CFR 192.167(a)(2).

  49 CFR 192.167(a) states in part that "Each compressor station must have an emergency shutdown system that meets the following: … (2) It must discharge gas from the blowdown piping at a location where the gas will not create a hazard."

In addition to the comments, Staff recommended that:

> Consumers perform a system-wide study of compressor station blowdown methods and locations. The blowdown method considerations should include discharge velocity, volumetric flow characteristics, height of discharge, plume modeling, etc. The blowdown locations should be evaluated considering proximity to competent ignition sources, including equipment that can meet or exceed natural gas auto-ignition temperatures, open flames or sparks, and potential static electricity discharge. This study should include consideration of single failure of components that may have designs protecting against these ignition sources from being exposed to atmosphere. Consumers should then develop an action plan to remediate all such instances identified in this study.

Staff concluded:

> Although the ignition did not involve personal injury nor complete system outages, Staff contends that there was a potential for injuries or fatalities and larger scale outages. In addition to the root cause analysis, Staff requests that Consumers specifically focus on factors that could have increased the significance of this incident. Consumers should implement countermeasures to its findings to all facilities within its system. Consumers should also communicate lessons learned and best practices to its industry peers in Michigan and elsewhere to help ensure safe and reliable natural gas transportation. Subsequent to this response, the Commission will be submitting its Statewide Energy Assessment in response to Docket U-20464. Staff will also be working with Consumers

> to fully understand any remaining discrepancies and newly identified facts related to this incident and will subsequently be drafting its RCA report in the coming months. At the completion of the RCA report, Staff plans to identify potential violations and make additional recommendations based on the final conclusions of the RCA report.

Each identified issue by Staff was further evaluated and are included in the "July 1, 2019" sub-section of the "Investigation Details" section of this report.

<u>May 30, 2019</u>

On May 30, 2019, Consumers filed a response to Staff's comments (dated May 8, 2019) to Docket No. U-20463 (Refer to Appendix K). Consumers did not specifically discuss the comments by Staff, but rather generally implied that their summary of new findings, consequent actions, and lessons learned would address them. They stated that their reply "will review these new findings and lessons learned, provide insight into activities undertaken and planned since the event, and articulate the Company's commitment to continue meeting timely with Staff to ensure a satisfactory resolution for all stakeholders." The new findings included:

> Consumers Energy's ongoing investigation into the origin of the fire has revealed that a grounding fault was the underlying cause of the initial firegate event. When the station's well pump started up, its variable frequency drive caused a voltage spike in the grounding system of the Det-tronics panel located in the headquarters building. These high voltages caused enhanced discrete input/output (EDIO) and analog input module (AIM) modules to lose communication with the Det-tronics pilot air system, a fault which triggered the initial firegate.
>
> To eliminate the grounding voltage into the Det-tronics system, the well pump pressure switch and pressure transmitter will be relocated to the east side of the Plant 3 auxiliary building. The risk of a communications break-down between the pilot air system and its modules has been mitigated by relocating the modules from the headquarters building to the Plant 3 auxiliary building.
>
> Consumers Energy has contracted with an engineering firm and is collaborating to develop an air/gas dispersion model that illustrates how the fire occurred, evaluates the condition of affected facility components, and identifies designs that provide better mitigation. The model revealed a better design for gas dispersion pipes. New straight pipes, which allow gas to exit at a high velocity, have been installed at the Ray Compressor Station (Figure 2) in conformity with this finding. Future gas ejections will reach a higher elevation before mixing with enough air to become combustible. The Company continues to model additional scenarios for analysis and, by year end, will have developed a standard for Plant Hazard Analysis that will apply to all future projects and sites.

July 1, 2019

Staff received an update from Consumers via a conference call on July 1, 2019. Consumers worked with Staff to align on what pressure data specifically was most relevant to fully validate the timeline correlation in the absence of a technical validation from a software coding level. There appeared to be discrepancies in several pressure data sets that did not appropriately represent the ESD blowdown valves being actuated. Consumers stated that they are confident in the timeline correlation and hold higher relevance in comparing the ESD alarms from the HMI to the video events. Consumers also confirmed that Plant 2 ESD occurred at 10:27:58 and the Plant 1 ESD occurred at 10:28:22 per Historian alarm data and that their report from April 5, 2019, filed to Docket No. U-20463 in response to the Commission's Order (Refer to Appendix I) had an error.

Consumers discussed the preliminary findings from their communications system vendor for what caused the Plant 3 ESD prior to the fire event. It was identified that the variable frequency drive (VFD) for the domestic water well pump, upon startup, caused a voltage spike in the grounding system of the communications system panel located in the headquarters building. The voltages on the grounding system caused enhanced discrete input/output module (EDIO) and analog input module (AIM) to lose communication and go into fault mode resulting in a Plant 3 ESD. Refer to Consumers' Communications System Vendor Apparent Cause Investigation (Appendix G) for more details.

July 2, 2019

On July 2, 2019, the Commission ordered Consumers in Docket No. U-20463 (Refer to Appendix L) to:

A. Conduct a system-wide study of compressor station blowdown methods and locations and to compose a related incident action plan by September 3, 2019,
B. Conduct an evaluation of the company's incident command system and procedures and shall prepare a report with recommended improvements by November 1, 2019,
C. Provide testimony and exhibits detailing the costs for the Ray Natural Gas Compressor Station incident in their next general rate case, power supply cost recovery case, and/or gas cost recovery case,
D. File a report that details the Ray Natural Gas Compressor Station storage field natural gas injection timeline and a status update on the plant repairs at the facility by August 2, 2019, and
E. File a final report on the Ray Natural Gas Compressor Station storage field capacity for the 2019/2020 heating season and updates on repairs and other changes made at the facility since January 31, 2019, by October 1, 2019.

August 2, 2019

On August 2, 2019, Staff received a report from Consumers in Docket No. U-20463 that detailed the Ray Natural Gas Compressor Station storage field natural gas injection timeline and a status update on the plant repairs at the facility (Refer to Appendix M). Significant details were included in the "Summary of Return-to-Service" section of this report.

August 29, 2019

On August 29, 2019, Staff met with Consumers in their Lansing annex office to review ICS notes and records from the Ray incident. A detailed accounting of emergency response steps and communications from the event were shared with staff, including positive actions, mis-steps, and lessons learned.

September 3, 2019

On September 3, 2019, Staff received a report from Consumers in Docket No. U-20463 outlining their system-wide study of compressor station blowdown methods, locations, and related incident action plan (Refer to Appendix N). The report concluded that:

> Overall, the review of gas blowdown vents and associated risk related to competent ignition sources indicates there is not a scenario that presents a fire risk similar to the Ray incident. Consumers Energy does plan to conduct dispersion modeling at additional locations summarized above as a precautionary measure as part of the Company's action plan.

However, it appears that the report came to this conclusion prior to completing the dispersion modeling at other stations that the report identified as requiring dispersion modeling. The report summarized the following:

Station	Dispersion Model Required
Ray Plant 3	Yes
Muskegon River Plant 2	No
Northville	No
St. Clair Plant 1	No
St. Clair Plant 1 Units	Yes
St. Clair Plant 2	No
St. Clair Plant 3	Yes
St. Clair Plant 4	Yes
White Pigeon Plant 1	No
White Pigeon Plant 2	No
White Pigeon Plant 3	No
White Pigeon Plant 3 Units	Yes
Overisel	No
Freedom Plant 1	No
Freedom Plant 2	No
Huron	Yes

Figure 2: Excerpts from Table 2 of Consumers' Blowdown Evaluation Report

The proposed schedule for dispersion modeling was as follows:[4]

Priority	Station	Dispersion Model Completion Date
1	Ray Plant 3 Fire Restoration - Injection	Complete
2	Ray Final Design	9/15/2019
3	White Pigeon 3	11/1/2019
	St Clair 1, 3, and 4	11/1/2019
	Freedom	11/1/2019
4	Huron	2/1/2020
	Overisel	2/1/2020

Figure 3: Table 3 of Consumers' Blowdown Evaluation Report

<u>September 18, 2019</u>

On September 18, 2019, Consumers sought out the MSP as a third-party expert to review their communication protocols, employee training, and emergency response plans and procedures with the intention of gaining feedback on how better to prepare for and respond to emergencies within the incident command framework. One member of Staff was present. Additional meetings between Consumers and MSP were scheduled to improve communication and better coordinate preparation and response to emergencies.

<u>October 1, 2019</u>

On October 1, 2019, Staff received a report from Consumers in Docket No. U-20463 outlining the Ray Natural Gas Compressor Station storage field capacity for the 2019/2020 heating season and updates on repairs and other changes made at the facility since January 31, 2019 (Refer to Appendix O). Significant details were included in the "Summary of Return-to-Service" section of this report.

<u>November 1, 2019</u>

On November 1, 2019, Staff received a report from Consumers in Docket No. U-20463 outlining their evaluation of the company's incident command system and procedures with recommended improvements (Refer to Appendix P).

[4] Consumers has stated that the dispersion modeling has been completed as planned to-date without findings contrary to their original conclusion.

<u>November 27, 2019</u>

Staff contacted Consumers to request a status update on all pending activities and confirmation of completion dates for completed activities. Staff did not receive a response.

<u>December 20, 2019</u>

Staff contacted Consumers to request a status update on all pending activities and confirmation of completion dates for completed activities. Staff did not receive a response.

<u>January 9, 2020</u>

Staff contacted Consumers to request a status update on all pending activities and confirmation of completion dates for completed activities. On January 16, 2020, Consumers provided an update on return-to-service dates for Plant 3 withdrawal and Plant 2 withdrawal operations. They indicated that their final incident report to PHMSA is planned to be submitted on February 17, 2020.

<u>January 24, 2020</u>

Staff contacted Consumers to request a status update on all pending activities and confirmation of completion dates for completed activities. Consumers committed to provide updates on their proposed action plan items listed at the end of their RCA Presentation (Refer to Appendix A) by January 31, 2020, and as such, are not included in this report.

Findings and Contributing Factors

Staff determines that the root cause of the Consumers' Ray Compressor Station Fire that occurred on January 30, 2019, was interference from the domestic water well pump at the station, which caused a voltage spike in the grounding system of the communications system of the Plant 3 controls. This caused the system to lose communication and go into "fault mode," resulting in a Plant 3 ESD.

Contributing to the Significance: The design and location of the Plant 3 blowdown silencers allowed for a plume of gas to come into contact with the exhaust stream of Plant 2's thermal oxidizer, which exceeded the auto-ignition temperature of natural gas. The silencer design produced a low-velocity plume that inhibited gas dispersion at an elevation where it would not pose an ignition hazard.

Contributing Factor 1: The proximity of the grounding of Plant 3's communications system to the domestic water well pump grounding.

Contributing Factor 2: The design of the communications system loss-of-communications "fault mode" resulting in an ESD. Note that this design is intentional and designed as a safety mechanism.

Contributing Factor 3: Consumers' Process Hazard Analysis Study for Plant 3's original construction did not address fire risk once gas left the blowdown silencers.

Contributing Factor 4: Wind direction and velocity contributed to the plume of gas encountering the thermal oxidizer exhaust stream.

Ray Compressor Station Fire RCA
February 28th, 2019


Consumers Energy
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Steven J. Wohlscheid, P.E.
Director of Design Engineering

Ray Compressor Station Fire RCA Team

Steven Wohlscheid	**Director of Design Engineering**
Sean Kelly	**Generation Maintenance, Outage & Scheduling**
John Foley	**Gas Compliance**
Ben Dudley	**Compression Engineering**
Shane Higgins	**Station Engineering**
Matt Pahl	**Transmission Pipeline Operations**
Dennis Hyek	**Field Safety Support**
John DiCerbo	**Corporate Safety**
John M Johns	**Gas Compression Operations**
Rob Randall	**Gas Compression Operations**
Devon Washington	**Design Engineering**
Dan McAninch	**EPM Quality**
Russell Ogle	**Exponent (Third Party Fire Investigation)**
Brent Cox	**Exponent (Third Party Fire Investigation)**

RCA Objective:

A. *Identify the ignition source initiating the fire at the Ray Compressor Station Plant 3 blow down silencers.*
B. Define how we can control or prevent recurrence.

RCA Problem Statement

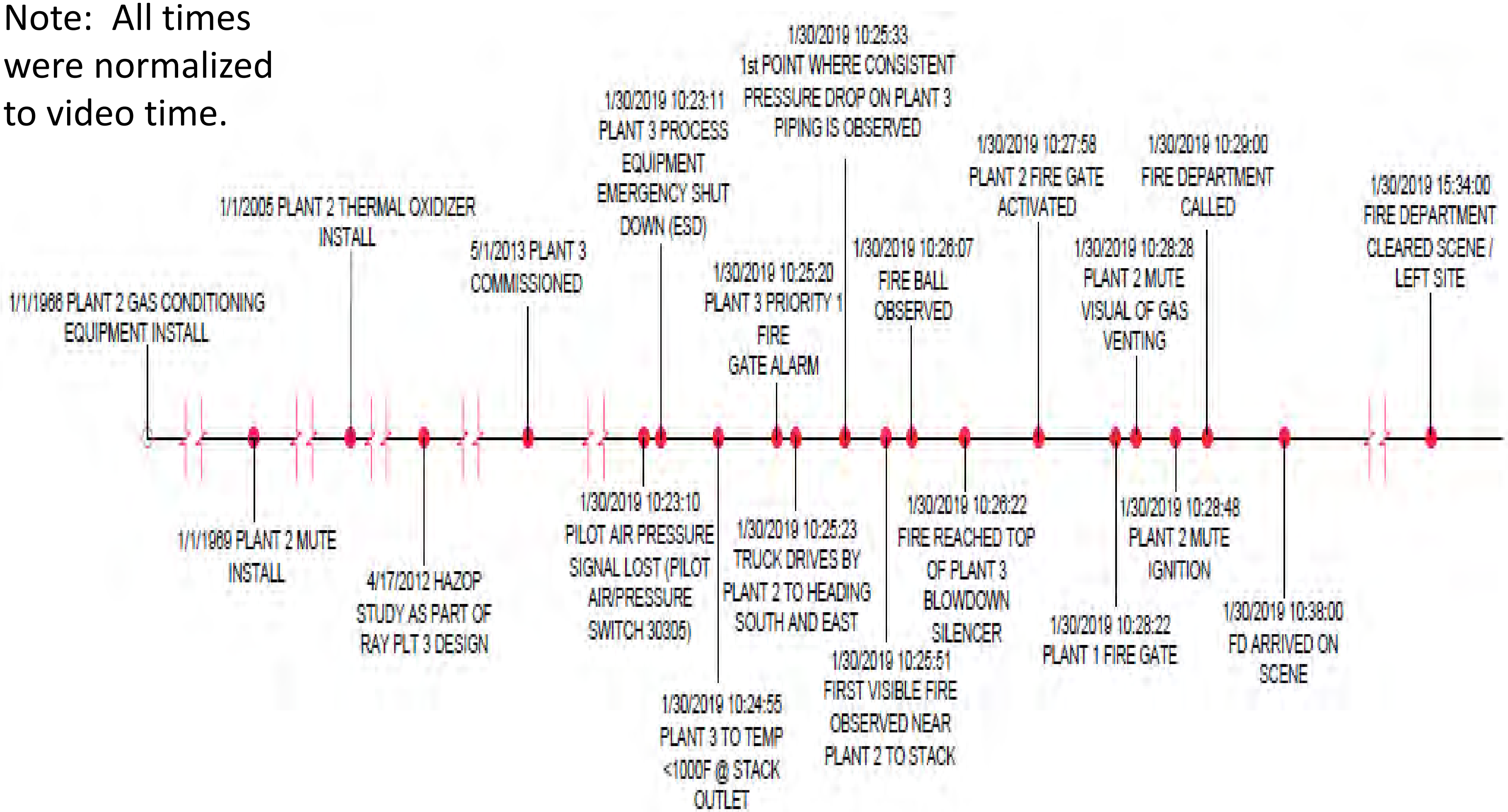
The fire at Ray Compressor Station jeopardized employee safety, damaged plant equipment, and impacted gas deliverability for the lower peninsula of Michigan during a high demand period.

Executive Summary

- **RCA Trigger**
  - On January 30, 2019, at 10:25:51 AM the Plant 3 blowdown silencers' (suction & discharge) gas plume ignited.
- **Root Cause:**
  - Process Hazard Analysis (PHA) Study by Engineer of Record for Plant 3 did not address fire risk once gas left the blow down silencers to qualify siting of blow down silencers and/or their required design characteristics.
- **Impact:**
  - Concerns with employee safety due to fire.
  - Damage to plant equipment.
  - Gas deliverability impact and requests for reductions in gas usage made to industrial, large commercial and residential customers.
  - Approximately 3.26 MMCF natural gas released from the station.
  - Potential damage to reputation and loss of customer confidence.

Sequence of Events Explored

Note: All times were normalized to video time.



Third Party Fire Investigation

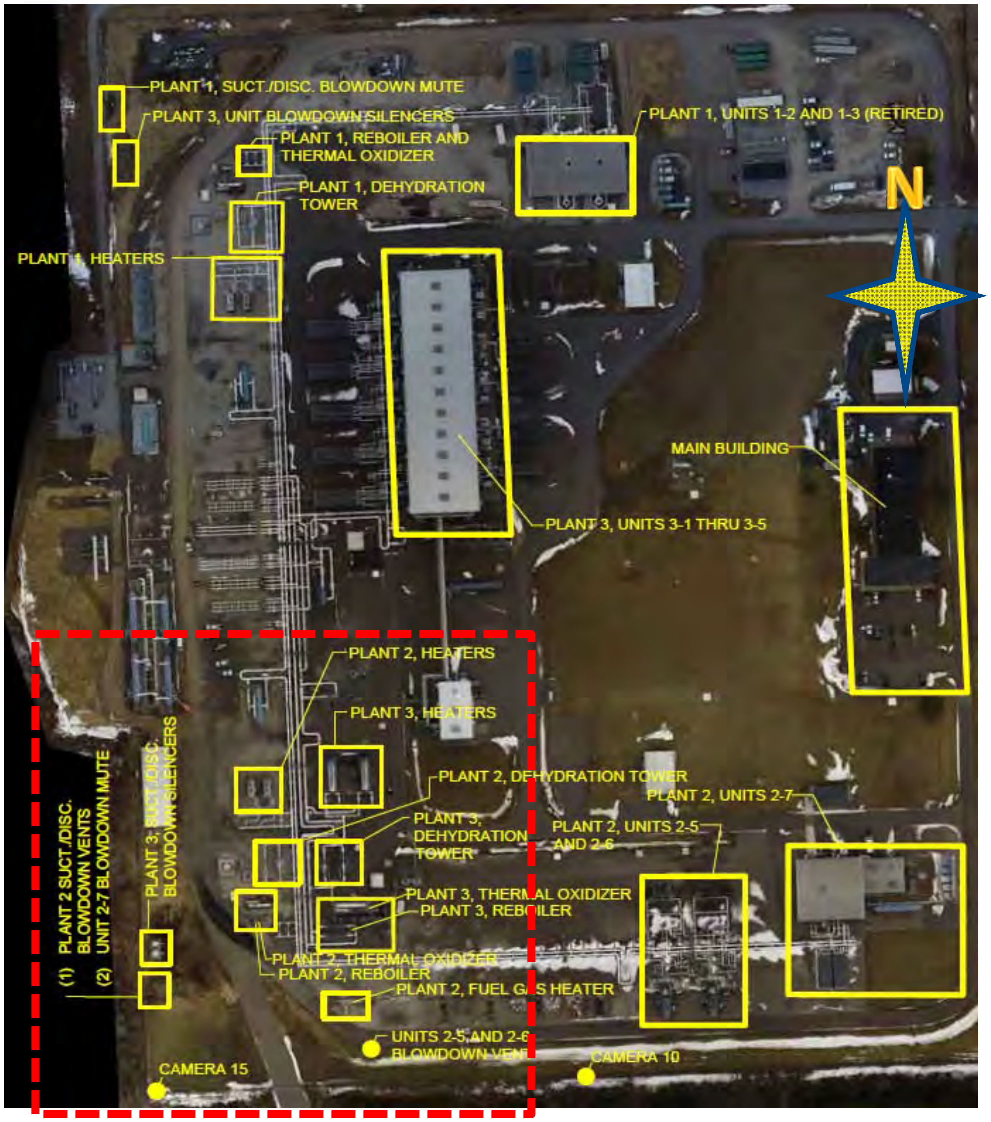
- **Consumers Energy contracted with E^x^ponent® to assist the RCA team in the evaluation of the various ignition scenarios.**
  - Exponent has nearly 50 years of experience leading investigations into accidents working for corporations and insurers.
  - Lead investigator is Russell Ogle, PH.D., P.E., who has extensive expertise as a chemical engineer with scientific investigation and prevention of accidents. He specializes in the investigation of complex industrial accidents; catastrophic fires, etc. and has over 30 years of experience in this area.

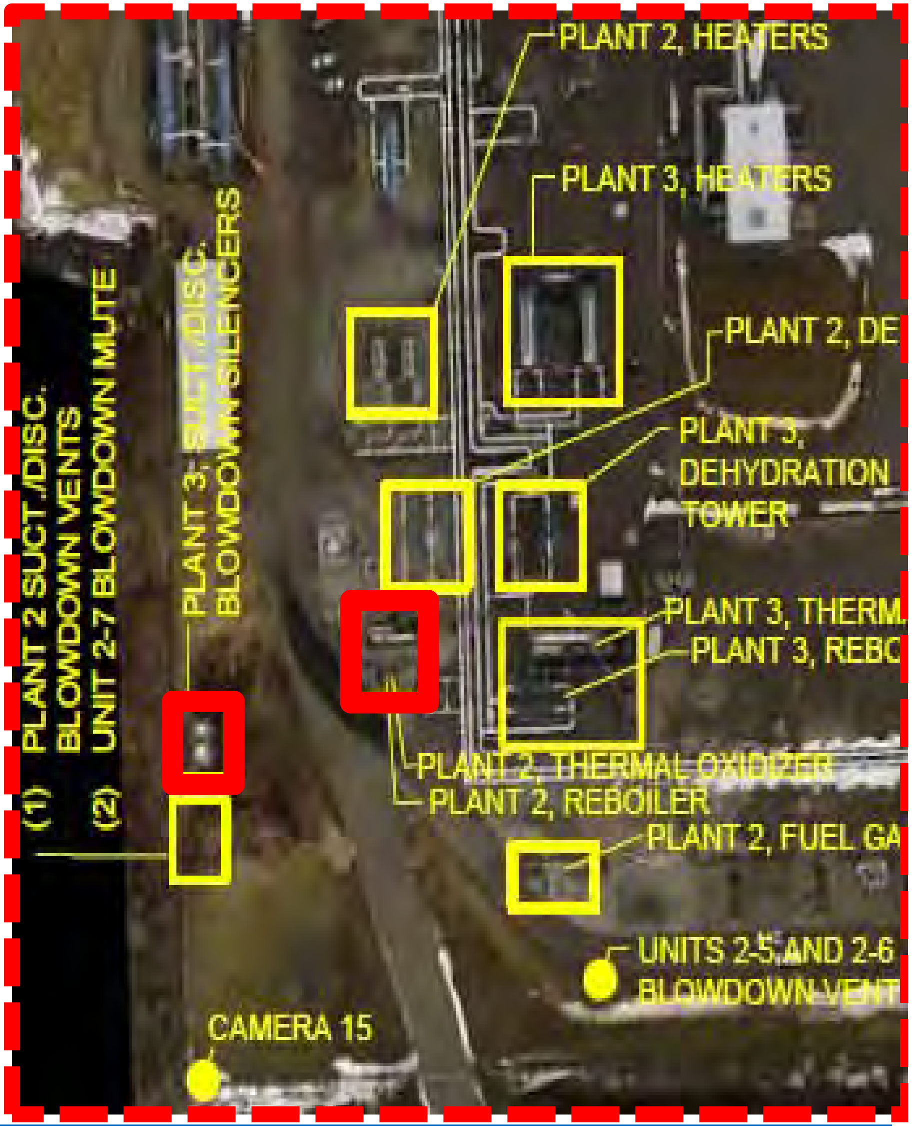
Third Party Fire Investigation - Conclusion

Exponent's Findings:

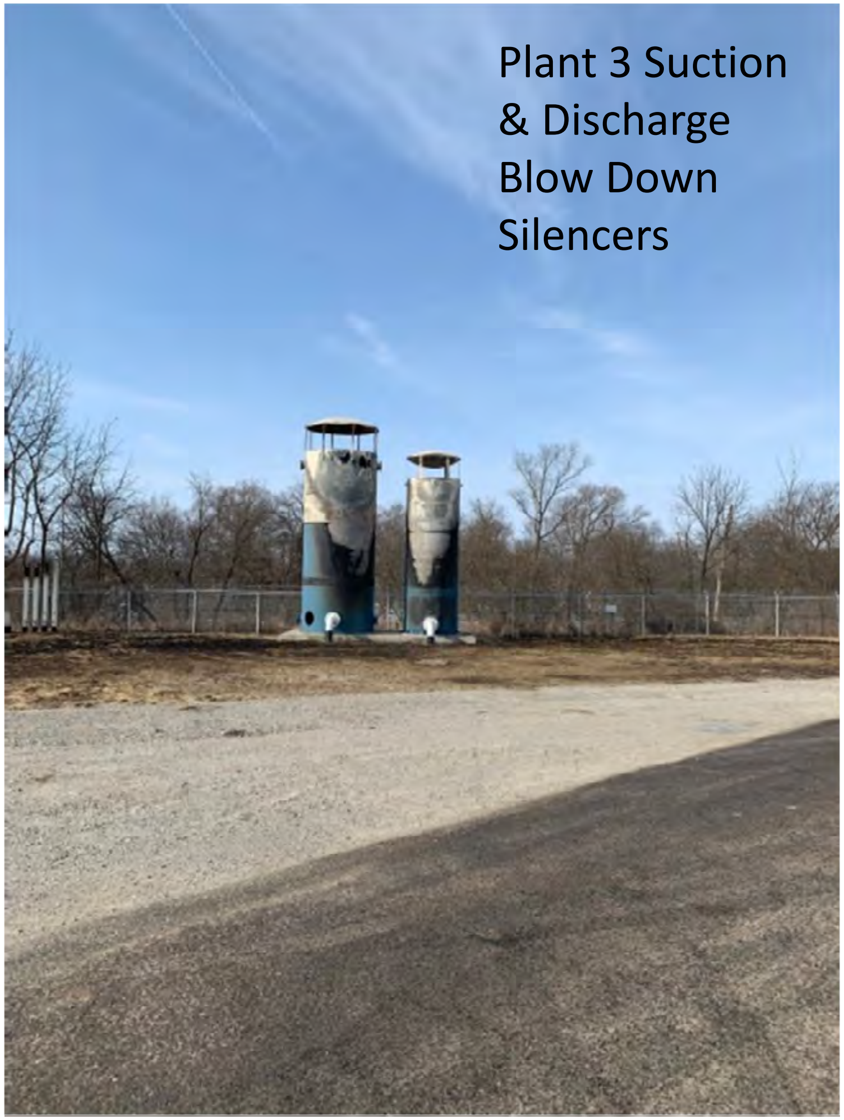
- Direct causal factors for fire
  - Fuel:
    - Fuel provided by blowdown discharges
  - Oxidizer (air):
    - Dispersion and mixing with air
    - Contributing factors: silencer design, wind conditions
  - Ignition source:
    - Probable ignition source was Plant #2 thermal oxidizer exhaust raising fuel/air mixture above auto-ignition temperature
    - Contributing factors: elevation and proximity of TO stack relative to silencer stack elevation
- Root Cause
  - Less than adequate (LTA) siting analysis for Plant #3 silencers
    - Failed to identify flammability hazard associated with blowdown
    - 49 CFR 192.167(a) (2) requires that discharges of gas during blowdowns "will not create a hazard."
    - Plant #3 silencers too close to #2 TO as currently designed

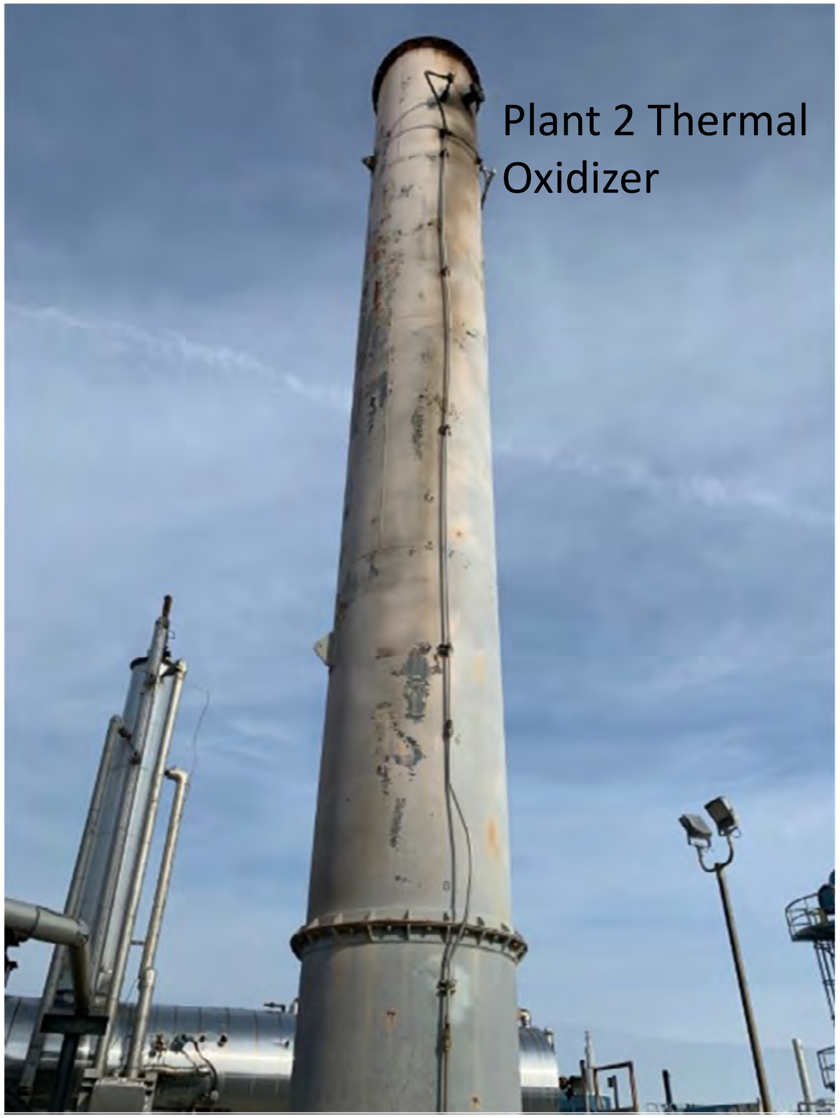
Site Layout


PLANT 1, SUCT./DISC. BLOWDOWN MUTE
PLANT 3, UNIT BLOWDOWN SILENCERS
PLANT 1, REBOILER AND THERMAL OXIDIZER
PLANT 1, DEHYDRATION TOWER
PLANT 1, UNITS 1-2 AND 1-3 (RETIRED)
N
PLANT 1, HEATERS
MAIN BUILDING
PLANT 3, UNITS 3-1 THRU 3-5
PLANT 2, HEATERS
PLANT 3, HEATERS
PLANT 2, DEHYDRATION TOWER
PLANT 2, UNITS 2-7
PLANT 3, DEHYDRATION TOWER
PLANT 2, UNITS 2-5 AND 2-6
PLANT 3, THERMAL OXIDIZER
PLANT 3, REBOILER
PLANT 2, THERMAL OXIDIZER
PLANT 2, REBOILER
PLANT 2, FUEL GAS HEATER
UNITS 2-5 AND 2-6 BLOWDOWN VENT
CAMERA 10
CAMERA 15
(1) PLANT 2 SUCT./DISC. BLOWDOWN VENTS
(2) UNIT 2-7 BLOWDOWN MUTE
PLANT 3, SUCT./DISC. BLOWDOWN SILENCERS

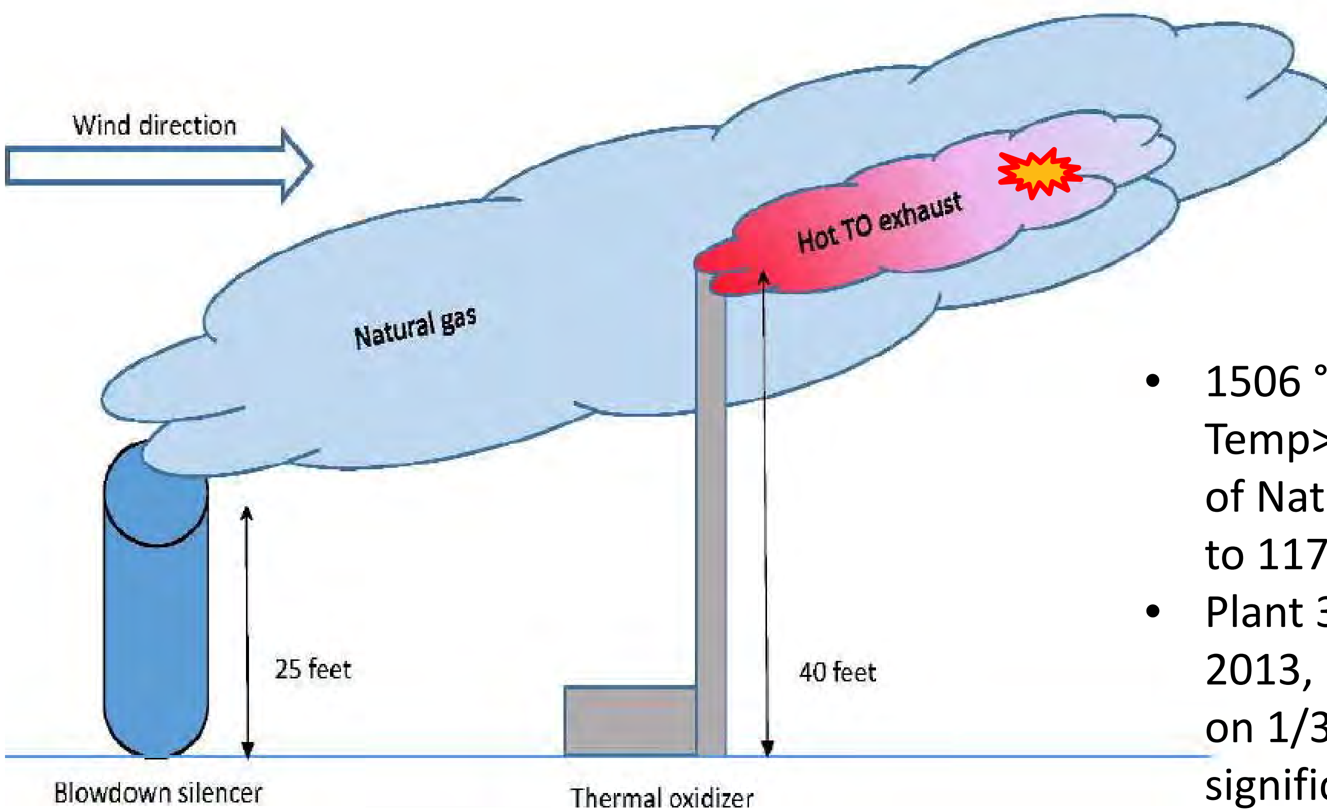

PLANT 2, HEATERS
PLANT 3, HEATERS
PLANT 2, DE
PLANT 3, DEHYDRATION TOWER
PLANT 3, THERM
PLANT 3, REBO
PLANT 2, THERMAL OXIDIZER
PLANT 2, REBOILER
PLANT 2, FUEL GA
UNITS 2-5 AND 2-6 BLOWDOWN VENT
CAMERA 15
(1) PLANT 2 SUCT./DISC. BLOWDOWN VENTS
(2) UNIT 2-7 BLOWDOWN MUTE
PLANT 3, SUCT./DISC. BLOWDOWN SILENCERS

Fuel Source & Ignition Source





Simple Event Diagram



- 1506 °F Thermal Oxidizer Exhaust Temp> Auto Ignition Temperature of Natural Gas ranges from 900°F to 1170°F.
- Plant 3 was commissioned in 2013, and the event that occurred on 1/30/19 happened with significant wind directing the gas plume towards Plant 2 Thermal Oxidizer while in operation.

Physical Failure Mode-First Indication of Ignition

View from Camera #10

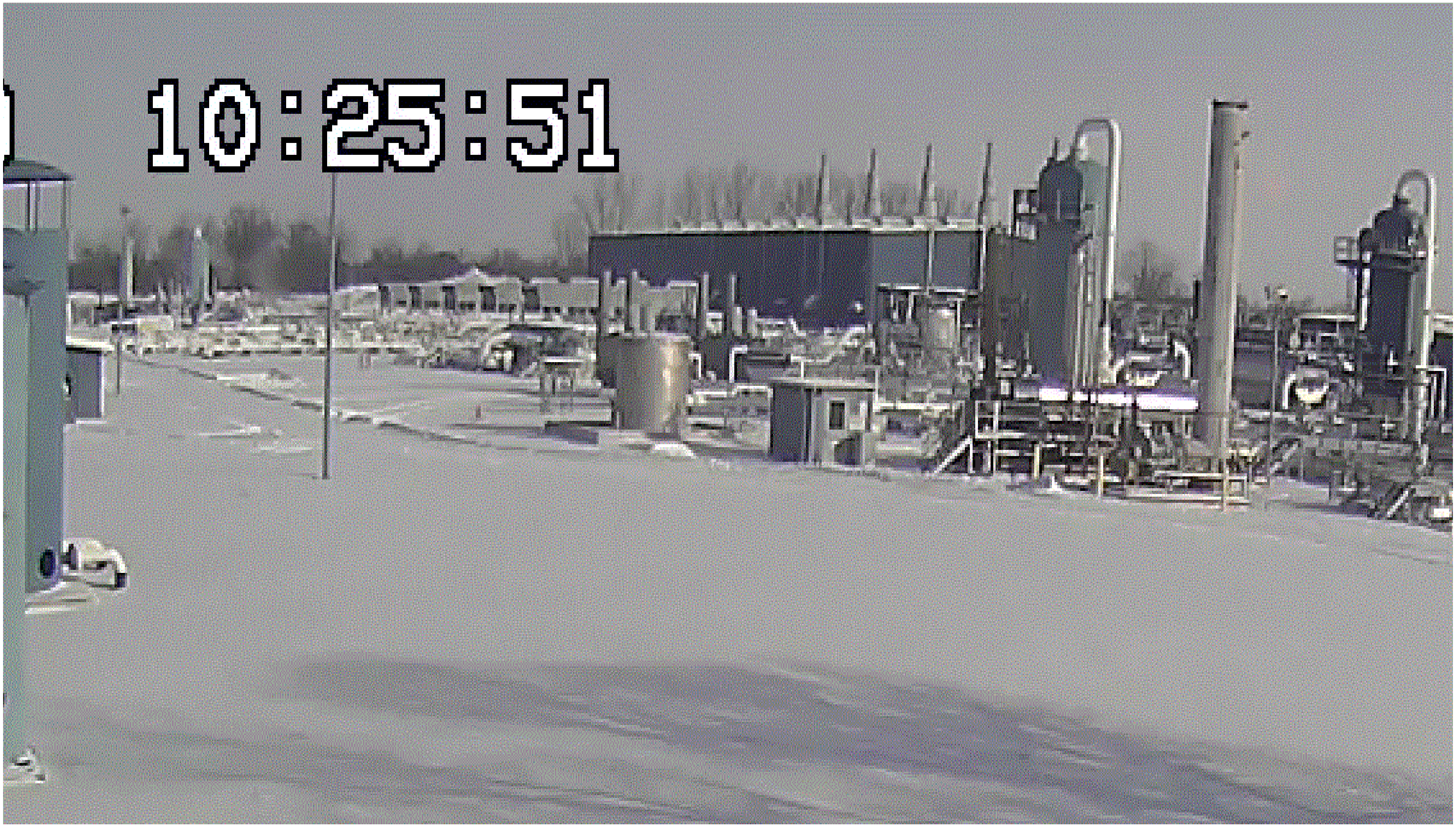
Physical Failure Mode-First Indication of Ignition

Physical Failure Mode-First Indication of Ignition

Sequential Still Photos from Security Video

Utilizing Security Cameras 10 & 15

Security Video Footage From Camera #15



Looking North/North East Utilizing Security Camera #15

Evaluated Failure Mechanisms

Credible and Plausible (Fuel)
- Plant 3 Discharge/Suction Silencers

Credible and Plausible (Ignition)
- Plant 2 Thermal Oxidizer (TO)

Eliminated (Fuel)
- Unit 2-7 Mute
- Plant 2 Suction / Discharge Headers
- Plant 3 Reboiler
- Plant 3 Thermal Oxidizer
- Plant 3 Dehydration Tower
- Plant 3 Heaters
- Plant 2 Thermal Oxidizer
- Plant 2 Reboiler
- Plant 2 Dehydration Tower
- Unit 2-5, 2-6 Blowdown Vent
- Plant 2 Fuel Gas Heater
- Plant 2 Heaters
- Suction Header Pipe
- Discharge Header Pipe
- Plant 2 Control Vanes
- Leak from gas field
- *Other (Leak Survey)

Eliminated (Ignition)
- Plant 3 discharge and suction silencers
- Unit 2-7 Mute
- Plant 2 Suction / Discharge Vents
- Plant 3 Reboiler
- Plant 3 Thermal Oxidizer
- Plant 3 Dehydration Tower
- Plant 3 Heaters
- Plant 2 Reboiler
- Plant 2 Dehydration Tower
- Unit 2-5, 2-6 Blowdown Vent
- Plant 2 Fuel Gas Heater
- Plant 2 Heaters
- Suction/Discharge Header Pipe
- Plant 2 Control Valves
- Lightning
- CE Truck
- Gun Shot
- FME Plant Silencers
- Cigarette/Smoking
- Pyrophoric Material in gas line
- Electric Switching
- Foreign Material in Air
- Foul Play
- Yard Lights

Credible and Plausible Failure Modes Used to Populate Cause Map

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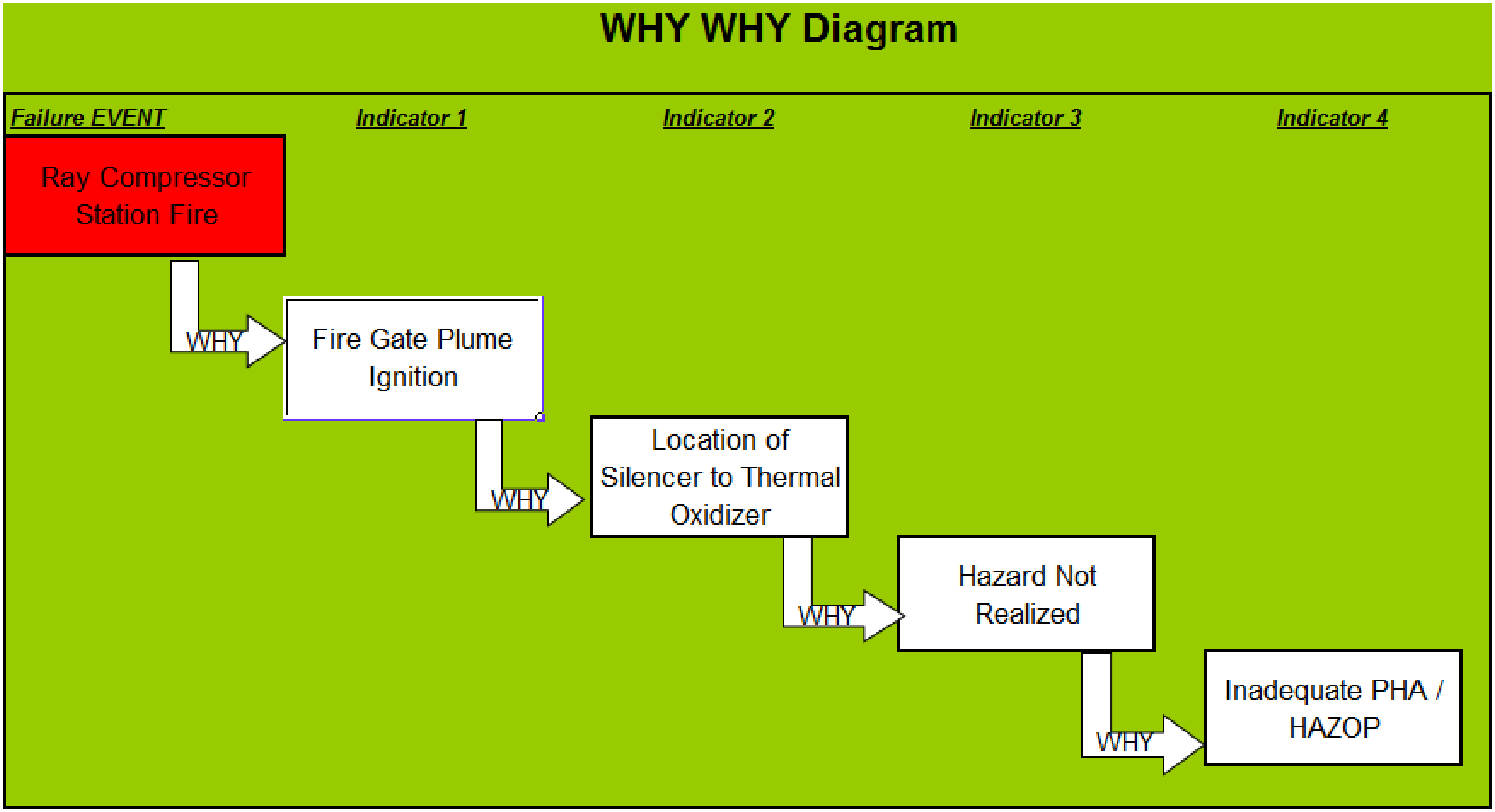
Why Why Diagram



Summary

- **The Ray Plant 3 blow down silencers were sited too close to a competent ignition source. Plant 3 fire-gate gas plume was ignited by the Plant 2 thermal oxidizer exhaust stream.**
  - Thermal oxidizer uses a flame to destroy pollutants from the reboiler, so as long as the equipment is running during a release of gas, an ignition source is present.
  - At the time of ignition, the Plant 2 Thermal Oxidizer exit temperature was 1506 F per thermocouple historian data. Per NFPA 921 Guide for Fire & Explosion Investigations, the auto ignition temperature of natural gas ranges from 900°F to 1170°F.
  - Michigan Gas Safety Standard section 192.167 "*Compressor Stations: Emergency Shutdown*" states each compressor station must have an emergency shutdown system that meets the following: It must discharge gas from the blowdown piping at a location were the gas will not create a hazard.
  - Design criteria for installation of Plant 3 blow down silencers allowed a gas plume to come in contact with exhaust of the Plant 2 Thermal Oxidizer causing ignition.

Summary Cont.

- Root Cause Components
  - Physical Root components:
    - Ignition source (thermal oxidizer) too close to fuel source (blow down silencers) based on characteristics of blow down silencers and physical location of the equipment.
  - Human Root components:
    - Process Hazard Analysis performed by Engineer of Record did not address risk of gas once it left blow down silencers and require gas dispersion model to qualify siting of blow down silencers and/or their required design characteristics.
  - Systemic Root components:
    - No CE Process Hazard Analysis standard
      - No minimum requirements for PHA.

Summary Cont.

- Contributing Factors
  - 20 mph wind with 28 mph gusts
  - Blow down silencers' design focused on acoustic attenuation
    - Low velocity of gas release
    - Elevation of gas release in relation to the elevation of a nearby competent ignition source.
  - Unit 2 thermal oxidizer in operation at time of ignition
  - Det-Tronics control system failure
  - Volume of gas released

Physical Corrective Actions Summary

Physical Root

Impact	Caused By	Corrective Action	Responsible Person	Target Date
Fire at Ray Compressor Station	Ignition source (thermal oxidizer) too close to fuel source (blow down silencers) based on characteristics of blow down silencers and physical location of the equipment.	Perform condition assessment for Plants 2 and 3 develop scope / schedule / budget for restoration for injection only without gas conditioning equipment in service.	M. VanderHuevel	Plant 2-6/3/19 Plant 3-3/18/19
Fire at Ray Compressor Station	Ignition source (thermal oxidizer) too close to fuel source (blow down silencers) based on characteristics of blow down silencers and physical location of the equipment.	Execute scope of work to bring Plant 2 & 3 back to service for injection only.	M. VanderHuevel	Plant 2-7/1/19 Plant 3-5/18/18
Fire at Ray Compressor Station	Ignition source (thermal oxidizer) too close to fuel source (blow down silencers) based on characteristics of blow down silencers and physical location of the equipment.	Complete PHA/HAZOP evaluation for Ray Compressor Site. Specific recommendations should be provided.	H. Bowers	6/28/19
Fire at Ray Compressor Station	Ignition source (thermal oxidizer) too close to fuel source (blow down silencers) based on characteristics of blow down silencers and physical location of the equipment.	Based on results of PHA/HAZOP exercise, incorporate required plant modifications for Ray Compressor Station.	J. Paris	Plant 2- 2/1/20 Plant 3-10/1/19
Fire-gate initiated	Det-Tronics signal / controller did not initiate alarm and fire-gated for unknown reasons.	Determine cause of Det-Tronics failure and implement corrective actions to prevent recurrence.	S. Wohlscheid	3/18/19

Human Corrective Actions Summary

Human Roots

Impact	Caused By	Corrective Action	Responsible Person	Target Date
Fire at Ray Compressor Station	Process Hazard Analysis performed by Engineer of Record did not address risk of gas once it left blow down silencers and require gas dispersion model to qualify siting of blow down silencers and/or their required design characteristics.	Develop an engineering procedure to define minimum requirements of a PHA for gas assets including specifying criteria for safe distance of various categories of gas blow down sources and competent ignition sources without requiring gas dispersion modeling.	H. Bowers	9/27/19
Fire at Ray Compressor Station	Process Hazard Analysis performed by Engineer of Record did not address risk of gas once it left blow down silencers and require gas dispersion model to qualify siting of blow down silencers and/or their required design characteristics.	For EPM Stage Gate Process, ensure PHA Process is followed and PHAs are implemented as required per the process on current and new gas projects based on the risk level.	L. Coury	3/2/20

Systemic Corrective Actions Summary

Systemic Roots

Impact	Caused By	Corrective Action	Responsible Person	Target Date
Fire at Ray Compressor Station	No CE standard requirement to perform PHA/HAZOP Study, and no minimum requirements for study.	Evaluate all compressor stations for competent ignition sources (similar to thermal oxidizers) adjacent to blow down vents: 1) Create criteria for initial site self-assessments. 2) Perform assessment at each compressor station to identify potential ignition risks. 3) Evaluate identified potential risks. Develop list of corrective actions based on evaluation.	H. Bowers	1) 2/18/19 2) 2/22/19 3) 3/06/19
Fire at Ray Compressor Station	No CE standard requirement to perform PHA/HAZOP Study, and no minimum requirements for study.	1) Set up standard checklist to be reviewed on gas distribution & transmission assets with a 6" or larger diameter stack capable of discharging gas with or without an operator present (manually vs. relief valve) targeted at fire and explosion risk and develop a plan for site . 2) Perform assessment at each site to identify risk as part of normal inspection activities. 3) Evaluate identified potential risks. 4) Develop list of corrective actions based on evaluation. 5) Ensure that a standard exists and is up to date regarding the safe and proper operation of manually operated blow downs.	S. McKee (Distribution) M. Beach (Transmission)	1) 4/5/19 2) 5/1/20 3) 5/1/20 4) 6/5/20 5)3/29/19

Observations of RCA Team

Corrective Action	**Responsible Person**	**Target Date**
RCA team recommends a warning system (audible and visual) be in place adjacent to blow down silencers/mutes. Local emergency plans to be updated to address safety risk with blowdown exclusion zones for Operation's staff members.	H. Bowers	12/27/19
Conduct an ICS after action review for the RAY local ICS response and capture lessons learned in appropriate compression procedures and/or Business Continuity Plans.	G. Baustian	6/28/19
Update individual gas compression stations' HMI, historian, and security video to be on the same time datum aligned with CE Gas Control's historian.	Tom O'Reilly	4/30/19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COLOR FIG PLAN
COVER SHEET
1 EMERGENCY PLAN A
2 EMERGENCY PLAN B
3 EMERGENCY PLAN C
12 EMERGENCY PLAN L
13 EMERGENCY PLAN M
14 EMERGENCY PLAN N
15 EMERGENCY PLAN O
16 EMERGENCY PLAN P
17 EMERGENCY PLAN Q
18 EMERGENCY PLAN R
19 EMERGENCY PLAN S
20 EMERGENCY PLAN T
21 EMERGENCY PLAN U
22 EMERGENCY PLAN V
23 EMERGENCY PLAN W
24 EMERGENCY PLAN X
25 EMERGENCY PLAN Y
26 EMERGENCY PLAN Z
27 EMERGENCY PLAN AA
28 EMERGENCY PLAN BB
COLOR FIG PLAN
29 EMERGENCY PLAN CC
32 EMERGENCY PLAN FF
33 EMERGENCY PLAN GG
34 EMERGENCY PLAN HH
35 EMERGENCY PLAN II
36 EMERGENCY PLAN JJ
37 EMERGENCY PLAN KK
FIREGATE CONTROL POINT
41 EMERGENCY PLAN OO
42 EMERGENCY PLAN PP
43 EMERGENCY PLAN QQ
44 EMERGENCY PLAN RR
45 EMERGENCY PLAN SS
46 EMERGENCY PLAN TT
47 EMERGENCY PLAN UU
48 EMERGENCY PLAN VV
49 EMERGENCY PLAN WW
50 EMERGENCY PLAN XX
51 EMERGENCY PLAN YY
52 EMERGENCY PLAN ZZ
LEGEND
SUCTION
DISCHARGE
TRANSMISSION
FUEL GAS LINE
BLOW DOWN LINE
VALVE
FIREGATE VALVE/EMERGENCY VALVE
BLOW DOWN VALVE/EMERGENCY VALVE
CHECK VALVE
METER
RELIEF VALVE
FIREGATE STATION
X-X
SEQUENTIAL NUMBER
PLANT NUMBER
VALVE QUICK REF CALL-OUT
Consumers Energy
Plant 1 - Firegate Valves
Plant 1 - Firegate Vent valves
Plant 2 - Firegate Valves
Plant 2 - Firegate Vent valves
Plant 3 - Firegate Valves
Plant 3 - Firegate Vent valves
HEADQUARTERS BUILDING
PLANT 1 COMPRESSOR BUILDING
AUXILIARY BUILDING NO. 1
AUXILIARY BUILDING NO. 2
AUXILIARY BUILDING NO. 3
PLANT 3 COMPRESSOR BUILDING
AFTERCOOLERS
AFTERCOOLER
HEATER
REGULATORS
RECONCENTRATION SKID
DEHYDRATION TOWER
DEHYDRATION TOWERS
TOWER 1
TOWER 2
HEATERS
SCRUBBERS
DISCHARGE FILTER SEPARATOR
SUCTION FILTER SEPARATOR
PLANT 1 FIELD SCRUBBER
PLANT 2 FIELD SCRUBBER
FLINT/MACOMB JUMPER
MARYSVILLE
FLINT JCT
MACOMB JCT
RAY FIELD
Additional gas vented off during the firegate 603-607 and 604-608
Flow Control valve R4 and R8 were closed during firegate to help control fuel to the fire. This trapped gas in the plant 2 suction area. Trapped gas 608 to 366/R4/R8
"WARNING"
COORDINATE ALL VALVE POSITION CHANGES AND REGULATOR SET-POINT ADJUSTMENTS WITH GAS CONTROL
RAY
COMPRESSOR STATION
EMERGENCY PLAN A
FIG 1
COVER SHEET
REV 07/07/17
H-3679 SH 1
GASTEC.H3679.001
PRFKMC120715
STATE MAP REFERENCE POINT (14-M)

U.S. Department of Transportation
Pipeline and Hazardous Materials Safety Administration

National Response Center Incident Report # 1236339
INC

GOVERNMENT USE ONLY
Information released to a third party shall comply with any applicable federal and/or state Freedom of Information and Privacy Laws.This is the summary NRC report. Further information about this report can be obtained at http://www.nrc.uscg.mil/

Incident Description

Report taken by:	OTA1461
At:	11:35
On:	01/30/2019
Incident Type:	FIXED FACILITY
Incident Cause:	OTHER
Affected Area:	
Incident:	OCCURRED on 01/30/2019 local incident time.
Affected Medium:	AIR ,
Offshore:	N

Reporting Party

Name:	SHERMAN WASHINGTON
Organization:	CONSUMER ENERGY
Address:	1 ENERGY PLAZA JACKSON MI 49201 , , , JACKSON ,MI 49201
Primary Phone:	2485689460
Second Phone:	
Type of Organization:	PRIVATE ENTERPRISE

Suspected Responsible Party

Name:	SHERMAN WASHINGTON
Organization:	CONSUMER ENERGY
Address:	1 ENERGY PLAZA , , , JACKSON ,MI49201
Primary Phone:	2485689460
Second Phone:	
Type of Organization:	PRIVATE ENTERPRISE

Incident Location

Incident Location:	
Address:	69333 OMO RD
Streets:	
County:	MACOMB
Nearest City:	ARMADA TOWNSHIP
State:	MI
Zip:	
Subdivision:	
Distance from city:	
Latitude:	
Longitude:	
Section:	
Township:	
Range:	

Released Material

Chris Code:	ONG
Official Material Name:	NATURAL GAS
Quantity Released:	3 MIL CBF
Quantity in Water:	

Description of Incident

CALLER REPORTED AN UNKNOWN AMOUNT BUT AT LEAST 2 MCBF OF NATURAL GAS WAS RELEASED INTO THE ATMOSPHERE FROM A RELEASE VALVE DUE TO A FIRE.

Sensitive Information

Consumers Energy Company - Ray Compressor Station Fire

Incident Details - FIXED FACILITY

Building ID:	
Type of Fixed Object:	OTHER
Power Generating Facility:	U
Generating Capacity:	
Type of Fuel:	
NPDES:	
NPDES Compliance:	U

Sheen Size:	
Sheen Length:	
Sheen Width:	
Sheen Color:	
Direction of Sheen Travel:	
Sheen Odor Description:	
Body of Water:	
Tributary of:	
Nearest River Mile Marker:	
Water Supply Contaminated:	U

Impacts

UNKNOWN.

Fire Involved:	Y	Fire Extinguished:	U
Injuries:	N	Number of Injuries:	
Number Hospitalized:			
Fatalities:	N	Number of Fatalities:	
Evacuations:	N	Number Evacuated:	
Who evacuated:		Radius/Area:	
Damages:	N	Damage Amount:	
Waterway Closure:	N		
Air Closure:	N		
Road Closure:	N		
Major Artery:	N		
Direction of Road Closure:			
Rail Track Closure:	N		
Direction of Track Closure:			
Track Milepost:			
Media Interest:	UNKNOWN		
Environmental Impact:	U		
Community Impact due to Material:			

Remedial Actions

UNKNOWN.

Released Secured:	U
Release Rate:	
Estimated Release Duration:	

Weather

Weather Condition:
Air temperature:
Wind Speed:
Wind Direction:
Wave Condition:
Current Speed:
Current Direction:
Water Temperature:

Additional Agencies Notified

Federal Agency Notified:

State Agency Notified:
State/local on Scene:
State Agency Number:

Additional Information

Notification by NRC

Organization	Sub Organization	Date Time Sent	E-mail	Phone
CENTERS FOR DISEASE CONTROL	GRASP	01/30/2019 11:42	eocgis@cdc.gov	(770) 4887100

END INCIDENT REPORT 1236339

NOTICE: This report is required by 49 CFR Part 191. Failure to report can result in a civil penalty not to exceed 100,000 for each violation for each day that such violation persists except that the maximum civil penalty shall not exceed $1,000,000 as provided in 49 USC 60122.		OMB NO: 2137-0522 EXPIRATION DATE: 8/31/2020
U.S Department of Transportation Pipeline and Hazardous Materials Safety Administration	**Original Report Date:**	03/01/2019
	No.	20190021 - 31720 (DOT Use Only)

INCIDENT REPORT - GAS TRANSMISSION AND GATHERING PIPELINE SYSTEMS

A federal agency may not conduct or sponsor, and a person is not required to respond to, nor shall a person be subject to a penalty for failure to comply with a collection of information subject to the requirements of the Paperwork Reduction Act unless that collection of information displays a current valid OMB Control Number. The OMB Control Number for this information collection is 2137-0522. All responses to this collection of information are mandatory. Send comments regarding the burden estimate or any other aspect of this collection of information, including suggestions for reducing the burden to: Information Collection Clearance Officer, PHMSA, Office of Pipeline Safety (PHP-30) 1200 New Jersey Avenue, SE, Washington, D.C. 20590.

INSTRUCTIONS

Important: *Please read the separate instructions for completing this form before you begin. They clarify the information requested and provide specific examples. If you do not have a copy of the instructions, you can obtain one from the PHMSA Pipeline Safety Community Web Page at http://www.phmsa.dot.gov/pipeline/library/forms.*

PART A - KEY REPORT INFORMATION

Report Type: *(select all that apply)*	**Original:**	**Supplemental:**	**Final:**
	Yes		

Last Revision Date:	
1. Operator's OPS-issued Operator Identification Number (OPID):	2748
2. Name of Operator	CONSUMERS ENERGY CO
3. Address of Operator:	
3a. Street Address	ONE ENERGY PLAZA
3b. City	JACKSON
3c. State	Michigan
3d. Zip Code:	49201
4. Local time *(24-hr clock)* and date of the Incident:	01/30/2019 10:25
5. Location of Incident:	
Latitude:	42.809468
Longitude:	-82.867501
6. National Response Center Report Number (if applicable):	1236339
7. Local time *(24-hr clock)* and date of initial telephonic report to the National Response Center (if applicable):	01/30/2019 11:29
8. Incident resulted from:	Unintentional release of gas
9. Gas released: (select only one, based on predominant volume released)	Natural Gas
- Other Gas Released Name:	
10. Estimated volume of commodity released unintentionally - Thousand Cubic Feet (MCF):	2,766.00
11. Estimated volume of intentional and controlled release/blowdown - Thousand Cubic Feet (MCF)	508.00
12. Estimated volume of accompanying liquid release (Barrels):	
13. Were there fatalities?	No
- If Yes, specify the number in each category:	
13a. Operator employees	
13b. Contractor employees working for the Operator	
13c. Non-Operator emergency responders	
13d. Workers working on the right-of-way, but NOT associated with this Operator	
13e. General public	
13f. Total fatalities (sum of above)	
14. Were there injuries requiring inpatient hospitalization?	No
- If Yes, specify the number in each category:	
14a. Operator employees	
14b. Contractor employees working for the Operator	
14c. Non-Operator emergency responders	
14d. Workers working on the right-of-way, but NOT associated with this Operator	
14e. General public	
14f. Total injuries (sum of above)	
15. Was the pipeline/facility shut down due to the incident?	Yes
- If No, Explain:	

- If Yes, complete Questions 15a and 15b: *(use local time, 24-hr clock)*	
15a. Local time and date of shutdown	01/30/2019 10:28
15b. Local time pipeline/facility restarted	
- Still shut down? (* Supplemental Report Required)	Yes
16. Did the gas ignite?	Yes
17. Did the gas explode?	No
18. Number of general public evacuated:	0
19. Time sequence *(use local time, 24-hour clock)*:	
19a. Local time operator identified Incident– effective 10-2014, changed from "Incident" to "failure"	01/30/2019 10:25
19b. Local time operator resources arrived on site	01/30/2019 10:25

PART B - ADDITIONAL LOCATION INFORMATION

1. Was the origin of the Incident onshore?	Yes
- Yes (Complete Questions 2-12)	
- No (Complete Questions 13-15)	
If Onshore:	
2. State:	Michigan
3. Zip Code:	48005
4. City	Armada
5. County or Parish	Macomb
6. Operator designated location	Milepost/Valve Station
Specify:	Plant 2 (T-O)
7. Pipeline/Facility name:	Ray Compressor Station
8. Segment name/ID:	Plant 2 Thermal Oxidizer (T-O)
9. Was Incident on Federal land, other than the Outer Continental Shelf (OCS)?	No
10. Location of Incident :	Operator-controlled property
11. Area of Incident (as found) :	Aboveground
Specify:	Typical aboveground facility piping or appurtenance
Other – Describe:	
Depth-of-Cover (in):	
12. Did Incident occur in a crossing?	No
- If Yes, specify type below:	
- If Bridge crossing –	
Cased/ Uncased:	
- If Railroad crossing –	
Cased/ Uncased/ Bored/drilled	
- If Road crossing –	
Cased/ Uncased/ Bored/drilled	
- If Water crossing –	
Cased/ Uncased	
Name of body of water (If commonly known):	
Approx. water depth (ft) at the point of the Incident:	
Select:	
If Offshore:	
13. Approx. water depth (ft) at the point of the Incident:	
14. Origin of Incident:	
- If "In State waters":	
- State:	
- Area:	
- Block/Tract #:	
- Nearest County/Parish:	
- If "On the Outer Continental Shelf (OCS)":	
- Area:	
- Block #:	
15. Area of Incident:	

PART C - ADDITIONAL FACILITY INFORMATION

1. Is the pipeline or facility: - Interstate - Intrastate	Intrastate
2. Part of system involved in Incident:	Onshore Compressor Station Equipment and Piping
3. Item involved in Incident:	Other
- If Pipe – Specify:	
3a. Nominal diameter of pipe (in):	
3b. Wall thickness (in):	
3c. SMYS (Specified Minimum Yield Strength) of pipe (psi):	

3d. Pipe specification:	
3e. Pipe Seam – Specify:	
- If Other, Describe:	
3f. Pipe manufacturer:	
3g. Year of manufacture:	
3h. Pipeline coating type at point of Incident – Specify:	
- If Other, Describe:	
- If Weld, including heat-affected zone – Specify:	
- If Other, Describe:	
- If Valve – Specify:	
- If Mainline – Specify:	
- If Other, Describe:	
3i. Mainline valve manufacturer:	
3j. Year of manufacture:	
- If Other, Describe:	Thermal Oxidizer
4. Year item involved in Incident was installed:	2005
5. Material involved in Incident:	Carbon Steel
- If Material other than Carbon Steel or Plastic – Specify:	
6. Type of Incident involved:	Other
- If Mechanical Puncture – Specify Approx. size:	
in. (axial) by	
in. (circumferential)	
- If Leak - Select Type:	
- If Other – Describe:	
- If Rupture - Select Orientation:	
- If Other – Describe:	
Approx. size: in. (widest opening):	
by in. (length circumferentially or axially):	
- If Other – Describe:	
	Plant 3 emergency shut down (ESD) activation resulting in a release of gas through the blow down silencers - due to wind conditions and location of the blow down silencers, a gas plume made contact with the Thermal Oxidizer exhaust causing gas to ignite and subsequent fire.

PART D - ADDITIONAL CONSEQUENCE INFORMATION

1. Class Location of Incident:	Class 1 Location
2. Did this Incident occur in a High Consequence Area (HCA)?	No
- If Yes:	
2a. Specify the Method used to identify the HCA:	
3. What is the PIR (Potential Impact Radius) for the location of this Incident? Feet:	702
4. Were any structures outside the PIR impacted or otherwise damaged due to heat/fire resulting from the Incident?	No
5. Were any structures outside the PIR impacted or otherwise damaged NOT by heat/fire resulting from the Incident?	No
6. Were any of the fatalities or injuries reported for persons located outside the PIR?	No
7. Estimated Property Damage :	
7a. Estimated cost of public and non-Operator private property damage paid/reimbursed by the Operator – effective 6-2011, "paid/reimbursed by the Operator" removed	$ 0
Estimated cost of gas released unintentionally – effective 6-2011, moved to item 7f	
Estimated cost of gas released during intentional and controlled blowdown – effective 6-2011, moved to item 7g	
7b. Estimated cost of Operator's property damage & repairs	$ 18,000,000
7c. Estimated cost of Operator's emergency response	$ 2,582
7d. Estimated other costs	$ 0
Describe:	
7e. Property damage subtotal (sum of above)	$ 18,002,582
Cost of Gas Released	
7f. Estimated cost of gas released unintentionally	$ 14,569
7g. Estimated cost of gas released during intentional and controlled blowdown	$ 0

7h. Total estimated cost of gas released (sum of 7.f & 7.g above)	$ 14,569
Total of all costs	$ 18,017,151
PART E - ADDITIONAL OPERATING INFORMATION	
1. Estimated pressure at the point and time of the Incident (psig):_	1,170.00
2. Maximum Allowable Operating Pressure (MAOP) at the point and time of the Incident (psig):	1,800.00
Added 10-2014 2a. MAOP established by 49 CFR section:	192.619(a)(2)
- If Other, specify:	
3. Describe the pressure on the system or facility relating to the Incident:	Pressure did not exceed MAOP
4. Not including pressure reductions required by PHMSA regulations (such as for repairs and pipe movement), was the system or facility relating to the Incident operating under an established pressure restriction with pressure limits below those normally allowed by the MAOP?	No
- If Yes - (*Complete 4a and 4b below)*	
4a. Did the pressure exceed this established pressure restriction?	
4b. Was this pressure restriction mandated by PHMSA or the State?	
5. Was "Onshore Pipeline, Including Valve Sites" OR "Offshore Pipeline, Including Riser and Riser Bend" selected in PART C, Question 2?	No
- If Yes - (*Complete 5a. – 5e. below):*	
5a. Type of upstream valve used to initially isolate release source:	
5b. Type of downstream valve used to initially isolate release source:	
5c. Length of segment isolated between valves (ft):	
5d. Is the pipeline configured to accommodate internal inspection tools?	
- If No – Which physical features limit tool accommodation? *(select all that apply)*	
- Changes in line pipe diameter	
- Presence of unsuitable mainline valves	
- Tight or mitered pipe bends	
- Other passage restrictions (i.e. unbarred tee's, projecting instrumentation, etc.)	
- Extra thick pipe wall (applicable only for magnetic flux leakage internal inspection tools)	
- Other	
- If Other, Describe:	
5e. For this pipeline, are there operational factors which significantly complicate the execution of an internal inspection tool run?	
- If Yes, which operational factors complicate execution? *(select all that apply)*	
- Excessive debris or scale, wax, or other wall build-up	
- Low operating pressure(s)	
- Low flow or absence of flow	
- Incompatible commodity	
- Other	
- If Other, Describe:	
5f. Function of pipeline system:	Transmission System
6. Was a Supervisory Control and Data Acquisition (SCADA)-based system in place on the pipeline or facility involved in the Incident?	Yes
- If Yes:	
6a. Was it operating at the time of the Incident?	Yes
6b. Was it fully functional at the time of the Incident?	Yes
6c. Did SCADA-based information (such as alarm(s), alert(s), event (s), and/or volume or pack calculations) assist with the detection of the Incident?	Yes
6d. Did SCADA-based information (such as alarm(s), alert(s), event (s), and/or volume calculations) assist with the confirmation of the Incident?	Yes
7. How was the Incident initially identified for the Operator?	Local Operating Personnel, including contractors
- If Other – Describe:	
7a. If "Controller", "Local Operating Personnel, including contractors", "Air Patrol", or "Ground Patrol by Operator or its contractor" is selected in Question 7, specify:	Operator employee
8. Was an investigation initiated into whether or not the controller(s) or control room issues were the cause of or a contributing factor to the	No, the Operator did not find that an investigation of the controller(s) actions or control room issues was necessary

Incident?	due to: (provide an explanation for why the Operator did not investigate)
- If No, the operator did not find that an investigation of the controller(s) actions or control room issues was necessary due to: *(provide an explanation for why the operator did not investigate)*	Control Room representative responded appropriately
- If Yes, Describe investigation result(s) *(select all that apply)*:	
- Investigation reviewed work schedule rotations, continuous hours of service (while working for the operator), and other factors associated with fatigue	
- Investigation did NOT review work schedule rotations, continuous hours of service (while working for the Operator) and other factors associated with fatigue	
- Provide an explanation for why not:	
- Investigation identified no control room issues	
- Investigation identified no controller issues	
- Investigation identified incorrect controller action or controller error	
- Investigation identified that fatigue may have affected the controller(s) involved or impacted the involved controller(s) response	
- Investigation identified incorrect procedures	
- Investigation identified incorrect control room equipment operation	
- Investigation identified maintenance activities that affected control room operations, procedures, and/or controller response	
- Investigation identified areas other than those above –	
Describe:	

PART F - DRUG & ALCOHOL TESTING INFORMATION

1. As a result of this Incident, were any Operator employees tested under the post-accident drug and alcohol testing requirements of DOT's Drug & Alcohol Testing regulations?	No
- If Yes:	
1a. How many were tested:	
1b. How many failed:	
2. As a result of this Incident, were any Operator contractor employees tested under the post-accident drug and alcohol testing requirements of DOT's Drug & Alcohol Testing regulations?	No
- If Yes:	
2a. How many were tested:	
2b. How many failed:	

PART G - APPARENT CAUSE

Select only one box from PART G in the shaded column on the left representing the APPARENT Cause of the Incident, and answer the questions on the right. Describe secondary, contributing, or root causes of the Incident in the narrative (PART H).

Apparent Cause:	G6 - Equipment Failure

G1 - Corrosion Failure - *only one* ***sub-cause*** *can be picked from shaded left-hand column*

Corrosion Failure – Sub-cause:	
- If External Corrosion:	
1. Results of visual examination:	
- If Other, Describe:	
2. Type of corrosion: *(select all that apply)*	
- Galvanic	
- Atmospheric	
- Stray Current	
- Microbiological	
- Selective Seam	
- Other	
- If Other – Describe:	
3. The type(s) of corrosion selected in Question 2 is based on the following: *(select all that apply)*	
- Field examination	
- Determined by metallurgical analysis	
- Other	

- If Other – Describe:	
4. Was the failed item buried under the ground?	
- If Yes:	
4a. Was failed item considered to be under cathodic protection at the time of the incident?	
- If Yes, Year protection started:	
4b. Was shielding, tenting, or disbonding of coating evident at the point of the incident?	
4c. Has one or more Cathodic Protection Survey been conducted at the point of the incident?	
If "Yes, CP Annual Survey" – Most recent year conducted:	
If "Yes, Close Interval Survey" – Most recent year conducted:	
If "Yes, Other CP Survey" – Most recent year conducted:	
- If No:	
4d. Was the failed item externally coated or painted?	
5. Was there observable damage to the coating or paint in the vicinity of the corrosion?	
- If Internal Corrosion:	
6. Results of visual examination:	
- If Other, Describe:	
7. Cause of corrosion *(select all that apply)*:	
- Corrosive Commodity	
- Water drop-out/Acid	
- Microbiological	
- Erosion	
- Other	
- If Other, Describe:	
8. The cause(s) of corrosion selected in Question 7 is based on the following *(select all that apply)*:	
- Field examination	
- Determined by metallurgical analysis	
- Other	
- If Other, Describe:	
9. Location of corrosion *(select all that apply)*:	
- Low point in pipe	
- Elbow	
- Drop-out	
- Other	
- If Other, Describe:	
10. Was the gas/fluid treated with corrosion inhibitors or biocides?	
11. Was the interior coated or lined with protective coating?	
12. Were cleaning/dewatering pigs (or other operations) routinely utilized?	
13. Were corrosion coupons routinely utilized?	
Complete the following if any Corrosion Failure sub-cause is selected AND the "Item Involved in Incident" (from PART C, Question 3) is Pipe or Weld.	
14. Has one or more internal inspection tool collected data at the point of the Incident?	
14a. If Yes, for each tool used, select type of internal inspection tool and indicate most recent year run:	
- Magnetic Flux Leakage Tool	
Most recent year run:	
- Ultrasonic	
Most recent year run:	
- Geometry	
Most recent year run:	
- Caliper	
Most recent year run:	
- Crack	
Most recent year run:	
- Hard Spot	
Most recent year run:	
- Combination Tool	
Most recent year run:	
- Transverse Field/Triaxial	
Most recent year run:	
- Other	
Most recent year run:	
If Other, Describe:	
15. Has one or more hydrotest or other pressure test been conducted	

since original construction at the point of the Incident?	
- If Yes,	
Most recent year tested:	
Test pressure (psig):	
16. Has one or more Direct Assessment been conducted on this segment?	
- If Yes, and an investigative dig was conducted at the point of the Incident:	
Most recent year conducted:	
- If Yes, but the point of the Incident was not identified as a dig site:	
Most recent year conducted:	
17. Has one or more non-destructive examination been conducted at the point of the Incident since January 1, 2002?	
17a. If Yes, for each examination conducted since January 1, 2002, select type of non-destructive examination and indicate most recent year the examination was conducted:	
- Radiography	
Most recent year examined:	
- Guided Wave Ultrasonic	
Most recent year examined:	
- Handheld Ultrasonic Tool	
Most recent year examined:	
- Wet Magnetic Particle Test	
Most recent year examined:	
- Dry Magnetic Particle Test	
Most recent year examined:	
- Other	
Most recent year examined:	
If Other, Describe:	
G2 - Natural Force Damage - *only one **sub-cause** can be picked from shaded left-handed column*	
Natural Force Damage – Sub-Cause:	
- If Earth Movement, NOT due to Heavy Rains/Floods:	
1. Specify:	
- If Other, Describe:	
- If Heavy Rains/Floods:	
2. Specify:	
- If Other, Describe:	
- If Lightning:	
3. Specify:	
- If Temperature:	
4. Specify:	
- If Other, Describe:	
- If Other Natural Force Damage:	
5. Describe:	
Complete the following if any Natural Force Damage sub-cause is selected.	
6. Were the natural forces causing the Incident generated in conjunction with an extreme weather event?	
6a. If yes, specify: *(select all that apply)*:	
- Hurricane	
- Tropical Storm	
- Tornado	
- Other	
- If Other, Describe:	
G3 - Excavation Damage *only one **sub-cause** can be picked from shaded left-hand column*	
Excavation Damage – Sub-Cause:	
- If Previous Damage Due to Excavation Activity: Complete Questions 1-5 ONLY IF the "Item Involved in Incident" (From Part C, Question 3) is Pipe or Weld.	
1. Has one or more internal inspection tool collected data at the point of the Incident?	
1a. If Yes, for each tool used, select type of internal inspection tool and indicate most recent year run:	
- Magnetic Flux Leakage	
Year:	
- Ultrasonic	
Year:	
- Geometry	

Year:	
- Caliper	
Year:	
- Crack	
Year:	
- Hard Spot	
Year:	
- Combination Tool	
Year:	
- Transverse Field/Triaxial	
Year:	
- Other:	
Year:	
Describe:	
2. Do you have reason to believe that the internal inspection was completed BEFORE the damage was sustained?	
3. Has one or more hydrotest or other pressure test been conducted since original construction at the point of the Incident?	
- If Yes:	
Most recent year tested:	
Test pressure (psig):	
4. Has one or more Direct Assessment been conducted on the pipeline segment?	
- If Yes, and an investigative dig was conducted at the point of the Incident:	
Most recent year conducted:	
- If Yes, but the point of the Incident was not identified as a dig site:	
Most recent year conducted:	
5. Has one or more non-destructive examination been conducted at the point of the Incident since January 1, 2002?	
5a. If Yes, for each examination conducted since January 1, 2002, select type of non-destructive examination and indicate most recent year the examination was conducted:	
- Radiography	
Year:	
- Guided Wave Ultrasonic	
Year:	
- Handheld Ultrasonic Tool	
Year:	
- Wet Magnetic Particle Test	
Year:	
- Dry Magnetic Particle Test	
Year:	
- Other	
Year:	
Describe:	
Complete the following if Excavation Damage by Third Party is selected as the sub-cause.	
6. Did the operator get prior notification of the excavation activity?	
6a. If Yes, Notification received from *(select all that apply)*:	
- One-Call System	
- Excavator	
- Contractor	
- Landowner	
Complete the following mandatory CGA-DIRT Program questions if any Excavation Damage sub-cause is selected.	
7. Do you want PHMSA to upload the following information to CGA-DIRT (www.cga-dirt.com)?	
8. Right-of-Way where event occurred *(select all that apply)*:	
- Public	
- If Public, Specify:	
- Private	
- If Private, Specify:	
- Pipeline Property/Easement	
- Power/Transmission Line	
- Railroad	
- Dedicated Public Utility Easement	
- Federal Land	
- Data not collected	
- Unknown/Other	
9. Type of excavator :	
10. Type of excavation equipment :	

11. Type of work performed :	
12. Was the One-Call Center notified? - Yes - No	
12a. If Yes, specify ticket number:	
12b. If this is a State where more than a single One-Call Center exists, list the name of the One-Call Center notified:	
13. Type of Locator:	
14. Were facility locate marks visible in the area of excavation?	
15. Were facilities marked correctly?	
16. Did the damage cause an interruption in service?	
16a. If Yes, specify duration of the interruption: (hours)	
17. Description of the **CGA-DIRT Root Cause** (*select only the one predominant first level CGA-DIRT Root Cause and then, where available as a choice, then one predominant second level CGA-DIRT Root Cause as well*):	
- Predominant first level CGA-DIRT Root Cause:	
- If One-Call Notification Practices Not Sufficient, Specify:	
- If Locating Practices Not Sufficient, Specify:	
- If Excavation Practices Not Sufficient, Specify:	
- If Other/None of the Above, Explain:	
G4 - Other Outside Force Damage - only one **sub-cause** can be selected from the shaded left-hand column	
Other Outside Force Damage – **Sub-Cause:**	
- If Damage by Car, Truck, or Other Motorized Vehicle/Equipment NOT Engaged in Excavation:	
1. Vehicle/Equipment operated by:	
- If Damage by Boats, Barges, Drilling Rigs, or Other Maritime Equipment or Vessels Set Adrift or Which Have Otherwise Lost Their Mooring:	
2. Select one or more of the following IF an extreme weather event was a factor:	
- Hurricane	
- Tropical Storm	
- Tornado	
- Heavy Rains/Flood	
- Other	
- If Other, Describe:	
- If Previous Mechanical Damage NOT Related to Excavation: Complete Questions 3-7 ONLY IF the "Item Involved in Incident" (from PART C, Question 3) is Pipe or Weld.	
3. Has one or more internal inspection tool collected data at the point of the Incident?	
3a. If Yes, for each tool used, select type of internal inspection tool and indicate most recent year run:	
- Magnetic Flux Leakage	
Most recent year run:	
- Ultrasonic	
Most recent year run:	
- Geometry	
Most recent year run:	
- Caliper	
Most recent year run:	
- Crack	
Most recent year run:	
- Hard Spot	
Most recent year run:	
- Combination Tool	
Most recent year run:	
- Transverse Field/Triaxial	
Most recent year run:	
- Other:	
Most recent year run:	
Describe:	
4. Do you have reason to believe that the internal inspection was completed BEFORE the damage was sustained?	
5. Has one or more hydrotest or other pressure test been conducted since original construction at the point of the Incident?	
- If Yes:	
Most recent year tested:	
Test pressure (psig):	
6. Has one or more Direct Assessment been conducted on the pipeline	

segment?	
- If Yes, and an investigative dig was conducted at the point of the Incident :	
Most recent year conducted:	
- If Yes, but the point of the Incident was not identified as a dig site:	
Most recent year conducted:	
7. Has one or more non-destructive examination been conducted at the point of the Incident since January 1, 2002?	
7a. If Yes, for each examination conducted since January 1, 2002, select type of non-destructive examination and indicate most recent year the examination was conducted:	
- Radiography	
Most recent year conducted:	
- Guided Wave Ultrasonic	
Most recent year conducted:	
- Handheld Ultrasonic Tool	
Most recent year conducted:	
- Wet Magnetic Particle Test	
Most recent year conducted:	
- Dry Magnetic Particle Test	
Most recent year conducted:	
- Other	
Most recent year conducted:	
Describe:	
- If Intentional Damage:	
8. Specify:	
- If Other, Describe:	
- If Other Outside Force Damage:	
9. Describe:	

G5 - Pipe, Weld, or Joint Failure	**Use this section to report material failures ONLY IF the "Item Involved in Incident" (from PART C, Question 3) is "Pipe" or "Weld."**
	Only one **sub-cause** can be selected from the shaded left-hand column

Pipe, Weld or Join Failure – Sub-Cause:	
1. The sub-cause shown above is based on the following *(select all that apply)*:	
- Field Examination	
- Determined by Metallurgical Analysis	
- Other Analysis	
- If "Other Analysis", Describe	
- Sub-cause is Tentative or Suspected; Still Under Investigation *(Supplemental Report required)*	
- If Construction-, Installation- or Fabrication	
2. List contributing factors: *(select all that apply)*	
- Fatigue or Vibration related:	
Specify:	
- If Other, Describe:	
- Mechanical Stress	
- Other	
- If Other, Describe:	
- If Environmental Cracking-related:	
3. Specify:	
- If Other, Describe:	
Complete the following if any Material Failure of Pipe or Weld sub-cause is selected.	
4. Additional Factors (*select all that apply*):	
- Dent	
- Gouge	
- Pipe Bend	
- Arc Burn	
- Crack	
- Lack of Fusion	
- Lamination	
- Buckle	
- Wrinkle	
- Misalignment	
- Burnt Steel	
- Other	

- If Other, Describe:	
5. Has one or more internal inspection tool collected data at the point of the Incident?	
5a. If Yes, for each tool used, select type of internal inspection tool and indicate most recent year run:	
- Magnetic Flux Leakage	
Most recent year run:	
- Ultrasonic	
Most recent year run:	
- Geometry	
Most recent year run:	
- Caliper	
Most recent year run:	
- Crack	
Most recent year run:	
- Hard Spot	
Most recent year run:	
- Combination Tool	
Most recent year run:	
- Transverse Field/Triaxial	
Most recent year run:	
- Other	
Most recent year run:	
Describe:	
6. Has one or more hydrotest or other pressure test been conducted since original construction at the point of the Incident?	
- If Yes:	
Most recent year tested:	
Test pressure (psig):	
7. Has one or more Direct Assessment been conducted on the pipeline segment?	
- If Yes, and an investigative dig was conducted at the point of the Incident:	
Most recent year conducted:	
- If Yes, but the point of the Incident was not identified as a dig site:	
Most recent year conducted:	
8. Has one or more non-destructive examination(s) been conducted at the point of the Incident since January 1,2002?	
8a. If Yes, for each examination conducted since January 1, 2002, select type of non-destructive examination and indicate most recent year the examination was conducted:	
- Radiography	
Most recent year conducted:	
- Guided Wave Ultrasonic	
Most recent year conducted:	
- Handheld Ultrasonic Tool	
Most recent year conducted:	
- Wet Magnetic Particle Test	
Most recent year conducted:	
- Dry Magnetic Particle Test	
Most recent year conducted:	
- Other	
Most recent year conducted:	
Describe:	

G6 - Equipment Failure - only one **sub-cause** can be selected from the shaded left-hand column	
Equipment Failure – Sub-Cause:	Malfunction of Control/Relief Equipment
- If Malfunction of Control/Relief Equipment:	
1. Specify:	
- Control Valve	
- Instrumentation	
- SCADA	
- Communications	Yes
- Block Valve	
- Check Valve	

- Relief Valve	
- Power Failure	
- Stopple/Control Fitting	
- Pressure Regulator	
- ESD System Failure	Yes
- Other	
- If Other, Describe:	
- If Compressor or Compressor-related Equipment:	
2. Specify:	
- If Other, Describe:	
- If Threaded Connection/Coupling Failure:	
3. Specify:	
- If Other, Describe:	
- If Non-threaded Connection Failure:	
4. Specify:	
- If Other, Describe:	
- If Other Equipment Failure:	
5. Describe:	
Complete the following if any Equipment Failure sub-cause is selected.	
6. Additional factors that contributed to the equipment failure *(select all that apply)*	
- Excessive vibration	
- Overpressurization	
- No support or loss of support	
- Manufacturing defect	
- Loss of electricity	
- Improper installation	
- Mismatched items (different manufacturer for tubing and tubing fittings)	
- Dissimilar metals	
- Breakdown of soft goods due to compatibility issues with transported gas/fluid	
- Valve vault or valve can contributed to the release	
- Alarm/status failure	
- Misalignment	
- Thermal stress	
- Other	Yes
- If Other, Describe:	On-going investigation into the ESD system failure
G7 – Incorrect Operation - only one **sub-cause** can be selected from the shaded left-hand column	
Incorrect Operation – Sub-Cause:	
- If Underground Gas Storage, Pressure Vessel, or Cavern Allowed or Caused to Overpressure:	
1. Specify:	
- If Other, Describe:	
- If Other Incorrect Operation:	
2. Describe:	
Complete the following if any Incorrect Operation sub-cause is selected.	
3. Was this Incident related to: *(select all that apply)*	
- Inadequate procedure	
- No procedure established	
- Failure to follow procedure	
- Other:	
- If Other, Describe:	
4. What category type was the activity that caused the Incident:	
5. Was the task(s) that led to the Incident identified as a covered task in your Operator Qualification Program?	
5a. If Yes, were the individuals performing the task(s) qualified for the task(s)?	
G8 - Other Incident Cause - only one **sub-cause** can be selected from the shaded left-hand column	
Other Incident Cause – Sub-Cause:	
- If Miscellaneous:	

1. Describe:	
- If Unknown:	
2. Specify:	

PART - H NARRATIVE DESCRIPTION OF THE INCIDENT

On January 30, 2019 at approximately 10:25:51 hours an activation of the emergency shut down (ESD) system occurred at Consumers Energy's Ray Compressor Station Plant 3 causing gas to be released through the blow down silencers. Due to wind conditions and the location of the silencer, a gas plume made contact with the Plant 2 Thermal Oxidizer exhaust causing an ignition and subsequent fire.

In response to the hazardous condition, station personnel activated emergency shutdown (ESD) at Plants 1 and 2. Personnel ensured all trapped gas was removed from the piping. The site was then released to the local fire department to extinguish any remaining fire and hotspots. Restoration efforts began for Plant 1 as it was not affected by the fire. (Plant 1 resumed operations at approximately 22:15 hours).

A Root Cause Analysis (RCA) team was assembled On February 2, 2019 to identify the ignition source initiating the fire at the Ray Compressor Station Plant 3 blow down silencers and define how to control and prevent re-occurrence.

Plants 2 and 3 are undergoing a damage assessment to evaluate the current condition and develop a restoration plan.

PART I - PREPARER AND AUTHORIZED SIGNATURE

Preparer's Name	Carmella King
Preparer's Title	Senior Engineering Technical Analyst II
Preparer's Telephone Number	989-280-2963
Preparer's E-mail Address	carmella.king@cmsenergy.com
Preparer's Facsimile Number	
Authorized Signature Title	Gas Compliance Lead
Authorized Signature Telephone Number	989-791-5749
Authorized Signature Email	jason.pionk@cmsenergy.com
Date	03/01/2019

MICHIGAN DEPARTMENT OF STATE POLICE

ORIGINAL INCIDENT REPORT

ORIGINAL DATE: Fri, Feb 01, 2019	**INCIDENT NO:** FIU-0000053-19
TIME RECEIVED: 0830	**FILE CLASS:** 95006
WORK UNIT: MSP FIU (FIRE INVESTIGATION UNIT)	**COUNTY:** MACOMB

COMPLAINANT: PAUL JERGENS		**TELEPHONE NO:** (248) 376-4579	
ADDRESS: STREET AND NO: 9440 NAPIER RD	**CITY:** NORTHVILLE	**STATE:** MI	**ZIP CODE:** 48167
INCIDENT STATUS: CLOSED			

FIRE AT NATURAL GAS FACILITY

INFORMATION:

I was contacted by Lt. Tim Ketvertis regarding a fire that occurred on 1/30/2019 at the Consumers Energy Ray Compressor Facility in Armada. He advised that they have been in contact with Consumers Energy and they were requesting assistance in determining an origin and cause of the fire that occurred at their facility. I made arrangements to respond to the scene on 1/31/2019 and conduct an investigation. Also assisting with the investigation were ATF Special Agents Greg Lotoczky and Mike Stassi, Detroit Fire Captain and ATF Task Force Agent Omar Davidson, Gas Safety Engineer Kyle Friske, and fire protection engineer Chris Redmond.

VENUE:

MACOMB COUNTY
69333 OMO RD
ARMADA, MI 48005
AT OR NEAR: RAY COMPRESSOR STATION

DATE & TIME:

ON OR AFTER: TUE, JAN 30, 2019 AT 1025

SCENE:

A fire occurred at Consumers Energy Ray Compressor Facility. Access to the facility is limited to two gates on the east side of the facility off Omo Road. The perimeter is secured with chain link fence capped with barbed wire. The facility consists of three plants. Plants 1 & 2 were constructed in the 1960’s and Plant 3 was constructed in 2012. Plant 1 is located on the north side of the facility, Plant 2 is located on the south side, and Plant 3 is located in between Plants 1 & 2. There is a paved roadway that circles the plants allowing access to different areas of the facility. The fire was isolated to the area in and around Plant 2 in the south west corner of the facility.

MICHIGAN DEPARTMENT OF STATE POLICE

ORIGINAL INCIDENT REPORT

ORIGINAL DATE:	INCIDENT NO:
Fri, Feb 01, 2019	FIU-0000053-19
TIME RECEIVED:	**FILE CLASS:**
0830	95006

WEATHER:

Weather as reported by www.weatherunderground.com for the Armada area on the date of this incident was as follows-

As 1015 hrs the temperature was reported to be -2° Fahrenheit. Humidity was 55%. Winds were WSW at 9 mph gusting up to 18 mph with the weather conditions reported to be mostly cloudy. There was no reported storm activity or lightning strikes in the area around the time of the incident.

COMPLAINANT:

NAM:	PAUL JERGENS						
BIR:				RAC:	WHITE	ETH:	
NBR:	9440	DIR:		SEX:	MALE	DL:	/
STR:	NAPIER			DOB:		SSN:	
SFX:	ROAD			HGT:	' "	SI:	/
CTY:	NORTHVILLE	ST:	MI	WGT:		FBI:	
TXH:		ZIP:	48167	HAI:		MNU:	
TXW:				EYE:		PR:	

CT: (248) 376-4579
SMT:

EMPLOYER: CONSUMERS ENERGY

INTERVIEW JERGENS:

Upon arriving at the facility, I made contact with Paul Jergens plant manager of the facility. He showed us to his office where we began to discuss the incident. Jergens advised that on 1/30/2019, Plants 2 & 3 were on line and providing a large amount of natural gas as the weather was extremely cold. They were reaching the max capacity of distribution. Plant 1 was off line on the day of the incident.

Jergens explained how the facility operates. He advised that there is natural gas saved in several underground reservoirs in and around the area. During the winter months they pull from those reserves and disseminate it to the customers. Due to the extreme cold temperatures they were expecting a large demand for natural gas. At the time of the incident Plant 2 was flowing approximately 600 million cubic feet while Plant 3 was flowing 800 million cubic feet.

Jergens advised that some employees in Plant 3 smelled gas around the facility. At 10:23 am an emergency shut down (ESD) off was activated for Plant 3. Jergens informed us that when an ESD is activated the flow of natural gas from the field is stopped and the natural gas in the system is purged to avoid an incident. The pipes that are used to purge the systems for Plant 2 & Plant 3 are located near the west perimeter fence SW of Plant 2. He explained that there are two different type of pipes in that area. Plant 2 pipes, used for the purging of natural gas, are straight pipes that when activated will blow the natural gas straight up into the air. Plant 3's pipes are called mutes. They are designed so that the natural gas travels through small holes within the pipe to quiet the off gassing. Additionally, there is a hood on the top of the stack that prevents debris from entering.

MICHIGAN DEPARTMENT OF STATE POLICE	**ORIGINAL DATE:** Fri, Feb 01, 2019	**INCIDENT NO:** FIU-0000053-19
ORIGINAL INCIDENT REPORT	**TIME RECEIVED:** 0830	**FILE CLASS:** 95006

JERGENS INTERIVEW CONTINUED:

Jergens advised that shortly after the ESD was activated a fire was observed near Plant 2. Upon seeing the fire an ESD for Plant 2 was initiated. This caused Plant 2 to purge its natural gas through the pipes just south of where the fire was observed. A large fire consumed the area for several minutes until the flow of gas was controlled. At that point both Plant 2 & 3 stacks actively had fire at the top of their stacks for approximately 4 hours as a controlled pilot.

Jergens advised that Armada Township Fire Department responded to the scene and stood by until all the natural gas was shut off. At that time the fire department was used to extinguish any hot spots that remained around the facility.

Jergens advised that there was video of the explosion and allowed us to view it prior to the scene examination.

VIDEO SURVEILLANCE:

Video of the explosion was recorded on several surveillance videos around the facility. The following times were observed using the surveillance video time stamp (it should be noted that the time stamp on the surveillance video is approximately 5 minutes ahead of the times from the data alarm log in the control room. All times in this report will be using the camera time stamp).

10:25.23	Observe Consumer’s Energy pick up drive past Plant 2
10:25.54	First sight of flame near above Plant 2 near the thermal oxidizer
10:26.07	Observe large fire ball
10:26.22	Fire has travelled west through the air and ignited gas from Plant 3 stacks
10.28.28	Plant 2 stack begin to purge natural gas
10:28.48	Fire is at Plant 2 Stack
10:33.30	Fire becomes a controlled pilot at post Plant 2 & 3 Stacks

Further observation of the video shows the fire igniting high above the ground. The video shows a distortion which appears to be a large cloud of natural gas around Plant 2 moments before ignition. Upon the ignition of the natural gas vapors, the fire is observed on the video travelling west against the wind to the top of the Plant 3 mutes. While observing the video I did not observe fire travel to any other source of natural gas.

PHOTOGRAPHS:

Digital photographs were taken by Spl/Tpr. Hoyt. The photographs were uploaded to the MSP Photo Lab via the digital crime scene software program.

MICHIGAN DEPARTMENT OF STATE POLICE

ORIGINAL INCIDENT REPORT

ORIGINAL DATE:	INCIDENT NO:
Fri, Feb 01, 2019	FIU-0000053-19
TIME RECEIVED:	**FILE CLASS:**
0830	95006

CONSUMERS ENERGY FIRE PROTECTION ENGINEER:

NAM: CHRIS REDMOND

BIR:				RAC:	WHITE	ETH:	
NBR:	1	DIR:		SEX:	MALE	DL:	/
STR:	ENERGY			DOB:		SSN:	
SFX:	PLAZA			HGT:	' "	SI:	/
CTY:	JACKSON	ST:	MI	WGT:		FBI:	
TXH:		ZIP:	49201	HAI:		MNU:	
TXW:				EYE:		PR:	

CT: (517) 788-1560
SMT:

EMPLOYER: CONSUMERS ENERGY

STATE OF MICHIGAN GAS SAFETY ENGINEER:

NAM: KYLE FRISKE

BIR:				RAC:	WHITE	ETH:	
NBR:	7109	DIR:		SEX:	MALE	DL:	/
STR:	W SAGINAW			DOB:		SSN:	
SFX:	HIGHWAY			HGT:	' "	SI:	/
CTY:	LANSING	ST:	MI	WGT:		FBI:	
TXH:		ZIP:	48909	HAI:		MNU:	
TXW:				EYE:		PR:	

CT: (810) 229-6608
SMT:

EMPLOYER: STATE OF MICHIGAN

SCENE EXAMINATION:

Though the scene was inside the perimeter of the facility, Plant 2 was not secured prior to our arrival.

I was accompanied to the site with Consumers Energy employees as well as Chris Redmond and Kyle Friske. While observing the area we were checking for any obvious signs of rupture or damage to any of the pipes around Plant 2. Plant 2 is located at the south end of the facility. We were unable to locate any obvious ruptures. There was heat and fire damage to several pieces of equipment including the melting of plastic and rubber components throughout Plant 2. Plant 2 had two large stacks extending up from the equipment. One large stack was a thermal oxidizer and the second was a still column. We were informed that the large stack was a thermal oxidizer and is made of carbon steel. Both the still column and thermal oxidizer showed signs of discoloration due to heat and fire damage.

There were two small control structures around Plant 2 that sustained heat damage. There was a storage shed located north of the Plant 3 mute that sustained thermal damage due to radiant heat. Additionally, there were several drains and plastic components near ground level that had heat damage due to the radiant heat.

MICHIGAN DEPARTMENT OF STATE POLICE

ORIGINAL INCIDENT REPORT

ORIGINAL DATE:	INCIDENT NO:
Fri, Feb 01, 2019	FIU-0000053-19
TIME RECEIVED:	**FILE CLASS:**
0830	95006

SCENE EXAMINATION CONTINUED:

Along the west perimeter fence were a series of pipes extending up from the ground. On the south side there was one large straight pipe and directly north of that were four smaller straight pipes. The large pipe sustained heat and fire damage. The tips of the small pipes also showed signs of heat and fire damage. These pipes are the purge pipes for Plant 2.

Directly north of the Plant 2 purge pipes are two large mutes. These are the two large pipes that purged the gas from Plant 3. Both sustained extensive heat and fire damage. The top half of both pipes show signs of clean burn, where all the paint has been consumed exposing the bare steel. The burn patterns are located on the east sides of the pipe which is consistent with a WSW wind at the time of the fire.

The grass is burned around the stacks due to the radiant heat from the fire. Damage was observed on a barn north of the Plant 3 stacks. This was due to radiant heat.

PLANT INFORMATION:

After observing the video, we requested information specific to Plant 2 including the temperature of the thermal oxidizer. Chris Redmond provided me a copy of temperature sensor of the thermal oxidizer of the Plant 2. At 10:15a.m. the temperature was 1496˚ Fahrenheit, the temperature dropped to 576˚ at 10:30am.

FIRE ORIGIN:

Based on the information and evidence available to this investigator at the time of this report as well as the fire patterns and fire damage observed, it is this investigator's opinion that the origin of the fire is above Plant 2.

FIRE CAUSE:

At the time of this report, accidental sources/scenarios could not be eliminated, or supported to a sufficient level to reach an opinion to classify the cause of this fire outside of undetermined.

Two possible causes include:

1) The ESD of Plant 3 caused the natural gas to purge out the stacks near the west perimeter. At the time of the purge there was strong WSW wind that cause the natural gas to migrate over to Plant 2 at which time it was ignited by a competent ignition source including the thermal oxidizer or static electricity.

2) A relief valve from the still column released gas and ignited, and then the natural gas from Plant 3 contributed to the growth of the fire.

The cause of this fire will be classified as undetermined.

MICHIGAN DEPARTMENT OF STATE POLICE

ORIGINAL INCIDENT REPORT

ORIGINAL DATE:	INCIDENT NO:
Fri, Feb 01, 2019	FIU-0000053-19
TIME RECEIVED:	**FILE CLASS:**
0830	95006

EXTERNAL DOCUMENTS:

Satellite view of facility
Surveillance camera outline of facility
Thermal Oxidizer Temperature Log

STATUS:

CLOSED

Exponent
Engineering P.C.

Exponent
39100 Country Club Drive
Farmington Hills, MI 48331

telephone 248-324-9100
www.exponentengineering.com
info@exponentengineering.com

February 28, 2019

Steven Wohlscheid, PE
Consumers Energy
1945 West Parnall Road
Jackson, Michigan 49201

Subject: Ray Compressor Station Fire Investigation
Exponent Project No. 1901111.EX0

Dear Steven:

At your request, Exponent P.C. conducted an investigation of the fire that occurred on January 30, 2019, at the Ray Compressor Station located at 69333 Omo Road, Armada Township, Michigan. The objective of this investigation was to assist the Consumers Energy Root Cause Analysis (RCA) team in the evaluation of ignition scenarios. The Exponent project scope was to determine the cause of the fire and to suggest corrective actions to prevent a recurrence. This letter report summarizes Exponent's investigation.

Executive Summary

The analysis and conclusions expressed in this report are based on current information. Should additional information become available, Exponent reserves the right to supplement these opinions. Exponent holds the following opinions to a reasonable degree of engineering certainty:

1. The source of the flammable gas was the natural gas blowdown from Plant 3.
2. The formation of an ignitable fuel gas cloud was strongly influenced by the wind speed and direction.
3. The hot gas stream discharged at the stack of the Plant 2 thermal oxidizer is the most likely source of ignition.
4. The siting of the blowdown stacks for Plant 3 was too close to Plant 2's thermal oxidizer, as built.
5. Exponent suggests that Consumers Energy considers the following recommendations:
    a. Prevent a flammable concentration of blowdown gas from contacting a competent ignition source.

b. Ensure that employees are warned by both visual and audible alarms that a blowdown is occurring.

c. Train employees to stay a safe distance away from the blowdown area (the blowdown exclusion zone, a distance to be determined by Consumers Energy) until the gas has dispersed into the atmosphere to a concentration below the lower flammable limit.

d. Consider developing a procedure to verify that the gas has dispersed into the atmosphere to a concentration below the lower flammable limit before allowing employees to enter the blowdown exclusion area.

Note that this Executive Summary does not contain all of Exponent's technical evaluations, analyses, conclusions, and recommendations. Hence, the main body of this report is at all times the controlling document.

Incident Summary

Consumers Energy (Consumers) operates a natural gas storage field at 69333 Omo Road, Armada Township, Michigan. This storage facility, referred to as the Ray Compressor Station, has three compressor buildings designated Plant 1, Plant 2, and Plant 3. The facility was originally built in 1966 and has been expanded or upgraded over time. The fire event affected Plants 2 and 3. The thermal oxidizer for Plant 2 was installed in 2005, and the thermal oxidizer for Plant 3 was installed by 2013. Figure 1 shows the layout of the facility.

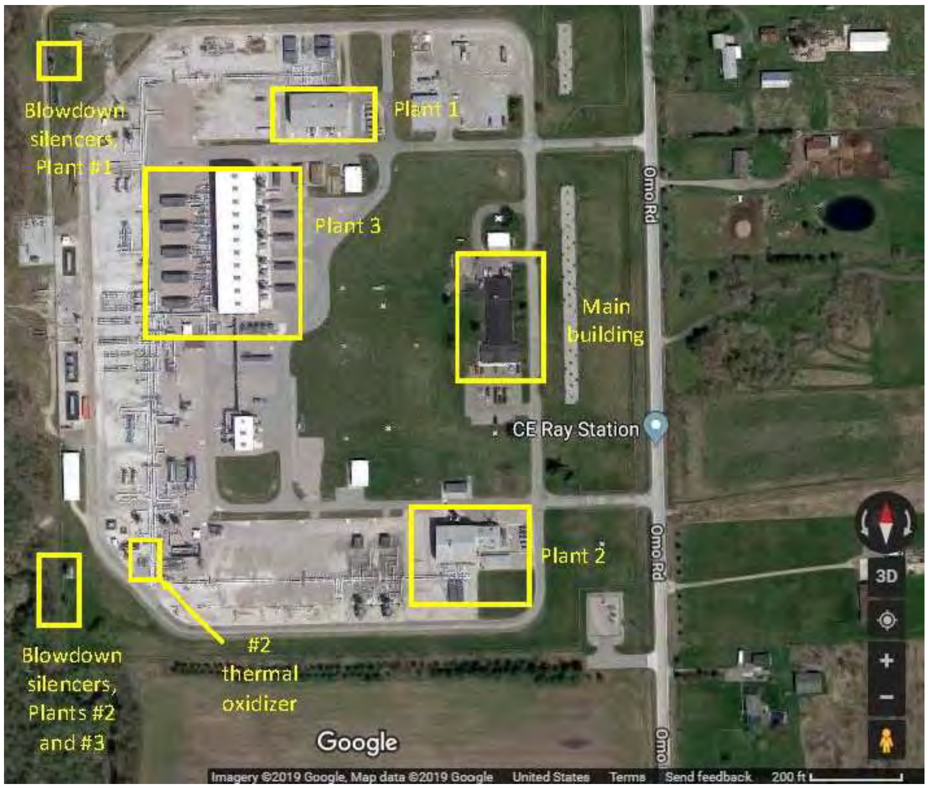

Figure 1. Ray Compressor Station

On January 30, 2019, a fire occurred at Consumer Energy's Ray Compressor Station. A loss of pilot air pressure signal triggered an emergency shutdown in Plant 3. As designed, the emergency shutdown initiated a blowdown of the natural gas inventory in Plant 3. The blowdown gas vented through the silencers located at the southwest corner of the station property. This blowdown gas was ignited. The flames were pushed eastwards by the wind. The flames self-extinguished when the inventory of blowdown gas was completely vented.

The ignition event and subsequent fire were recorded by security cameras. Still captures from a video can be seen in Figure 2, showing the first visible image of flame, the second occurrence of visible flame, and the fire once it extended back to the silencer.

The security cameras also documented a Consumers' employee driving a pickup truck along the service road approximately one minute before ignition of the blowdown gas. An audible alarm is reportedly supposed to activate during a gas blowdown to alert workers to stay away from the silencers. This alarm apparently did not activate.

It is important to note that the video may not capture all of the combustion activity associated with the blowdown gas. Three factors can influence the visibility of natural gas flames: the degree of natural gas-air mixing, the brightness of ambient light, and the degree of contrast provided by background images.

If a flammable gas is mixed with air prior to ignition, it is called a premixed flame. Methane, the primary component of natural gas forms a flammable mixture in air in the range of 5% to 15% by volume. When the gas concentration is less than the stoichiometric value, about 10% by volume, there is excess air in the mixture (these are also called fuel-lean mixtures). Premixed flames that form with excess air burn with a light blue, nearly transparent, flame. Premixed flames are difficult to see in bright sunlight with a background formed by a bright blue sky or a snow-covered field. On the day of this incident, there was bright sunshine and few clouds. The ground in the vicinity of the silencers was covered with white snow. So it is possible that some premixed combustion occurred prior to the formation of visible flames.

If the flammable gas is kept separate from air, then the gas and air must mix by diffusion to form a flammable mixture. If the mixture is ignited, it can only burn in the zone where the fuel and air have mixed to the flammable concentration range. These flames are called diffusion flames. Diffusion flames of natural gas tend to burn with a bright orange-yellow color and are nearly opaque (not transparent). Diffusion flames are readily observed and recorded by the typical surveillance cameras. Bright sunlight and blue skies enhance the visibility of these flames.

"10_190130102000_3000.n3r" (left), "15_190130102500_2500.n3r" (right)

Figure 2. Video stills at different times showing the progression of the ignition event. Camera facing west on the left hand column and camera facing north on the right hand column.

Investigation Methodology

The investigation of fires to determine their origin (the location where ignition occurred) and cause (the reason why ignition occurred) can be a challenging assignment. This is because fire destroys evidence, the very evidence that is needed to determine origin and cause. To improve the scientific integrity of the fire investigation process, the National Fire Protection Association (NFPA) has published a guidance document entitled, NFPA 921 Guide for Fire and Explosion Investigations (2017).[1] One of the key principles of NFPA 921 is to develop and test fire causation hypotheses using the evidence collected at the fire scene and to evaluate the feasibility of these ignition hypotheses using engineering science.

Exponent has performed this investigation in a manner generally consistent with the tenets of NFPA 921. Several ignition hypotheses were developed and tested by the Consumers Energy Root Cause Analysis (RCA) Team. Exponent was asked to assist in the evaluation of potential causes of the fire and to offer recommendations for preventing a recurrence of this accident.

As part of its investigation, Exponent conducted an inspection of the compressor station facility. Exponent also reviewed interview statements, process data, design documents, working papers, laboratory test results, and calculations prepared by the Consumers Energy RCA Team. Independently of Consumers Energy, Exponent conducted a review of the scientific literature on natural gas blowdowns and fires that may result from such events. Additionally, Exponent performed calculations and obtained additional data from various technical sources as documented in this report.

Engineering Analysis of the Fire Event

The analysis of relevant ignition hypotheses is structured around the fire triangle, i.e., a fire can only occur if fuel, oxidizer, and a competent ignition source come together simultaneously. Thus, a viable fire scenario must include each component of the fire triangle. The analysis that follows is based on a consideration of the fuel source, the dispersion of the fuel into the air, and the ignition source.

Fuel: blowdown of natural gas from Plant 3

Consumers' RCA team had previously considered and eliminated a variety of potential fuel sources for this fire. Exponent independently reviewed this work and agrees with the finding that the natural gas from the blowdown of the Plant 3 Discharge and/or Suction silencers (Plant 3 blowdown silencers) was the first and most significant fuel source for the fire.

---

[1] NFPA 921: Guide for Fire and Explosion Investigations, National Fire Protection Association, 2017.

The Plant 3 Discharge and Suction silencers are located approximately 160-170 feet from the first visible ignition on the surveillance videos (see Figure 3).[2] The blowdown from these silencers was initiated when Valve 722 and Valve 724 began to open, either 10:24 a.m. or 10:25 a.m.[3] The blowdown was part of the emergency shutdown associated with Plant 3, which was initiated between 10:22 a.m. and 10:24 a.m.[4] Within 30 seconds of the first visible ignition, the fire had traveled backward toward the Plant 3 blowdown silencers, indicating a continuous flammable cloud between the initial area of ignition and the blowdown silencers. The blowdown from these stacks was the only ongoing, high pressure release of fuel that has been identified in the vicinity of the ignition location.

[2] Plant 3 Suction Blowdown Silencer (BDSL-03-01-06) and Plant 3 Discharge Blowdown Silencer (BDSL-03-01-07).

[3] The data historian did not explicitly record when these valves began to open, only when they were fully open, between 10:26 and 10:27 a.m. However, the 12” valves take a finite amount of time to travel from fully closed to fully open. Valve 702, a 2” equalizing valve that should open simultaneously per the Emergency Plan, was open before 10:25 a.m., and a sustained drop in header pressure can be observed in process data at 10:25 a.m.

[4] Ray Compressor Station Emergency Plans, Plan A, p. 5.

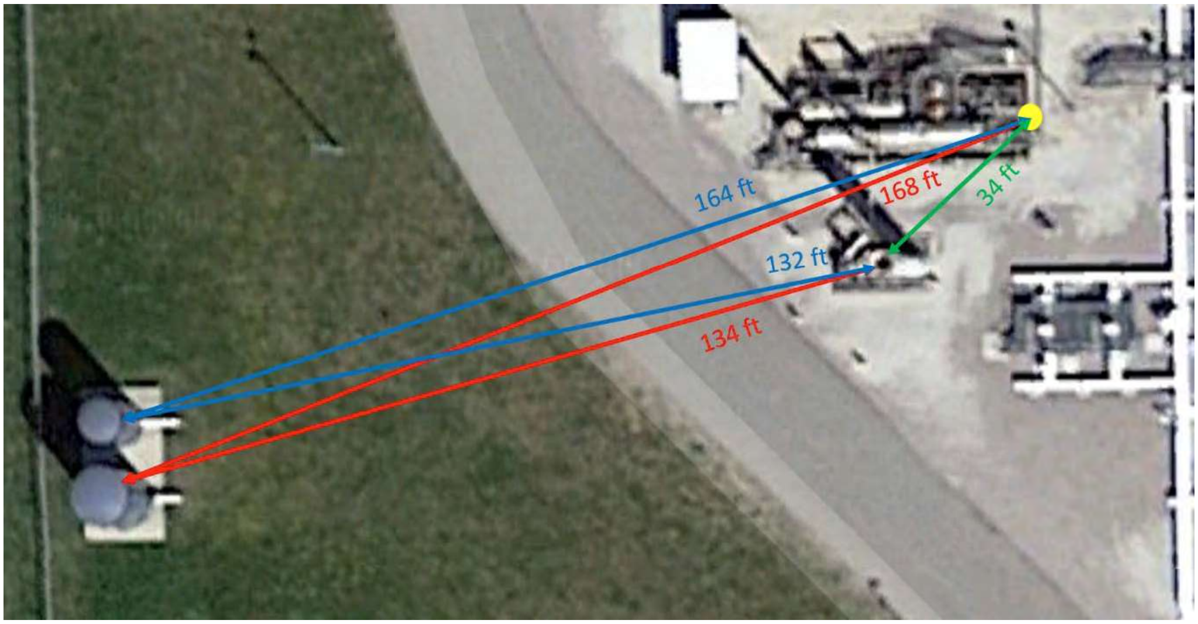

Figure 3. Location of first observed flame based on analysis of surveillance video

Plant 1 was manually fire gated and underwent a blowdown.[5][6] However, there was no indication that natural gas from Plant 1 ignited during the event. Plant 1 was operational during the incident, but its equipment was located on the other side of the facility from the event, and thus any ignition hypothesis involving a fuel release from Plant 1 equipment or the Plant 1 blowdown is refuted.

Plant 2 was fire gated and underwent a blowdown as a safety measure after the fire was first observed.[7] The blowdown from Plant 2 silencers contributed significantly to the overall magnitude of the fire, and likely caused the overpressure ("explosion") observed by both onsite and offsite witnesses to the event.[8] While the natural gas released from the Plant 2 blowdown became involved in the incident, it could not have been the first fuel ignited, and thus ignition hypotheses involving the Plant 2 blowdown were refuted.

Plant 2 was operational during the initial stages of the event, and some of the Plant 2 process equipment, specifically the Plant 2 thermal oxidizer and Plant 2 reboiler, was in the vicinity of the ignition location. The Plant 2 reboiler feeds potentially flammable waste gas to the Plant 2

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[5] Various fire gate panels are located around the facility. A Station Mechanic used the fire gate panel nearest the control room. The action of fire gating initiated a blowdown.

[6] Station Mechanic interview, HMI Alarm Log, RCA Sequence of Events.

[7] Station Mechanic interview, HMI Alarm Log, RCA Sequence of Events.

[8] Media coverage, Station Mechanic interview.

thermal oxidizer, and both rely on natural gas as a fuel gas. However, there was no evidence to suggest an ongoing release of natural gas or waste gas from either piece of equipment. There was no observed flame at the base of this equipment, where the natural gas was fed. The Plant 2 reboiler showed minimal signs of fire and/or heat damage, primarily on the elevated portions and in the area facing the Plant 3 blowdown silencers. Approximately 20 seconds after the first observed ignition, fire was visible in the vicinity of waste gas piping from the Plant 2 reboiler to the Plant 2 thermal oxidizer (see Figure 4). However, the fire was concentrated around the waste gas relief valve and two apparently-closed valves (c.f., Figure 5). It is more likely than not that these appurtenances appeared to be on fire due to the turbulence generated as the natural gas blowdown traveled past them. Thus, ignition hypotheses involving fuel sources associated with the Plant 2 process equipment were refuted.

Surveillance Camera 10, 10:26:12 (cropped)

Figure 4. Reboiler Still Column (in yellow box).

D17875 - 0351

Figure 5. Reboiler Still

The RCA team also contemplated a leak of natural gas from somewhere else in the facility traveling to the area of ignition. However, fire did not travel west beyond the array of Plant 3 silencers, or elsewhere, and thus these ignition hypotheses were refuted.

Blowdown Discharge

The blowdown from the Plant 3 Suction and Discharge silencers began as a result of an emergency shutdown of Plant 3 equipment. The shutdown resulted in the opening of Plant 3 Firegate Blowdown Valves 722 and 724, consistent with Ray Compressor Station Emergency Plan A.[9] Nonetheless, a blowdown of the station piping during an emergency shutdown is a necessary safety function, and it should discharge the gas to a location that does not create a hazard.

The blowdown event resulted in a rapid depressurization of natural gas in the piping from approximately 950 psig to near atmospheric pressure over the course of about 10 minutes. The flow of natural gas was driven by this internal pressure, and as a result of the depressurization, the flow rate of natural gas started very high and decayed as the pressure within the header

9 Ray Compressor Station Emergency Plans, Plan A, p. 5.

dropped. Consumers Energy developed a preliminary flow model to examine the flow from the blowdown silencers during the event.[10] This model incorporated details related to the piping, valves, and other equipment, in addition to measured natural gas pressures and temperatures upstream of the release. The result was a calculated flow rate (in standard cubic feet per minute, scfm) and velocity (in feet per second, fps) of natural gas from each of the two blowdown silencers. The results of this model are shown in Figure 6.

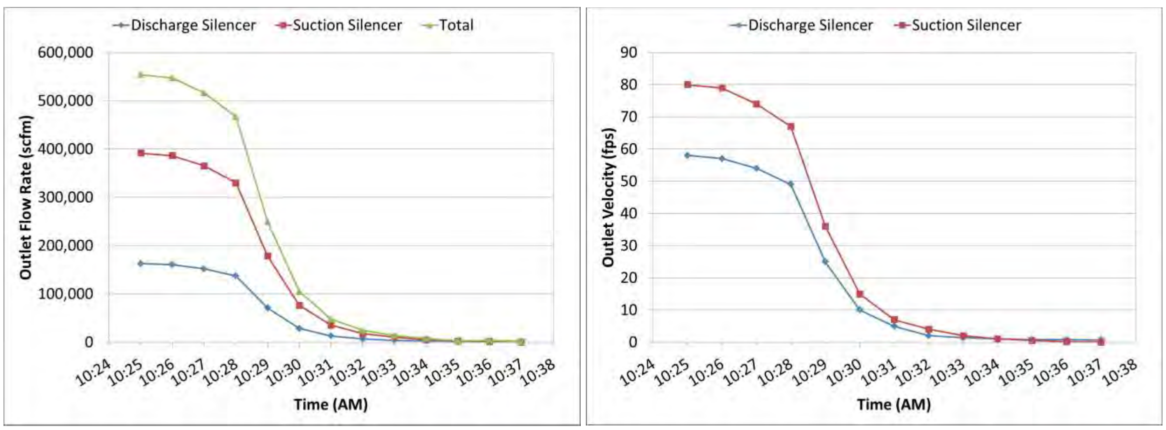

Figure 6. (Left) Calculated flow rate (scfm) for the Plant 3 Suction and Discharge silencers and the total combined flow rate. (Right) Calculated velocity (fps) for the Plant 3 Suction and Discharge silencers.

The release started at a very high flow rate, which produced a large, concentrated cloud of natural gas.

Oxidizer (air): mixing of the natural gas discharge with the atmosphere

During an emergency shutdown, it is necessary to bring the compressor station to a safe state. One aspect of managing the shutdown safely is to vent the pressurized natural gas that is contained in the compressors, piping, and associated gas treatment equipment. This is called a gas blowdown. The blowdown discharge is routed away from the compressor plant and personnel to an isolated location on the property. Given the high pressure of the natural gas and its low molecular weight (compared to air), the expectation is that the flow structure of the discharge will be vertically upwards. That would be the case in the absence of a silencer.

[10] Ray Compressor Station Fire RCA – Plant 3 Blowdown Silencers Preliminary Flow Model, February 13, 2019.

However, uncontrolled discharges of highly pressurized gas occur at sonic velocity (this is equivalent to a Mach number of one) and create significant noise.[11] Thus, the blowdown is routed through a silencer.

The purpose of the silencer is to reduce the noise produced by the blowdown to an acceptable level. The silencer accomplishes this goal by reducing the velocity of the blowdown discharge to a very low velocity giving a Mach number of perhaps 0.1. In the absence of wind, the blowdown discharge will be directed vertically upwards. This type of flow structure is called a turbulent buoyant jet.

Because of the slow exit velocity of the gas as caused by the silencer, the flow of the gas is very sensitive to perturbations by the wind. The wind causes the jet to bend away from the wind direction. Figure 7 illustrates the bent jet configuration caused by the interaction of the wind with the turbulent jet.

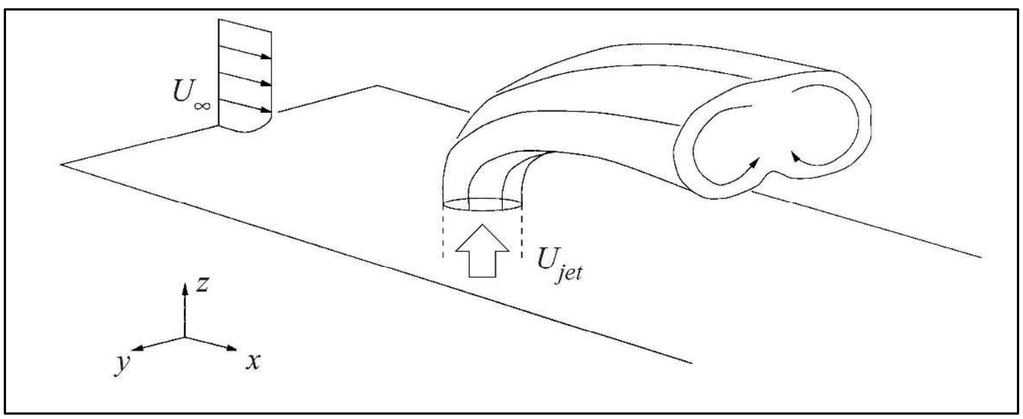

Figure 7. Illustration of turbulent jet in a cross wind[12]

The interaction of the wind with the discharging jet causes the formation of vortices (circulating flow patterns) which enhance the mixing of natural gas with the surrounding air. This illustration of the flow pattern is highly idealized and does not convey the turbulent mixing and dispersion that accompanies this process. Figure 8 is a photograph of a turbulent jet in a cross wind that better indicates the effect of turbulence.

[11] The Mach number of a flow is defined as the ratio of the fluid velocity divided by the speed of sound in that fluid.

[12] Cortelezzi, L. and Karagozian, A.R., 2001. On the formation of the counter-rotating vortex pair in transverse jets. *Journal of Fluid Mechanics*, *446*, pp.347-373.

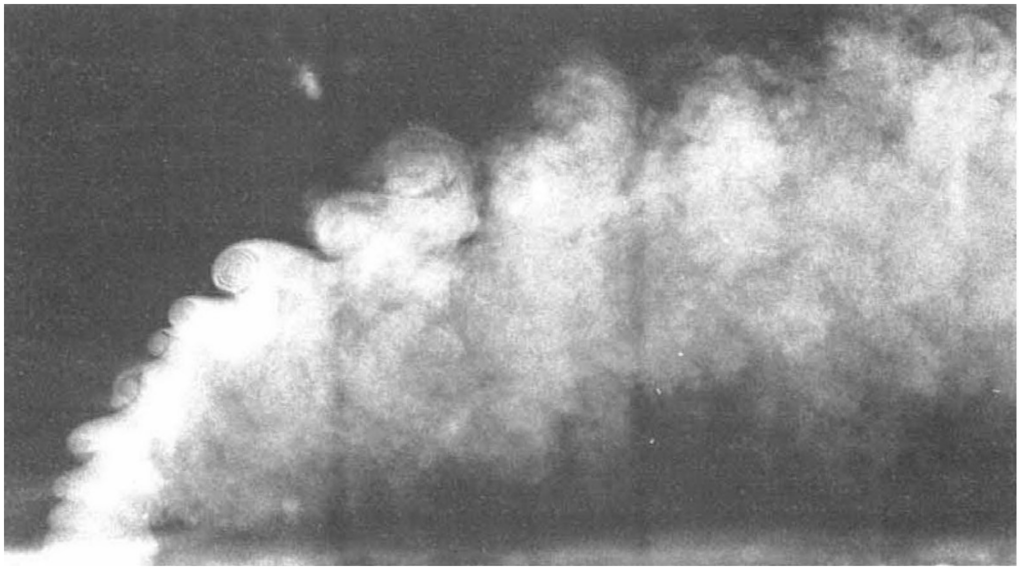

Figure 8. Photograph of laboratory study of a vertical turbulent jet in a cross wind.[13] The cross wind flow is from left to right.

An analysis of natural gas dispersion from a silencer stack with a cap indicated the potential for flammable gas concentrations even at ground level.[14] Perhaps contrary to expectations, the buoyancy of the natural gas cloud does not cause a significant vertical upwards displacement in the immediate vicinity of the silencer.

The surveillance video footage shows that on the day of the fire incident the prevailing wind caused the jet to bend away from the vertical axis of the silencer. In fact, the prevailing wind direction, from the southwest, pushed the blowdown discharge almost directly into the path of the Plant 2 thermal oxidizer. In a previous blowdown that occurred in November 2018, it was determined that the wind was from the north. A northerly wind would push the blowdown discharge in a direction perpendicular to the Plant 2 thermal oxidizer, making it less likely to be ignited.

The elevation of the tops of the Plant 3 silencer stacks is 23 feet and 25 feet. Figure 9 shows the silencers prior to the fire.

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[13] Fric, T.F. and Roshko, A., 1994. Vortical structure in the wake of a transverse jet. *Journal of Fluid Mechanics*, *279*, pp.1-47.

[14] García, J., Migoya, E., Lana, J.A. and Crespo, A., 2008. Study of the dispersion of natural gas issuing from compressor stations through silencers with upper cover. *Journal of hazardous materials*, *152*(3), pp.1060-1072.

Figure 9. Silencers for Plant 3 (two right hand side stacks) and Plant 2 (large stack on the left) in their pre-fire condition.

Note that the Plant 3 silencers had rain caps and the Plant 2 silencer did not. The presence of the rain caps likely contributed to the horizontal dispersion of the blowdown discharge from Plant 3.[15]

The blowdown discharge and its interaction with the wind caused a turbulent, highly dynamic natural gas cloud. Figure 10 is a flow visualization photograph from an experiment of a jet in a cross wind.

[15] García, J., Migoya, E., Lana, J.A. and Crespo, A., 2008. Study of the dispersion of natural gas issuing from compressor stations through silencers with upper cover. *Journal of hazardous materials*, *152*(3), pp.1060-1072.

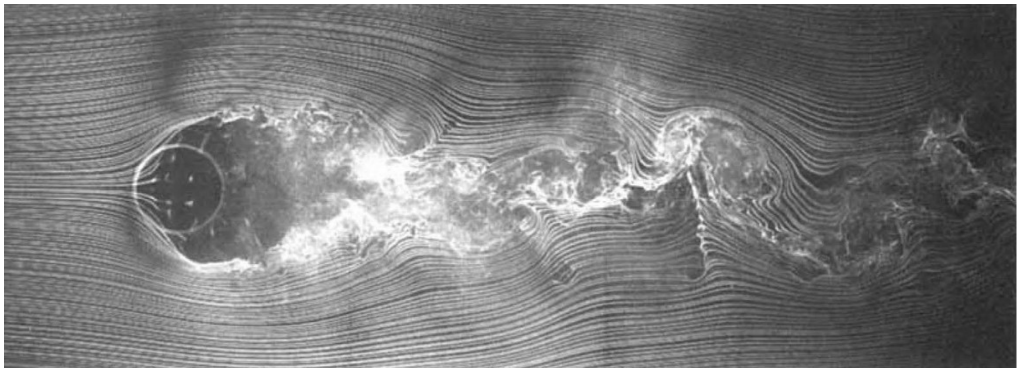

Figure 10. Photograph of a flow visualization experiment illustrating the complex flow pattern of a jet in a cross wind.

The photograph illustrates the complex flow field created by a steady wind as it interacts with the blowdown discharge. This complex flow field, called a wake, is not static; it is dynamic. The wake swirls and undulates with time creating a complex dispersion and mixing process for the natural gas discharge. In addition, as the wind blows around the cylindrical silencer stack another wake is formed that will interact with the flow field created by the wind interacting with the blowdown discharge. Finally, the weather data indicates that the wind was not steady on the day of the incident. The wind was variable and gusting. This is yet another factor that led to a very chaotic dispersion of natural gas across the station property. The complexity of gas dispersion process is evident in the surveillance video in which patches of flame appear and disappear in the early stages of the ignition event and later in the fire with the formation of wake vortices as illustrated in Figure 11.

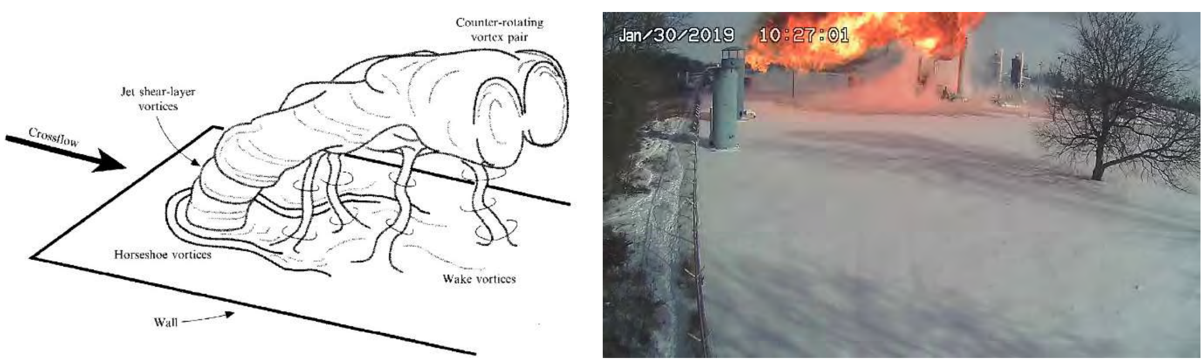

Figure 11. Formation of wake vortices indicating the complex dispersion pattern

Ignition source: Plant 2 thermal oxidizer

Ignition, the initiation of combustion in a flammable gas mixture, requires thermal energy. There are a variety of ways to produce the thermal energy of ignition. The quantity of energy and the temperature of its source vary with the type of energy. Electric spark discharge, static electricity, hot surfaces, small flames, and mechanical sparks are all potential sources of ignition energy. In this blowdown incident, there was only one competent ignition source active in the vicinity of the natural gas release: the Plant 2 thermal oxidizer.

Consumers' RCA team had previously considered a variety of potential ignition sources including mechanical sparks, vehicle engines, hot work, electrical sources, and electrostatic discharge. Their analysis considered 19 different potential ignition sources and all but two of those ignition sources were able to be eliminated due to their physical location, classification of their electronics, power service to their equipment, and/or no supporting evidence of human or natural causes. This is consistent with Exponent's observation that there was no obvious electrical source in proximity to the apparent ignition location. The area near the ground was considered a Class 1, Division 2 hazardous (flammable) location, and the equipment contained in the area contained markings consistent with this area's classification. A summary of the reasons behind the elimination of potential ignition sources is provided in Table 1.

Table 1: Overview of eliminated ignition sources

Reasoning for Elimination of Potential Ignition Source	Potential Ignition Source Eliminated
Physical Location/Video Evidence	Plant 3 Discharge and Suction Silencers, Unit 2-7 Mute, Plant 2 Suction/Discharge Vents, Plant 3 Reboiler, Plant 3 Thermal Oxidizer, Plant 3 Dehydration Tower, Plant 3 Heaters, Plant 2 Dehydration Tower, Unit 2-5 & 2-6 Blowdown Vent, Plant 2 Fuel Gas Heater, Plant 2 Heaters, FME from Plant 3 Silencers, CE Truck
Class I, Div II Electrical service	Plant 3 Dehydration Tower, Plant 2 Dehydration Tower, Plant 2 Fuel Gas Heater, Plant 2 Heaters
No power at ignition	Plant 3 Reboiler, Plant 3 Thermal Oxidizer, Plant 3 Heaters, Unit 2-5 & 2-6 Blowdown Vent, Plant 2 Fuel Gas Heater
No evidence for human or natural ignitions sources	Lightning, Cigarette Smoke, Gun Shot

For these reasons, ignition hypotheses involving adjacent mechanical, thermal, or electrical sources were not considered further.

The only remaining potential ignition sources are the hot exhaust gases from the Plant #2 reboiler and the Plant #2 thermal oxidizer. The phenomenon of hot gases as potential ignition sources is established in the literature.[16] Additionally, experiments have been performed that illustrate the potential to ignite a flammable gas mixture from the exhaust of a hot jet.[17,18]

Three factors favored the Plant 2 thermal oxidizer as the ignition source: the temperature of the exhaust gas in relation to the autoignition temperature of natural gas, the wind direction, and the elevation of the Plant 2 thermal oxidizer stack in relation to the elevation of the silencer stack.

The temperature of the Plant 2 thermal oxidizer exhaust is measured at the stack exit. The temperature was at approximately 1,500°F prior to the fire. This exhaust temperature is approximately 500°F hotter than the usual range of autoignition temperatures for natural gas, 900 to 1170°F.[19] Thus, the thermal oxidizer exhaust was significantly hotter than the autoignition temperature, making the exhaust a competent ignition source. On the other hand, Consumers' RCA team analyzed the Plant 2 reboiler and determined the temperature was not high enough to auto-ignite natural gas.

The Plant 3 thermal oxidizer temperature begins to drop shortly after the emergency shutdown of Plant 3 had initiated. The Plant 2 thermal oxidizer temperature data documents a temperature rise consistent with the flame exposure. This temperature rise started shortly after the observation of flames in the surveillance videos. The temperature data are plotted in Figure 12.

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[16] Lees, F.P., 1996. Loss Prevention in the Process Industries, *Reed Educational and Professional Publishing Ltd.*, p. 16/65.

[17] Biswas, S., Tanvir, S., Wang, H., and Qiao, L., 2016. On ignition mechanisms of premixed CH_4/air and H_2/air using a hot turbulent jet generated by pre-chamber combustion. *Applied Thermal Engineering, 106*, pp. 925-937.

[18] Babrauskas, V., 2003, Ignition Handbook, pp. 96-101.

[19] NFPA 921 Guide for Fire and Explosion Invstigations, National Fire Protection Association, Batterymarch MA, p. 241, 2017.

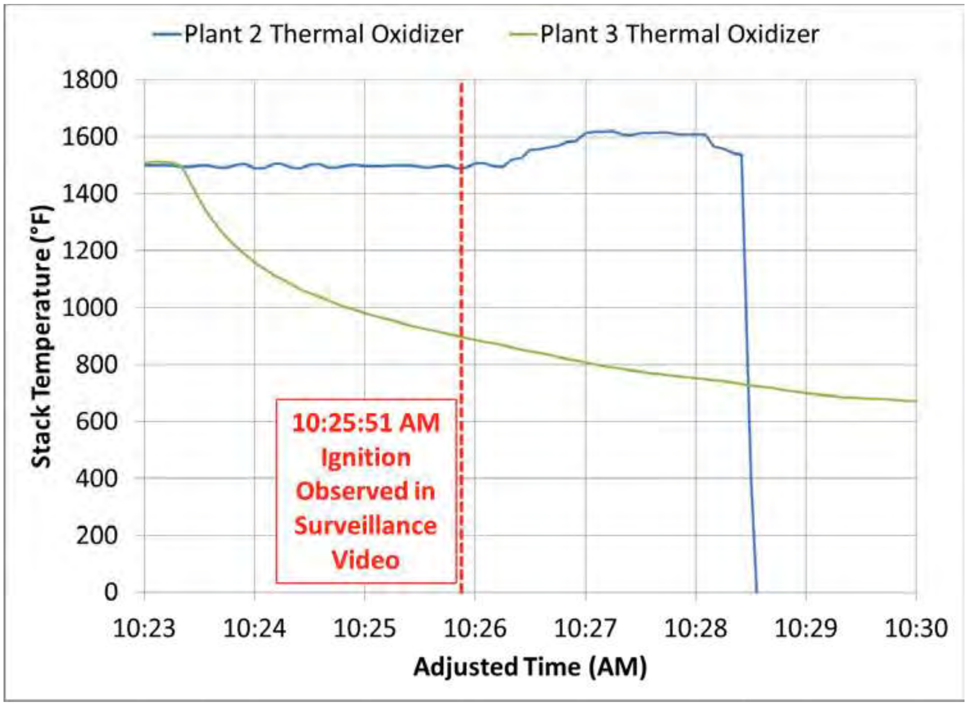

Figure 12. Process data for the Plant 2 and Plant 3 Thermal Oxidizers (time adjusted by -50 seconds per RCA team findings).

Weather data were obtained from three different stations. The data indicate that the wind was coming generally from the west/southwest. In Figure 13 a vector is drawn from the blowdown silencers to the Plant 2 thermal oxidizer.

Figure 13. Aerial photograph depicting the compass direction from the blowdown silencers to the Plant 2 thermal oxidizer

The direction of the vector is west-southwest. Thus, the wind was blowing the blowdown discharge almost directly at the Plant 2 thermal oxidizer.

Jet dispersion behavior is often characterized by the horizontal distance from source to target (potential ignition source) in jet diameters. The jet diameter is defined as the diameter of the opening of the discharge device. The largest silencer has a diameter of about 10 feet, so the jet diameter would be 10 feet. The horizontal distance from the largest silencer to the thermal oxidizer is thus about 13 jet diameters. This is considered to be near field dispersion. In near field dispersion, the mixing process is dominated by both momentum and buoyancy effects. Turbulent transport assists the dispersion process, but plays a secondary role compared to the jet characteristics.

In addition to the horizontal distance from source to target, the other properties that influence jet behavior are the exit velocity of the fluid, the density of the discharged fluid and the ambient air, the temperature of the gas and the ambient air, and the average wind speed. The flow behavior is characterized by the volume flux, the momentum flux, and the buoyancy flux. A table of calculated jet characteristics is shown in Appendix A. These jet characteristics provide insight into the behavior of the individual jets and their interaction with each other as well as the cross wind. For the natural gas blowdown jets, the cross wind length scale indicates that the jet will become appreciably bent at a vertical height of between 4.1 and 7.4 meters (between 13 and 24 feet). This means that the natural gas jets bend horizontally towards the elevation of the thermal oxidizer stack exit just in time to intercept the hot thermal oxidizer jet.

An important factor in the ignition of the natural gas discharge was that the elevation of the thermal oxidizer stack was 15 to 17 feet taller than the blowdown silencers. The buoyancy of the natural gas discharge would tend to cause the blowdown jet to rise. The hot exhaust from the thermal oxidizer was ideally positioned (given the prevailing wind direction) to inject hot gas into the dispersing natural gas cloud, and conversely, to entrain natural gas into the hot thermal oxidizer exhaust. This scenario is depicted in Figure 14.

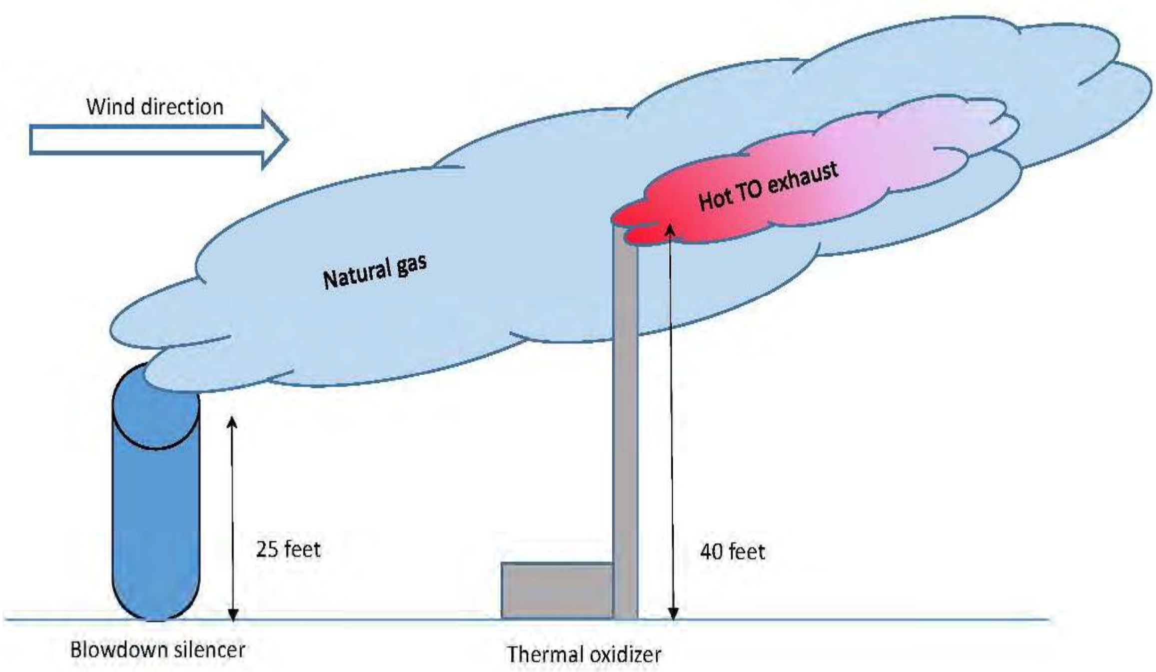

Figure 14. Schematic illustrating the intersection of the Suction blowdown jet with the thermal oxidizer jet.

Although there is no gas composition data for the thermal oxidizer, these devices typically are operated in fuel lean (excess air) conditions. Thus, it is likely that the thermal oxidizer jet was not only hotter than the autoignition temperature of natural gas, but it is also likely that it injected oxygen into the natural gas cloud. Based on the design characteristics of the thermal oxidizer, the discharge can contain over 16% oxygen, which is well above the limiting oxygen concentration for the ignition of methane, even after the plumes have mixed to the lower flammable limit of natural gas.[20] Additionally, high temperature of the oxidizer plume permits a significant amount of mixing (and thus cooling) to occur while maintaining temperatures capable of autoigniting the mixture.[21]

Prior blowdowns did not result in a fire

It must be noted that the prevailing wind conditions were a necessary factor to make this fire event occur. The high wind speed (averaging 20 miles per hour with gusts up to 28 miles per hour) were a factor in diluting the natural gas to the flammable range, and the wind direction pushed the blowdown discharge directly towards the only competent ignition source in that section of the station. The facility has experienced blowdowns before, and these events did not result in a fire.[22] The occurrence of this fire does indicate that the siting of the blowdown stacks for Plant 3 was too close to Plant 2's thermal oxidizer, as built.

Recommendations

Handling natural gas at high pressure presents a number of hazards at different points along its supply chain. Based on our observations at the Ray Compressor Station and our interactions with Consumers' employees, it is apparent that Consumers Energy endeavors to conduct their operations safely for both their employees and the general public. In the course of our investigation, Exponent has been asked to also offer recommendations to prevent a recurrence of a blowdown fire.

The U.S. Department of Transportation (DOT) governs the design, operation, and maintenance of natural gas compressor stations. One of the DOT regulations applicable to this fire incident states that during an emergency shutdown "It must discharge gas from the blowdown piping at a location where the gas will not create a hazard."[23]

Exponent offers the following recommendations:

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[20] Zlochower, Isaac A., and Gregory M. Green. "The limiting oxygen concentration and flammability limits of gases and gas mixtures." Journal of Loss Prevention in the Process Industries, Vol. 22, Iss. 4, July 2009, pp. 499-505.

[21] The hot Thermal Oxidizer plume may be diluted by cold air and/or natural gas between 20-40% and maintain a temperature in the range of reported autoignition temperatures for natural gas (900°F-1170°F).

[22] For example, Form 82 Ray CS 8-11-2016, Form 82 Ray CS 12-20-16, and Form 82 Ray Firegate activation 11-14-18.

[23] 49 CFR 192.167 (a) (2) Compressor stations: Emergency shutdown.

1. Prevent a flammable concentration of blowdown gas from contacting a competent ignition source.
2. Ensure that employees are warned by audible alarms that a blowdown is occurring.
3. Train employees to stay a safe distance away from the blowdown area (the blowdown exclusion zone, a distance to be determined by Consumers Energy) until the gas has dispersed into the atmosphere to a concentration below the lower flammable limit.
4. Consider developing a procedure to verify that the gas has dispersed into the atmosphere to a concentration below the lower flammable limit before allowing employees to enter the blowdown exclusion area.

The basis for each recommendation is explained below.

Recommendation 1: Prevent ignition

This is likely the most challenging recommendation to implement. Many aspects of ignition control are relatively easy to implement. Classified electrical service, a hot work permit program, and combustible gas indicators are all effective means for controlling ignition or monitoring for flammable gas environments. Thermal oxidizers, equipment necessary for controlling volatile organic compound emissions, are competent ignition sources. The Plant 2 thermal oxidizer was discharging combustion product gases at a temperature of roughly 1,500°F, a temperature well in excess of the autoignition temperature of methane. If a blowdown of natural gas achieves a concentration in the flammable range, the thermal oxidizer can become an ignition source.

While there are possible strategies for preventing ignition, few of them are completely under CEC's control. Possible strategies include:

- Dilution of the blowdown discharge with air to a concentration below the lower flammable limit.
- Termination of the hot thermal oxidizer exhaust during a blowdown.
- Diversion of the blowdown discharge jet away from the hot thermal oxidizer exhaust.

Dilution of the blowdown discharge could be done either passively or actively. Passive dilution relies on the prevailing wind and the distance from the blowdown discharge to the thermal oxidizer. For choked flow (sonic velocity discharges) of natural gas, one guidance document suggests that horizontal dispersion is negligible at or below the elevation of the discharge.[24] The silencer reduces the discharge velocity far below the sonic velocity. Therefore, horizontal dispersion becomes very important and is largely dependent on the prevailing wind conditions.

[24] API 521 Pressure-relieving and Depressuring Systems. American Petroleum Institute, Washington DC, pp. 67-69, 2007.

One way to achieve dilution is by spacing. The distance from the Plant 3 blowdown silencers to the Plant 2 thermal oxidizer was roughly 130 feet. The ignition of the blowdown gas was largely due to the prevailing wind speed and direction at the time of the blowdown. A risk assessment based on gas dispersion analysis may be a useful tool to determine if the current spacing is adequate or if it could possibly be increased. However, depending on the site layout and other constraints, it may not be feasible to move either the blowdown silencers or the thermal oxidizers to achieve a greater spacing.

An alternative passive dilution strategy might be to eliminate the blowdown silencers and discharge the blowdown gas at sonic velocity. This will likely achieve adequate dilution of the blowdown discharge with minimal horizontal dispersion. However, it will also generate noise during the blowdown event.

Active dilution of the blowdown discharge with air would require the installation of an inline stack blower or similar device. This could create additional noise and introduce new equipment reliability issues.

A control interlock is another potential safeguard. Currently, if a compressor plant undergoes an emergency shutdown, then the thermal oxidizer for that plant also trips offline. In the event that either Plant 2 or Plant 3 undergoes an emergency shutdown, it may be feasible to trip both thermal oxidizers offline. During this incident, the Plant 3 thermal oxidizer tripped offline and the exhaust gas cooled to a temperature below the autoignition temperature within approximately two minutes. This may be a cost-effective safeguard to prevent a blowdown fire.

It is recommended that CEC consider the engineering and economic factors to choose the best solution for safely managing the blowdown discharge.

Recommendation 2: Blowdown alarm

Exponent recommends that CEC evaluate the reliability and effectiveness of the blowdown alarm system. Specifically, in the surveillance video it appears that a truck drove past the blowdown location during the initiation of the blowdown sequence. Employees should receive an adequate warning when an emergency shutdown and blowdown is occurring or about to occur.

Recommendation 3: Training

Exponent recommends that CEC reviews the safety training that is given to employees with respect to blowdowns during an emergency shutdown.

Recommendation 4: Procedures

Exponent recommends that CEC reviews the safety procedures for determining if the area surrounding the blowdown location is safe to enter following an emergency shutdown and blowdown.

Conclusions

The analysis and conclusions expressed in this report are based on current information. Should additional information become available, Exponent reserves the right to supplement these opinions. Exponent holds the following opinions to a reasonable degree of engineering certainty:

1. The source of the flammable gas was the natural gas blowdown from Plant 3.
2. The formation of an ignitable fuel gas cloud was strongly influenced by the wind speed and direction.
3. The hot gas stream discharged at the stack of the Plant 2 thermal oxidizer is the most likely source of ignition.
4. The siting of the blowdown stacks for Plant 3 was too close to Plant 2's thermal oxidizer, as built.
5. Exponent suggests that Consumers Energy considers the following recommendations:
    a. Prevent a flammable concentration of blowdown gas from contacting a competent ignition source.
    b. Ensure that employees are warned by both visual and audible alarms that a blowdown is occurring.
    c. Train employees to stay a safe distance away from the blowdown area (the blowdown exclusion zone, a distance to be determined by Consumers Energy) until the gas has dispersed into the atmosphere to a concentration below the lower flammable limit.
    d. Consider developing a procedure to verify that the gas has dispersed into the atmosphere to a concentration below the lower flammable limit before allowing employees to enter the blowdown exclusion area.

Limitations

At the request of Consumers Energy, Exponent conducted an investigation of the fire that occurred on January 30, 2019, at the Ray Compressor Station located at 69333 Omo Road, Armada Township, Michigan. Exponent investigated specific issues relevant to this incident as requested by Consumers Energy. The scope of services performed during this investigation may not adequately address the needs of other users of this report, and any re-use of this report or its findings, conclusions, or recommendations presented herein is at the sole risk of the user. The opinions and comments formulated during this assessment are based on observations and information available at the time of the investigation. No guarantee or warranty as to future life or performance of any reviewed condition is expressed or implied.

The findings presented herein are made to a reasonable degree of engineering certainty. We have made every effort to accurately and completely investigate all areas of concern identified during our investigation. If new data become available or there are perceived omissions or misstatements in this report regarding any aspect of those conditions, we ask that they be brought to our attention as soon as possible so that we have the opportunity to fully address them.

If you have any questions or require additional information, please do not hesitate to contact me at (630) 658-7502 or rogle@exponent.com.

Sincerely,

Russell A. Ogle

Russell A. Ogle, PhD, CSP, CFEI
Principal

Brenton Cox

Brenton Cox, PhD, CFEI
Manager

Nicholas Traina, PhD, CFEI
Associate

Appendix (2)

Appendix A: Jet Characteristics

Table 2 summarizes the jet characteristics of the Plant 3 blowdown discharges and the Plant 2 thermal oxidizer discharge during the first minute of the discharge.[25,26]

Table 2: Jet characteristics for blowdown discharges and thermal oxidizer exhaust[27]

Jet Parameter	Plant 3 Suction	Plant 3 Discharge	Plant 2 Thermal Oxidizer
Stack diameter, ft	10.0	7.5	4.0
Gas volume flow rate, acfm	376,024	155,802	17,136
Stack cross-sectional area, m^2	7.30	4.10	1.17
U, average wind speed, m/s	8.94	8.94	8.94
Air temperature, K	253 (-4°F)	253 (-4°F)	253 (-4°F)
ρ_{air} air density, kg/m^3	1.40	1.40	1.40
ρ_{gas}Gas temperature, K	277 (39.2°F)	275 (36.1°F)	1086 (1496°F)
Gas density, kg/m^3	0.698	0.703	0.325
W, gas velocity, m/s	24.3	17.9	6.93
$Q = \frac{\pi}{4} D^2 W$, volume flux, m^3/s (actual)	177.5	73.53	8.09

25 Fischer, Hugo B., John E. List, C. Robert Koh, Jorg Imberger, and Norman H. Brooks. Chapter 9 Turbulent Jets and Plumes, *Mixing in inland and coastal waters*. Elsevier, 2013.

26 Lee, Joseph Hun-wei, and Vincent Chu. Chapter7 Jet in Crossflow and Chapter 8 Plume in Crossflow, *Turbulent jets and plumes: a Lagrangian approach*. Springer Science & Business Media, 2012.

27 Blowdown discharge flow rates, velocities, and temperatures based on data provided by Consumers Energy in document RCS Fire RCA Flow Model Rev 3 (02-17-19). Thermal oxidizer discharge flow rates and velocities based on design characteristics in Operation, Installation, & Maintenance Manual for Model Firecat 2.4.8 Thermal Oxidizer (F.I. Combustion Systems Project #C04-448) and Piping & Instrumentation Diagram for Firecat Model #2.4.8 Thermal Oxidizer, C04448P-1-2. Thermal oxidizer temperature was average Thermal Oxidizer stack temperature measured from 10:25 am to 10:26 am (adjusted time).

Jet Parameter	Plant 3 Suction	Plant 3 Discharge	Plant 2 Thermal Oxidizer
$M = \frac{\pi}{4} D^2 W^2$, momentum flux, m^4/s^2	4,316	1,317	56.0
$B = g(\Delta\rho/\rho)\, Q$, buoyancy flux, m^4/s^3	1,751	715	262
$L_Q = A^{1/2}$, flow length scale, m	2.70	2.03	1.08
$L_M = M^{3/4}/B^{1/2}$, momentum length scale, m	12.73	8.18	1.26
$Z_M = M^{1/2}/U$, cross wind momentum length scale, m	7.35	4.06	0.84
$Z_B = B/U^3$, cross wind buoyancy length scale, m	2.45	1.00	0.37

Steven Wohlscheid
February 28, 2019
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Appendix B: Weather Data

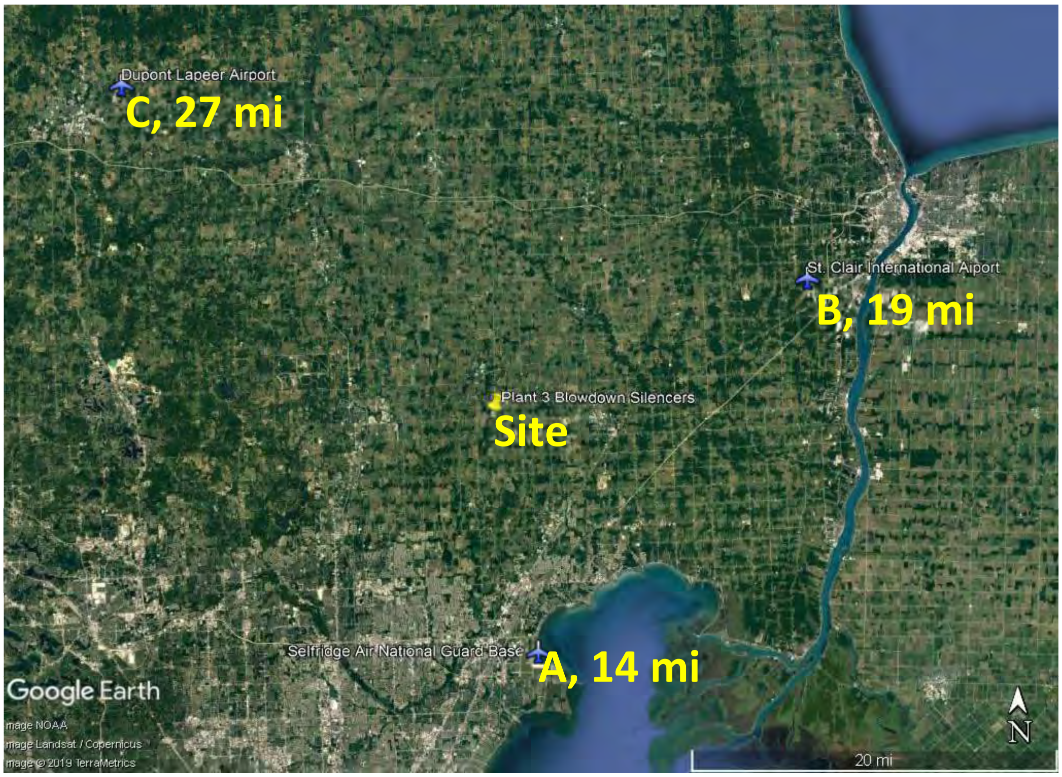

Figure 15. Location of Weather Stations in Relation to Plant 3 Blowdown Silencers

Table 3: Global Hourly Surface Data, National Oceanic and Atmospheric Administration, Retrieved 2/13/2019

	USAF-WBAN_ID	STATION NAME	LATITUDE	LONGITUDE	ELEVATION
A	725377 14804	SELFRIDGE AIR NATIONAL GUARD B	+42.608	-082.818	176.8
B	725384 04888	ST CLAIR COUNTY INTL ARPT	+42.911	-082.529	195.1
C	720902 00298	DUPONT LAPEER AIRPORT	+43.067	-083.267	254.2

Table 4: Weather Data at Selfridge National Guard Base, 14 mi (approx)

Time	Wind Direction	Speed (mph)	Gust (mph)	Temp (°F)	Dew Point (°F)
9:56 AM	240	20	28	-4	-13
10:56 AM	230	20	23	-3	-14

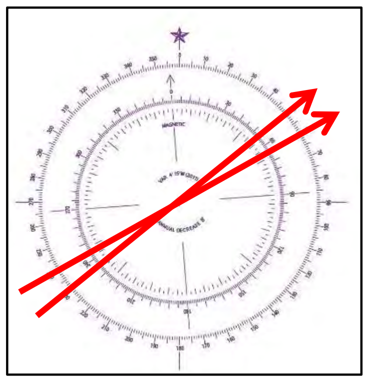

Figure 16. Wind Direction at Selfridge National Guard Base

Table 5: Weather Data at St Clair Intl Airport, 19 mi (approx)

Time	Wind Direction	Speed (mph)	Gust (mph)	Temp (°F)	Dew Point (°F)
9:55 AM	250	9	21	-2	-15
10:55 AM	220	8	23	-2	-15

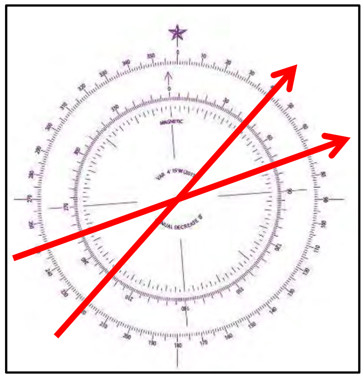

Figure 17. Wind Direction at St Clair Intl Airport

Table 6: Weather Data at Dupont Lapeer Airport, 27 mi (approx)

Time	Wind Direction	Speed (mph)	Gust (mph)	Temp (°F)	Dew Point (°F)
10:55 AM	270	16	24	-3	-12
10:56 AM	270	14	24	-3	-13

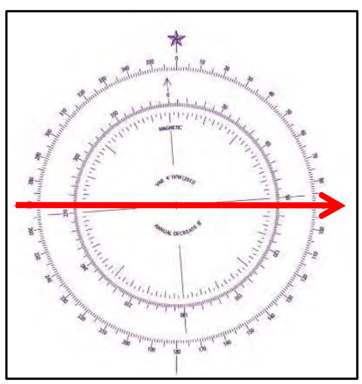

Figure 18. Wind Direction at Dupont Lapeer Airport

APPARENT CAUSE INVESTIGATION REPORT

Evaluator's Name	Kevin Sims
Date of Evaluation	16 April 2019
Analysis Title	Ray Det-tronics system
Date of Occurrence	30 January 2019
Event Description	*Brief description of what happened, who was involved, when did it happen, where did it happen and the time it happened*
On 30 January 2019 at approximately 10:25 AM the Ray compressor station's plant 3 fire detection system (Det-tronics) failed to its failsafe position causing plant 3 to vent down the gas in the plant 3 piping.	
Event Consequences	*State below what happened as a result of this event*
The gas in the plant 3 piping vented and mixed with the Plant 2 thermal oxidizer exhaust. The temperature of the exhaust caused the vented gas to ignite. The fire damaged equipment in plant 2 and plant 3 caused both plants to be inoperable.	
Event Evaluation/Apparent Cause Analysis	*Provide evaluation and cause details; describe why the event occurred, contributing factors, extent of condition (ie, how event applies or could occur on like equipment or other units*
On 19 March 2019 it was identified that the VFD (Variable Frequency Drive) for the well pump caused a voltage spike in the grounding system of the Det-tronics' panel located in the headquarters building upon well pump startup. The voltages on the grounding system caused EDIO and AIM modules to loose communication and go into fault which resulted in plant 3 initiating a firegate.	
Apparent Causes:	
Physical Cause	*State below the tangible cause of the event*
The well pump started up causing a voltage spike into the plant 3 Det-tronics ground system.	
Human Root	*State below what human action or lack of action that contributed to the event*
LON alarms were identified but not resolved	
Systemic Root	*State below what management control did not encourage or discourage the action of the human*
None standard design for fire and gas emergency shut down system. Lack of alarm response plans. Common practice to operate with alarm in the system.	
Actions to Prevent Recurrence	*Remedial Actions - List the actions taken to restore system or equipment to operable conditions or to mitigate control consequences of event).*
The modules that communicated with the pilot air system in the Det-tronics panel have been relocated from the headquarters building to the plant 3 auxiliary building Det-tronics panel. The pressure switch and pressure transmitter will be relocated to the east side of the plant 3 auxiliary building to limit the cable runs. Elimination of the grounding voltage into the Det-tronics system. All of the fireeye and gas detectors were verified to be installed per the drawings and the connections were verified to be tight. Commissioning and testing of the system to verify the system works per the design.	
Corrective Actions	*List the long term actions to prevent recurrence of the event*
Review of the system to verify that none of the modules exceed their design capacity.	
Review the 24 volt system to determine if the 24 volt power supply should be moved to a climate control building.	
Additional periodic maintenance on the fireeye and gas detector heads to ensure there are no loose wires.	
Develop standard design inputs for fire and gas detection systems.	

STATE OF MICHIGAN

BEFORE THE MICHIGAN PUBLIC SERVICE COMMISSION

* * * * *

In the matter, on the Commission's own motion, to commence an investigation into a January 30, 2019 fire at **CONSUMERS ENERGY COMPANY's** Ray Compressor Station in Macomb County.	)))))	Case No. U-20463

At the February 7, 2019 meeting of the Michigan Public Service Commission in Lansing, Michigan.

PRESENT: Hon. Sally A. Talberg, Chairman
Hon. Norman J. Saari, Commissioner

ORDER

At approximately 10:30 a.m. on January 30, 2019, a fire occurred at Consumers Energy Company's (Consumers) Ray Natural Gas Compressor Station in Macomb County (the Ray facility). As a result of the fire, equipment was damaged and the company stopped gas flow from the compressor station. The Ray facility is the largest source of working gas capacity in the state of Michigan and supplies a significant portion of Consumers' natural gas needs during peak winter periods. The fire and shutdown of the Ray facility occurred at a time of unprecedented demand in natural gas usage due to extremely cold weather conditions on January 30 and 31, 2019. To ensure continued delivery of natural gas during this emergency, Consumers arranged alternative supplies from natural gas pipelines and other storage fields, limited natural gas used for electricity production, coordinated with large commercial and industrial customers to curtail usage, and requested that all customers conserve energy. Late on January 30, 2019, Consumers resumed operation of Plant 1 of the Ray facility, however the other two plants continued to be inoperable due to the fire. To ensure the stability of the natural gas system and avoid a potentially life-threatening situation with forced outages of natural gas service to residential customers, the Michigan State Police issued an emergency alert to cellular phones in the Lower Peninsula of Michigan asking residents to reduce their thermostats to 65 degrees or less and Governor Gretchen Whitmer called on residents to do the same through the media. At 12:00 a.m. on Friday, February 1, 2019, Consumers resumed normal natural gas delivery operations.

Given the significance of this emergency event, the Commission opens this docket for the purpose of investigating: (1) the origin of the fire; (2) how Consumers responded to the fire, both at the site and at its corporate office; (3) the company's implementation of gas curtailment procedures; (4) whether there is evidence of a failure on the part of Consumers to properly maintain its equipment or any non-compliance with Commission rules; (5) whether the company properly responded to the natural gas shortage; (6) estimated reductions in natural gas usage from large customer curtailments and residential conservation over time during the emergency with corresponding timeframes of actions (e.g., public appeals, emergency alerts) by Consumers and the State of Michigan; (7) Consumers' coordination and communication with State of Michigan officials and local emergency response agencies; (8) actions directed toward physical security and cybersecurity before, during, and after the event; and (9) the total cost of the incident, including gas lost on site, emergency natural gas purchases, estimates of customer curtailment impacts, and repair of the facility. Issues not within the scope of the investigation in this docket are the adequacy of energy supply and delivery and contingency planning, including reliance on the Ray facility under different operating conditions, Consumers' interconnections with interstate pipelines, and Consumers' gas supply arrangements and procurement strategies.[1]

The Commission directs Consumers to file a report in this docket no later than 5:00 p.m. on April 7, 2019, addressing these issues. Thereafter, the Commission Staff (Staff) shall file a response in this docket no later than 5:00 p.m. on May 8, 2019, responding to the company's filings, outlining the process and anticipated timeline for the subsequent Root Cause Analysis Report that the Commission's Gas Operations Section will provide, and recommending potential changes to utility operations or procedures, if such changes are identified. Stakeholders, including end-use customers and local governments, are also encouraged to provide input by May 8, 2019, to be considered by the Commission. Consumers may thereafter file a reply to the Staff's response and stakeholder input no later than 5:00 p.m. on May 30, 2019. At the conclusion of the process, the Commission may propose remedial action, as appropriate.

THEREFORE, IT IS ORDERED that:

A. Consumers Energy Company shall file a report in this docket as outlined in this order no later than 5:00 p.m. on April 7, 2019.

B. The Commission Staff shall file a response in this docket no later than 5:00 p.m. on May 8, 2019, responding to the company's filings, outlining the process and anticipated timeline for the subsequent Root Cause Analysis Report that the Commission's Gas Operations Section will provide, and recommending potential changes to utility operations or procedures, if such changes are identified.

---

[1] As requested by Governor Whitmer, the Commission's assessment of the supply and deliverability of natural gas, electricity and propane, and contingency planning will be addressed in the February 7, 2019 order in Case No. U-20464. Review of Consumers' plans and actions for procuring natural gas to meet customer demand during normal and peak operational conditions is addressed through an annual gas cost recovery proceeding.

C. Stakeholders, including end-use customers and local governments, may file input by May 8, 2019.

D. Consumers Energy Company may file a reply to the Commission Staff's response and stakeholder input no later than 5:00 p.m. on May 30, 2019.

The Commission reserves jurisdiction and may issue further orders as necessary.

Any party desiring to appeal this order must do so in the appropriate court within 30 days after issuance and notice of this order, pursuant to MCL 462.26. To comply with the Michigan Rules of Court's requirement to notify the Commission of an appeal, appellants shall send required notices to both the Commission's Executive Secretary and to the Commission's Legal Counsel. Electronic notifications should be sent to the Executive Secretary at mpscedockets@michigan.gov and to the Michigan Department of the Attorney General - Public Service Division at pungp1@michigan.gov. In lieu of electronic submissions, paper copies of such notifications may be sent to the Executive Secretary and the Attorney General - Public Service Division at 7109 W. Saginaw Hwy., Lansing, MI 48917.

MICHIGAN PUBLIC SERVICE COMMISSION

Sally A. Talberg, Chairman

Norman J. Saari, Commissioner

By its action of February 7, 2019.

Kavita Kale, Executive Secretary

PROOF OF SERVICE

STATE OF MICHIGAN)

Case No. U-20463

County of Ingham)

Brianna Brown being duly sworn, deposes and says that on February 7, 2019 A.D. she electronically notified the attached list of this **Commission Order via e-mail transmission**, to the persons as shown on the attached service list (Listserv Distribution List).

Brianna J. Brown

Brianna Brown

Subscribed and sworn to before me
this 7th day of February 2019.

Angela P. Sanderson

Angela P. Sanderson
Notary Public, Shiawassee County, Michigan
As acting in Eaton County
My Commission Expires: May 21, 2024

Service List for Case: U-20463

Name	Email Address
Consumers Energy Company 1 of 2	mpsc.filings@cmsenergy.com
Consumers Energy Company 2 of 2	matorrey@cmsenergy.com

Consumers Energy Company - Ray Compressor Station Fire

GEMOTION DISTRIBUTION SERVICE LIST

kadarkwa@itctransco.com	ITC
tjlundgren@varnumlaw.com	Energy Michigan
lachappelle@varnumlaw.com	Energy Michigan
david.d.donovan@XCELENERGY.COM	Xcel Energy
ddasho@cloverland.com	Cloverland
bmalaski@cloverland.com	Cloverland
vobmgr@UP.NET	Village of Baraga
braukerL@MICHIGAN.GOV	Linda Brauker
info@VILLAGEOFCLINTON.ORG	Village of Clinton
jgraham@HOMEWORKS.ORG	Tri-County Electric Co-Op
mkappler@HOMEWORKS.ORG	Tri-County Electric Co-Op
psimmer@HOMEWORKS.ORG	Tri-County Electric Co-Op
frucheyb@DTEENERGY.COM	Citizens Gas Fuel Company
mpscfilings@CMSENERGY.COM	Consumers Energy Company
jim.vansickle@SEMCOENERGY.COM	SEMCO Energy Gas Company
kay8643990@YAHOO.COM	Superior Energy Company
christine.kane@we-energies.com	WEC Energy Group
jlarsen@uppco.com	Upper Peninsula Power Company
dave.allen@TEAMMIDWEST.COM	Midwest Energy Coop
bob.hance@teammidwest.com	Midwest Energy Coop
tharrell@ALGERDELTA.COM	Alger Delta Cooperative
tonya@CECELEC.COM	Cherryland Electric Cooperative
bscott@GLENERGY.COM	Great Lakes Energy Cooperative
sculver@glenergy.com	Great Lakes Energy Cooperative
kmarklein@STEPHENSON-MI.COM	Stephson Utilities Department
debbie@ONTOREA.COM	Ontonagon County Rural Elec
ddemaestri@PIEG.COM	Presque Isle Electric & Gas Cooperative, INC
dbraun@TECMI.COOP	Thumb Electric
rbishop@BISHOPENERGY.COM	Bishop Energy
mkuchera@AEPENERGY.COM	AEP Energy
todd.mortimer@CMSENERGY.COM	CMS Energy
jkeegan@justenergy.com	Just Energy Solutions
david.fein@CONSTELLATION.COM	Constellation Energy
kate.stanley@CONSTELLATION.COM	Constellation Energy
kate.fleche@CONSTELLATION.COM	Constellation New Energy
mpscfilings@DTEENERGY.COM	DTE Energy
bgorman@FIRSTENERGYCORP.COM	First Energy
rarchiba@FOSTEROIL.COM	My Choice Energy
greg.bass@calpinesolutions.com	Calpine Energy Solutions
rabaey@SES4ENERGY.COM	Santana Energy
cborr@WPSCI.COM	Spartan Renewable Energy, Inc. (Wolverine Power Marketing Corp)
cityelectric@ESCANABA.ORG	City of Escanaba
crystalfallsmgr@HOTMAIL.COM	City of Crystal Falls
felicel@MICHIGAN.GOV	Lisa Felice

Consumers Energy Company - Ray Compressor Station Fire

GEMOTION DISTRIBUTION SERVICE LIST

mmann@USGANDE.COM	Michigan Gas & Electric
mpolega@GLADSTONEMI.COM	City of Gladstone
rlferguson@INTEGRYSGROUP.COM	Integrys Group
lrgustafson@CMSENERGY.COM	Lisa Gustafson
daustin@IGSENERGY.COM	Interstate Gas Supply Inc
krichel@DLIB.INFO	Thomas Krichel
cityelectric@BAYCITYMI.ORG	Bay City Electric Light & Power
Stephen.serkaian@lbwl.com	Lansing Board of Water and Light
George.stojic@lbwl.com	Lansing Board of Water and Light
jreynolds@MBLP.ORG	Marquette Board of Light & Power
bschlansker@PREMIERENERGYLLC.COM	Premier Energy Marketing LLC
ttarkiewicz@CITYOFMARSHALL.COM	City of Marshall
d.motley@COMCAST.NET	Doug Motley
mpauley@GRANGERNET.COM	Marc Pauley
ElectricDept@PORTLAND-MICHIGAN.ORG	City of Portland
gdg@alpenapower.com	Alpena Power
dbodine@LIBERTYPOWERCORP.COM	Liberty Power
leew@WVPA.COM	Wabash Valley Power
kmolitor@WPSCI.COM	Wolverine Power
ham557@GMAIL.COM	Lowell S.
AKlaviter@INTEGRYSENERGY.COM	Integrys Energy Service, Inc WPSES
BusinessOffice@REALGY.COM	Realgy Energy Services
landerson@VEENERGY.COM	Volunteer Energy Services
Ldalessandris@FES.COM	First Energy Solutions
cmcarthur@HILLSDALEBPU.COM	Hillsdale Board of Public Utilities
mrzwiers@INTEGRYSGROUP.COM	Michigan Gas Utilities/Upper Penn Power/Wisconsin
djtyler@MICHIGANGASUTILITIES.COM	Michigan Gas Utilities/Qwest
Teresa.ringenbach@directenergy.com	Direct Energy
christina.crable@directenergy.com	Direct Energy
angela.schorr@directenergy.com	Direct Energy
ryan.harwell@directenergy.com	Direct Energy
johnbistranin@realgy.com	Realgy Corp.
jweeks@mpower.org	Jim Weeks
mgobrien@aep.com	Indiana Michigan Power Company
mvorabouth@ses4energy.com	Santana Energy
sjwestmoreland@voyager.net	MEGA
hnester@itctransco.com	ITC Holdings
lpage@dickinsonwright.com	Dickinson Wright
Karl.J.Hoesly@xcelenergy.com	Xcel Energy
Deborah.e.erwin@xcelenergy.com	Xcel Energy
mmpeck@fischerfranklin.com	Matthew Peck
CANDACE.GONZALES@cmsenergy.com	Consumers Energy
JHDillavou@midamericanenergyservices.com	MidAmerican Energy Services, LLC
JCAltmayer@midamericanenergyservices.com	MidAmerican Energy Services, LLC

Updated 9-12-2018

GEMOTION DISTRIBUTION SERVICE LIST

LMLann@midamericanenergyservices.com	MidAmerican Energy Services, LLC

Consumers Energy
Count on Us

A CMS Energy Company

General Offices:
One Energy Plaza Tel: (517) 788-0550
Jackson, MI 49201 Fax: (517) 768-3644

*Washington Office:
1730 Rhode Island Ave. N.W. Tel: (202) 778-3340
Suite 1007
Washington, DC 20036 Fax: (202) 778-3355

Writer's Direct Dial Number: (517) 788-0835
Writer's E-mail Address: bret.totoraitis@cmsenergy.com

LEGAL DEPARTMENT
CATHERINE M REYNOLDS
Senior Vice President
and General Counsel

MELISSA M GLEESPEN
Vice President, Corporate
Secretary and Chief
Compliance Officer

SHAUN M JOHNSON
Vice President and Deputy
General Counsel

Bret A Totoraitis
Kelly M Hall
Eric V Luoma
Assistant General Counsel

Ashley L Bancroft
Robert W Beach
Ian F. Burgess
Don A D'Amato
Robert A. Farr
Gary A Gensch, Jr.
Emerson J. Hilton
Chantez P Knowles
Mary Jo Lawrie
Jason M Milstone
Rhonda M Morris
Deborah A Moss*
Michael C. Rampe
Scott J Sinkwitts
Adam C Smith
Theresa A G Staley
Janae M Thayer
Anne M Uitvlugt
Aaron L Vorce
Attorney

April 5, 2019

Ms. Kavita Kale
Executive Secretary
Michigan Public Service Commission
7109 West Saginaw Highway
P.O. Box 30221
Lansing, MI 48909

RE: **Case No. U-20463 - In the matter, on the Commission's own motion, to commence an investigation into a January 30, 2019 fire at Consumers Energy Company's Ray Compressor Station in Macomb County.**

Dear Ms. Kale:

Enclosed for electronic filing in the above-captioned case is **Consumers Energy Company's Ray Compressor Station Fire Report.**

This is a paperless filing and is therefore being filed only in PDF format.

Sincerely,

Bret Totoraitis
Digitally signed by Bret A. Totoraitis
Date: 2019.04.05 13:17:46 -04'00'

Bret A. Totoraitis

Consumers Energy Company

Ray Compressor Station Fire, Jan. 30, 2019

MPSC Commission Order in Case No. U-20463

April 5, 2019

Introduction

Consumers Energy Company's (Consumers Energy or the Company) natural gas storage fields are critical assets for Michigan's energy infrastructure and reliability. The unique geological features at our sites allow us to buy and store many billions of cubic feet of natural gas at lower prices, then withdraw and distribute the gas during the winter when prices and demand are higher. Consumers Energy purchases gas during periods of low demand, injects the gas into depleted wells and withdraws it during the winter avoiding both seasonally higher prices and limitation in pipeline capacity.

The Ray Natural Gas Compressor Station, including the Ray Storage Facility, is our largest storage asset and has served our customers and the people of Michigan safely and effectively since the initial equipment was installed in 1966. The station's evolving design, culminating with the addition of Plant 3 in 2013, is resilient and provides three pathways for gas to flow in and out of the station.

Extreme cold weather hit Michigan Jan. 29 through Feb. 1. Consumers Energy entered this record cold weather period with 61.9 billion cubic feet (Bcf) of working natural gas inventory — above our target of 61.4 Bcf during a typical winter. We planned to fulfill demand during this cold period using baseload production storage fields, Ray field and pipeline supply as the primary sources with our peaker fields in reserve to support system packing and any potential interruptions in pipeline supply, baseload fields and compressor stations.

At approximately 10:30 a.m. on Jan. 30, a fire occurred at our Ray Natural Gas Compressor Station in Macomb County. The Ray facility, the largest source of working gas capacity in Michigan, is a combination compressor station and nearby storage field where we store natural gas until it is needed by customers. The fire, which did not cause injuries, reduced the amount of natural gas we could deliver to customers from underground storage located in the Ray field near the compressor station. The damage to our largest storage and delivery system, which occurred during historically high natural gas demand due to cold temperatures, prompted us to take steps to ensure natural gas deliveries to our state's residential and most vulnerable customers continued uninterrupted. These steps included requests for voluntary reductions in gas usage of all customers. The Company also, for the first time in its history, implemented an Operational Flow Order (OFO) for natural gas transportation customers which required those customers to match their natural gas deliveries to Consumers Energy's system to their usages. When the requests for voluntary actions and the OFO did not result in the reductions in gas usage necessary to stabilize our system, we implemented, for the first time in the Company's history, a mandatory curtailment of gas deliveries to large business customers which required them to reduce their natural gas usage down to minimum loads required to protect equipment. In addition, in cooperation with Gov. Whitmer, we requested all natural gas customers in Michigan to conserve natural gas by dialing down their thermostats. On Thursday, Jan. 31, we announced that the appeal for assistance would end at 12:00 a.m. on Feb. 1 for all customers – commercial, industrial and residential.

On Feb. 7, the Michigan Public Service Commission (MPSC or the Commission) issued an Order in MPSC Case No. U-20463 requiring Consumers Energy to submit a report addressing nine items regarding the Ray Compressor Station fire. Specifically, the Commission required the report to set forth the following:

(1) the origin of the fire;
(2) how Consumers Energy responded to the fire, both at the site and at its corporate office;
(3) the Company's implementation of gas curtailment procedures;
(4) whether there is evidence of a failure on the part of Consumers Energy to properly maintain its equipment or any non-compliance with Commission rules;
(5) whether the Company properly responded to the natural gas shortage;
(6) estimated reductions in natural gas usage from large customer curtailments and residential conservation over time during the emergency with corresponding timeframes of actions (e.g., public appeals, emergency alerts) by Consumers Energy and the State of Michigan;
(7) Consumers Energy's coordination and communication with State of Michigan officials and local emergency response agencies;
(8) actions directed toward physical security and cybersecurity before, during and after the event; and
(9) the total cost of the incident, including gas lost on site, emergency natural gas purchases, estimates of customer curtailment impacts and repair of the facility.

As directed by the Commission, Consumers Energy submits this report providing responses to the items outlined in the order.

1. Origin of the Fire

On Jan.30, Plant 3 at the Ray Compressor station detected an abnormal operating condition in the Det-Tronics control system. As part of the emergency safety fire-gate process, the plant released natural gas into the atmosphere through Plant 3 blowdown silencers. A fire-gate event is a rapid de-pressurization of natural gas from a compressor station plant along with all of its piping. Compression stations are protected from extreme fire damage by fire-gate systems where, manually or automatically, the station piping is evacuated through vents at the perimeter of the station so that any fire within the equipment will be quickly extinguished due to lack of fuel to burn. The natural gas discharge is routed away from the compressor plant and personnel to an isolated location on the station. This safety protocol blows down the plant from approximately 950 pounds per square inch gauge (psig) to near atmospheric pressure over the course of about 10 minutes. Since being placed in service in 2013, Ray Plant 3 has successfully completed both planned and unplanned fire-gate evolutions successfully without incident.

The natural gas released from the fire-gate event migrated in a northeast direction over the Plant 2 processing equipment as a result of the wind conditions occurring at the time of the event. At 10:25:51[1] a.m., a gas plume ignited from the Plant 3 blowdown silencers (suction and discharge). The Plant 2 thermal oxidizer's 1506 degrees F exhaust stream auto-ignited the Plant 3 fire-gate gas plume (see figure 1).

[1] Times have been normalized to align with the security camera timestamps.

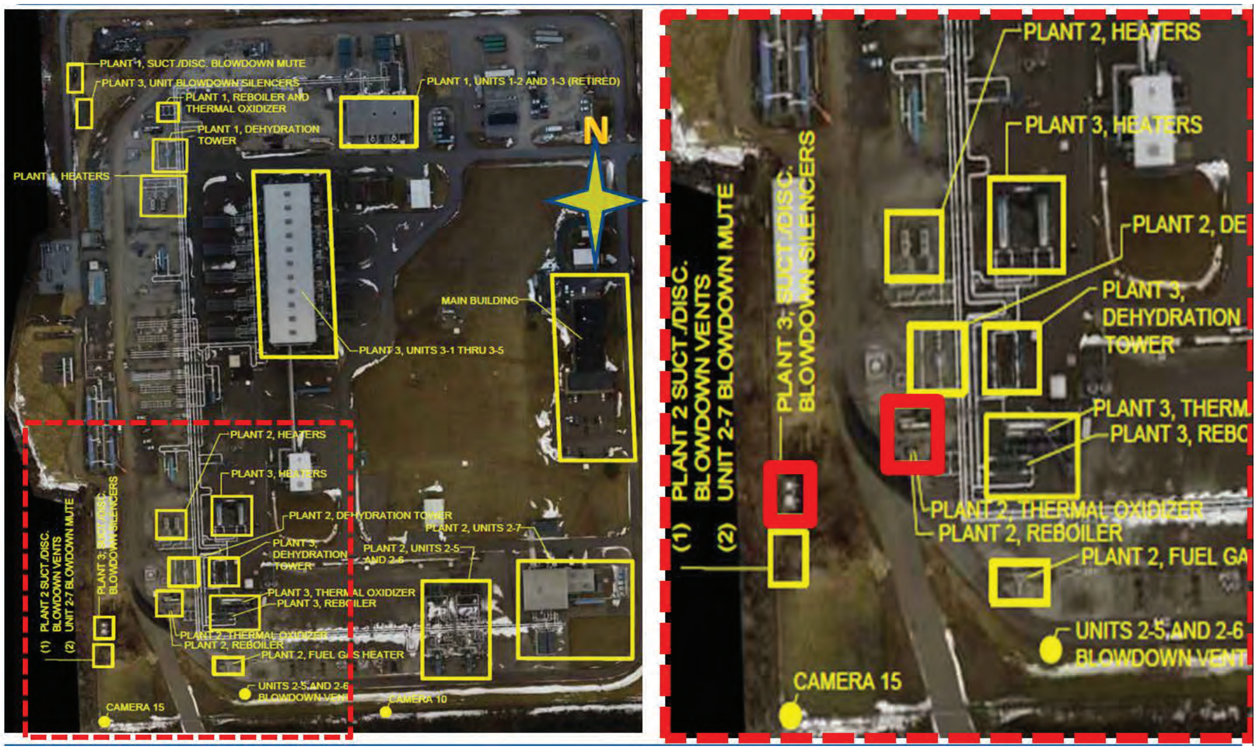

Figure 1. General layout of the Ray Compression Station

Three Elements for Ignition

There are three elements required for a fire to ignite:

- A fuel source;
- Oxidizer (air); and
- An ignition source.

Fuel Source: The blowdown discharge plume provided the fuel for the fire when Plant 3 fire-gated, releasing natural gas from the station.

Oxidizer: As a safety protocol, when a fire-gate is triggered all the gas in a compressor plant is blown down away from the plant, causing depressurization. For Ray Plant 3, the natural gas is typically routed through a silencer which reduces the noise produced by the blow down to a level that is less disruptive to the surrounding community than traditional straight pipe high velocity vents. This is accomplished by reducing the velocity as the natural gas is discharged. With the slow exit velocity, the gas flow is more sensitive to the wind which can enhance the mixing of the natural gas with the surrounding air.

Natural gas needs to be mixed with air to form a flammable mixture (5% to 15% by volume). When that mixture is ignited, it can only burn in the zone where the fuel and air mixture is within the flammable concentration range. The natural gas released by the fire-gate dispersed and mixed with the air when it was discharged. At the time the station was fire-gated, the wind conditions were approximately 20 mph with 28 mph gusts.

The prevailing wind conditions were a necessary factor to make this fire event occur. The blowdown discharge and its interaction with the wind caused a turbulent, highly dynamic natural gas cloud. The high wind speed was a factor in diluting the natural gas to the flammable range. The prevailing southwest wind pushed the natural gas plume directly towards the only competent ignition source, the Plant 2 thermal oxidizer, in that section of the station. The wind was variable and gusting which also led to a chaotic dispersion of the natural gas.

Ignition Source: When the fire-gate occurred, the significant wind directed the gas plume towards the Plant 2 thermal oxidizer (see figure 2). The thermal oxidizer was in operation at the time due to the peak natural gas demands on the system. A thermal oxidizer uses a flame to destroy pollutants from the reboiler. The ignition source was determined to be the Plant 2 thermal oxidizer exhaust which raised the temperature of the plume of natural gas and air mixture above the auto-ignition temperature.

Per National Fire Protection Association (NFPA) 921 Guide for Fire & Explosion Investigations, the auto-ignition temperature of natural gas ranges from 900 degrees F to 1,170 degrees F. Natural gas will auto-ignite at or above this range. At the time of ignition, the Plant 2 thermal oxidizer's exit temperature was 1,506 degrees F per thermocouple historian data. The thermal oxidizer's exhaust temperature was greater than the auto-ignition temperature of natural gas, making the exhaust a competent ignition source.

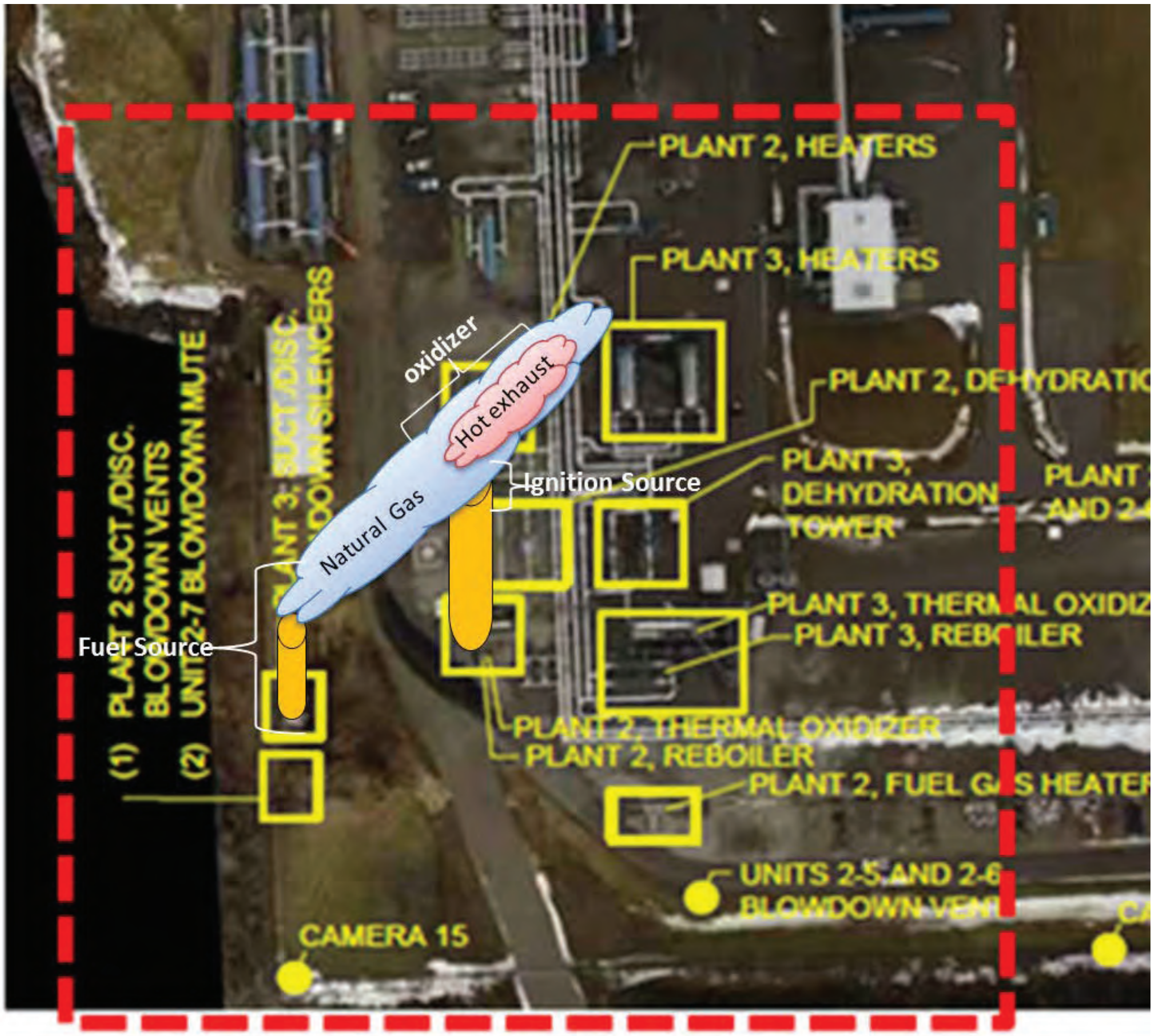

Figure 2. Illustration of ignition elements

We contracted with a third party to validate the internal investigation of the origin of the fire. The third-party consultant performed its investigation in a manner generally consistent with the NFPA's guidance document, NFPA 921 Guide for Fire and Explosion Investigations (2017), and its conclusion aligned with our analysis.

Timeline of Events

On the morning of Jan. 30 at 10:23:10 a.m.,[2] the Ray Compressor Station lost the pilot air pressure signal for the Plant 3 fire-gate system. As designed, this triggered Plant 3's process equipment emergency shutdown. The plant experienced a priority 1 fire-gate alarm at 10:25:20 a.m. and the station was blown down at 10:25:33 a.m.

[2] Times have been normalized to align with the security camera timestamps.

The blowdown gas vented through the silencers located at the southwest corner of the station property. This blowdown gas ignited. The wind pushed the flames north eastward. The first visible sign of fire was observed near the Plant 2 thermal oxidizer stack at 10:25:51 am. The fire increased in size and reached the top of the Plant 3 blowdown silencer by 10:26:22 a.m. (see figures 3 and 4)

Figure 3. Initial visible flame

Figure 4. Wind direction and camera angles

Personnel at the Ray Plant manually fire-gated Plant 1 and Plant 2, as part of our standard safety protocols, at 10:27:58 a.m. and 10:28:22 a.m., respectively. At 10:28:48 a.m., there was a second ignition at the Plant 2 vent stack, which is located next to Plant 3's blowdown silencers and is the location where the natural gas is released for Plant 2 (see figure 5). The flames extinguished when the natural gas was completely vented. The fire department arrived on scene at 10:38 a.m. and left at 3:34 p.m.

Figure 5. Progression of the fire

2. Response to the Fire, Both at the Site and at our Corporate Office

Since 2014, we have developed proficiencies and capabilities in emergency management, including the use of the Incident Command System (ICS). These core capabilities enabled the team involved in this event to respond rapidly and organize into an ICS structure that included both a command post and an Emergency Operations Center (EOC). The well-defined chain of command, incident objectives and tactics allowed for effective internal coordination of resources. It also enabled fast, complete and transparent engagement with the MPSC, State Emergency Operations Center (SEOC) and the Governor's office throughout the event. Furthermore, it provided an organized approach to protect life and safety, to stabilize the incident, and to protect property and the environment.

At the outset, we made required emergency notifications and we entered the initial response period. We identified the on-scene commander at the Ray Compressor Station, and the on-scene commander worked through the initial response to stabilize the scene. As the incident was stabilized, the Corporate Emergency Management department's director was informed and a subject matter expert from the team was deployed to the scene to serve as Documentation Unit Lead and to work with local leadership in setting up an ICS structure. We established the Ray Command Post and assigned roles to form both a command and general staff. The ICS team worked to establish a formal Incident Action Plan with all the required ICS elements including ICS forms that contain situational summaries, high level objectives, tactics and the ICS structure.

Meanwhile, due to the classification of the incident and the potential for losses in gas supply to the system, a team involving organizations such as Gas Management Services, Gas Asset Management and Gas Regulatory Compliance assembled at a remote location which would become the EOC. The personnel at the EOC worked to support the Ray Command Post and manage the larger impact on the gas supply system. We deployed a subject matter expert from the Corporate Emergency Management department to the EOC to work with the leadership in establishing an ICS structure and an Incident Action Plan.

We also activated the Crisis Management Team and identified an Officer in Charge, giving this incident the ICS classification of Level 3 - Full Scale Activation. We have four ICS incident classifications including: Level 0: Routine; Level 1: Elevated; Level 2: Serious; and Level 3: Full-Scale. With the Level 3 classification, the ICS structure includes one or more command posts, an EOC and senior level executives functioning as the Crisis Management Team.

Incident Command Structure

With such a complex ICS activation, the ICS structure and gas Emergency Response Plan proved invaluable, providing the framework for an appropriate and coordinated response. The Incident Action Plans developed each operating period at the Ray Command Post and EOC provided a clear operating picture to help guide the response and deliver consistent, accurate communication. This communication followed a clear path from the Ray Command Post to the EOC to the Crisis Management Team. Throughout the ICS activation, which was active from Jan. 30 through Feb. 6, multiple update calls took place. The safety plans developed by the safety officers helped mitigate the safety risks for employees and the public. These safety plans were the priority during the response. We deployed the Mobile

Command Center, a mobile emergency response vehicle, to the Ray Command Post, which provided great value to those working on scene in very harsh conditions.

We had personnel in ICS roles from the following respective areas:

- Safety
- Gas Operations
- Gas Management Services
- Business Customer Care
- Public Affairs
- Rates and Regulatory Affairs
- Logistics
- Finance
- Security
- Legal
- Emergency Management
- Gas Engineering

We demobilized the ICS activation as the incident neared completion. Although work continued, we determined those tasks were manageable through normal daily operations. We held after-action reviews for the Ray Command Post and the EOC, which will allow for continuous improvement opportunities.

Our readiness to respond was the result of advanced planning and preparedness activities. In 2018, for example, a functional exercise at Ray Compressor Station with a scenario involving a fire was held and was helpful in preparing employees to use ICS to manage this incident. We utilize the Homeland Security Exercise and Evaluation program's preparedness activities such as planning, training, exercising and evaluating. We have continuously used these since the Emergency Management program's creation to prepare for this type of emergency. This preparedness was critical in prioritizing life and safety, stabilizing the incident, preserving property and protecting the environment.

3. Implementation of Gas Curtailment Procedures

On Jan. 24, we notified interruptible Act 9 natural gas transportation customers that interruptible service would not be available due to forecasted cold weather conditions beginning on gas day Jan. 25 and continuing until further notice. Those customers included Midland Cogeneration Venture, LP (MCV), SEMCO Energy Gas Company (SEMCO), Michigan Gas Utilities and British Petroleum.

Following those communications, SEMCO requested to flow some gas under the interruptible portion of its Act 9 contract because the cold forecast exceeded SEMCO's current design day expectations and current distribution system deliverability constraint. We granted the requested interruptible service to SEMCO because SEMCO serves residential customers and had identified a critical need for interruptible service. The Commission Staff was notified of this exception on Jan. 29 at 3:36 p.m.

On the morning of Jan. 30, Business Customer Care (BCC) received an alert regarding a problem at the Ray Compressor Station and of the potential for a Gas Curtailment. The timing of events and steps taken by BCC are outlined below:

Jan. 30

11:00 a.m. - BCC first awareness of event at Ray Compressor Station.
11:46 a.m. - OFO communication to Customer Account Manager team.
11:50 a.m. - Curtailment customer list pulled and adapted for efficient BCC use.
12:07 p.m. - Information Posting Website (IPW) notification of OFO order.
12:15 p.m. - BCC team leadership alignment.
12:46 p.m. - Operating concern outreach to 18 specific industrial customer locations regarding low gas pressure in the Warren/Sterling Heights Area.
1:00 p.m. - BCC team alignment. Account managers begin reaching out to 104 of the highest volume customers to request voluntary gas load reductions.
2:00 p.m. - BCC team alignment: outreach progress check-in.
2:55 p.m. - Formal curtailment issued for customers using greater than 1250 Mcf/Month (priorities 2-5 – per section C3.3 Paragraph F of Consumers Energy Rate Book for Natural Gas Service).
3:00 p.m. - BCC team notification of curtailment and outreach communication adjusted to reflect that mandatory reductions are required.
3:08 p.m. - Notification of curtailment posted on IPW.
8:00 p.m. - BCC team check-in outlining reduction estimates by customer totaling approximately 95,000 Mcf/day.
11:30 p.m. - Lansing/Delta City Gate specific customer update regarding low pressure concerns.

Jan. 31

7:30 a.m. - BCC leadership alignment.
8:00 a.m. - BCC team alignment call - event updates to curtailed customers continued generating additional 40,000 Mcf reduction.
4:00 p.m. - BCC team alignment – curtailment end communicated internally.
4:15 p.m. - BCC outreach communication of curtailment lift effective as of 12:00 a.m. on Feb. 1.
4:38 p.m. - Curtailment end posted on IPW.

Feb. 1

8:22 a.m. - IPW notification reiterating curtailment and OFO end at 12:00 a.m. on Feb. 1.

During the day of Jan. 30, the Midcontinent Independent System Operator, Inc. (MISO) experienced a Maximum Generation Event, Step 2b. We communicated with MISO to determine the need to continue to serve Michigan natural gas-powered power plants during the curtailment. MISO indicated we could ask those plants to shut down or reduce operations. We required MCV to cease consuming natural gas delivered from the Consumers Energy gas system and CMS Kalamazoo River to shut down. Other natural gas plants on our system reduced their usage but continued to generate power due to the nature of their customers and the necessity to preserve electric service to them. Those included: the Lansing Board of Water & Light and Michigan State University.

4. Whether there is evidence of a failure on the part of Consumers Energy to properly maintain its equipment or any non-compliance with Commission rules

Based on our review of the event, there was no evidence of a failure to properly maintain equipment.

The current installation meets requirements of Michigan's gas regulations. Additional design enhancements are being considered for current and future installations as we incorporate this most recent event into our plan-do-check-act cycle. As Consumers Energy embarks on its Safety Management System implementation, a critical component to improving safety is to manage changes by incorporating learnings into forward actions.

5. Whether the Company properly responded to the natural gas shortage

Jan. 30, 2019

On Jan. 30, when the Company experienced a fire-gate of the Ray Compressor station, the result was the loss of the ability to deliver approximately 1.8 Bcf/day flowing supply for roughly 12 hours. Our actions included initiating pre-curtailment procedures of requesting voluntary reductions of gas usage and implementing an OFO, dispatching peaker fields, purchasing incremental pipeline supply, asking for additional gas supply above the scheduled amount from interconnecting pipelines and implementing a curtailment (as discussed in section 3) pursuant to Rule C3.3 of the Company's natural gas tariffs. The actions taken by Consumers Energy avoided unplanned customer gas outages due to this event, and preserved service to residential and vulnerable customers during an extremely cold weather pattern.

Consumers Energy entered the record cold weather period of Jan. 30 to Feb. 1 with 61.9 Bcf of working gas inventory in storage. The demand plan for 10:00 a.m. on Jan. 30 to 9:59 a.m. on Jan. 31 included delivery of over 3.0 Bcf for the 24-hour period with a peak hourly rate of 3.7 Bcf/day occurring on the morning of Jan. 31 between the hours of 8:00 a.m. and 10:00 a.m. The plan called for setting a record for total day and peak hour demand on our system.

The supply and operations plan for the day was to fulfill demand using baseload storage fields, Ray Field, and pipeline supply as the primary sources, with peaker fields in reserve to support system packing and any potential interruptions in supply. Pipeline suppliers issued critical notices for this period. We issued an internal notice to ensure critical facilities and equipment were ready when needed. The daily supply plans and actuals for Jan. 30 and Jan. 31 are shown in Figure 6.

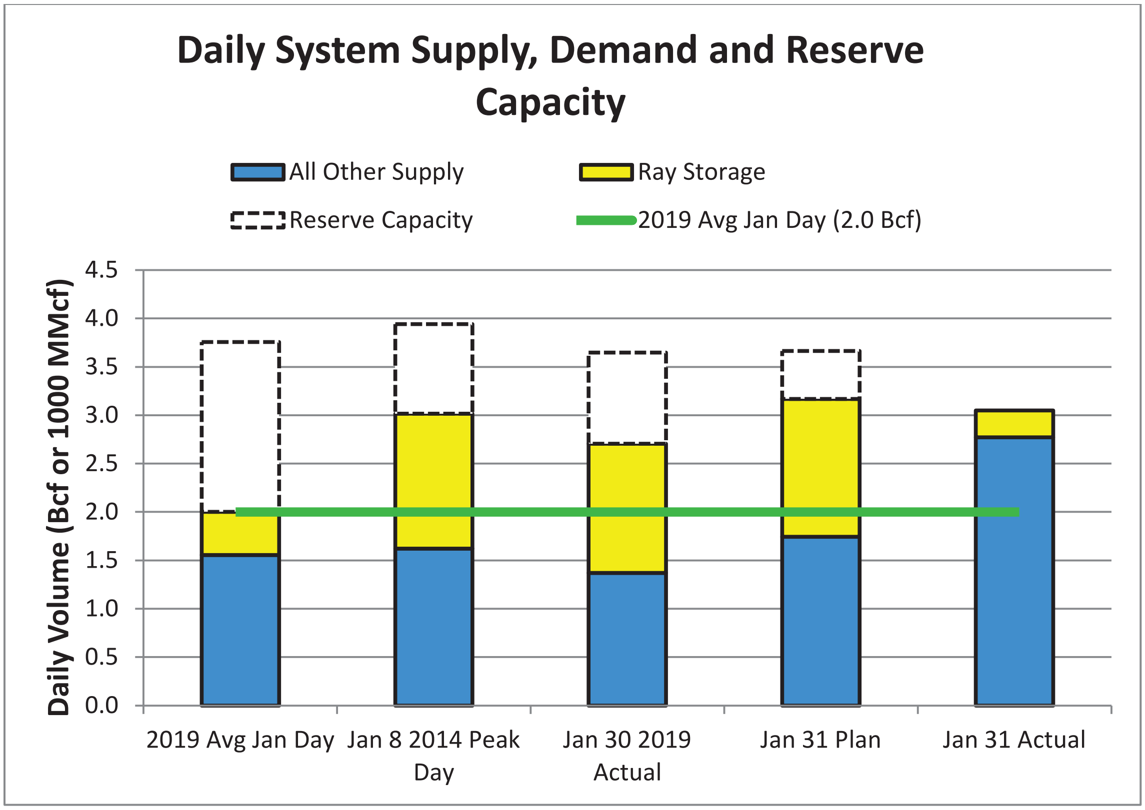

Figure 6. Daily supply plans and actuals for Jan. 30 and Jan. 31

The system was operating according to plan until 10:28[3] a.m. on Jan. 30 when Gas Control received a Ray Plant 2 fire-gate alarm and the instantaneous rate at Ray reduced from approximately 1,800 MMcf/day (1.8 Bcf/day) to zero. Due to the alarm, the first response to the restriction on access to our natural gas supply began in our Gas Control Center. Gas Control notified leadership and the appropriate operations personnel at approximately 10:30 a.m. As shown in Figure 7, the loss of Ray flow caused the system to begin unpacking at an excessive rate. Unpacking means the amount of gas and the available pressure in the pipeline system are decreasing. Unpacking occurs when the rate of total system supplies is lower than the rate of total deliveries to customers. Figure 7 depicts the status of system supply, demand, rate of system unpack, Ray Field flow prior to the fire-gate alarm through peak hour of Jan. 30 at 11:00 p.m. and the peak hour of the next day at 8:06 a.m. on Jan. 31. The loss of Ray and the rate at which the pipeline system was unpacking caused key system pressures to decline at excessive rates.

[3] Time based on gas logs; normalized time to video surveillance is 10:33am.

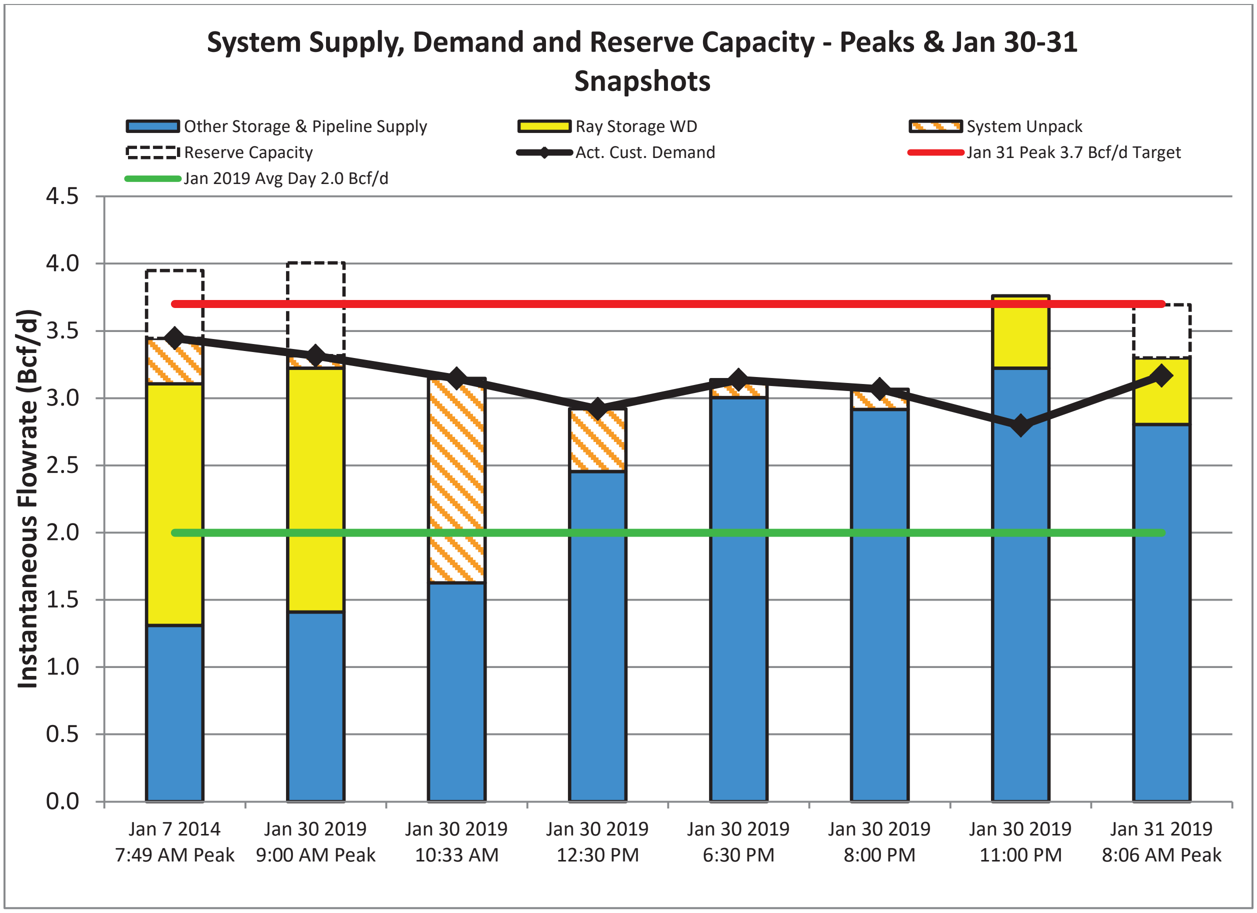

Figure 7. System supply, demand and reserve capacity

Dispatch of Peaker Fields

Shortly after the fire-gate alarm was received, Gas Control adjusted the storage field rate orders to dispatch all peaking storage fields at maximum flow rates including those fields on standby. The peaking storage fields dispatched at maximum rates included Lenox and Ira located in the St. Clair area and Lyon 34, Lyon 29 and the Northville Reef located in the Northville area. Lenox field, which received a dispatch order prior to the fire, began flowing and ramping up at about 9:15 a.m. The St. Clair, Northville and Ray storage areas are identified in Figure 8. The Northville Reef began flowing to system at 10:57 a.m. and Lyon 29 and Lyon 34 began flowing to system at 11:30 a.m. Ira began flowing to the system at 12:46 p.m. The peaking storage fields added approximately 975 MMcf/day of supply to the system. The dispatch of the peaking fields maximized the total amount of storage supply delivered to the system and reduced the system unpack rate. This peaking capacity, however, was forecasted to decline by approximately 500 MMcf/day by the next morning's peak hour as field inventories depleted. We considered the peaker field flow reduction in the gas supply procurement decisions throughout the day. As shown in Figure 7, the supply from the peaker fields significantly reduced the system unpack rate. It did not provide enough supply to begin repacking the system as demand remained relatively steady.

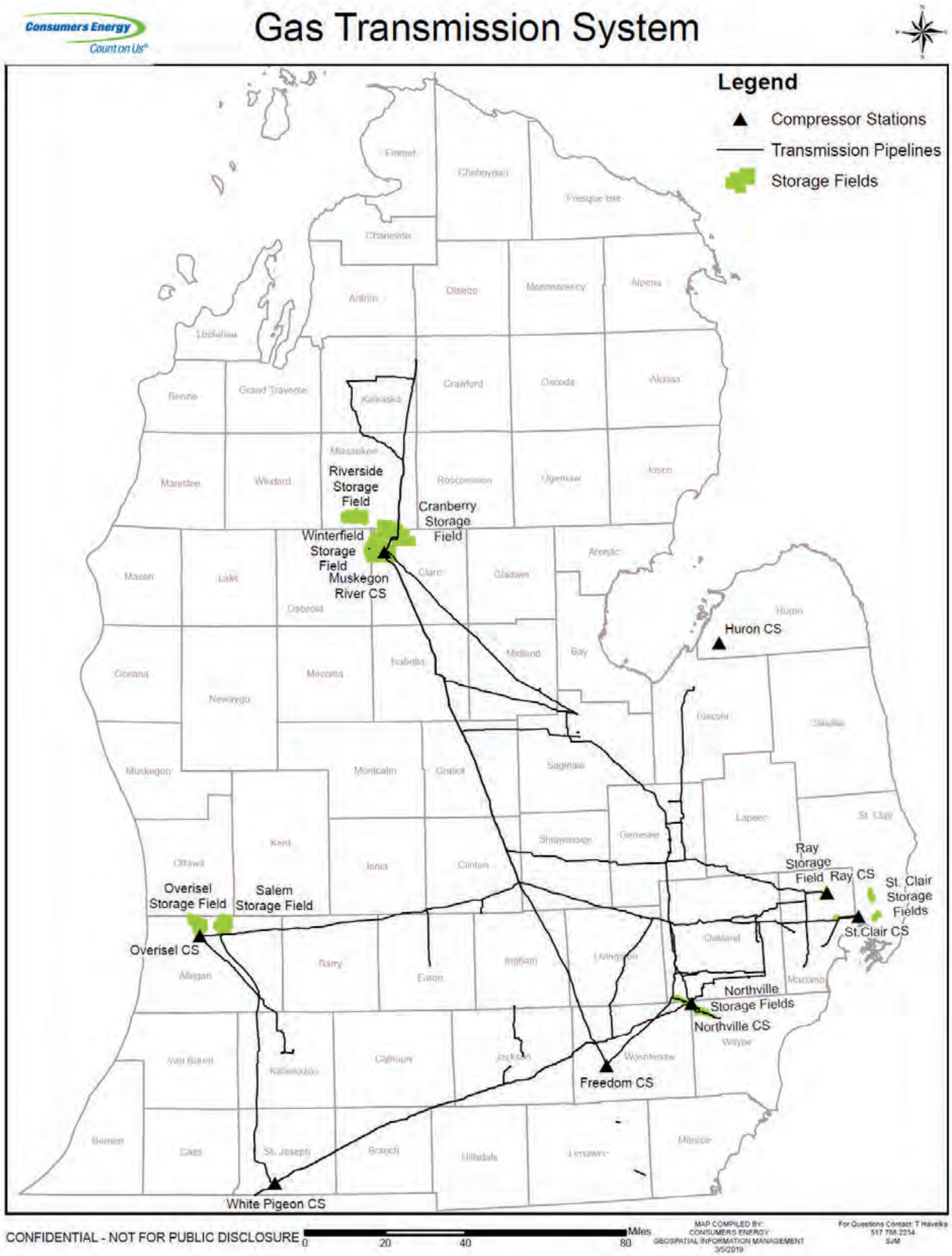

Figure 8. Map of Consumers Energy compression stations and storage fields

Assistance from Other Pipelines

At 10:41 a.m. on Jan. 30, Gas Control was notified of a fire at Ray Compressor Station. This notification contributed to the Gas Control response to seek additional gas deliveries as assistance from other interconnecting pipelines. Phone calls for assistance began as early as 10:45 a.m. We made phone calls to five major pipelines interconnected to Consumers Energy and all agreed to provide assistance on a best efforts basis. Communications continued periodically throughout the day to align on the volumes and constraints. This additional supply and the peaker field supply are reflected in the blue supply bars in Figure 7 above. The amount received from other pipelines varied somewhat throughout the day of Jan. 30. At times, it was uncertain how long and how much assistance gas could be provided to us. At 12:30 a.m. on Jan. 31, the net gain above the scheduled nominations was approximately 309 MMcf/day.

Procurement of Additional Supply

While Gas Control contacted other pipelines for assistance, Gas Control leadership assessed the system status. We quickly determined procurement of additional gas supply had to begin as soon as possible due to the uncertain return of Ray flow and the approaching 11:00 a.m. intraday North American Energy Standards Board (NAESBE) nomination deadline. An initial target of 500 MMcf/day for gas days Jan. 30 and Jan. 31 was established and provided to Gas Supply. This amount of gas for same day (gas day Jan. 30) delivery had never been procured before by our Gas Supply which created uncertainty about how much could be contracted and scheduled, particularly given the extreme cold weather conditions and the accelerated time frame.

At about 10:45 a.m. on Jan. 30, Gas Supply began the procurement process of the 500 MMcf/day. Due to the short time line, Gas Supply was not able to schedule any gas by the 11:00 a.m. deadline. This meant the scheduling of procured gas wouldn't begin until 3:30 p.m. for an earliest delivery time of 7:00 p.m., following the NAESBE Nomination Timeline. Receiving assistance from other pipelines and dispatching the peaker fields helped stabilize the system until procured supply was scheduled and delivered.

Implementation of Pre-Curtailment and Operational Flow Order

Next, we completed a more detailed assessment of the projected weather, customer demand and available supply over the next 24 hours. The assessment excluded any uncertain or unknown supply volumes at the time such as gas that may be loaned from other pipelines and any partial return of Ray's flowrate capacity. The assessment indicated the potential of a supply shortfall. At 10:57 a.m., the Vice President of Gas Engineering and Supply was informed of the potential of a supply shortfall over the next 24 hours given the weather and demand forecast. Shortly thereafter, we decided to begin the pre-curtailment process and we issued an OFO notification.

Throughout the day on Jan. 30, we completed periodic system assessments based on the conditions depicted in Figure 7. Demand through the period continued in line with projections near or above the rate of 3.0 Bcf/day. The system assessments led to increases in the same-day gas supply purchase targets. The increases were aimed at repacking the system and closing the gap between the supply available and the projected 3.7 Bcf peak hour demand for Jan. 31. At 12:48 p.m., the target for Gas Supply increased by an additional 130 MMcf/day of point specific supply on the southeast side of the system for Jan. 30 and Jan. 31. The purpose of the point specific supply was to increase pressures in the southeast market area of our system. At 2:37 p.m. on Jan. 30, the total gas supply procurement target increased to 830 MMcf/day. We increased the target to reflect fewer hours that remained before the Jan. 31 peak hour to repack the system and increase system pressures.

Implementation of Curtailment

At 2:41 p.m. on Jan. 30, Gas Supply provided a status update that 544,243 dth/day or about 520 MMcf/day had been procured for gas day Jan. 30. Gas Supply shared concerns about finding enough gas to purchase to meet the procurement target with executive leadership. With key pressures dropping within the southeast market area and the Lansing region putting over 400,000 customers at risk, we determined reducing industrial demand was necessary to ensure uninterrupted service to critical, priority, and residential customers. This information also initiated discussions about other potential supply options such as diverting gas supply away from our Zeeland and Jackson gas-fired electric generating plants to our gas system. During discussions with suppliers, Gas Supply became aware of upstream interstate capacity constraints which prevented the diversion of Zeeland supply. Gas Supply was able to procure an additional 31 MMcf/day by diversion away from the Jackson plant.

At approximately 3:00 p.m. on Jan. 30, we decided to implement a curtailment of gas deliveries pursuant to Rule 3.3 of the Company's natural gas tariffs in order to help stabilize the system and maintain deliveries to residential and vulnerable customers.

Around 6:00 p.m. on Jan. 30, we determined Gas Supply would not meet the 830 MMcf/day target with firm gas supply contracts for Jan. 30. Gas Supply had procured what was available on a firm basis. Ray field had not been returned to service and the system was still unpacking as reflected in the 6:30 p.m. snapshot in Figure 7. Based on this information, we decided to add interruptible supply contracts in an attempt to access supply on an interstate pipeline segment that we believed may have a sufficient capacity. Gas Supply executed approximately 191 MMcf/day of interruptible purchases close to the last nomination deadline. Gas Supply reported to leadership uncertainty about how much gas would be confirmed, scheduled and delivered later that day.

By 8:00 p.m. on Jan. 30 and for gas day Jan. 30, Gas Supply had entered into 925 MMcf/day of incremental supply deals, consisting of 679 MMcf/day of firm citygate gas, 55 MMcf/day of point specific supply, and 191 MMcf/day of interruptible supply. City gate gas is not point specific as the supplier has flexibility to deliver the gas to Consumers Energy at any available supply interconnect. Of the 925 MMcf/day procured, approximately 80% was confirmed in the scheduling process and 61% — or 564 MMcf/day — was ultimately delivered. By 11:00 p.m., all of the incremental gas began to be delivered, and is reflected in Figure 2. The undelivered volumes consisted of 191 MMcf/day of interruptible supply and 170 MMcf/day of firm supply. The firm supply cuts reflect the lack of timely information underpinning the NAESBE Nomination and Scheduling process for pipeline supply. In this case, the Company believes that the speed of market transactions likely outpaced the speed at which pipeline receipt and delivery point available capacity volumes become public and known to market participants, resulting in points being oversold and cuts to supply. For gas day Jan. 31, Gas Supply procured 585 MMcf/day, which was confirmed and scheduled for delivery starting at 10:00 a.m. on Jan. 31 which included 149 MMcf/day of point specific supply in the southeast.

Request for Assistance from the State Emergency Operations Center

From noon to 9:00 p.m. on Jan. 30, system pressures continued to drop and pipeline gas increased less than expected — possibly due to scheduling limitations and congestion in upstream pipeline systems. Industrial load reduction was not occurring as quickly as hoped, and load was growing from below 3 Bcf/day to over 3 Bcf/day in hourly flow rates. Given the adverse pressure trends shown in Figure 9, we worked with the SEOC and Gov. Whitmer’s office around 8:00 p.m. to utilize the Emergency Broadcast System along with public appeals from CEO Patti Poppe and Gov. Whitmer to ask residential customers to help reduce natural gas usage.

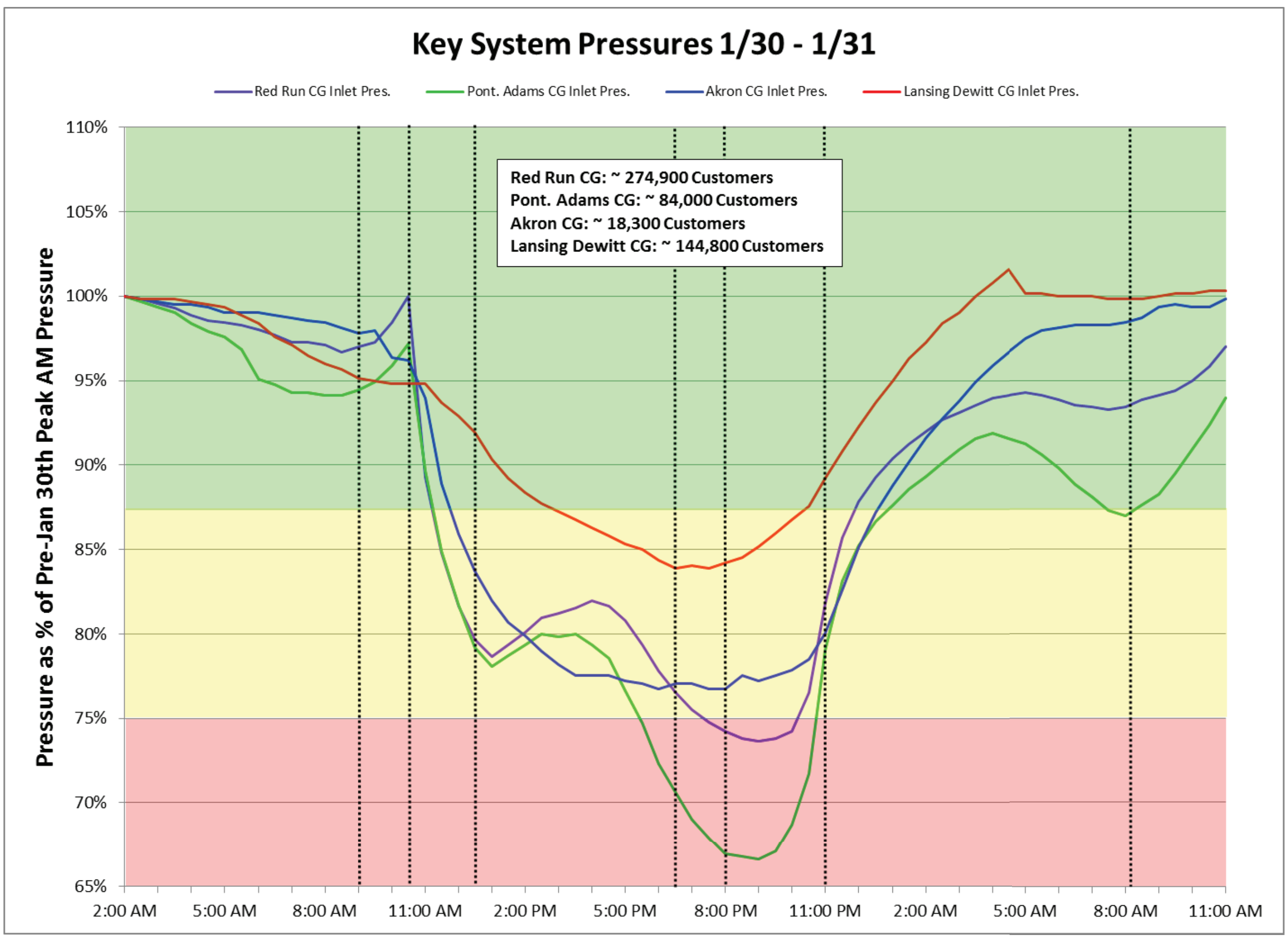

Figure 9. Gas pressure trends

At around 10:40 p.m. on Jan. 30, the Ray Compression station was able to provide about 30% of its originally intended supply through the minimally damaged Plant 1 unit. This supply — combined with the reduction of demand and the receipt of growing pipeline supply — enabled Gas Control to stabilize at-risk areas in the statewide system and repack the entire network.

Jan. 31, 2019

The actions taken on Jan. 30 enabled the successful delivery of high flow rates through the night and successful delivery of gas through the 8:06 a.m. peak hour on Jan. 31. The peak hour flow rate was reduced to 3.2 Bcf/day from a forecast of 3.7 Bcf through the curtailment of industrial and commercial customers and the Jan. 30 appeal for voluntary reductions in all loads, including residential demand.

Curtailment Lifted

The demand reduction measures were lifted effective at 12:00 a.m. on Feb. 1, earlier than anticipated due to rapid stabilization of the system from Ray plant and expanded pipeline supplies achieved through aggressive procurement. To ensure supply and storage deliverability for the balance of winter, we refilled the peaker fields depleted during the Ray event and secured incremental market supply using short-term contracts.

6. Estimated reductions in natural gas usage from large customer curtailments and residential conservation over time during the emergency with corresponding timeframes of actions (e.g., public appeals, emergency alerts) by Consumers Energy and the State of Michigan

Communications

The incident at Ray Compressor Station required a swift and strategic communications response to ensure the safety of those close to the facility, to keep customers abreast of the impact statewide and — perhaps most importantly — to appeal for assistance in managing our natural gas supply amid extreme temperatures. We connected quickly and effectively with our business and residential customers to seek their help in curtailing natural gas use. Their decisive response was vital to successfully managing the situation and helping us continue to provide natural gas service for Michigan.

Our comprehensive approach included personal outreach and communications through a wide variety of channels, including social, owned, earned, and paid media. Please see the appendix for a detailed breakdown of our communications activities.

From the start, we committed to being transparent and timely in our communications, utilizing the ICS structure as our guide and framework. Utilizing ICS and working in tandem with operations and legal, the structure truly helped keep controls in place, particularly for ensuring disciplined and accurate messaging.

Our key audiences for the communications included the following:

1. FIRST RESPONDERS: Initially, our primary goal was to arm first responders, public officials and neighbors near the Ray plant with the information they needed to perform their jobs safely and to stay out of harm's way;

2. KEY STAKEHOLDERS: Once that was accomplished, we shifted our focus to relaying vital information about the fire's impact to the MPSC, the Governor's office, local governmental officials and other key stakeholders through regular briefings;

3. LARGE BUSINESS: After issuing an initial news release statement on the incident to the general public, we began communicating with business customers throughout the state, asking for help to conserve natural gas – allowing us to meet the energy needs of all homes and businesses in our service territory.

   On Wednesday, Jan. 30, at approximately 3:00 p.m., we notified suppliers of the mandatory curtailment through the IPW and asked them to continue delivering gas for their customers into Consumers Energy's system in order to help stabilize the system. BCC also began phone contacts with customers under Priorities 5, 4, 3 and 2 to inform them about the mandatory curtailment, the reason for the curtailment and to advise them of the need to limit the use of gas at their facilities. By 8:00 p.m., we had commitments for reduction of approximately 95,000 Mcf from 85 customers statewide.

   On Thursday, Jan. 31, account managers continued customer outreach. Following the previous evening's media coverage of the event and socialization, curtailment commitments increased resulting in an additional estimated load reduction of about 40,000Mcf. This resulted in a total reduction estimate of 135,000 Mcf/day; and

4. RESIDENTIAL CUSTOMERS: While we had already notified Michigan residents statewide of the incident earlier that day, it became clear we needed more reductions from residential customers too. We began executing a voluntary load reduction communications strategy on the afternoon and evening of Jan. 30, which ultimately helped drive reduction. We saw a 10% reduction at the larger metro Detroit city gates in the city-gate throughput after the 10:37 p.m. State of Michigan emergency text message. We attribute this reduction primarily to residential load reductions.

Media Strategy

In order to maintain transparency throughout the event and to reach the maximum number of customers as quickly as possible, we executed a multi-channel media strategy. Specifically, we used technology and social media to reach customers in real time, which was successful in helping residential customers understand the need for a voluntary load reduction of natural gas usage. In addition to the statewide emergency alert used by the SEOC, we maintained communications with stakeholders and customers through various media channels throughout the event. These efforts also included our community affairs managers visiting Ray's immediate neighbors door-to-door during the week of the incident. The following channels and tactics were also used throughout the event:

Social Media: Social media was a powerful tool in helping us deliver key information about the incident and the resulting energy delivery challenges we faced. Over two days, we had 21 posts on Facebook and Twitter on the incident. These posts resulted in 2.7 million impressions and 120,000 engagements over two days. Our 9:00 p.m. Facebook Live post on Jan. 30 featuring CEO Patti Poppe, drew 5,000 viewers in real time and drew 21 times the average number of impressions (30,000) for a Facebook post.

Digital Outreach: We leveraged email and our website to connect with business and residential customers by delivering key information — such as the latest facts and answers to frequently asked questions (FAQs) — on the front page of our Company website and through email. Over the two days we sent 1 million emails to residential customers and 70,000 emails to business customers. Representatives in our contact centers also were prepared with up-to-date information to share with customers who called for assistance.

News Media: Informing print, electronic and broadcast media throughout the state was critical to helping customers and stakeholders understand the situation. We issued five news releases and held two phone news conferences and one in-person news conference on Jan. 31 featuring President and CEO Patti Poppe and Senior Vice President of Operations Garrick Rochow. Patti Poppe was the chief spokesperson and centerpiece of these efforts as the leader of our Company. In addition, our media relations team members and executive officers did more than 50 radio, TV and phone interviews and responded to more than 130 media inquiries related to the Ray Compressor Station situation.

Paid Media: Finally, we tapped the power of paid media, or advertising, to thank our customers following the incident. The response of our business and residential customers was a true game changer that helped us continue to provide natural gas service for Michigan during the incident. In December, we had purchased advertising time in major out-state Michigan markets to air a brand spot featuring the story of Patti Poppe following in the footsteps of her father to work at Consumers Energy. Following the Ray situation, we opted instead to use that time — and one additional ad in the Detroit market — for Patti Poppe to deliver a message of gratitude to customers. In total, the local spots cost less than $350,000, which we paid from shareholder dollars. The Company did not and will not seek recovery of these costs in customer utility rates.

7. Consumers Energy's coordination and communication with State of Michigan officials and local emergency response agencies

Throughout the event, Consumers Energy was committed to keeping legislative, regulatory, and emergency officials apprised of the situation at Ray Compressor Station and the status of the natural gas system. Communication began early after the fire started and occurred frequently throughout the duration of the event. Consumers Energy quickly established an ICS structure with a meeting cadence designed to support ongoing and transparent briefings to the MPSC, State and Local EOCs, the Governor's office, the Michigan State Police and state and federal legislators.

Governor's Office

Our Senior Vice President of Governmental, Regulatory and Public Affairs maintained contact with Gov. Whitmer's chief legal counsel, throughout the two days following the event to discuss the status and identify potential response activities. Contacts were also made to Gov. Whitmer's Energy and Environmental Policy Advisor. As the event progressed, our senior leadership team participated in several calls with Gov. Whitmer's senior staff to provide updates on the Ray plant and the status of the system and to ask for help via the Emergency Broadcast System. By the afternoon of Jan. 31, our team was able to notify the governor and her senior staff that the system had stabilized, and we planned to issue an "all clear."

Regulatory

Shortly after the fire ignited on Jan. 30, our Senior Vice President of Operations contacted MPSC Commissioners to notify them and share that we were creating a restoration plan. He provided the Commissioners with updates on the Ray Plant and the status of the system throughout the event, and he kept them abreast of communications occurring with the Governor's Office and upcoming press briefings. He also answered their questions about voluntary reductions, exchanged correspondence about providing potential outage information to local EOCs and notified them of the plan to deliver an "all clear" announcement. Our teams were also in close communication with MPSC Staff to provide them plant and system information as the event progressed, such as when Ray 1 came back online.

As part of the response, Consumers Energy's Gas Compliance Technical Analyst and the MPSC's Gas Safety Engineer met onsite on Jan. 30 and Jan. 31 to investigate the incident. They collected information, reviewed records and performed a field observation at the location of the fire. In addition, they collaborated with the Michigan State Police and Bureau of Alcohol, Tobacco, Firearms and Explosives representative on the cause and origin investigation. This included a review of the incident details, a review of the camera footage, a field observation and a timeline development to identify the possible cause/origin.

Emergency Officials

Many communications occurred throughout the event to update the SEOC, local EOCs and the Michigan State Police on the Ray plant and natural gas system. Our Director of Corporate Security, Public Safety Outreach team and senior leaders exchanged multiple calls with the Michigan State Police to provide status updates, discuss potential community impacts, ensure support for local and SEOCs and answer questions. They also provided multiple updates to emergency managers from Macomb, Genesee, Oakland, Monroe, Clinton and Jackson counties, as well as the city of Lansing. Topics of discussion included system status and warming shelter needs. Communications took place with the Armada Fire Department, Sterling Heights Fire Department and Midland 911. Throughout the event, our Public Safety Outreach Team provided copies of media statements to Emergency Managers, Michigan State Police coordinators, Red Cross, LARA and county 911s, and they posted information to the Michigan Critical Incident Management System.

We participated in seven conference calls with the joint MPSC/SEOC to discuss the event and review the status of the natural gas system. The conference calls were led by Consumers Energy Incident Command senior leaders and included MPSC Staff members, Emergency Management and Homeland Security, Michigan State Police, the Governor's Office, Michigan Agency for Energy, and Consumers Energy senior leadership.

The Michigan State Police requested that we provide an onsite representative at the SEOC. We fulfilled this request by having our Executive Director of Gas Distribution Operations report to the SEOC. She participated in the Incident Command Structure and provided updates on system stability, the plant status and other operational items during the 9:00 a.m. and 3:00 p.m. ICS briefings.

Legislative

Shortly after the event started on Jan. 30, our Federal and State Governmental Affairs teams contacted the offices of federal and state legislators to notify their staffs of the Ray fire. They also communicated with representatives who serve on the House Energy and Commerce Committee to inform them of the incident in progress. Updates were provided to key staff for the entire Michigan congressional delegation as we asked our customers to voluntarily reduce their gas usage. Public communications, as described earlier, including links to press conferences, media releases and Patti Poppe's Facebook Live video were shared with legislators and the entire delegation until the "all clear" announcement was made by Patti Poppe on Jan. 31.

8. Actions directed toward physical security and cybersecurity before, during, and after the event

Consumers Energy has an integrated security organization covering both cyber and physical security. This organization allows us to respond in a coordinated manner when major events occur which have a security component.

Physical Security

The Security Command Center was notified of a fire at the Ray Compressor site and immediately responded at 10:33 a.m. with a conference call to discuss response from the Security Team. The initial response team included members of Corporate Security, the Director of Corporate Security, and Executive Director of Security. Corporate Security dispatched three Corporate Security personnel to the site to assist in the response to the incident. Corporate Security also arranged for two private security personnel to be on site 24 hours a day during the event and subsequent response. The additional security staff remains onsite today.

The Director of Corporate Security also was added to the ICS structure to lead any security response efforts for the Company. The Ray Compressor site has an intrusion detection system embedded in the fence, a video surveillance system and the buildings at the site have a card reader system that provide secure access into the buildings. The Corporate Security Team reviewed all of these systems after the incident. The Director of Corporate Security spoke with the Federal Bureau of Investigation and reached out to the Michigan State Police Michigan Intelligence Operations Center requesting any information relevant to the incident. It was determined that no known threats were detected.

Cybersecurity

Consumers Energy has developed a stellar cyber security program which focuses on people, process and technology solutions to create a defense in depth approach to cyber security. In addition to our prevention initiatives, we focus heavily on detecting and responding to cyber security events by working with industry, state and federal partners to share relevant information regarding cyber threats. Specifically, the gas compression functions at Ray fall into our Operational Technology (OT) Security program, which includes various security tools aimed at preventing and detecting cyberattacks at Ray and other critical infrastructure facilities. These include: firewalls to separate OT systems, no Internet access, no email, antivirus, end-point detection and response tools and centralized logging and intrusion detection systems.

Cybersecurity was not initially involved during the first day of the incident as there was no indication that anything malicious occurred. While there continued to be no indication of malicious activity, we felt it best to conduct a deep-dive analysis to rule out a cyberattack as a root cause or contributing factor. We reviewed all available data from both a system and network perspective and found no indication of malicious activity. In addition, a team of five Cybersecurity team members visited Ray and conducted further detailed analysis to validate initial findings. Based upon both assessments, there was no malicious cyberactivity which contributed to or caused this event.

9. Total Cost of the Incident

Gas Lost On Site

The amount of lost and unaccounted for gas as a result of the fire was 3,260 Mcf estimated at $14,000.

Emergency Natural Gas Purchases

The total cost of emergency natural gas purchases for gas day Jan. 30 and gas day Jan. 31 was approximately $10.6 million. The incremental cost of these purchases compared to the cost of gas in storage at the time was approximately $7.2 million.

Purchase of Customer Owned Natural Gas Estimates

Some Gas Transportation customers reduced their consumption of natural gas in response to the curtailment order and some of these customers continued to have gas delivered to the Company's system pursuant to our request as part of the efforts to stabilize the system.

When a transportation customer purchases gas they cannot use in a given month, they normally will continue to own the gas, and it becomes part of their authorized tolerance level balance that carries forward into the next month. This is still true, but with a slight change for customers who reduced consumption on Jan. 30 and 31 in response to our curtailment order. Consistent with our tariffs, we have already waived any load balance penalties incurred for January 2019.

Gas Transportation customers who reduced their consumption in response to our curtailment order and continued to bring gas onto the system above their consumption level have two options under our MPSC-approved tariffs to either:

1. Have the excess of the customer's deliveries over the customer's consumption injected into storage without penalty or additional charges; or

2. Sell the excess of the customer's deliveries over the customer's consumption to Consumers Energy at a price to be negotiated between the Company and the customer subject to certain limitations set forth in our tariffs.

We sent a letter to transportation customers on Feb. 15 outlining these options. If a transportation customer believed they qualified and wanted to sell excess gas to Consumers Energy, we asked them to notify us no later than Mar. 15, 2019. They were required to provide documentation, or other evidence substantiating the volume of excess gas deliveries that are eligible for these options. If the customer did not contact us by Mar. 15, load balancing penalties would continue to be waived on the volume of gas in storage at the end of Jan. 2019.

The estimated cost for the customers who have notified us through Apr. 5 is $300,000.

Facility Estimated Repair Costs

Immediately after the Ray Compression Station fire, we estimated a high level $18 million risk based on whether the Ray Plant 2 dehydration system would have to be replaced ($14 million) and repair/replacement of the Ray Plant 3 support systems ($4 million). The project team is working on an order of magnitude, scope and forecast. We expect to refine the costs in the near future as more information is gathered.

Cost Estimates	
Lost and Unaccounted For Gas Estimate	$14,000
Emergency Natural Gas Purchases Incremental Estimate	$7,200,000
Purchase of Customer Owned Natural Gas Estimate	$300,000
Ray Compressor Facility Repair Cost Estimate	$18,000,000
Total Cost Estimate as of 04/05/19	$25,514,000

Conclusion

Our natural gas delivery system was operating under extraordinary, record-setting conditions on Jan. 30. We were prepared for and projecting a record cold day with record gas deliveries. We had a supply and operating plan with a 16.5% contingency versus our projected record demand. By leveraging our standard mix of storage and pipeline supply, we were positioned to supply this record demand with no cost penalty to our customers. Losing the Ray Station during the peak demand of a near record day on Jan. 30 tested our system resilience to its maximum. We provided continuous gas supply to 100% of our residential customers — resulting in warm homes and safe residents during a dangerously cold night. The heroic team at Ray returned Plant 1 to service in the toughest of conditions and we accessed additional supply through pipeline purchases and the use of the industrial and commercial tariff curtailment options by the Gas Management Services team. The people of Michigan also responded selflessly to our joint request with state government to reduce demand for a brief period. Transparent and detailed communication with officials in the government, SEOC and MPSC made this successful collaboration possible. We provided these stakeholders with regular, frequent and detailed briefings throughout the event. We are grateful for their engagement, assistance and partnership.

The fire and damage at the Ray Station was precipitated by a safety venting fire-gate process that has been proven safe and effective in the past. But under the unique and extreme weather conditions, the process became hazardous to the station equipment. This new failure mode has now been added and new risk mitigation countermeasures will be implemented at the Ray Station and across the fleet to further enhance resilience and help to avoid failure under extraordinary circumstances in the future.

Appendix

Acronyms

BCC = Business Customer Care
Bcf/day = 1,000,000,000 cubic feet per day
Dth/day = Dekatherm per day
EOC = Emergency Operations Center
FAQ = Frequently Asked Question
ICS = Incident Command System
IPW = Information Posting Website
Mcf = 1,000 cubic feet per day
MCV = Midland Cogeneration Venture, LP
MISO = Midcontinent Independent System Operator, Inc.
MMcf/day = 1,000,000 cubic feet per day
MPSC = Michigan Public Service Commission
NAESBA = North American Energy Standards Board
NFPA = National Fire Protection Association
OFO = Operational Flow Order
OT = Operational Technology
Psig = gauge pressure in pounds per square inch
SEMCO = SEMCO Energy Gas Company
SEOC = State Emergency Operations Center

#6. Communications Timeline Enabling Reductions in Natural Gas Usage

Here is a detailed breakdown of internal, external and public affairs communications activities related to the Ray situation on Jan. 30-31:

News media

- 10 Company Statements/News Releases
- 25 Officer Interviews
- 130 Media inquiries
- 3 News Conferences
    - In-Person News Conference w/Patti Poppe & Garrick Rochow on Jan. 31 drew statewide media attention.

Social media

- 21 Social Media Posts
    - Facebook and Twitter
- 1 Facebook LIVE Session
    - Patti Poppe's 9:00 p.m. Facebook Live post saw 21 times more impressions than an average Facebook post (average is: 30,000 impressions); 5,000 people watched it LIVE.

Internal communication

- 3 All-Employee Emails

Customer and stakeholder outreach

- 535,000 residential and business emails
- 4 Website Updates
    - Front page displayed Ray Compressor Update/Gas Reduction Request as our only message as of 6:00 p.m. on Jan. 30.
- Provided Call Center with talking points and FAQ; Worked to change out the Interactive Voice Response hold message to include info on Ray incident at 11:00 p.m. on Jan. 30.

Paid media

- 1 Super Bowl Ad
    - In December, we had already purchased all out-state (Lansing, Grand Rapids, Traverse City and Saginaw/Flint) markets for a brand spot. We were planning to run our "Hard Hat" ad.
    - On Thursday, Jan. 31, we shifted our thinking due to the Ray incident and recorded Patti Poppe that afternoon and evening for a direct "Thank You" ad.
    - We purchased an additional 30-second ad for the Detroit market to hit all five major media markets.

- These were local spots with a **total cost** of less than $350,000 of non-customer shareholder dollars. The Company did not and will not seek recovery of these costs in customer utility rates.

Public Affairs

- 6 Area Managers went door-to-door to visit with neighborhood residents near the Ray station.
- Internal Governmental, Regulatory, BCC, Call Centers, Digital Customer Experience and Community Affairs made appropriate and aligned external outreach throughout the situation.
- Governor's office contacts were being made regularly with press office, front office and energy policy staff.

Staff Response

In the matter, on the Commission's own motion, to commence an investigation into a January 30, 2019 fire at **CONSUMERS ENERGY COMPANY's** Ray Compressor Station in Macomb County.

Incident Date: January 30, 2019

Case No. U-20463

May 8, 2019

Sally A. Talberg, Chairman
Norman J. Saari, Commissioner
Daniel C. Scripps, Commissioner

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Commission Request of Staff

On February 7, 2019, the Michigan Public Service Commission, on the Commission's own motion, opened Docket U-20463 to commence an investigation into the January 30, 2019 fire at Consumers Energy Company's (Consumers or Company) Ray Compressor Station in Macomb County. The fire took place during a period of extremely cold temperatures culminating in an unprecedented emergency request for residential customers to set thermostats to 65 degrees or less on January 30 through January 31, 2019. The Commission directed Consumers to file a report in this Docket no later than 5:00 p.m. on April 7, 2019, addressing the following:

1) The origin of the fire;
2) How Consumers responded to the fire, both at the site and at its corporate office;
3) The Company's implementation of gas curtailment procedures;
4) Whether there is evidence of a failure on the part of Consumers to properly maintain its equipment or any non-compliance with Commission rules;
5) Whether the Company properly responded to the natural gas shortage;
6) Estimated reductions in natural gas usage from large customer curtailments and residential conservation over time during the emergency with corresponding timeframes of actions (e.g., public appeals, emergency alerts) by Consumers and the State of Michigan;
7) Consumers' coordination and communication with State of Michigan officials and local emergency response agencies;
8) Actions directed toward physical security and cybersecurity before, during, and after the event; and
9) The total cost of the incident, including gas lost on site, emergency natural gas purchases, estimates of customer curtailment impacts, and repair of the facility.

On April 5, 2019, Consumers filed its report in Docket U-20463. The Commission Order directed Staff to file a response to Consumers' filing by May 8, 2019, outlining the process and anticipated timeline for the subsequent Root Cause Analysis (RCA) that the Commission's Gas Operations Section will provide, and recommending potential changes to utility operations or procedures, if such changes are identified. This report is being filed in Docket U-20463 by Staff in response to Consumers' filing. The Commission Order also encouraged stakeholders, including end-use customers and local governments, to provide input by May 8, 2019. Consumers is directed to file a response by May 30, 2019.

Background on the Gas Operations Responsibilities

The Michigan Public Service Commission (Commission) participates in the federal Department of Transportation's Pipeline and Hazardous Materials Safety Administration's (PHMSA) pipeline safety program as authorized under 49 USC Chapter 601, which provides the statutory basis for the pipeline safety program and establishes a framework for promoting pipeline safety through federal delegation to participating states for all or part of the responsibility for intrastate pipeline facilities under annual certification or agreement. This participation by the State of Michigan is a voluntary practice, although most states do participate in a pipeline safety program in some capacity. The Commission participates in the pipeline safety program acting as an intrastate and interstate agent for PHMSA for natural gas pipelines.

The Commission's authority is found in Public Act 165 of 1969 (MCL 483.151 *et seq*.) which states "AN ACT to authorize the public service commission to establish and enforce gas safety standards; and to provide penalties for violations there of." The authority granted to the Commission in Public Act 165 allows for the Commission, among other things, to promulgate rules, conduct inspections and investigations, and issue accident reports. The Commission has promulgated the Michigan Gas Safety Standards (R 460.20101 *et seq*.) which establishes safety regulations for gas pipeline operators and incorporates the federal pipeline safety regulations by reference. Intrastate pipeline inspections and enforcement are wholly under the purview of the Commission. Consumers is an intrastate pipeline operator and therefore inspection and enforcement of the pipeline safety regulations falls solely under the purview of the Commission. It is the responsibility of the Commission Staff to ensure that Consumers is compliant with both the federal and State gas safety standards, in addition to conducting thorough incident investigations of Consumers when the need arises.

Incident Investigation Process

Commission Staff has the responsibility to take telephonic notice of pipeline incidents at any time and respond to the scene of the incident as necessary. Both PHMSA and the Commission have developed criteria defining an incident, and an intrastate pipeline operator such as Consumers has the responsibility to notify Staff of any event that meets *either* criteria. The federal regulations have defined an incident in 49 CFR 191.3 as –

> Incident means any of the following events:
>
> (1) An event that involves a release of gas from a pipeline, gas from an underground natural gas storage facility, liquefied natural gas, liquefied petroleum gas, refrigerant gas, or gas from an LNG facility, and that results in one or more of the following consequences:
>
> > (i) A death, or personal injury necessitating in-patient hospitalization;
> >
> > (ii) Estimated property damage of $50,000 or more, including loss to the operator and others, or both, but excluding cost of gas lost; or
> >
> > (iii) Unintentional estimated gas loss of three million cubic feet or more.
>
> (2) An event that results in an emergency shutdown of an LNG facility or an underground natural gas storage facility. Activation of an emergency shutdown system for reasons other than an actual emergency does not constitute an incident.
>
> (3) An event that is significant in the judgment of the operator, even though it did not meet the criteria of paragraph (1) or (2) of this definition.

The State of Michigan has promulgated more stringent reporting criteria of incidents, as defined in Michigan Rule 460.20503:

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> (b) An event resulting in estimated property damage of $10,000.00 or more including loss to the operator and others, or both, but excluding the cost of gas lost. As used in this subdivision, an "event" means on or relating to an operator's facilities that may or may not involve a release of gas.
>
> (c) An event resulting in the loss of service to more than 100 customers.
>
> (d) An event involving a customer's gas facility that results in a fatality or an explosion causing structural damage.
>
> (e) An event resulting in an unintentional release of gas estimated by the operator to be 1 million cubic feet or more or an unintentional activation of an emergency shutdown system of any portion of a compressor station involving the release of gas.
>
> (f) An event that causes the pressure of any portion of a distribution system to rise above its maximum allowable operating pressure plus the build-up allowed for operation of pressure limiting or control devices.
>
> (g) An event that receives or is likely to receive extensive news coverage or is significant in the judgment of the operator….

Significant incident investigations result in Staff responding on-site to the scene of the incident and remaining there until at least such time as the scene has stabilized. Many incidents require repeat inspections to the scene to collect evidence, conduct interviews of involved personnel, ensure the appropriate evidence has been tagged and preserved for investigation, and to determine whether there is any indication of non-compliance with the gas pipeline safety regulations by the involved pipeline operator. This is in accordance with PHMSA's "Guidelines for States Participating in the Pipeline Safety Program" which states:

> Pursuant to Federal/State regulations, a State agency shall conduct an investigation of each significant or reportable incident/accident involving jurisdictional pipeline facilities. The primary objective of the investigation activities is to minimize the possibility of recurrence of this operator and other operators in the state's jurisdiction and to institute enforcement action where non-compliance with the safety standards has occurred.

Staff was onsite at the Ray Compressor Station on January 30, 2019, to investigate the incident. Once the fire was extinguished, Staff observed the incident site for possible sources of gas and sources of ignition. Staff worked with Consumers to review the sequence of events, including data from Consumers' onsite control room and video surveillance system. Staff and Consumers were unable to determine the initial source of gas on this day; however, Plant 1 involvement was ruled out and Consumers initiated its return to service.

Staff returned to the site on January 31, 2019 to continue the investigation. Staff worked with the Michigan State Police (MSP) and the Federal Bureau of Alcohol, Tobacco, and Firearms to perform the investigation. This day primarily consisted of reviewing the data and performing site observations. The investigation preliminarily concluded that a Plant 3 fire-gate[1] likely occurred prior to the fire, however this could not be substantiated due to discrepancies in many data sets, including Consumers' Historian database, its control room human machine interface (HMI) data, the Plant 3 control system (Det-Tronics), and unknown time differentials between these systems in relation to the video surveillance system. The investigation also preliminarily concluded that the Plant 2 thermal oxidizer was likely the ignition source.

Staff returned to the site on February 2, 2019 to continue the investigation. Staff continued reviewing the various data sets to attempt to determine the time differentials and to look for indications of an automatic Plant 3 fire-gate prior to the fire. Staff collected data to substantiate the investigation's findings and continued to work with Consumers to review and evaluate new developments in the following days. To date, Staff has had numerous interactions with Consumers to further the investigation and continues to keep abreast of new developments related to this incident.

Incident Report, Compliance Actions, and Recommendations

Significant incident investigations are formally documented by Staff in the form of an incident investigation report or an RCA report. Such a report contains the system details, describes the events that led up to the failure, the emergency response undertaken by the involved pipeline operator, a summary of how the pipeline facility was returned to service, the investigation that was undertaken by both the pipeline operator and Commission Staff, and concludes with Staff's findings and the contributing factors that led to the incident. In addition to the report, Staff will issue notices of probable violation to the operator if it was determined that there were instances where the federal or state gas pipeline safety regulations were not followed. These notices can contain penalties for violating the safety regulations that were found during the investigation. Lastly, where Staff has discovered shortcomings from the pipeline operator that are not in direct violation with the applicable gas safety standards, Staff will issue a formal recommendation letter to the operator informing them of the identified shortcomings and recommending the operator enhance its programs to close the relevant gaps.

Response to the Company's Filing

The following items contain specific references to Consumers' filed report with associated Staff comments.

Introduction

- Page 1 of Consumers' report states in part that "The station's evolving design, culminating with the addition of Plant 3 in 2013, is resilient…"

[1] Consumers defines "fire-gate" on page two of its April 5, 2019 report to the Commission in Docket U-20463. A fire-gate is a required (49 CFR 192.167) emergency shutdown system that, among other things, is manual or automatic activation that discharges the gas to atmosphere through blowdown piping from the compressor station. Compressor station fire-gate systems are also commonly known as emergency shutdown systems or blowdown systems.

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Staff's Response – Staff is aware of numerous unintended releases of gas from Ray Compressor Station's Plant 3, totaling more than 30 MMcf of gas loss since 2011. Staff will include a further analysis of these types of failures in its subsequent RCA report.

The Origin of the Fire (1)

- Page 2 of Consumers' report states in part that "On Jan. 30, Plant 3 at the Ray Compressor station detected an abnormal operating condition in the Det-Tronics control system."

  Staff's Response – It does not appear that Consumers included an investigation into the abnormal operating condition in the Det-Tronics control system in its report. Staff will include a further analysis of this failure in its subsequent RCA report.

- Page 3 of Consumers' report states in part that "For Ray Plant 3, the natural gas is typically routed through a silencer which reduces the noise produced by the blow down to a level that is less disruptive to the surrounding community than traditional straight pipe high velocity vents. This is accomplished by reducing the velocity as the natural gas is discharged. With the slow exit velocity, the gas flow is more sensitive to the wind which can enhance the mixing of the natural gas with the surrounding air."

  Staff's Response – Consumers does not discuss whether the silencer design and/or location contributed to the incident. It appears that this incident could have been avoided if the silencer had a different design or was installed in a different location. Staff will include a further analysis of the adequacy of the design of the blowdown piping in its subsequent RCA report.

- Page 5 of Consumers' report states in part that "On the morning of Jan. 30 at 10:23:10 a.m. (Times have been normalized to align with the security camera timestamps), the Ray Compressor Station lost the pilot air pressure signal for the Plant 3 fire-gate system. As designed, this triggered Plant 3's process equipment emergency shutdown. The plant experienced a priority 1 fire-gate alarm at 10:25:20 a.m. and the station was blown down at 10:25:33 a.m."

  Staff's Response – Staff was unfamiliar with the pilot air pressure data point. Staff was originally provided with the 10:25:33 a.m. data point as the first data point indicating the activation of the emergency shutdown system. However, Staff was unable to see any significance to the 10:25:33 a.m. time in the data provided. As part of the RCA, Staff will work with Consumers to understand the timeline in relation to the data originally provided.

- Page 6 of Consumers' report states in part that "Personnel at the Ray Plant manually fire-gated Plant 1 and Plant 2, as part of our standard safety protocols, at 10:27:58 a.m. and 10:28:22 a.m., respectively."

  Staff's Response – Staff's investigation identified that Plant 2 actually fire-gated at 10:27:58. Staff was unable to verify the Plant 1 fire-gate time due to that event not being recorded electronically. As part of the RCA, Staff will work with Consumers to understand the timeline in relation to the data originally provided.

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How Consumers Responded to the Fire (2)

- Page 7 of Consumers' report states in part that "It also enabled fast, complete and transparent engagement with the Commission, State Emergency Operations Center (SEOC) and the Governor's office throughout the event."

  Staff's Response – Missing from this assertion is the fact that communication between Consumers and other utilities within the state appears to have been poor. During Staff's investigation of the event, other utilities indicated that Consumers failed to notify them of the seriousness of the situation, in addition to not being provided any advance notice that there was going to be an emergency plea issued to residents within the State, many of whom did not have Consumers as a natural gas provider. Staff recommends to the Commission that this issue be addressed in the Statewide Energy Assessment report (SEA) in Docket U-20464.

The Company's Implementation of Gas Curtailment Procedures (3)

- Page 10 of Consumer's report states in part that "Our actions included initiating pre-curtailment procedures of requesting voluntary reductions of gas usage and implementing an OFO, dispatching peaker fields, purchasing incremental pipeline supply, asking for additional gas supply above the scheduled amount from interconnecting pipelines and implementing a curtailment (as discussed in section 3) pursuant to Rule C3.3 of the Company's natural gas tariffs."[2]

  Staff's Response – Based on the report provided, Consumers took appropriate steps leading up to and implementing a curtailment, including those discussed in the excerpt above. Consumers, however, does not provide statistics pertaining to the overall effectiveness of the mandatory curtailment, such as the load in Priorities Two through Five, as outlined in Rule C3.3, Section F of the Company's Rate Book for Natural Gas Service, that was reduced as a result of the mandate. Further, the report does not describe the enforcement actions taken pursuant to Rule C3.3, Section I, nor does it provide discussion of penalties as described under Rule C3.3, Section J. As such, Staff is unable to opine as to whether the implementation, enforcement actions, and penalties were effective in ensuring curtailment. As discussed later in this response, the subsequent request for assistance from the SEOC and Governor Whitmer indicates that the effectiveness of curtailment could be improved. To this end, Staff recommends that Consumers should continue to evaluate the effectiveness of its curtailment procedures and the Commission may consider recommending a review of all natural gas utility emergency curtailment procedures as part of the SEA report in Docket U-20464.

[2] If implemented by the Company, an Operational Flow Order (OFO) invokes daily-balancing upon transportation customers and allows the Company to limit both transportation and storage customers' daily storage withdrawal volumes to that level authorized by the Company. Peaker fields are Consumers' small storage fields that can deliver a high volume of gas to the system for a short duration and aid in balancing the available gas.

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Evidence of a Failure on the Part of Consumers to Properly Maintain its Equipment or any Non-Compliance with Commission Rules (4)

- Page 10 of Consumers' report states in part that "The current installation meets requirements of Michigan's gas regulations."

  Staff's Response – Considering the origin of the fire (Page 6 of Consumers' report states in part that "[t]he blowdown gas vented through the silencers located at the southwest corner of the station property. This blowdown gas ignited. The wind pushed the flames north eastward. The first visible sign of fire was observed near the Plant 2 thermal oxidizer stack at 10:25:51 am. The fire increased in size and reached the top of the Plant 3 blowdown silencer by 10:26:22 a.m."), it appears that the design does not meet the requirements of 49 CFR 192.167(a)(2).

  49 CFR 192.167(a) states in part that "Each compressor station must have an emergency shutdown system that meets the following: … (2) It must discharge gas from the blowdown piping at a location where the gas will not create a hazard."

Whether the Company Properly Responded to the Natural Gas Shortage (5)

- Page 10 of Consumers' report states in part that "The actions taken by Consumers Energy avoided unplanned customer gas outages due to this event."

  Staff's Response – Staff agrees that there were no systems that completely lost gas and that the actions taken by Consumers, asking customers for voluntary curtailments, were not necessarily inappropriate; however, Staff considers the curtailments, voluntary outages, and voluntary conservation of gas as restrictions put on customers that impacted their ability to conduct business, generate electricity, or maintain their residences at their preferred temperatures during the harsh winter conditions, to be an unacceptable contingency plan. It was the willingness of businesses and residents to voluntarily curtail their gas usage and not solely the actions of Consumers to secure additional sources of supply that allowed the natural gas infrastructure in the State to be able to remain in service.

- Page 11 of Consumers' report states in part that "The system was operating according to plan until 10:28 a.m. (Time based on gas logs; normalized time to video surveillance is 10:33am) on Jan. 30 when Gas Control received a Ray Plant 2 fire-gate alarm and the instantaneous rate at Ray reduced from approximately 1,800 MMcf/day (1.8 Bcf/day) to zero."

  Staff's Response – Staff believes this is referencing the Plant 3 blow down which occurred at 10:25:33 a.m. As part of the RCA, Staff will work with Consumers to understand the timeline in relation to the data originally provided.

Estimated Reductions in Natural Gas Usage (6)

- Page 19 of Consumers' report states in part that "In addition to the statewide emergency alert used by the SEOC, we maintained communications with stakeholders and customers through various media channels throughout the event."

Staff's Response – As previously mentioned, there were significant communication shortcomings between Consumers and the other natural gas providers within the State. Staff recommends to the Commission that this issue be addressed in the SEA report in Docket U-20464.

- Page 19 of Consumers' report states in part that "Our 9:00 p.m. Facebook Live post on Jan. 30 featuring CEO Patti Poppe, drew 5,000 viewers in real time and drew 21 times the average number of impressions (30,000) for a Facebook post."

  Staff's Response – Staff does not agree that 5,000 viewers was significant and asserts that other channels of communication should have been utilized. This is less than one-half of one-percent of Consumers' customers. Staff recommends to the Commission that this issue be addressed in the SEA report in Docket U-20464.

- Page 19 of Consumers' report states in part that "Over the two days we sent 1 million emails to residential customers and 70,000 emails to business customers."

  Staff's Response – This seems to conflict with the 535,000 residential and business emails referenced on page 26. A better data point for email notification would be the number of households contacted. This would help reduce the inaccuracies of multiple emails sent to the same email address and for where there may be more than one email address per account.

Coordination and Communication with State of Michigan Officials and Local Emergency Response Agencies (7)

- Page 16 of Consumers' report states in part that "Given the adverse pressure trends shown in Figure 9, we worked with the SEOC and Gov. Whitmer's office around 8:00 p.m. to utilize the Emergency Broadcast System along with public appeals from CEO Patti Poppe and Gov. Whitmer to ask residential customers to help reduce natural gas usage."

  Staff's Response – Because system pressure was dropping since 11:00 a.m. on January 30, 2019, it may have been prudent to discuss options for public service announcements prior to 8:00 p.m., likely gaining better understanding and broader acceptance from Michigan residents.

- Page 20 of Consumers' report states in part that "Consumers Energy quickly established an ICS structure with a meeting cadence designed to support ongoing and transparent briefings to the MPSC, State and Local Emergency Operations Centers (EOC), the Governor's office, the Michigan State Police and state and federal legislators."

  Staff's Response – Consumers maintained a comprehensive communication strategy with state and local officials, including the Governor's Office, MSP, Commission, county emergency managers (EM), etc., throughout the event. The establishment of an on-site subject matter expert at the SEOC was met in a timely fashion and proved useful.

  However, lack of coordinated conversations sometimes led to overlapping or conflicting information being shared with state entities and leadership. This inefficiency leads to confusing narratives, timelines, and wasted resources. At times, Consumers had conversations with 1) Governor's office, 2) Legislature, 3) Michigan Public Service Commissioners, 4) Staff at SEOC, and 5) Commission Gas Operations Staff.

Efforts should be made to streamline these paths for future emergency events.

- Page 21 of Consumers report states in part that "Many communications occurred throughout the event to update the SEOC, local EOCs and the Michigan State Police on the Ray plant and natural gas system. Our Director of Corporate Security, Public Safety Outreach team and senior leaders exchanged multiple calls with the Michigan State Police to provide status updates, discuss potential community impacts, ensure support for local and SEOCs and answer questions."

  Staff Response – Although communication with Commission, MSP and local EMs was frequent and comprehensive, Consumers incorrectly identified areas of concern for loss of residential natural gas service. This resulted in some counties needlessly preparing for potential loss of residential service (e.g., warming centers, evacuations, etc.) and others not preparing at all. Ensuring proper identification and communication of risk is a critical component of maintaining proper situational awareness.

  Staff recommends to the Commission that the issues associated with coordination and communication be addressed in the SEA report in Docket U-20464.

Actions Directed Toward Physical Security and Cybersecurity (8)

- Page 22 of Consumers' report states in part that "Corporate Security dispatched three Corporate Security personnel to the site to assist in the response to the incident. Corporate Security also arranged for two private security personnel to be on site 24 hours a day during the event and subsequent response."

  Staff's Response – Staff notes that Consumers' efforts to leverage internal and external physical security personnel, the site's physical intrusion detection systems, and law enforcement resources helped manage the incident and contributed to the protection of public health and safety.

- Page 22 of Consumers' report states in part that "Cybersecurity was not initially involved during the first day of the incident as there was no indication that anything malicious occurred. While there continued to be no indication of malicious activity, we felt it best to conduct a deep-dive analysis to rule out a cyberattack as a root cause or contributing factor."

  Staff's Response – Staff contends that Consumers' decision to do a "deep-dive" cybersecurity review was warranted and appropriate. It notes, however, that "indications of malicious activity" should not be viewed as a critical element to initiate such a review. Staff argues this partly because the current threat environment demands an increasingly proactive cybersecurity approach, and partly because sophisticated actors take great care to mask their malicious actions.

Staff recommends to the Commission that the issues associated with security be addressed in the SEA report in Docket U-20464.

Total Cost of the Incident (9)

- Page 23 of Consumers' report states in part that "The incremental cost of these purchases compared to the cost of gas in storage at the time was approximately $7.2 million." Page 24 of Consumers' report states in part that "Immediately after the Ray Compression Station fire, we estimated a high level $18 million risk based on whether the Ray Plant 2 dehydration system would have to be replaced ($14 million) and repair/replacement of the Ray Plant 3 support systems ($4 million). The project team is working on an order of magnitude, scope and forecast. We expect to refine the costs in the near future as more information is gathered."

  Staff's Response – Staff will review the prudency of these costs in the Company's next general rate case, power supply cost recovery case, and/or gas cost recovery case.

Outline of the Process and Anticipated Timeline for the Subsequent Root Cause Analysis Report

As of the date of this filing, Staff has performed the onsite incident investigation and has attended follow-up meetings in person and remotely. Subsequent to these submittals in response to Docket U-20463, as part of the RCA, Staff will work with Consumers to fully understand any remaining discrepancies and newly identified facts. Staff will then begin to draft its RCA report immediately after these follow-up meetings. It is Staff's intention to have a preliminary draft of the incident report no later than 60 days after the last investigation piece has concluded. Staff is expecting to finalize its report by January 1, 2020.

Recommend Changes to Utility Operations or Procedures

At this point in Staff's investigation, it appears that the blowdown silencer for Ray Plant 3 that was designed and placed into service in 2013 was located where gas would be discharged at a location where it could create a hazard due to its proximity to the thermal oxidizer. The decreased discharge velocity of the silencer design, in conjunction with the close proximity to a competent ignition source, allowed a gas plume to ignite. **Staff recommends that Consumers perform a system-wide study of compressor station blowdown methods and locations. The blowdown method considerations should include discharge velocity, volumetric flow characteristics, height of discharge, plume modeling, etc. The blowdown locations should be evaluated considering proximity to competent ignition sources, including equipment that can meet or exceed natural gas auto-ignition temperatures, open flames or sparks, and potential static electricity discharge. This study should include consideration of single failure of components that may have designs protecting against these ignition sources from being**

exposed to atmosphere. Consumers should then develop an action plan to remediate all such instances identified in this study.

Conclusions

Although the ignition did not involve personal injury nor complete system outages, Staff contends that there was a potential for injuries or fatalities and larger scale outages. In addition to the root cause analysis, Staff requests that Consumers specifically focus on factors that could have increased the significance of this incident. Consumers should implement countermeasures to its findings to all facilities within its system. Consumers should also communicate lessons learned and best practices to its industry peers in Michigan and elsewhere to help ensure safe and reliable natural gas transportation. Subsequent to this response, the Commission will be submitting its Statewide Energy Assessment in response to Docket U-20464. Staff will also be working with Consumers to fully understand any remaining discrepancies and newly identified facts related to this incident and will subsequently be drafting its RCA report in the coming months. At the completion of the RCA report, Staff plans to identify potential violations and make additional recommendations based on the final conclusions of the RCA report.

Consumers Energy
Count on Us

A CMS Energy Company

General Offices:
One Energy Plaza Tel: (517) 788-0550
Jackson, MI 49201 Fax: (517) 768-3644

*Washington Office:
1730 Rhode Island Ave. N.W. Tel: (202) 778-3340
Suite 1007
Washington, DC 20036 Fax: (202) 778-3355

Writer's Direct Dial Number: (517) 788-0835
Writer's E-mail Address: bret.totoraitis@cmsenergy.com

May 30, 2019

Ms. Kavita Kale
Executive Secretary
Michigan Public Service Commission
7109 West Saginaw Highway
P.O. Box 30221
Lansing, MI 48909

RE: **Case No. U-20463 - In the matter, on the Commission's own motion, to commence an investigation into a January 30, 2019 fire at Consumers Energy Company's Ray Compressor Station in Macomb County.**

Dear Ms. Kale:

Enclosed for electronic filing in the above-captioned case is **Consumers Energy Company's Reply to the Commission Staff's Response and Stakeholder Comments.**

This is a paperless filing and is therefore being filed only in PDF format.

Sincerely,

Bret Totoraitis
Digitally signed by
Bret A. Totoraitis
Date: 2019.05.30
14:13:27 -04'00'

Bret A. Totoraitis

Consumers Energy Company’s Reply to the Commission Staff’s Response and Stakeholder Comments

MPSC Case No. U-20463

May 30, 2019

<u>Consumers Energy Company's Reply to the Commission Staff's Response and Stakeholder Comments</u>

Consumers Energy Company ("Consumers Energy" or the "Company") thanks the Michigan Public Service Commission ("MPSC" or the "Commission") Staff ("Staff"), the Office of the Attorney General, and the Association of Businesses Advocating Tariff Equity for their comments on its April 5, 2019 Ray Compressor Station Fire Report (MPSC Case No. U-20463).

The Company's ongoing after-action reviews of the event continue to yield findings in addition to those included in the April 5 Fire Report; and the new information enables the Company to respond more comprehensively to Staff comments. This Reply to Staff's Response will review these new findings and lessons learned, provide insight into activities undertaken and planned since the event, and articulate the Company's commitment to continue meeting timely with Staff to ensure a satisfactory resolution for all stakeholders.

<u>New Findings, Consequent Actions and Lessons Learned</u>

Consumers Energy's ongoing investigation into the origin of the fire has revealed that a grounding fault was the underlying cause of the initial firegate event. When the station's well pump started up, its variable frequency drive caused a voltage spike in the grounding system of the Det-tronics panel located in the headquarters building. These high voltages caused enhanced discrete input/output (EDIO) and analog input module (AIM) modules to lose communication with the Det-tronics pilot air system, a fault which triggered the initial firegate.

To eliminate the grounding voltage into the Det-tronics system, the well pump pressure switch and pressure transmitter will be relocated to the east side of the plant 3 auxiliary building (Figure 1). The risk of a communications break-down between the pilot air system and its modules has been mitigated by relocating the modules from the headquarters building to the plant 3 auxiliary building.

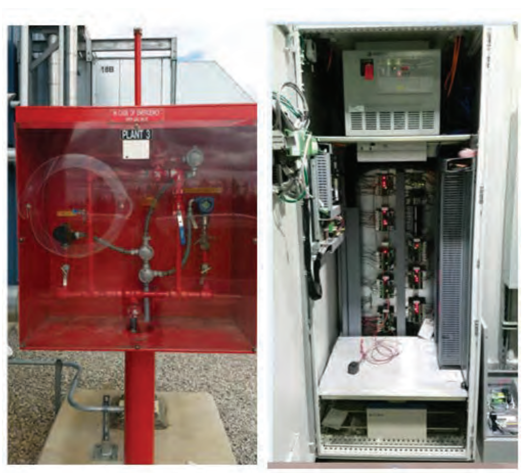

Figure 1. Relocated controls

Consumers Energy has contracted with an engineering firm and is collaborating to develop an air/gas dispersion model that illustrates how the fire occurred, evaluates the condition of affected facility components, and identifies designs that provide better mitigation. The model revealed a better design for gas dispersion pipes. New straight pipes, which allow gas to exit at a high velocity, have been installed at the Ray Compressor Station (Figure 2) in conformity with this finding. Future gas ejections will reach a higher elevation before mixing with enough air to become combustible. The Company continues to model additional scenarios for analysis and, by year end, will have developed a standard for Plant Hazard Analysis that will apply to all future projects and sites.

Figure 2. Old and new straight pipe designs

Ongoing after-action review of the event flagged many of the same opportunities for improvement that Staff recommended in its Response, particularly including the portions of the Company's Incident Command System ("ICS") pertaining to incident action planning, resource management, interagency coordination, crisis communication, and business continuity. Company employees made good-faith efforts to supply clear, transparent, and accurate information as quickly as it became available, and reached out to each of these stakeholders, but the rapidly changing status at Ray Compressor Station, and throughout the gas delivery system, resulted in those communications not always being consistent and contemporaneous. Differences in the communications' content, timing, and source generated unnecessary confusion. Consumers Energy welcomes the opportunity to work with Staff, state officials and emergency responders on improving its ICS communication activities going forward. The Company further commits to continuing to work with Staff to ensure accurate and timely reporting of information.

The fire has prompted the Company to begin a review of its curtailment procedures, including the tariff provision relating to operational flow orders. The event raised questions about the effectiveness of the existing tariff procedures in emergencies, and the Company welcomes the opportunity to ensure that its curtailment tariff enables it to operate safely and minimize customer disruptions during extraordinary circumstances. If the Company's ongoing review indicates a need for improvements, Consumers Energy will file proposed changes to the tariff in a future gas rate case. Company employees are also exploring the potential to add new demand response and interruptible provisions to its tariffs to add customer value and reduce the impact of future disruptions.

Consumers Energy concurs with Staff's recommendation that, in addition to the root cause analysis, the Company should review factors that could have increased the significance of this incident and identify potential countermeasures. Consumers Energy looks forward to collaborating with Staff to implement the recommended improvements and renew its commitment to deliver natural gas safely and reliably, especially during extreme winter weather when customers need it most.

Other Activities Undertaken Since the Event

Consumers Energy took the opportunity to listen to and learn from residents affected by the fire. On May 16, 2019, Consumers Energy hosted a Community Open House in Armada, Michigan, where the Ray Compressor Station is located. The event was attended by the members of more than 20 households, who interacted with Company employees at "conversation stations." Each of these stations was staffed by Company subject matter experts equipped to answer questions about a specific topic: what a compressor station is and how it works, what happened at Ray Compressor Station on January 30, 2019, and how the Company has responded to the event. Consumers Energy acknowledges the value of the community perspectives provided at this event.

Internally, the Company has continued to review both the events leading to the Ray Compressor Station fire, its response to the incident, and how its facilities, policies, and procedures can be revised to function as effectively as possible in all conditions. This information gathering has resulted in a change in the layout at the Ray Compressor Station, an evaluation of changes potentially needed at other facilities, and plans to make both the improvements cited in this Reply and others to be agreed upon in future discussions with Staff.

Consumers Energy's Commitment to Stakeholders

Extraordinary circumstances on the morning of January 30, 2019 created an emergency with unfortunate consequences for Michigan families and businesses. The Company was prepared with a significant contingency supply of gas to keep customers safe, warm, and productive – even during the extreme cold predicted for that day. Nevertheless, Consumers Energy customers had to cope with voluntary and involuntary reductions in gas consumption during dangerous winter weather. For this, the Company gratefully acknowledges impacted businesses and residents for their help. While the Company did not plan or expect to have to call on its customers, this cooperation helped to stabilize the system and was an important aid in restoring service as soon as possible.

While Consumers Energy is proud of how well its employees executed their emergency plans, it also acknowledges that events such as the Ray Compressor Station fire provide critical opportunities to identify and mitigate previously unforeseeable risks. The Company commits to making the improvements revealed by this event, and to working closely with Staff to ensure that all stakeholders can continue to count on Consumers Energy.

S T A T E O F M I C H I G A N

BEFORE THE MICHIGAN PUBLIC SERVICE COMMISSION

* * * * *

In the matter, on the Commission's own motion, to commence an investigation into a January 30, 2019 fire at **CONSUMERS ENERGY COMPANY's** Ray Compressor Station in Macomb County.	)))))	Case No. U-20463

At the July 2, 2019 meeting of the Michigan Public Service Commission in Lansing, Michigan.

PRESENT: Hon. Sally A. Talberg, Chairman
Hon. Norman J. Saari, Commissioner
Hon. Daniel C. Scripps, Commissioner

ORDER

Procedural History

At approximately 10:30 a.m. on January 30, 2019, a fire occurred at Consumers Energy Company's (Consumers) Ray Natural Gas Compressor Station in Macomb County (the Ray facility). As a result of the fire, equipment was damaged, and Consumers stopped gas flow from the compressor station into the company's gas distribution system. The Ray facility supplies a significant portion of Consumers' natural gas to serve its 1.6 million customers' needs during peak winter periods. The fire and shutdown of the Ray facility occurred at a time of unprecedented demand in natural gas usage due to extremely cold weather conditions on January 30 and 31, 2019. To ensure continued delivery of natural gas during this emergency, Consumers arranged to receive alternative supplies from natural gas pipelines and other storage fields, limited natural gas used for electricity production, coordinated with large commercial and industrial customers to curtail usage, and requested that all customers conserve energy. Late on January 30, 2019, Consumers resumed operation of Plant 1 of the Ray facility; however, the other two plants continued to be inoperable due to the fire. To ensure the stability of the natural gas system and avoid a potentially life-threatening situation with forced outages of natural gas service to residential customers, the Michigan State Police (MSP) issued an emergency alert to cellular phones in the Lower Peninsula of Michigan asking residents to reduce their home thermostats to 65 degrees or less. Governor Gretchen Whitmer called on Michigan residents to do the same through the media. At 12:00 a.m. on Friday, February 1, 2019, Consumers resumed normal natural gas delivery operations.

Given the significance of this emergency event, the Commission opened this docket on February 7, 2019 (February 7 order) for the purpose of investigating the fire to determine: Consumers' response to the fire, the company's gas curtailment procedures, whether there is evidence of a failure by Consumers to properly maintain its equipment or any non-compliance with Commission rules, the total cost of the incident, and other related issues. In the February 7 order, the Commission directed Consumers to file a report in this docket addressing these issues and provided the Commission Staff (Staff) and stakeholders an opportunity to file a response to the company's report. The Staff's response was to include an anticipated timeline for the subsequent Root Cause Analysis (RCA) Report that the Commission's Gas Operations Section will provide, and any potential changes to utility operations or procedures, if such changes are identified. The February 7 order also allowed Consumers to file a reply to the Staff's response and stakeholder input.

On April 5, 2019, Consumers filed a timely report addressing the items set forth in the February 7 order. The Staff filed a timely response to the company's report on May 8, 2019. The Michigan Department of the Attorney General (Attorney General) and the Association of

Businesses Advocating Tariff Equity (ABATE) filed comments in response to Consumers' report on May 8 and 9, 2019, respectively. On May 30, 2019, the company filed a timely reply to the Staff's response and the Attorney General's and ABATE's comments.

"Consumers Energy Company's Ray Compressor Station Fire, Jan. 30, 2019" Report and the Commission Staff's Response

Consumers' report and the Staff's response address the items identified by the Commission for investigation in the February 7 order, *ad seriatim*.

1. Origin of the Fire

Consumers states that, at approximately 10:23 a.m. on January 30, 2019, "Plant 3 at the Ray Compressor station detected an abnormal operating condition in the Det-Tronics control system. As part of the emergency safety fire-gate process, the plant released natural gas into the atmosphere through Plant 3 blowdown silencers." Consumers' report, p. 2. The company believes that, due to prevailing wind conditions, the natural gas that was released from the fire-gate process was carried over the Plant 2 processing equipment. According to Consumers, at approximately 10:25 a.m., the first visible sign of fire was observed near the Plant 2 thermal oxidizer, leaving the company to conclude that the Plant 2 thermal oxidizer's exhaust stream auto-ignited the gas plume. The company avers that, as part of its standard safety protocols, personnel at the Ray facility manually fire-gated Plant 1 and Plant 2 at approximately 10:27 a.m. and 10:28 a.m., respectively. Consumers states, "there was a second ignition at the Plant 2 vent stack, which is located next to Plant 3's blowdown silencers and is the location where the natural gas is released for Plant 2 . . . . The flames extinguished when the natural gas was completely vented. The fire department arrived on scene at 10:38 a.m. and left at 3:34 p.m." *Id*., p. 6.

In response, the Staff contends that, regarding the "abnormal operating condition in the Det-Tronics control system," Consumers did not include in its report an investigation of this unusual condition. Staff's response, p. 7, quoting Consumers' report, p. 2. In addition, the Staff notes that the company failed to discuss whether the design and/or location of the silencer at Plant 3 contributed to the fire at the Ray facility. The Staff asserts that it will address these two issues in its RCA report and will work with Consumers to further understand the timeline of the Ray facility event in relation to the data originally provided.

2. Response to the Fire, Both at the Site and at Consumers Energy Company's Corporate Office

Consumers states that, since 2014, it has developed and improved emergency management through the use of an Incident Command System (ICS). In response to the January 30, 2019 incident at the Ray facility, the company activated the Crisis Management Team, which was comprised of senior level executives, who classified the incident as an ICS Level 3 – Full Scale Activation. Because the incident was classified as Level 3, the company notes that the ICS structure included a command post and an Emergency Operations Center (EOC). Consumers explains that the Ray Command Post assigned roles to form a chain of command and general staff, and the ICS team established a formal incident action plan, which included situational summaries, high level objectives, and tactics, and set forth the ICS structure. Consumers' report, p. 7. The company states that "the EOC worked to support the Ray Command Post and manage the larger impact on the gas supply system." *Id*. Consumers asserts that the incident action plans "provided a clear operating picture to help guide the response and deliver consistent, accurate communication. This communication followed a clear path from the Ray Command Post to the EOC to the Crisis Management Team." *Id*. In addition, the company believes that the ICS structure supplied a method of rapid, comprehensive, and transparent communication with the Commission, the State Emergency Operations Center (SEOC), and the Governor's office. Finally, Consumers avers that the safety plans developed by the safety officers minimized risks for employees and the public.

Although the company stated that it provided swift, comprehensive, and transparent communication with the Commission, SEOC, and the Governor's office, the Staff argues that Consumers' communication with other Michigan utilities was deficient. The Staff states that "other utilities indicated that Consumers failed to notify them of the seriousness of the situation, in addition to not being provided any advance notice that there was going to be an emergency plea issued to residents within the State, many of whom did not have Consumers as a natural gas provider." Staff's response, p. 8. The Staff recommends that this issue be addressed in the Statewide Energy Assessment (SEA) report in Case No. U-20464.

3. Implementation of Gas Curtailment Procedures

The company states that, on the morning of January 30, 2019, Consumers' Business Customer Care (BCC) received an alert that there was an incident at the Ray facility and that gas curtailment may be necessary. In its report, Consumers details a timeline of events and actions taken by BCC. *See*, Consumers' report, p. 9. According to the company, after notification of the incident, BCC compiled a curtailment customer list, posted notification of the operational flow order (OFO) to the information posting website, and aligned team leadership. Then, Consumers asserts that the team began contacting the highest volume customers to request voluntary gas load reductions to mitigate stress on the depleting natural gas supply. However, the company states that by the afternoon of January 30, 2019, low-pressure concerns on the gas distribution system required formal curtailment by some customers. Consumers contends that the curtailment continued throughout the day on January 31, 2019, and was formally lifted as of 12:00 a.m. on February 1, 2019. The company also notes that it "communicated with MISO [Midcontinent Independent

System Operator, Inc.] to determine the need to continue to serve Michigan natural gas-powered power plants during the curtailment," and concluded that Midland Cogeneration Limited Partnership could operate without using gas supply by Consumers for electric generation, Kalamazoo River Generating Station could shut down, and other natural gas plants on the company's system could reduce usage, but continue to generate power. Consumers' report, p. 9.

The Staff commends Consumers' efforts leading up to, and implementing, the curtailment. However, the Staff notes that the company failed to:

> provide statistics pertaining to the overall effectiveness of the mandatory curtailment, such as the load in Priorities Two through Five, as outlined in Rule C3.3, Section F of the Company's Rate Book for Natural Gas Service, that was reduced as a result of the mandate. Further, the report does not describe the enforcement actions taken pursuant to Rule C3.3, Section I, nor does it provide discussion of penalties as described under Rule C3.3, Section J.

Staff's response, p. 8. As a result, the Staff is unable to evaluate "whether the implementation, enforcement actions, and penalties were effective in ensuring the curtailment." *Id*. And, because Consumers had to request assistance from the SEOC and the Governor's office, the Staff believes that the company's curtailment procedures could be improved. Therefore, the Staff recommends that Consumers evaluate the effectiveness of its curtailment procedures and that the Commission consider reviewing all natural gas utility emergency curtailment procedures in the SEA report in Case No. U-20464.

4. Whether There is Evidence of a Failure to Properly Maintain Equipment or any Non-compliance with Commission Rules

Consumers contends that, based on its review of the incident at the Ray facility, there is no evidence that the company failed to properly maintain its equipment. According to the company, the "current installation meets [the] requirements of Michigan's gas regulations. Additional design enhancements are being considered for current and future installations as we incorporate this most recent event into our plan-do-check-act cycle." Consumers' report, p. 10.

The Staff disputes Consumers' claim that the "'current installation meets [the] requirements of Michigan's gas regulations.'" Staff's response, p. 9, quoting Consumers' report, p. 10. The Staff notes that the cause of the fire appears to have been a gas plume from a blowdown of gas that was vented through silencers, which was then ignited by the exhaust from a nearby thermal oxidizer. According to the Staff, the design of the compressor station does not meet the requirements of 49 CFR 192.167(a)(2), which states in part: "Each compressor station must have an emergency shutdown system that meets the following: . . . (2) It must discharge gas from the blowdown piping at a location where the gas will not create a hazard." *Id*., p. 9.

5. Whether Consumers Energy Company Properly Responded to the Natural Gas Shortage

As a result of the Ray facility incident, Consumers states that it was unable to deliver approximately 900 million cubic feet (Mmcf) of natural gas between January 30 and 31, 2019. In response, the company contends that it implemented measures that avoided unplanned customer gas outages and ensured service to residential and vulnerable customers during an extremely cold weather event.

Consumers asserts that, at the beginning of the cold weather pattern on January 30, 2019, prior to the Ray facility incident, the company had sufficient working gas inventory in storage to meet the demand for that 24-hour period. The company avers that the system was operating according to plan until the Ray facility incident at approximately 10:30 a.m. on January 30, 2019. Then, Consumers explains, "the loss of Ray flow caused the system to begin unpacking at an excessive rate. Unpacking means the amount of gas and the available pressure in the pipeline system are decreasing. . . . The loss of Ray and the rate at which the pipeline system was unpacking caused key system pressures to decline at excessive rates." Consumers' report, p. 11.

The company states that, after the Ray facility fire-gate alarm was received at approximately 10:41 a.m. on January 30, 2019, Consumers' Gas Control Center (GCC) dispatched all peaking storage fields at maximum flow rates, which added approximately 975 MMcf per day to the system and reduced the unpack rate. However, Consumers notes that the peaking capacity "was forecasted to decline by approximately 500 MMcf/day by the next morning's peak hour as field inventories depleted." *Id*., p. 12. As a result, the company avers, its GCC contacted the owners of five major pipelines that interconnect with Consumers' system and they agreed to assist the company on a best-efforts basis. In addition, Consumers asserts that additional gas supply was needed and, therefore, Gas Supply began the procurement process. The company notes that gas deliveries must be scheduled by the North American Energy Standards Board nomination deadline of 11:00 a.m. Because of the short time line, Consumers explains that it was forced to schedule procured gas at 3:30 p.m. for delivery no earlier than 7:00 p.m. on January 30, 2019.

The company also states that it employed pre-curtailment and an OFO notification, and explored other potential supply options, such as diverting gas supply from the company's Zeeland and Jackson gas-fired electric generating plants. However, the company asserts that there were "upstream interstate capacity constraints which prevented the diversion of Zeeland supply. Gas Supply was able to procure an additional 31 MMcf/day by diversion away from the Jackson plant." *Id*., p. 15.

When key gas pressures dropped within the southeast market area and the Lansing region, Consumers states that it began implementing formal curtailment pursuant to Rule 3.3 of the company's natural gas tariffs. The company avers that it added interruptible supply contracts to access gas supply on an interstate pipeline that could have sufficient capacity. According to Consumers, "[o]f the 925 MMcf/day procured, approximately 80% was confirmed in the scheduling process and 61% — or 564 MMcf/day — was ultimately delivered." *Id*.

The company notes that from 12:00 p.m. to 9:00 p.m. on January 30, 2019, system pressures continued to drop and pipeline gas supply increased less than expected. Therefore, Consumers states that, in coordination with the SEOC and the Governor's office, the company employed the Emergency Broadcast System and appealed to the public to reduce gas usage. The company asserts that, at approximately 10:40 p.m. on January 30, 2019, the Ray facility "was able to provide about 30% of its originally intended supply through the minimally damaged Plant 1 unit. This supply — combined with the reduction of demand and the receipt of growing pipeline supply — enabled Gas Control to stabilize at-risk areas in the statewide system and repack the entire network." *Id*., p. 17. According to Consumers, because of the actions taken on January 30, 2019, the demand reduction measures could be lifted at 12:00 a.m. on February 1, 2019, which was earlier than expected.

In response to the company's claim that "'[t]he actions taken by Consumers Energy avoided unplanned customer gas outages due to this event . . . ,'" the Staff believes that the curtailments, voluntary outages, and voluntary reductions in gas usage "impacted [customers'] ability to conduct business, generate electricity, or maintain their residences at their preferred temperatures during the harsh winter conditions, to be an unacceptable contingency plan." Staff's response, quoting Consumers' report, p. 10. The Staff asserts that it was the voluntary compliance by businesses and residents that allowed Consumers to avoid an outage, not the company's actions.

6. Estimated Reductions in Natural Gas Usage from Large Customer Curtailments and Residential Conservation Over Time During the Emergency with Corresponding Timeframes of Actions (e.g., Public Appeals, Emergency Alerts) by Consumers Energy Company and the State of Michigan

Consumers explains that the "incident at Ray Compressor Station required a swift and strategic communications response to ensure the safety of those close to the facility, to keep customers abreast of the impact statewide and — perhaps most importantly — to appeal for assistance in managing our natural gas supply amid extreme temperatures." Consumers' report, p. 17. The company states that it utilized a wide variety of media channels, such as social media, digital outreach, news media, and paid media, to reach customers in real time and provide information to stakeholders. Consumers notes that its primary audiences included first responders, key stakeholders, large businesses, and residential customers. *Id*., p. 18.

The Staff notes that Consumers claimed that it "maintained communications with stakeholders and customers through various media channels throughout the event," that the company's live Facebook post regarding the company's response to the Ray facility incident "drew 5,000 viewers in real time and drew 21 times the average number of impressions (30,000) for a Facebook post," and that "[o]ver the two days, [Consumers] sent 1 million emails to residential customers and 70,000 emails to business customers." Staff's response, pp. 9-10, quoting Consumers' report, p. 19. Because 5,000 viewers of the live Facebook post represents less than one half of 1% of Consumers' customers, the Staff argues that this was not a significant or effective communication. And, the Staff states that the one million e-mails to residential customers and 70,000 e-mails to business customers "seems to conflict with the 535,000 residential and business emails referenced on page 26 [of Consumers' report]. A better data point for email notification would be the number of households contacted. This would help reduce the inaccuracies of multiple emails sent to the same email address and for where there may be more than one email address per account." Staff's response, p. 10. Finally, the Staff disputes that Consumers effectively maintained communications with other natural gas providers in the state of Michigan. The Staff asserts that the aforementioned issues should be addressed in the SEA report in Case No. U-20464.

7. Coordination and Communication with State of Michigan Officials and Local Emergency Response Agencies

Consumers asserts that, promptly after the start of the fire at the Ray facility and throughout the duration of the incident, the company "was committed to keeping legislative, regulatory, and emergency officials apprised of the situation at Ray Compressor Station and the status of the natural gas system." Consumers' report, p. 20. According to Consumers, its senior leadership maintained contact with the Governor's senior staff throughout the event, and during the two days following, to provide status updates and explain potential response activities. In addition, shortly after the fire ignited at the Ray facility, the company states that it contacted the Commission to provide status updates and notification of communications and press briefings, and to answer questions. Consumers also notes that its Gas Compliance Technical Analyst and a Gas Safety Engineer from the Commission, along with MSP and the federal Bureau of Alcohol, Tobacco, Firearms and Explosives, met at the Ray facility on January 30 and 31, 2019, to investigate the incident.

The company states that, during the Ray facility incident, it communicated regularly with the SEOC, local EOCs, local fire departments, and MSP to provide system updates, discuss potential community impacts, and answer questions. Additionally, Consumers asserts that, immediately after the beginning of the Ray facility incident, it contacted state and federal legislators to provide an early notification and ongoing system updates.

The Staff notes that Consumers claimed that, because of a continuing reduction in system pressure, around 8:00 p.m. on January 30, 2019, it was necessary to utilize the Emergency

Broadcast System to request that residential customers reduce natural gas usage. The Staff responds that system pressure had been dropping since 11:00 a.m. on January 30, 2019, and it may have been reasonable and prudent for the company to discuss the options for a public service announcement prior to 8:00 p.m. Although the Staff acknowledged Consumers' establishment of the ICS structure and the company's continued communications with state and local authorities and stakeholders, the Staff asserts that the "lack of coordinated conversations sometimes led to overlapping or conflicting information being shared with state entities and leadership. This inefficiency leads to confusing narratives, timelines, and wasted resources." Staff's response, pp. 10-11. The Staff recommends that the company streamline these paths of communication for future emergency events. Additionally, regarding Consumers' claim that it communicated frequently with the SEOC, local EOCs, and MSP, the Staff argues that the company failed to correctly identify areas of concern, which led to "some counties needlessly preparing for potential loss of residential service (e.g., warming centers, evacuations, etc.) and others not preparing at all. Ensuring proper identification and communication of risk is a critical component of maintaining proper situational awareness." *Id.*, p. 11. The Staff recommends that this issue be addressed in the SEA report in Case No. U-20464.

8. Actions Directed Toward Physical Security and Cybersecurity Before, During, and After the Event

Consumers states that when its Security Command Center was notified of the fire at the Ray facility, it immediately responded with a conference call to discuss the incident. According to the company, "Corporate Security dispatched three Corporate Security personnel to the site to assist in the response to the incident. Corporate Security also arranged for two private security personnel to be on site 24 hours a day during the event and subsequent response." Consumers' report, p. 22. The company avers that the additional security staff were still onsite as of April 5, 2019.

Consumers contends that the Ray facility's several security systems were reviewed by the Corporate Security Team after the incident, and the company requested any information relevant to the incident from the Federal Bureau of Investigation and MSP. Consumers asserts that "no known threats were detected." *Id*.

The company also states that it has developed an excellent cybersecurity program, which focuses on prevention, detection, and response to cybersecurity threats. Consumers contends that, "[w]hile there continued to be no indication of malicious activity, we felt it best to conduct a deep-dive analysis to rule out a cyberattack as a root cause or contributing factor. We reviewed all available data from both a system and network perspective and found no indication of malicious activity." *Id*.

The Staff commends Consumers' response to the Ray facility incident for its dispatch of security personnel, the company's review of the physical security system for signs of intrusion, Consumers' engagement of law enforcement for incident management and the protection of public health and safety, and the company's deep-dive cybersecurity analysis. However, the Staff contends that "'indications of malicious activity' should not be viewed as a critical element to initiate such a [deep-dive cybersecurity] review. Staff argues this partly because the current threat environment demands an increasingly proactive cybersecurity approach, and partly because sophisticated actors take great care to mask their malicious actions." Staff's response, pp. 11-12, quoting Consumers' report, p. 22. The Staff recommends that security issues be addressed in the SEA report in Case No. U-20464.

9. Total Cost of the Incident

Consumers states that the total cost of emergency natural gas purchases for January 30 and 31, 2019, was approximately $10.6 million, and the incremental cost of these purchases compared to the cost of gas in storage was approximately $7.2 million. Consumers' report, p. 23. Next, the company explains that some gas transportation customers reduced their consumption in response to the curtailment order and elected to sell excess gas to Consumers. The company avers that the estimated cost of the gas sold to Consumers, through April 5, 2019, is $300,000. Finally, Consumers states that the estimated high level of repair costs for the Ray facility is $18 million. Therefore, according to the company, the total estimated cost of the Ray facility incident is $25.514 million, as of April 5, 2019.

The Staff states that it will review the prudency of Consumers' costs for the Ray facility incident in the company's next general rate case, power supply cost recovery (PSCR) case, and/or gas cost recovery (GCR) case.

Concluding its response to Consumers' report, the Staff provided an outline of the processes and anticipated timeline for the RCA report. The Staff states that it performed an onsite incident investigation and attended follow-up meetings. In addition, the Staff intends to work with Consumers to garner a more complete understanding of any remaining issues and recently discovered facts. The Staff plans to "have a preliminary draft of the incident report no later than 60 days after the last investigation piece has concluded. Staff is expecting to finalize its report by January 1, 2020." Staff's response, p. 12.

The Ray facility incident did not involve personal injury or widescale outages, but the Staff believes there was real potential for more serious consequences. The Staff contends that, at this point in its investigation, the blowdown silencer for Plant 3 was placed in a location where it could create a hazard because of its proximity to the Plant 2 thermal oxidizer. As a result, the Staff recommends that:

> Consumers perform a system-wide study of compressor station blowdown methods and locations. The blowdown method considerations should include discharge

> velocity, volumetric flow characteristics, height of discharge, plume modeling, etc. The blowdown locations should be evaluated considering proximity to competent ignition sources, including equipment that can meet or exceed natural gas auto-ignition temperatures, open flames or sparks, and potential static electricity discharge. This study should include consideration of single failure of components that may have designs protecting against these ignition sources from being exposed to [the] atmosphere. Consumers should then develop an action plan to remediate all such instances identified in this study.

Id., pp. 12-13. Additionally, the Staff requests that Consumers focus on factors that may have contributed to this event, implement countermeasures to its findings, and communicate learned information and best practices to the utility industry. In the event the Staff discovers violations that led to and/or contributed to the Ray facility incident, the Staff will include them with its recommendations at the completion of the RCA report.

<u>Comments in Response to Consumers Energy Company's Report</u>

1. Michigan Department of the Attorney General

On page 1 of the Attorney General's May 8, 2019 comments, she contends that, "[a]t this point, it is hard to make any conclusions regarding the reasonableness and prudence of the Company's actions before and after the fire based simply on a review of the Company's account. While the report provides some useful background information, there may be other facts and issues not addressed by the report that should be evaluated." The Attorney General states that she intends to further monitor the docket in this case and respond to the Staff's report and recommendations, if necessary. She also reserves the right to respond to the Ray facility incident and Consumers' actions in future proceedings.

2. Association of Businesses Advocating Tariff Equity

After reviewing Consumers' report of the Ray facility incident, ABATE argues that a more detailed review of the company's curtailment service is required. Specifically, ABATE asserts that the review should explore whether Consumers' current curtailment program should be expanded, whether the underlying pricing strategy is equitable, and whether the pricing distinguishes between firm and curtailment service, and should also consider the terms under which the company may call curtailments. ABATE's May 9, 2019 comments, p. 3. In addition, ABATE recommends that the Commission examine, in this case or Consumers' next general rate case, OFO curtailments for sales and transportation customers. Finally, ABATE questions the company's method of arriving at a $25.514 million cost for the Ray facility incident. ABATE recommends that, in a future proceeding, the Commission require Consumers to provide a more detailed prudency analysis of its costs for the incident.

3. Other Comments

Dale Puckett, retired former Manager of Gas Control & System Planning for Consumers, filed comments cautioning that the proceeding may become a "vulnerability analysis." Mr. Puckett's February 18, 2019 comments, p. 1. He expresses security concerns regarding the confidentiality of the company's critical assets and requests that the Commission "carefully balance the public's right to know with the enhanced security we need to increase reliability." *Id*.

Consumers Energy Company's Reply to the Michigan Public Service Commission Staff's Response and Other Stakeholders' Comments

Consumers states that, during its ongoing investigation of the Ray facility incident, it discovered that:

> a grounding fault was the underlying cause of the initial firegate event. When the station's well pump started up, its variable frequency drive caused a voltage spike in the grounding system of the Det-tronics panel located in the headquarters building. These high voltages caused enhanced discrete input/output (EDIO) and analog input module (AIM) modules to lose communication with the Det-tronics pilot air system, a fault which triggered the initial firegate.

Consumers' reply, p. 1. To remedy this issue, the company states that it will relocate the well pump pressure switch and pressure transmitter to the east side of the Plant 3 auxiliary building. In addition, Consumers notes that it contracted with an engineering company to develop an air/gas dispersion model that explains the origin of the fire, assesses the condition of the affected facility components, and identifies better facility designs. According to the company, the model revealed a better design for the gas dispersion pipes, which has already been installed at the Ray facility. Consumers states that it "continues to model additional scenarios for analysis and, by year end, will have developed a standard for Plant Hazard Analysis that will apply to all future projects and sites." *Id*., p. 2.

Consumers states that following its review of the Ray facility incident, it identified many of the same issues recognized by the Staff regarding its ICS incident action planning, resource management, interagency coordination, crisis communication, and business continuity. The company avers that it made "good-faith efforts to supply clear, transparent, and accurate information as quickly as it became available, and reached out to each of these stakeholders, but the rapidly changing status at Ray Compressor Station, and throughout the gas delivery system, resulted in those communications not always being consistent and contemporaneous." *Id*. Consumers contends that it plans to work with the Staff, state and local officials, and emergency responders to improve its ICS communications going forward.

The company is reviewing its curtailment procedures, including the tariff provision for OFO, and is evaluating "the effectiveness of the existing tariff procedures in emergencies . . . ." *Id*. Consumers states that, if it determines that improvements are necessary, it will propose changes in a future gas rate case. The company is also investigating new demand response and interruptible provisions for its tariffs.

Consumers notes that on May 16, 2019, it hosted an open house to meet with and answer questions from residents who were affected by the fire. In addition, the company states that it continues to review the Ray facility incident, plans to work with the Staff to implement recommended improvements, and intends to try to identify and mitigate previously unforeseeable risks.

Discussion

As a threshold matter, the Commission expresses its significant disappointment with the limited nature of Consumers' April 5, 2019 initial report and its three-page May 30, 2019 reply to the responses and comments filed by the Staff, Attorney General, and ABATE. Given the seriousness of the fire incident at the Ray facility and the near calamitous consequences that followed, the brevity of the company's response suggests a failure to truly reflect on the scope and scale of the incident or to take corrective measures necessary to ensure that the incident does not reoccur in the future.

The Commission has reviewed Consumers' report, the Staff's response, stakeholder comments, and the company's reply. The items identified in the February 7 order are addressed *ad seriatim*, followed by additional findings and recommendations.

1. Origin of the Fire

In its initial report, Consumers determined that the origin of the fire was a failure in the Det-Tronics control system, which initiated the emergency safety fire-gate process and caused the release of natural gas into the atmosphere through Plant 3 blowdown silencers, which was then ignited by the Plant 2 thermal oxidizer exhaust system. Through subsequent investigation, the company states that it identified a grounding fault as the underlying cause of the initial firegate event. Consumers asserts that it has relocated the well pump pressure switch and pressure transmitter to eliminate future grounding fault issues. In addition, the company avers that it has contracted with an engineering firm to evaluate the origin of the fire and improve facility design;

some improvements have already been identified and installed. As noted by the Staff, the issues with the Det-Tronics control system and the blowdown silencers will be further addressed in the RCA report. Notwithstanding, as discussed on page 23, the Commission is directing Consumers to conduct a system-wide evaluation of compressor blowdown methods and locations.

2. Response to the Fire, Both at the Site and at Consumers Energy Company's Corporate Office

Consumers provided a limited overview of its ICS structure and how the process was implemented during the Ray facility incident. The Staff contends that communication between the company and other utilities needs improvement, and Consumers agreed to work with the Staff on this issue.

To begin, the Commission finds that a utility's energy emergency communication plan should include other utilities impacted by the emergency so that statewide pleas for curtailment are received by other utilities and the curtailment message is consistent throughout the utility industry. Next, although a number of the company's ICS issues shall be addressed in the initial and final SEA reports filed in Case No. U-20464, the Commission finds that Consumers' ICS structure and process needs additional improvement. Therefore, Consumers shall conduct, preferably through an independent third-party, an evaluation of the company's ICS and procedures, and shall prepare a report that includes: (1) an evaluation of the company's response to the incident at the Ray facility and (2) recommendations for improving the company's procedures for activation and operation of its ICS. The report shall be filed no later than 5:00 p.m. (Eastern time) on November 1, 2019, in this docket. The Commission also instructs the Staff to examine records and information on Consumers' ICS and implementation.

3. Implementation of Gas Curtailment Procedures

In response to the Ray facility incident, the company implemented gas curtailment to certain customers. However, the Staff asserts that, from the information provided in Consumers' report, it was unable to determine whether implementation, enforcement actions, and penalties were effective in ensuring curtailment. The company replied that it was reviewing its curtailment procedures and possible tariff updates.

ABATE asserts that the Commission should determine whether Consumers' current curtailment program should be expanded, whether the underlying pricing strategy is equitable, and whether the pricing distinguishes between firm and curtailment service, and should also consider the terms under which the company may call curtailments. In addition, ABATE recommends that the Commission examine, in this case or Consumers' next general rate case, OFO curtailments for sales and transportation customers.

These issues, including the Commission's preliminary findings, are addressed in the initial SEA report that was filed on July 1, 2019, in Case No. U-20464. The final report and specific directives will be issued on or before September 13, 2019, in Case No. U-20464.

4. Whether There is Evidence of a Failure to Properly Maintain Equipment or any Non-compliance with Commission Rules

Although Consumers contends that there is no evidence that the company failed to properly maintain its equipment, the Staff argues that design elements of the Ray facility appear to violate 49 CFR 192. The Commission directs the Staff to include analyses and findings in its RCA report regarding the company's compliance with the Michigan Gas Safety Standards and incorporated requirements of 49 CFR 192 at the Ray facility.

5. Whether Consumers Energy Company Properly Responded to the Natural Gas Shortage

To offset the natural gas shortage, Consumers states that it arranged alternative supplies from natural gas pipelines and other storage fields, limited natural gas used for electricity production, coordinated with large commercial and industrial customers to curtail usage, and requested that all customers conserve energy. The Staff agrees with the company that there were no forced system outages; however, the curtailments, voluntary outages, and voluntary reductions in gas usage affected customers' ability to conduct business, generate electricity, and maintain the temperature in residences. Consumers responds that it continues to review the incident and plans to work with the Staff to implement improvements.

A number of these issues, including the Commission's initial findings, are addressed in the initial SEA report that was filed on July 1, 2019, in Case No. U-20464. The final report and specific directives will be issued on or before September 13, 2019, in Case No. U-20464.

6. Estimated Reductions in Natural Gas Usage from Large Customer Curtailments and Residential Conservation Over Time During the Emergency with Corresponding Timeframes of Actions (e.g., Public Appeals, Emergency Alerts) by Consumers Energy Company and the State of Michigan

According to the company, it utilized a wide variety of media channels, such as social media, digital outreach, news media, and paid media, to reach customers in real time and to maintain transparency with stakeholders. Consumers' primary audiences included community and state first responders, key stakeholders, large businesses, and residential customers. The Staff disputes the effectiveness of the company's communication strategy and suggested improvements.

In retrospect, Consumers' communications did not adequately convey messages that could have better prepared the public to accommodate the broad appeal to conserve gas. The Commission's initial findings on this issue are set forth in the initial SEA report that was filed on

July 1, 2019, in Case No. U-20464. As noted above, the final report and specific directives will be issued on or before September 13, 2019, in Case No. U-20464.

7. Coordination and Communication with State of Michigan Officials and Local Emergency Response Agencies

Consumers states that it maintained contact with the Commission, the Governor's office, the SEOC, local EOCs, local fire departments, and MSP throughout and after the Ray facility incident to provide status updates, notification of communications and press briefings, and to answer questions. The Staff asserts that the company could improve the timeframe and effectiveness of its communications during emergency events.

The Commission's initial findings on this issue are addressed in the initial SEA report that was filed July 1, 2019, in Case No. U-20464. The final report and specific directives will be issued on or before September 13, 2019, in Case No. U-20464.

8. Actions Directed Toward Physical Security and Cybersecurity Before, During, and After the Event

Consumers states that, in response to the incident, it sent three corporate security personnel to the site, it arranged for two private security personnel to be onsite 24 hours a day during the event, and that additional security staff was still onsite as of April 5, 2019. In addition, the company asserts that there was no indication of malicious activity, and Consumers did a deep-dive analysis to rule out a cyberattack as a root cause or contributing factor. The Staff contends that, even in the absence of indications of a malicious attack, the company should be conducting thorough cybersecurity analyses.

These issues, including the Commission's initial findings, are addressed in the initial SEA report that was filed July 1, 2019, in Case No. U-20464. As noted above, the final report and specific directives will be issued on or before September 13, 2019, in Case No. U-20464.

9. Total Cost of the Incident

Consumers states that, as of April 5, 2019, the total estimated cost of the Ray facility incident is $25.514 million. The Staff states that it will review the prudency of Consumers' costs for the Ray facility incident in the company's next general rate case, PSCR case, and/or GCR case. ABATE recommends that, in a future proceeding, the Commission require Consumers to provide a more detailed prudency analysis of the costs for the incident.

The Commission directs Consumers to provide testimony and exhibits detailing the costs for the Ray facility incident in the company's next general rate case, PSCR case, and/or GCR case, which shall be subject to a prudency review.

Additional Findings and Conclusions

In addition to the above, the Commission expresses concern that the events triggering the fire at the Ray facility could occur in the future, potentially involving injury or loss of life. As such, the Commission adopts the Staff's recommendation that Consumers conduct a system-wide study of compressor station blowdown methods and locations, which shall be filed no later than 5:00 p.m. (Eastern time) on September 3, 2019, in this docket. As stated by the Staff on pages 12-13 of its May 8, 2019 response, Consumers' study shall analyze and evaluate blowdown methods and shall consider factors such as discharge velocity, volumetric flow characteristics, height of discharge, plume modeling, etc. Consumers shall also analyze and evaluate its blowdown locations and shall consider the proximity to competent ignition sources, including equipment that can meet or exceed natural gas auto-ignition temperatures, open flames or sparks, and potential static electricity discharge. The company's study must include consideration of single failure of components that may have designs protecting the ignition sources from atmospheric exposure. After the study is complete, Consumers shall develop an action plan to address and remediate the identified issues and it shall be filed, with the study, on September 3, 2019, in this docket.

Additionally, the Commission directs Consumers to file, no later than 5:00 p.m. (Eastern time) on August 2, 2019, a report in this docket that details the Ray facility storage field natural gas injection timeline and a status update on the plant repairs at the Ray facility. Then, by 5:00 p.m. (Eastern time) on October 1, 2019, the company shall file in this docket a final report on the Ray facility storage field capacity for the 2019/2020 heating season and updates on repairs and other changes made at the facility since January 31, 2019. The Commission finds that the October 1, 2019 report should also include a study into the vulnerabilities at Consumers' other compressor stations. The report shall contain a company-wide assessment of findings related to:

- Potential grounding faults that can impact control systems at other compressor stations;
- Potential compressor station blowdown silencers that could unsafely vent creating a gas plume close to ignition sources;
- Potential compressor station blowdown silencers from one plant that vent in close proximity to another plant's blowdown silencer; and
- Potential compressor station blowdown silencers that, if vented, gas ignited would cause fire damage to adjacent equipment.

In addition, the Commission finds that the Staff's final RCA report shall be completed and filed in this docket by 5:00 p.m. (Eastern time) on January 31, 2020. During the proceedings of this case, the Commission directs Consumers and the Staff to conduct follow-up meetings, as necessary, and to establish timelines for information sharing so that they may complete the required reports in a timely manner.

THEREFORE, IT IS ORDERED that:

A. As set forth in this order, Consumers Energy Company shall conduct a system-wide study of compressor station blowdown methods and locations and shall compose a related incident action plan, both of which shall be filed no later than 5:00 p.m. (Eastern time) on September 3, 2019, in this docket.

B. As set forth in this order, Consumers Energy Company shall conduct an evaluation of the company's incident command system and procedures and shall prepare a report with recommended improvements. The report shall be filed no later than 5:00 p.m. (Eastern time) on November 1, 2019, in this docket.

C. In Consumers Energy Company's next general rate case, power supply cost recovery case, and/or gas cost recovery case, the company shall provide testimony and exhibits detailing the costs for the Ray Natural Gas Compressor Station incident.

D. By 5:00 p.m. (Eastern time) on August 2, 2019, Consumers Energy Company shall file a report in this docket that details the Ray Natural Gas Compressor Station storage field natural gas injection timeline and a status update on the plant repairs at the facility.

E. By 5:00 p.m. (Eastern time) on October 1, 2019, Consumers Energy Company shall file in this docket a final report on the Ray Natural Gas Compressor Station storage field capacity for the 2019/2020 heating season and updates on repairs and other changes made at the facility since January 31, 2019.

F. The Commission Staff's final Root Cause Analysis report shall be completed and filed in this docket by 5:00 p.m. (Eastern time) on January 31, 2020.

The Commission reserves jurisdiction and may issue further orders as necessary.

Any party desiring to appeal this order must do so in the appropriate court within 30 days after issuance and notice of this order, pursuant to MCL 462.26. To comply with the Michigan Rules of Court's requirement to notify the Commission of an appeal, appellants shall send required notices to both the Commission's Executive Secretary and to the Commission's Legal Counsel. Electronic notifications should be sent to the Executive Secretary at mpscedockets@michigan.gov and to the Michigan Department of the Attorney General - Public Service Division at pungp1@michigan.gov. In lieu of electronic submissions, paper copies of such notifications may be sent to the Executive Secretary and the Attorney General - Public Service Division at 7109 W. Saginaw Hwy., Lansing, MI 48917.

MICHIGAN PUBLIC SERVICE COMMISSION

Sally A. Talberg

Sally A. Talberg, Chairman

Norman J. Saari

Norman J. Saari, Commissioner

Daniel C. Scripps, Commissioner

By its action of July 2, 2019.

Barbara S. Kunkel

Barbara S. Kunkel, Acting Executive Secretary

PROOF OF SERVICE

STATE OF MICHIGAN)

Case No. U-20463

County of Ingham)

Brianna Brown being duly sworn, deposes and says that on July 2, 2019 A.D. she electronically notified the attached list of this **Commission Order via e-mail transmission**, to the persons as shown on the attached service list (Listserv Distribution List).

Brianna J. Brown

Brianna Brown

Subscribed and sworn to before me
this 2nd day of July 2019.

Angela P. Sanderson

Angela P. Sanderson
Notary Public, Shiawassee County, Michigan
As acting in Eaton County
My Commission Expires: May 21, 2024

Service List for Case: U-20463

Name	Email Address
Consumers Energy Company 1 of 2	mpsc.filings@cmsenergy.com
Consumers Energy Company 2 of 2	matorrey@cmsenergy.com

Consumers Energy Company - Ray Compressor Station Fire

GEMOTION DISTRIBUTION SERVICE LIST

kadarkwa@itctransco.com	ITC
tjlundgren@varnumlaw.com	Energy Michigan
lachappelle@varnumlaw.com	Energy Michigan
awallin@cloverland.com	Cloverland
bmalaski@cloverland.com	Cloverland
mheise@cloverland.com	Cloverland
vobmgr@UP.NET	Village of Baraga
braukerL@MICHIGAN.GOV	Linda Brauker
info@VILLAGEOFCLINTON.ORG	Village of Clinton
jgraham@HOMEWORKS.ORG	Tri-County Electric Co-Op
mkappler@HOMEWORKS.ORG	Tri-County Electric Co-Op
psimmer@HOMEWORKS.ORG	Tri-County Electric Co-Op
frucheyb@DTEENERGY.COM	Citizens Gas Fuel Company
mpscfilings@CMSENERGY.COM	Consumers Energy Company
jim.vansickle@SEMCOENERGY.COM	SEMCO Energy Gas Company
kay8643990@YAHOO.COM	Superior Energy Company
christine.kane@we-energies.com	WEC Energy Group
jlarsen@uppco.com	Upper Peninsula Power Company
dave.allen@TEAMMIDWEST.COM	Midwest Energy Coop
bob.hance@teammidwest.com	Midwest Energy Coop
tharrell@ALGERDELTA.COM	Alger Delta Cooperative
tonya@CECELEC.COM	Cherryland Electric Cooperative
bscott@GLENERGY.COM	Great Lakes Energy Cooperative
sculver@glenergy.com	Great Lakes Energy Cooperative
kmarklein@STEPHENSON-MI.COM	Stephenson Utilities Department
debbie@ONTOREA.COM	Ontonagon County Rural Elec
ddemaestri@PIEG.COM	Presque Isle Electric & Gas Cooperative, INC
dbraun@TECMI.COOP	Thumb Electric
rbishop@BISHOPENERGY.COM	Bishop Energy
mkuchera@AEPENERGY.COM	AEP Energy
todd.mortimer@CMSENERGY.COM	CMS Energy
jkeegan@justenergy.com	Just Energy Solutions
david.fein@CONSTELLATION.COM	Constellation Energy
kate.stanley@CONSTELLATION.COM	Constellation Energy
kate.fleche@CONSTELLATION.COM	Constellation New Energy
mpscfilings@DTEENERGY.COM	DTE Energy
bgorman@FIRSTENERGYCORP.COM	First Energy
rarchiba@FOSTEROIL.COM	My Choice Energy
greg.bass@calpinesolutions.com	Calpine Energy Solutions
rabaey@SES4ENERGY.COM	Santana Energy
cborr@WPSCI.COM	Spartan Renewable Energy, Inc. (Wolverine Power Marketing Corp)
cityelectric@ESCANABA.ORG	City of Escanaba
crystalfallsmgr@HOTMAIL.COM	City of Crystal Falls
felicel@MICHIGAN.GOV	Lisa Felice
mmann@USGANDE.COM	Michigan Gas & Electric
mpolega@GLADSTONEMI.COM	City of Gladstone

GEMOTION DISTRIBUTION SERVICE LIST

rlferguson@INTEGRYSGROUP.COM	Integrys Group
lrgustafson@CMSENERGY.COM	Lisa Gustafson
daustin@IGSENERGY.COM	Interstate Gas Supply Inc
krichel@DLIB.INFO	Thomas Krichel
cityelectric@BAYCITYMI.ORG	Bay City Electric Light & Power
Stephen.serkaian@lbwl.com	Lansing Board of Water and Light
jreynolds@MBLP.ORG	Marquette Board of Light & Power
bschlansker@PREMIERENERGYLLC.COM	Premier Energy Marketing LLC
ttarkiewicz@CITYOFMARSHALL.COM	City of Marshall
d.motley@COMCAST.NET	Doug Motley
mpauley@GRANGERNET.COM	Marc Pauley
ElectricDept@PORTLAND-MICHIGAN.ORG	City of Portland
gdg@alpenapower.com	Alpena Power
dbodine@LIBERTYPOWERCORP.COM	Liberty Power
leew@WVPA.COM	Wabash Valley Power
kmolitor@WPSCI.COM	Wolverine Power
ham557@GMAIL.COM	Lowell S.
BusinessOffice@REALGY.COM	Realgy Energy Services
landerson@VEENERGY.COM	Volunteer Energy Services
cmcarthur@HILLSDALEBPU.COM	Hillsdale Board of Public Utilities
mrzwiers@INTEGRYSGROUP.COM	Michigan Gas Utilities/Upper Penn Power/Wisconsin
Teresa.ringenbach@directenergy.com	Direct Energy
christina.crable@directenergy.com	Direct Energy
angela.schorr@directenergy.com	Direct Energy
ryan.harwell@directenergy.com	Direct Energy
johnbistranin@realgy.com	Realgy Corp.
kabraham@mpower.org	Katie Abraham, MMEA
mgobrien@aep.com	Indiana Michigan Power Company
mvorabouth@ses4energy.com	Santana Energy
suzy@gomega.com	MEGA
hnester@itctransco.com	ITC Holdings
lpage@dickinsonwright.com	Dickinson Wright
Deborah.e.erwin@xcelenergy.com	Xcel Energy
mmpeck@fischerfranklin.com	Matthew Peck
CANDACE.GONZALES@cmsenergy.com	Consumers Energy
JHDillavou@midamericanenergyservices.com	MidAmerican Energy Services, LLC
JCAltmayer@midamericanenergyservices.com	MidAmerican Energy Services, LLC
LMLann@midamericanenergyservices.com	MidAmerican Energy Services, LLC
karl.j.hoesly@xcelenergy.com	Northern States Power
kerri.wade@teammidwest.com	Midwest Energy Coop
dixie.teague@teammidwest.com	Midwest Energy Coop
meghan.tarver@teammidwest.com	Midwest Energy Coop
Karen.wienke@cmsenergy.com	Consumers Energy
Michael.torrey@cmsenergy.com	Consumers Energy
croziera@dteenergy.com	DTE Energy

Consumers Energy Company - Ray Compressor Station Fire

GEMOTION DISTRIBUTION SERVICE LIST

stanczakd@dteenergy.com	DTE Energy
Michelle.Schlosser@xcelenergy.com	Xcel Energy
dburks@glenergy.com	Great Lakes Energy
kabraham@mpower.org	Michigan Public Power Agency
kerdmann@atcllc.com	American Transmission Company
handrew@atcllc.com	American Transmission Company
mary.wolter@wecenergygroup.com	UMERC, MERC and MGU
phil@allendaleheating.com	Phil Forner

Consumers Energy
Count on Us

A CMS Energy Company

General Offices:
One Energy Plaza Tel: (517) 788-0550
Jackson, MI 49201 Fax: (517) 768-3644

*Washington Office:
1730 Rhode Island Ave. N.W. Tel: (202) 778-3340
Suite 1007
Washington, DC 20036 Fax: (202) 778-3355

Writer's Direct Dial Number: (517) 788-0835
Writer's E-mail Address: bret.totoraitis@cmsenergy.com

August 2, 2019

Ms. Barbara Kunkel
Acting Executive Secretary
Michigan Public Service Commission
7109 West Saginaw Highway
P.O. Box 30221
Lansing, MI 48909

RE: Case No. U-20463 - In the matter, on the Commission's own motion, to commence an investigation into a January 30, 2019 fire at Consumers Energy Company's Ray Compressor Station in Macomb County.

Dear Ms. Kunkel:

Enclosed for electronic filing in the above-captioned case is **Consumers Energy Company's Ray Natural Gas Compressor Station Storage Field Injection Timeline and Facility Repair Update.**

This is a paperless filing and is therefore being filed only in PDF format.

Sincerely,

Bret Totoraitis Digitally signed by Bret A. Totoraitis
Date: 2019.08.02
14:51:01 -04'00'

Bret A. Totoraitis

Consumers Energy Company's Ray Natural Gas Compressor Station Storage Field Injection Timeline & Facility Repair Update

MPSC Case No. U-20463

August 2, 2019

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I. INTRODUCTION

In its July 2, 2019 Order ("the Order") the Michigan Public Service Commission ("MPSC") directed Consumers Energy Company ("Consumers Energy" or the "Company") to file a report detailing the injection timeline for the natural gas storage field at the Ray Compressor Station ("Ray"), and a status update on the repairs completed to the facility to date.

Repairs to the Ray facility are underway and have been prioritized in such a way as to minimize their impact on system operations, meet peak summertime injection demand, and ensure that the natural gas storage field can be filled to capacity by October 31, 2019, prior to the start of the 2019-2020 heating season. The October 31, 2019 target for Ray's working gas inventory is 47.1 Bcf. As of July 31, 2019, Ray is 76% full, with 11.4 Bcf of injection remaining for summer.

The January 30, 2019 fire at the Ray facility damaged equipment in Plants 2 and 3, including the dehydration systems, which are required components for withdrawal. This had the effect of limiting the facility's withdrawal capacity during the remainder of the 2018-2019 heating season, and of preventing storage field injections until certain repairs could be completed. Once the Company developed a plan to work around Ray's withdrawal limitations and continue to provide safe and reliable gas service to customers for the remainder of last winter, it prioritized efforts to restore injection operations during the 2019 summer period to ensure the field is filled to capacity in time for the coming winter.

II. REPAIR TIMELINE

The Company prioritized repairs in early February 2019 and finalized the assessment of the fire damage in May 2019. This process revealed that the most severely damaged equipment at the Ray facility was in proximity to the Plant 3 blowdown vents and silencers. There was also significant damage to the Plant 2 and 3 dehydration equipment, and moderate damage to those Plants' injection equipment. Most of the affected areas are illustrated below in Figure 1. Firegate and large bore valve damage also occurred. While not shown in the figure, this equipment is located within the same general vicinity as the other damaged equipment.

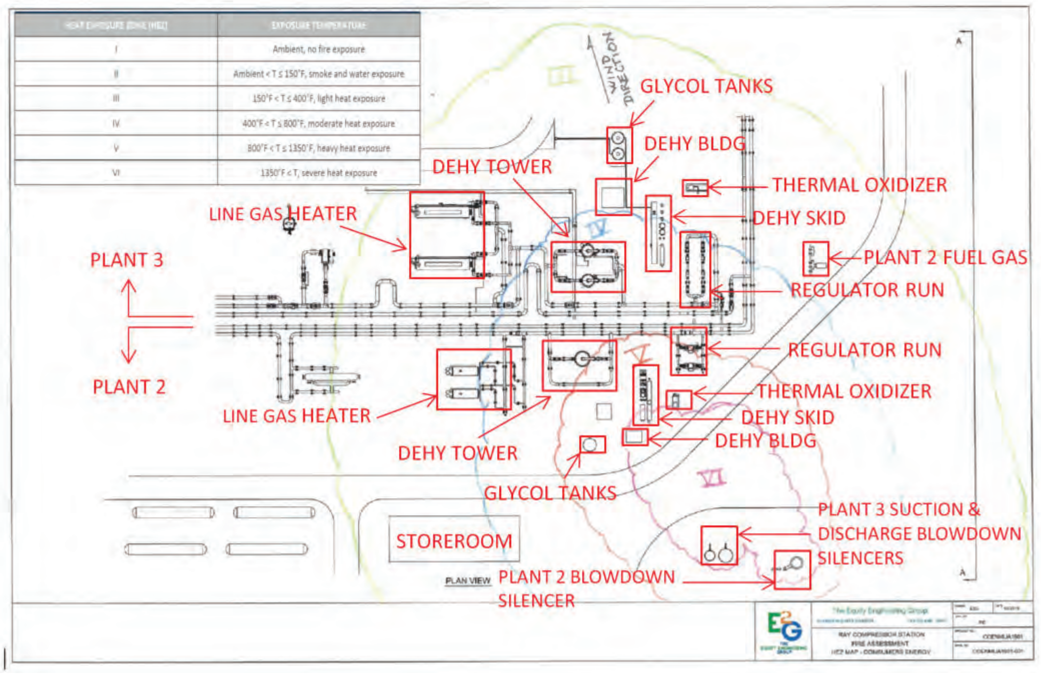

Figure 1. Locations of Damaged Equipment at Ray Compressor Station

The repair prioritization process reflects the order of operations necessary to ensure customer needs can be met safely and reliably during the coming heating season. With this in mind, the Company determined that it would be most important to repair the injection equipment first, so that the natural gas storage field could be filled in preparation for the repaired withdrawal equipment to return to service before winter. Repair activity would then focus on returning the Plant 2 backup generator to operation, before addressing the extensively damaged dehydration equipment and, finally, any damage to buildings on site.

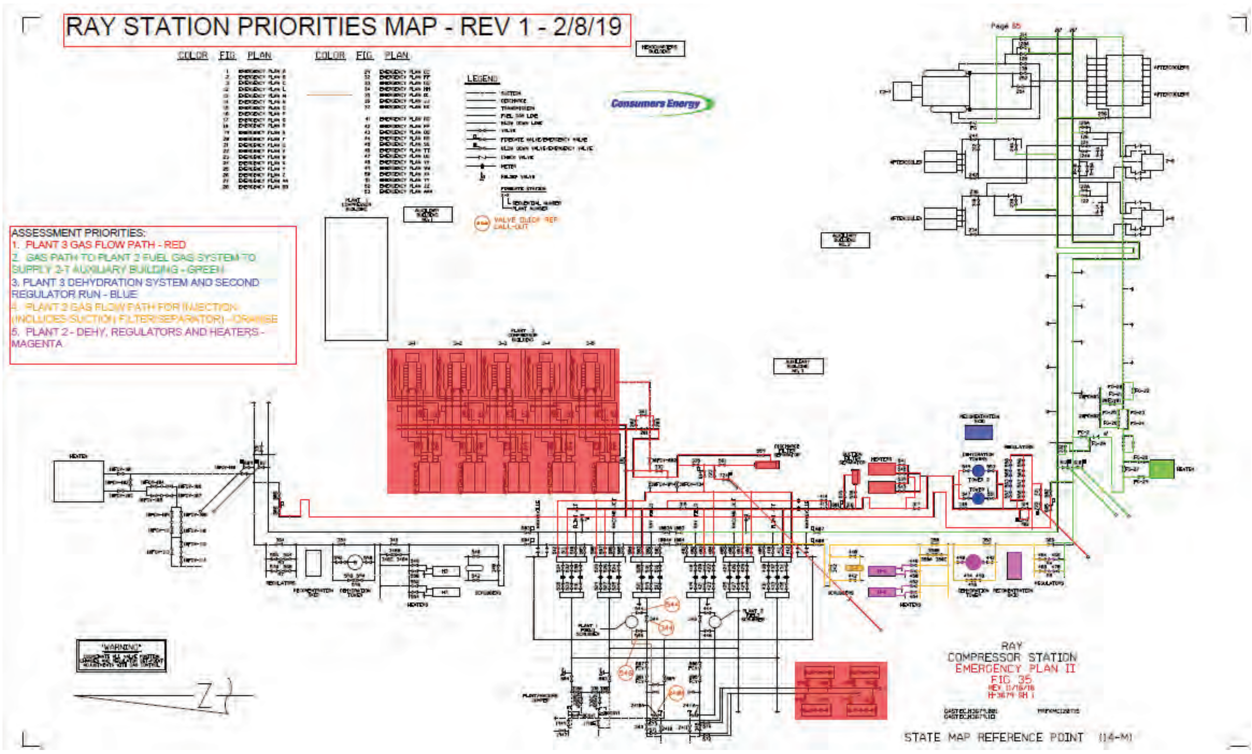

Figure 2. Ray Compressor Station Repair Priorities, illustrated

A. INJECTION EQUIPMENT REPAIR

The Company focused on restoring the injection equipment at Plant 3 first, because it maintains the highest compression capability. The injection system equipment requiring repair included the blowdown vents and silencers, as well as various valves, valve-actuators, data monitoring equipment, electrical cables, and segments of piping and pipe coatings. These repairs were completed on May 3, 2019. The equipment was tested and started up on May 9, 2019, allowing the successive engine-compressor equipment to be restored to service between May 9, 2019 and May 16, 2019. Storage field injections have been ongoing since May 16, 2019. This has provided sufficient injection capability to meet peak summertime demands and normal seasonal operations.

Plant 2 injection system damage inspections and assessments were completed on May 7, 2019. The equipment requiring repair included various valves, valve actuators, piping segments and coatings, electrical cables, and data monitoring equipment. Repairs are underway and projected to be fully complete by October 1, 2019. However, enough critical equipment will be repaired in order to partially restore Plant 2's injection capability by mid-August 2019. Plant 2 can return to injection service at that time, with full injection flow path scheduled for restoration by October 2019.

B. BACKUP GENERATOR & FUEL GAS SYSTEM REPAIR

The Ray facility's emergency generator is housed at Plant 2, so the next priority was to repair the fuel gas equipment necessary to operate the generator. The equipment was assessed, and the fuel gas system fully restored to service by June 14, 2019.

C. WITHDRAWAL EQUIPMENT REPAIR

The Company's next priority was to repair the equipment needed to withdraw gas from storage, beginning again with Plant 3. Employees assessed the damage to the withdrawal equipment caused by the fire and developed a scope of repairs needed to the valves, piping, and electrical equipment. This assessment was completed by May 24, 2019, and repairs are currently underway and forecasted for completion on September 16, 2019.

The assessment of damage and development of scope of repairs needed for Plant 2 withdrawal equipment was completed on June 7, 2019. This assessment revealed significant damage to the dehydration system. The Company is currently engaged in the necessary engineering and equipment procurement to effect needed repairs. The Company forecasts that this process will be complete on August 15, 2019, and that the withdrawal equipment repairs will be complete on December 20, 2019.

D. BUILDING REPAIR

Assessing the facility's buildings revealed damage to those in proximity to the Plant 3 blowdown vent and silencers. The scope of repair was determined on May 10, 2019, and the repair work was completed on July 31, 2019.

III. KEY DATES

Important operational dates, both past and future, include:

- ➢ Fire at Ray Compressor Station – January 30, 2019
- ✓ Initial damage assessment and repair prioritization – February 8, 2019
- ✓ Plant 3 restored to injection service – May 16, 2019
- ✓ Plant 2 fuel gas system and back-up generator restored – June 14, 2019
- o Plant 2 partial injection capability – August 14, 2019
- o Plant 3 restored to withdrawal service – September 16, 2019
- o Plant 2 full injection capability – October 1, 2019
- o Ray Storage field inventory at target – October 31, 2019
- o Plant 2 withdrawal restored to service – December 20, 2019

The table below illustrates milestones on the facility repair timeline.

Phase	System	Damage Assessment Complete	Scope Document Approved	Engineering and Procurement Complete	Construction Repairs Complete (Planned)
1	Plant 3 Injection Path	6-Apr	12-Apr	19-Apr	3-May
2	Plant 2 Fuel Gas	26-Apr	30-Apr	15-May	14-Jun
3	Plant 3 Withdrawal	7-May	24-May	30-May	16-Sep
4	Plant 2 Injection*	7-May	17-May	15-Jul	1-Oct
5	Plant 2 Withdrawal	14-May	7-Jun	15-Aug	20-Dec
F	Facilities/ Buildings	3-May	10-May	17-May	31-Jul

*Planned dates are future dates (post July 26) and are denoted in faded font.

** Plant 2 Injection ability was pulled ahead to August 14th; however all non-injection critical scope (remaining repairs in this system) will be complete by October 1st per the original schedule.

Figure 3. Repair Progress at Ray Compressor Station

IV. CONCLUSION

The Company has worked expeditiously and diligently to ensure that the damage caused in the January 30, 2019 fire at the Ray Compressor Station is repaired, and that the conditions that caused the fire have also been remedied. The safety of its employees, neighbors, and customers remain Consumers Energy's highest priority focus. Consumers Energy is committed to ensuring that its facilities are safe places to work and that they are capable of safely and reliably delivering energy needed to serve Consumers Energy's customers. The Company has developed, and is executing, a detailed, prioritized work plan, which will ensure that Consumers Energy's customers enjoy warm, comfortable homes and businesses this coming winter.

Consumers Energy
Count on Us

A CMS Energy Company

General Offices:
One Energy Plaza Tel: (517) 788-0550
Jackson, MI 49201 Fax: (517) 768-3644

*Washington Office:
1730 Rhode Island Ave. N.W. Tel: (202) 778-3340
Suite 1007
Washington, DC 20036 Fax: (202) 778-3355

Writer's Direct Dial Number: (517) 788-0835
Writer's E-mail Address: bret.totoraitis@cmsenergy.com

LEGAL DEPARTMENT
SHAUN M. JOHNSON
Senior Vice President
and General Counsel

MELISSA M. GLEESPEN
Vice President, Corporate
Secretary and Chief
Compliance Officer

KELLY M. HALL
Vice President and Deputy
General Counsel

Eric V. Luoma
Adam C. Smith
Bret A. Totoraitis
Assistant General Counsel

Robert W. Beach
Ian F. Burgess
Don A. D'Amato
Robert A. Farr
Gary A. Gensch, Jr.
Matthew D. Hall
Emerson J. Hilton
Chantez P. Knowles
Jason M. Milstone
Rhonda M. Morris
Deborah A. Moss*
Michael C. Rampe
Scott J. Sinkwitts
Theresa A.G. Staley
Janae M. Thayer
Anne M. Uitvlugt
Aaron L. Vorce
Attorney

September 3, 2019

Ms. Lisa Felice
Executive Secretary
Michigan Public Service Commission
7109 West Saginaw Highway
P.O. Box 30221
Lansing, MI 48909

RE: **Case No. U-20463 - In the matter, on the Commission's own motion, to commence an investigation into a January 30, 2019 fire at Consumers Energy Company's Ray Compressor Station in Macomb County.**

Dear Ms. Felice:

Enclosed for electronic filing in the above-captioned case is **Consumers Energy Company's Compressor Station Blowdown Report and Ray Compressor Station Incident Action Plan.**

This is a paperless filing and is therefore being filed only in PDF format.

Sincerely,

Bret Totoraitis
Digitally signed by
Bret A. Totoraitis
Date: 2019.09.03
10:58:40 -04'00'

Bret A. Totoraitis

Consumers Energy Company's Compressor Station Blowdown Report & Ray Compressor Station Incident Action Plan

MPSC Order in Case No. U-20463

September 3, 2019

I. EXECUTIVE SUMMARY

On January 30, 2019 a fire occurred at Consumers Energy Company's ("Consumers Energy" or the "Company") Ray Natural Gas Compression Station("Ray"). Following a root cause analysis, Consumers Energy performed a system-wide evaluation of blowdown methods and single-point failures at each of the Company's gas compressor stations, along with dispersion modeling of Ray Plants 2 and 3 discharge blowdowns. The analysis indicated that the circumstances that resulted in the Ray incident are not present at any other Consumers Energy facility. The Company will conduct precautionary dispersion modeling at additional locations as called for by its incident action plan.

II. INTRODUCTION

In its July 2, 2019 Order in Case No. U-20436 ("the Order"), the Michigan Public Service Commission ("MPSC" or the "Commission") directed Consumers Energy to conduct a system-wide evaluation of compressor blowdown methods and locations.

This report details Consumers Energy's system-wide study of compressor blowdown methods and locations. The blowdown method considerations include discharge velocity, volumetric flow characteristics, height of discharge, and plume modeling. The Company evaluated blowdown locations considering proximity to competent ignition sources, including equipment that can meet or exceed natural gas auto-ignition temperatures,[1] open flames or sparks, and potential static electricity discharge. Additionally, the study considered the potential single failure of components that may have engineering controls in place, to prevent these ignition sources from being exposed to the atmosphere. Consumers Energy focused on factors that may have contributed to the Ray incident and is implementing countermeasures to mitigate risk of future occurrence across the Company's compression fleet based on the blowdown evaluation.

[1] National Fire Protection Association ("NFPA") 921 Guide for Fire & Explosion Investigations, the auto-ignition temperature of natural gas ranges from 900 degrees F to 1,170 degrees F. Natural gas will auto-ignite at or above this range.

III. SYSTEM-WIDE BLOW DOWN EVALUATION

Following the results of the Ray incident root cause analysis, the Company conducted a system-wide evaluation of the gas compressor stations operating on its transmission system. The evaluation focused on natural gas automatic discharge vent source ignition protection from general-purpose areas, open flames, high-temperature equipment, electrical facilities, and other field-based concerns. The evaluation included all natural gas automatic and emergency discharge points within the Company-owned property boundaries for gas compression operated and maintained assets. The Ray equipment was evaluated separately by the Ray Recovery Team, as detailed below.

Consumers Energy assigned teams of engineering, operations, and union leadership to evaluate existing plant installations at each compressor station. The teams gathered information and broke it out into two categories: gas vents and ancillary equipment.

A. METHODOLOGY - GAS BLOWDOWNS (VENTS)

The methodology used to catalog the vent source points included identifying each vent source relative to the potential ignition source and considering scenarios where ignitable concentrations of gas could accumulate near the ignition source due to a single-point failure at the compression site.

The survey teams used the results from dispersion modeling at the Ray facility (discussed below under the Ray Recovery Evaluation) to establish representative minimum height and distance requirements for their evaluations at other facilities.

B. METHODOLOGY – ANCILLARY EQUIPMENT

The Company reviewed all ancillary equipment that has the potential to provide an ignition source. The review considered the following code references and documents:

- Michigan Gas Safety Standards 192.169(b); 192.179(c); 192.199(e); and 192.167(a)(2);
- National Fire Protection Association (“NFPA”) 70, Section 500: Hazardous Locations Class I, II, and II, Divisions 1 and 2; and
- American Petroleum Institute Recommended Practice 500AGA XL1001.

Following the review of both the gas blowdown vents and the ancillary equipment, the Company evaluated potential single-point failures against existing current engineering controls that are in place to prevent these scenarios from occurring.

IV. FINDINGS AND OBSERVATIONS- ANCILLARY EQUIPMENT

After evaluating the ancillary equipment, a disposition team comprised of cross-functional subject matter experts reviewed and analyzed the results. The team characterized the potential findings at each facility as high, medium, or low priority:

- A finding of high priority indicates the potential of a code non-conformity[2] at a facility. The disposition team made recommendations for immediate action or required the local site to develop alternative equipment configurations or operating standards that would ensure the condition was immediately mitigated, and that the equipment could continue to operate safely;
- Classifying an asset as medium priority meant that an installation was code-compliant but required expedited review to assess its system integrity and design to identify whether it could be operated more conservatively based on learnings from the Ray incident; and
- A low priority finding called for standard maintenance or a maintenance plan review.

The Company secured and mitigated risk items categorized as "High" with no impact to the gas transmission system. The most significant findings were related to the National Electrical Code and include general purpose devices being installed in class 1 division 2 hazardous locations. The Company secured these items by eliminating non-gas transport and/or auxiliary system hazards through a safety procedure called "lock-out tag-out" where the equipment is locked out of service. Actions were taken for follow up on long-term remediation and/or procedure revisions. A summary of the observations is shown in Table 1 below:

[2] The code references and documents related to this evaluation include: Michigan Gas Safety Standards 192.169(b); 192.179(c); 192.199(e); 192.167(a)(2); NFPA 70, Section 500; and API Recommended Practice 500AGA XL1001

Table 1 – Summary of Ancillary Equipment Findings

Station	High	Medium	Low
Ray	Relief valve discharge point relative to dehydration control building (general purpose)	Yard lighting in proximity to relief valve discharge points in out of service equipment.	None
St. Clair	Position of vents related to building intake fans.	Unknown profile from blowdown silencers	None
Northville	Yard lighting in proximity to silencer	None	None
Overisel	Non-rated electrical equipment in hazardous classification areas.	- New dehydration system design. - Pilot gas blowdown stack height increases	Ergonomics and hearing protection with relation to relief valve stacks.
Muskegon River	None	Small relief valve discharge review in relation to thermal oxidizer position.	None
White Pigeon	Yard lighting in proximity to silencer	Unknown profile from blowdown silencers	None
Freedom	Construction lighting in hazardous classification areas	New plant design.	None
Huron	Auxiliary building position in relative proximity of station blowdown silencer	None	None

V. RAY RECOVERY EVALUATION

As part of the Ray recovery process, Consumers Energy conducted dispersion modeling. Dispersion modeling is a mathematical simulation that predicts when a substance will disperse in the atmosphere based on a number of variables (i.e. temperature, pressure, wind velocity, etc.). As discussed in the "*Ray Natural Gas Compressor Station Storage Field Injection Timeline & Facility Repair Update*" report which the Company filed on August 2, 2019, the repair prioritization process reflects the order of operations necessary to ensure customer needs could be met safely and reliably during the coming heating season. With this in mind, the Company determined that it would be most important to repair the injection equipment first, so that the natural gas storage field could be filled in preparation for the repaired withdrawal equipment to return to service before winter. To support the fire restoration efforts at the Ray Station, the Company performed dispersion modeling in two parts:

1. Injection (short term) – this work modeled equipment needed for returning Plant 3 for injection operations; and
2. Withdrawal (long term) – final station design.

A. DISPERSION MODELING – INJECTION (SHORT TERM)

The model was created to simulate the original configuration as well as the new design to validate that a risk for ignition is not present. Figure 1 below shows the conditions present on the day of the fire event. The natural gas in the original configuration included a blowdown with silencers which created a horizontal flow that dispersed the gas over the gas processing equipment based on the wind conditions.

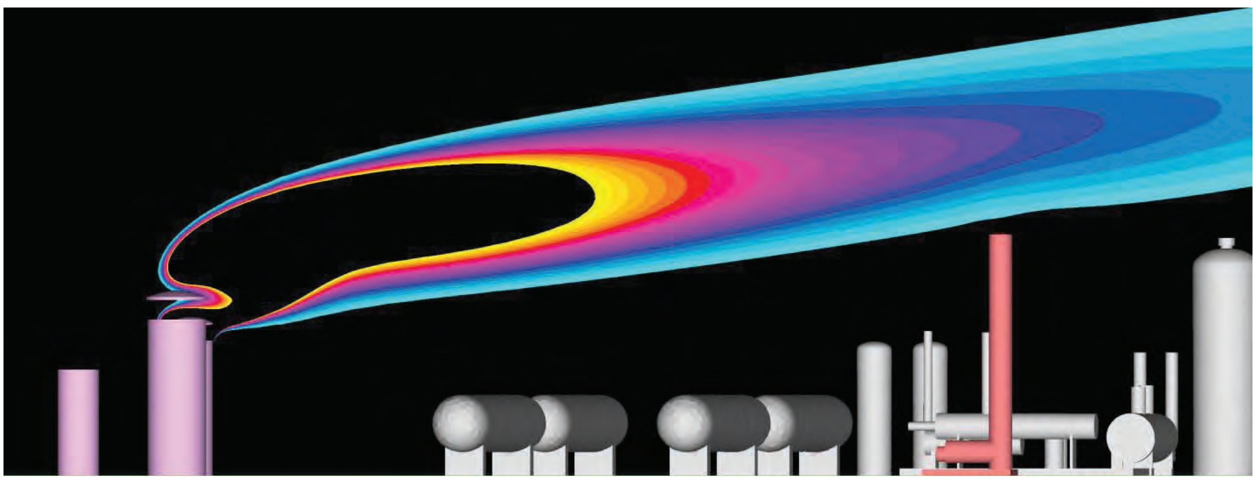

Figure 1. Ray Plant 3 Blowdown 3-1-7 Original Configuration (with silencer)

Based on the dispersion modeling results, Consumers Energy installed new blowdown piping that does not include silencers. The removal of these silencers from the design is the primary change allowing the gas to flow vertically. Figure 2 shows a simulation of the new configuration under similar wind conditions as the time of the incident.

Figure 2. Ray Plant 3 Blowdown 3-1-7 New Configuration (without silencer)

The dispersion model report concludes "*the simulations performed under the short-term scope of work shown that replacing the Plant 3 silencers and mutes with straight pipes will provide sufficient velocity to propel the vented gas above the elevation of potential ignition sources for the venting and ambient conditions simulated*." The April 1, 2019 Ray Dispersion Model details are included as Appendix 1 to this document.

Silencers are typically applied to blowdowns due to their ability to mitigate nuisance noise; however, each application is evaluated based on the specific site configuration and design. As a result of this incident, the Company is incorporating the assessment of combustion sources and their proximity to gas vents into a standard hazard analysis for new installations or design changes to existing assets. This will include dispersion modeling as a tool to understand the characteristics of the gas vent plume for consideration into the design and location of the vent. For these specific blowdowns the dispersion model and piping design resulted in the straight pipe application in lieu of silencers in order to mitigate the risk of combustion.

B. <u>DISPERSION MODELING – WITHDRAWAL (FINAL DESIGN)</u>

The Company completed dispersion modeling of the main blowdown at the Ray Compressor Station and is working toward the completion of dispersion modeling for the rest of the station by

September 15, 2019. The final station design and configuration will be supported by the second phase of the dispersion model effort. This will include the review and verification of all sources of combustion and gas vents to ensure the characteristics of each plume is understood and incorporated in the final configuration of the station in order to mitigate fire risk. The station will not be placed back into service[3] without review of the plume characteristics and a design review to ensure there is not a combustion risk present.

VI. FINDINGS AND OBSERVATIONS BLOWDOWN EVALUATION

Utilizing the information from the site evaluations and the initial Ray dispersion model, the Company conducted a blowdown study across its compression station fleet. The dispersion modeling conducted at the Company's Ray Compressor Station provided baseline information regarding characteristics related to discharge velocity and flow characteristics in relation to the proximity to competent ignition sources. As shown in Figure 2 above, natural gas will be released from a straight pipe blowdown that will have a near direct vertical release profile. The dispersion when a silencer[4] is incorporated into the blowdown design creates a horizontal flow profile, as demonstrated in Figure 1.

Each vent source was reviewed and characterized relative to a competent ignition source against the following risk factors:

- Blowdown type (e.g. silencer vs straight pipe);
- Distance from vent to combustion source (horizontal distance); and
- Combustion source height (vertical distance).

Competent ignition sources include:

- Thermal oxidizers – The temperature at which this equipment burns particulates can create a heat plume that is at or higher than 900 degrees F, which is in the auto ignition temperature range for natural gas;
- Ancillary buildings – General purpose electrical equipment that could cause a static discharge, which could create a source of ignition; and
- Off-site flare – Third-party operator adjacent to compressor station.

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[3] Timeline for station repairs provided in *Ray Natural Gas Compressor Station Storage Field Injection Timeline & Facility Repair Update* report filed on August 2, 2019.

[4] Apparatus attached to a straight pipe designed to minimize noise during a blowdown event.

The result of Consumers Energy’s system-wide study of compressor blowdown methods and locations is summarized in Table 2 below. See Appendix 2 for the full evaluation matrix.

Table 2 – Blowdown Evaluation Result Summary

Station	Blowdown Type	Horiz Distance	Vertical Distance	Dispersion Model Required
Ray Plant 3	Silencer	135'	+15'	Yes
Muskegon River Plant 2	No	No	Yes (+25')	No
Northville	Yes	No	No	No
St. Clair Plant 1	No	No	Yes (+32')	No
St. Clair Plant 1 Units	Yes	No	Yes (+18')	Yes
St. Clair Plant 2	No	No	Yes (+32')	No
St. Clair Plant 3	Yes	No	Yes (+30')	Yes
St. Clair Plant 4	Yes	No	Yes (+28')	Yes
White Pigeon Plant 1	No	No	No	No
White Pigeon Plant 2	No	No	No	No
White Pigeon Plant 3	No	No	No	No
White Pigeon Plant 3 Units	Yes	No	No	Yes
Overisel	No	No	N/a	No
Freedom Plant 1	No	No	Yes (+20')	No
Freedom Plant 2	No	No	Yes (+20')	No
Huron	Yes	Yes	No	Yes

The results of this study indicate that facilities with straight pipe blowdowns are an adequate distance from a competent ignition source so as to pose no risk of ignition. The findings for locations with silencers are as follows:

- Ray – Mitigation actions are underway to increase the height of the blowdown and remove the silencers;
- Northville – The height of the blowdown and competent ignition source are similar but sufficiently distant (>341’) from each other, so a natural gas plume would safely disperse above the off-site flare;
- St. Clair Plants 1, 3, and 4 – The distance between the competent ignition source and the blowdown allows for adequate and safe dispersion of the natural gas;
- White Pigeon Plant 3 – The blowdown height is higher than the competent ignition source allowing dispersion of a natural gas plume safely above the ignition source; and
- Huron – The finding for this station is also present in the ancillary evaluation summary. The Company is installing gas detectors in the auxiliary building that will automatically turn off the electrical equipment that could pose a source of ignition. The detectors will be operational prior to the plant being put into service standby

mode this fall (the plant only operates under certain customer demand and weather conditions).

Overall, the review of gas blowdown vents and associated risk related to competent ignition sources indicates there is not a scenario that presents a fire risk similar to the Ray incident. Consumers Energy does plan to conduct dispersion modeling at additional locations summarized above as a precautionary measure as part of the Company's action plan.

VII. ACTION PLAN

As described in this report, actions have been completed to address any high prioritized areas. The remaining action plan includes dispersion modeling at the compressor stations identified during the blowdown evaluation and in alignment with the Company's new engineering standard on conducting standard hazard analysis for new installations or design changes to existing assets. These stations have been prioritized as summarized below:

- Ray Station Injection – complete;
- Ray Station Withdrawal - dispersion model is in progress as part of the recovery team efforts;
- White Pigeon - contains similar blowdown equipment to that which contributed to the Ray incident. There is electrical equipment contained within the auxiliary building within 172 feet of the blowdown;
- St. Clair Plants 1, 3, and 4 - contains similar equipment which contributed to the Ray incident (specifically, a thermal oxidizer). The horizontal distance is sufficient; however, physical interactions between the plants will be verified;
- Freedom - dispersion modeling is being completed concurrently with the current upgrade project and planned installation of plant blowdowns and unit vents;
- Overisel - dispersion modeling is being completed prior to the installation of the new dehydration system and thermal oxidizer as part of the design phase of the project and is being utilized to determine appropriate location of the new equipment; and
- Huron – this is the compressor station that Consumers Energy operates on the distribution system. This site is a smaller capacity than the transmission stations, but its design does include a silencer that is close to a competent ignition source. This issue is being addressed with the installation of gas detectors prior to placing into service standby mode this fall.

The plan for dispersion modeling with anticipated completion dates is summarized in Table 3 below:

Table 3 – Dispersion Model Action Plan Summary

Priority	Station	Dispersion Model Completion Date
1	Ray Plant 3 Fire Restoration - Injection	Complete
2	Ray Final Design	9/15/2019
3	White Pigeon 3	11/1/2019
	St Clair 1, 3, and 4	11/1/2019
	Freedom	11/1/2019
4	Huron	2/1/2020
	Overisel	2/1/2020

After the dispersion modeling is complete, the Company will analyze the results and determine if additional mitigation actions are necessary at the locations.

VIII. CONCLUSION

The Company has worked expeditiously and diligently to complete a thorough system-wide evaluation of competent ignition sources at our compressor stations to address the risk that was identified in the Ray incident. The study concluded that there is not a scenario that presents a fire risk similar to that event. The Company found and mitigated a number of other potential risks as summarized in this report. The Company will follow the summarized action plan for dispersion modeling at various stations as a precautionary measure to ensure the safe, reliable operation of our compression fleet. The Company will provide ongoing updates to the Commission Staff regarding the analysis and outcomes of the additional dispersion modeling.

APPENDIX 1 – RAY DISPERSION MODEL REPORT

Ray Compressor Station Dispersion Modeling

Short Term Work Scope Simulation Results

R-19-CER-01-Rev2

1 April 2019

Airflow Sciences Corporation
12190 Hubbard St.
Livonia, MI 48150
734-525-0300

Prepared by:

Jeff Franklin, Ph.D., P.E.
Andrew Banka, P.E.
Paul Harris, Ph.D.
Kevin Linfield, Ph.D, P.E., P.Eng

Introduction

The Ray Compressor Station (RCS) located in Armada, MI, is one of eight storage and compressor stations operated by Consumers Energy (CE) in Michigan. During the summer months, natural gas purchased at lower market prices and is compressed and injected into underground wells, reaching a maximum pressure of 1800 PSI. During withdrawal season, the gas is extracted from the wells, conditioned, and returned to the transmission pipelines.

Withdrawal season consists of two segments. When the storage pressure is greater than the 960 PSI of the transmission pipelines, the system operates in “floating” mode, where it is only necessary to condition the gas to remove impurities. Once the field pressure drops below 960 PSI, the system switches to Powered Withdrawal, where compressors are used to bring the gas up to the transmission line pressure.

RCS has three plants: Plant 1, Plant 2, and Plant 3. Plants 1 and 2 are older, and were originally mirror images of each other. The compressor units of Plant 1 have since been decommissioned, so only operates in floating mode. Plant 3 is larger and newer than the other two plants.

Each plant features a number of “blowdown vents” that are used when a plant is fire-gated or blown down for maintenance. When that happens, pressurized gas in the system piping is vented to the atmosphere.

For the older plants (1 & 2), the vents consist of straight vertical pipes located on the west side of each of the respective plants. Due to the high pressures involved and the lack of any upstream throttling devices, the gas leaving the straight vent pipes will be choked and shock waves will occur. Due to noise concerns from nearby residents, the Plant 3 blowdowns were equipped with “mutes” or “silencers” that expand the gas within a larger steel cylinder that reduces the noise. In order to prevent precipitation from fouling these systems, rain hats are included with these silencers.

On January 30, 2019, the automatic controls of Plant 3 detected an error condition and initiated a shutdown of some of the Plant 3 systems. Due to the wind conditions on that day, the gas emanating from the Plant 3 suction and discharge blowdown silencers (BDSL-3-6 and BDSL-3-7) was blown toward the Plant 2 thermal oxidizer (TO), where the hot exhaust gases caused the vented gas at flammable concentrations to ignite.

Airflow Sciences Corporation (ASC) was contracted to conduct dispersion modeling of the blowdown operation to illustrate the dispersion patterns on the day of the incident and to assess both short-term and long-term solutions that will allow for safe operation of the plant during all weather conditions. The short-term solutions are for quick implementation; noise considerations will be addressed during the development of the long term solution options. Primarily, the short-term solutions considered replacement of the Plant 3 silencers with straight vent pipes. This report contains a summary of the short-term simulations.

Work Scope

The short term scope of work outlined in the RFP called for analysis in five areas. The fourth area addressed noise predictions, and was omitted from ASC's proposed scope of work. The remaining four areas are described below. Section numbers below refer to the sections in the RFP. All simulations were run using weather conditions reported for the day of the incident.

2.1.1.1 This section was interpreted to represent the plant operational conditions for the day of the incident. All equipment was assumed to be in its current configuration

2.1.1.2 For this run, the Plant 3 suction and discharge blowdown silencers were replaced by straight vent pipes.

2.1.1.3 For this item, the RFP calls for replacing BDSL-3-01 through BDSL-3-05 with straight pipes. Since the Plant 3 units were not operational on the day of the incident, the previous simulations did not include their effect with the existing blowdown silencers in place. For this reason, two simulations were performed for this portion of the work scope – the first with the Plant 3 unit blowdown silencers discharging, and a second simulation where the silencers were replaced by straight pipes.

2.1.1.5 The goal of this portion of the work scope is to ensure that any interactions between the blowdowns of all plant options be assessed. In collaboration with CE, it was agreed that this goal could be satisfied through a simulation in which *all* of the equipment blowdowns were active.

All Models: The gas discharge mass flows for each of these conditions were provided by DeVon Washington of CE through 1-D compressible modeling. TO exhaust flows were taken from the operational manuals for those devices and computed by ASC. A summary of the boundary conditions was shared via google sheets with CE personnel. Those sheets are reproduced in Appendix A.

Simulation Method

The domain of the CFD dispersion model for this study is one mile in diameter, centered on the western edge of the plant. The ground was assumed to be flat at an elevation of 690' above sea level. The height of the simulation domain was 2000'. Both the domain diameter and height were chosen to ensure that the boundary conditions applied at those locations did not have a controlling effect on the simulation results or conclusions.

The atmospheric boundary layer (ABL) was modeled using the method of Zhang (*CFD simulation of neutral ABL flows*, Risø National Laboratory for Sustainable Energy, Technical University of Denmark, April 2009), including the modification of the turbulent wall functions. The 17 MPH wind reported on the day of the incident was assumed to be at an elevation of 10m above ground.

The periphery of the round simulation domain was divided into 12 sections in order to facilitate modeling of different wind directions. The ABL was applied to all of these sections except for the section most directly downstream, which was allowed to adjust to provide an exact mass balance over the simulation domain. In practice, the velocity distribution in that section was very similar to the adjacent sections. The upper boundary of the domain was assumed to be free slip, with flow parallel to that boundary.

Wooded areas within the simulation domain were based on satellite imagery and verified with USGS Lidar data. Trees were assume to be 75' tall. The effect of the trees on the velocity and turbulence fields in the CFD model was modeled using the method of Knaus, Hofsäß, Rautenberg, and Bange (*Application of Different Turbulence Models Simulating Wind Flow in Complex Terrain: A Case Study for the WindForS Test Site*, Computation 2018, 6, 43, 27 July 2018). A key parameter in this model is the leaf area index (LAI), which represents the leaf (and branch) area per unit ground area. LAI values for deciduous forest in the winter time were hard to find. A blog posting on this topic (https://geoffreybell.net/2016/08/14/cfd-wind-power-modelling-and-forest-porosity/) provided a value of 0.625, which can be compared to a value of 5.0 for deciduous forests in the summer found in several additional references.

The geometry of the plant equipment and buildings was provided by the Andy Eagan company, working under separate contract with CE. Using an AutoDesk ReCap process, the entire plant was laser-scanned and converted to NavisWorks CAD model. A number of the finer features (e.g., piping runs) were suppressed, and an ACIS model was exported for ASC's use in building its CFD model. No attempt was made to verify the accuracy of this CAD model. As it strongly affected the simulation results, it was noted that the modeled sizes of the Plant 1 suction and discharge blowdown vents was incorrectly captured. These features were corrected, and ASC's model was rebuilt before running the final set of simulations.

For the straight pipe vents, the high system pressures indicated that there would be shock waves at the pipe exits, resulting in discontinuities in density, pressure, and temperature. In order to facilitate faster model turn-around times, ASC investigated an incompressible approximation to the more complex compressible flow physics. Detailed models were run of a single vent pipe at typical RCS venting conditions with both a fully compressible solver and an incompressible model in which the high gas density at elevated pressures was achieved by setting a much lower temperature for that gas stream. As the cold gas mixed with the (relatively) warmer air, the density decreased and the gas expanded in a way that was very similar to the fully compressible solution. A comparison of the results for these two cases is shown in Figures 113 and 114 in Appendix B. Given the good agreement, ASC proceeded with this approximation for the RCS gas dispersion simulations.

Each simulation was run under steady-state conditions using gas venting rates projected to have occurred at the beginning of the incident on the day in question, as provided by CE. Since the RCS field pressure was not at its maximum on that day, these rates are in the middle of the full range of possible flow rates.

Results

Figure 1 shows the extents of the model domain spanning a one mile diameter circle centered around the west side of the site. The height of the model was 2,000 ft above the site indicated by the circle above the green lower circle that represents the site location and surrounding area.

Figure 2 shows a zoomed in view of the site along with many plant features included in the model. Note also that the tree/foliage on the west side of the plant has been included in the model and is represented by the darker green shapes on the right side of this figure.

Each of the five simulations are detailed in a bank of 22 figures. The following sections detail the conditions assumed for each simulation. All simulations assumed the same ambient conditions of a steady 17 MPH west south west wind and an ambient air temperature of -4 ºF.

The first two figures show the silencer configurations assumed in the southwest and northwest corners of the site. The next three figures of each bank detail the air velocity profiles predicted by the model over and around the plant equipment. The next six figures show the predictions of natural gas dispersion over the plant location. Several different limits of natural gas mass fractions are shown in these plots to help clarify areas where the natural gas mass fraction values are the largest. The final ten figures display the natural gas distribution around the plant with respect to an air to fuel ratio, highlighting volumes of air around the plant that may have concentration ratios that could support combustion.

Simulation Run - SOW 2.1.1.1 - Existing Plant Equipment
The model predictions for this simulation are detailed in Figure 2-24. The conditions assumed for this simulation are as follows:

- Plant 1 Suction/Discharge Blowdown Vents 1 & 2 discharging natural gas
- Plant 1 TO operational
- Plant 2 Suction/Discharge Blowdown Vents 1 & 2 discharging natural gas
- Plant 2 Unit 2-7 Blowdown Mute discharging natural gas
- Plant 2 TO operational
- Plant 3 BDSL-3-01-06 and BDSL-3-01-07 discharging natural gas

Simulation Run - SOW 2.1.1.2 12" - Straight Pipes for BDSL-3-01-06 and BDSL-3-01-07
The model predictions for this simulation are detailed in Figure 25-46. The conditions assumed for this simulation are as follows:

- Plant 1 Suction/Discharge Blowdown Vents 1 & 2 discharging natural gas
- Plant 1 TO operational
- Plant 2 Suction/Discharge Blowdown Vents 1 & 2 discharging natural gas
- Plant 2 Unit 2-7 Blowdown Mute discharging natural gas
- Plant 2 TO operational
- Plant 3 BDSL-3-01-06 12” DIA pipe 26’ 8” high discharging natural gas
- Plant 3 BDSL-3-01-07 12” DIA pipe 23’ high discharging natural gas

Simulation Run – SOW 2.1.1.3a - Current configuration for BDSL-3-01-01 through -05
The model predictions for this simulation are detailed in Figure 47-68. The conditions assumed for this simulation are as follows:

- Plant 1 Suction/Discharge Blowdown Vents 1 & 2 discharging natural gas
- Plant 1 TO operational
- Plant 2 Suction/Discharge Blowdown Vents 1 & 2 discharging natural gas
- Plant 2 Unit 2-7 Blowdown Mute discharging natural gas
- Plant 2 TO operational
- Plant 3 BDSL-3-01-01 through -05 discharging natural gas (existing mutes)
- Plant 3 BDSL-3-01-06 12” DIA pipe 26’ 8” high discharging natural gas
- Plant 3 BDSL-3-01-07 12” DIA pipe 23’ high discharging natural gas

Simulation Run – SOW 2.1.1.3b - Straight Pipe for BDSL-3-01-01 through -07
The model predictions for this simulation are detailed in Figure 69-90. The conditions assumed for this simulation are as follows:

- Plant 1 Suction/Discharge Blowdown Vents 1 & 2 discharging natural gas
- Plant 1 TO operational
- Plant 2 Suction/Discharge Blowdown Vents 1 & 2 discharging natural gas
- Plant 2 Unit 2-7 Blowdown Mute discharging natural gas
- Plant 2 TO operational
- Plant 3 BDSL-3-01-01 through -05 (6” DIA pipe 18’ 8” high discharging natural gas)
- Plant 3 BDSL-3-01-06 (12” DIA pipe 26’ 8” high discharging natural gas)
- Plant 3 BDSL-3-01-07 (12” DIA pipe 23’ high discharging natural gas)

Simulation Run – SOW 2.1.1.5a - Discharges from Plants 1, 2, and 3
The model predictions for this simulation are detailed in Figure 91-104. The conditions assumed for this simulation are as follows:

- Plant 1 Suction/Discharge Blowdown Vents 1 & 2 discharging natural gas
- Plant 1 TO operational
- Plant 2 Suction/Discharge Blowdown Vents 1 & 2 discharging natural gas
- Plant 2 Unit 2-5 & 2-6 discharging natural gas
- Plant 2 Unit 2-7 Blowdown Mute discharging natural gas
- Plant 2 TO operational
- Plant 3 BDSL-3-01-01 through -05 (10” DIA pipe 18’ 8” high discharging natural gas)
- Plant 3 TO operational
- Plant 3 BDSL-3-01-06 (12” DIA pipe 26’ 8” high discharging natural gas)
- Plant 3 BDSL-3-01-07 (12” DIA pipe 23’ high discharging natural gas)

Conclusions

The simulations performed under the short-term scope of work show that replacing the Plant 3 silencers and mutes with straight pipes will provide sufficient velocity to propel the vented gas above the elevation of potential ignition sources for the venting and ambient conditions simulated.

Appendix A:

Plant Equipment Boundary Conditions Used in Simulations

Model Boundary Conditions

Plant	What	T	unit	Density	units	flow	units	mdot	units	Source
	BASELINE									
	Weather -4F, 29.94inHG, 10:25am									from DAW 2019/02/27
	Wind 17-24 mph WSW									
1	Suct/Disc Blowdown Vent 1 (NW)	5.6	F	0.3684	lb/ft3	31,052	acfm	190.66	lb/s	pg 12 of 2019/03/14 DAW
	Suct/Disc Blowdown Vent 2 (NW)	5.6	F	0.3684	lb/ft3	31,052	acfm	190.66	lb/s	pg 12 of 2019/03/14 DAW
	Reboiler & TO (NW)	1500	F	0.0186	lb/ft3	917	scfm	1.11	lb/s	OIM Manual Firecat 2.4.8 - assume max firing rate of 5000 SCFH, 10:1 air fuel, and exhaust density equal to air
	Dehydration Tower (NW)	n/a		n/a		n/a				DAW
	Heaters (NW)	n/a		n/a		n/a				DAW
2	Suct/Disc blowdown vents 1 (SW)	5.6	F	0.3684	lb/ft3	31,052	acfm	190.66	lb/s	pg 12 of 2019/03/14 DAW
	Suct/Disc blowdown vents 2 (SW)	5.6	F	0.3684	lb/ft3	31,052	acfm	190.66	lb/s	pg 12 of 2019/03/14 DAW
	Unit 2-7 Blowdown mute (SW)	48.2	F	0.0463	lb/ft3	33,606	acfm	25.93	lb/s	pg 12 of 2019/03/15 DAW
	Unit 2-6 & 2-5 combo blowdown vent (SW)	X		X		X				may need for 2.2.1.5
	Reboiler and TO (SW)	1500	F	0.0186	lb/ft3	916.7	scfm	1.11	lb/s	OIM Manual Firecat 2.4.8 - assume max firing rate of 5000 SCFH, 10:1 air fuel, and exhaust density equal to air
	Dehydration Tower (SW)	X		X		X				DAW
	Heaters (SW)	X		X		X				DAW
3	~~Blowdown silencers BDSL-3-01-01 (NW)~~	~~49.2~~	~~F~~	~~0.0462~~	~~lbm/ft3~~	~~21,825~~	~~acfm~~	~~16.81~~	~~lb/s~~	DAW said n/a for Run 1
	~~Blowdown silencers BDSL-3-01-02 (NW)~~	~~49.2~~	~~F~~	~~0.0462~~	~~lbm/ft3~~	~~21,825~~	~~acfm~~	~~16.81~~	~~lb/s~~	DAW said n/a for Run 1
	~~Blowdown silencers BDSL-3-01-03 (NW)~~	~~49.2~~	~~F~~	~~0.0462~~	~~lbm/ft3~~	~~21,825~~	~~acfm~~	~~16.81~~	~~lb/s~~	DAW said n/a for Run 1
	~~Blowdown silencers BDSL-3-01-04 (NW)~~	~~49.2~~	~~F~~	~~0.0462~~	~~lbm/ft3~~	~~21,825~~	~~acfm~~	~~16.81~~	~~lb/s~~	DAW said n/a for Run 1
	~~Blowdown silencers BDSL-3-01-05 (NW)~~	~~49.2~~	~~F~~	~~0.0462~~	~~lbm/ft3~~	~~21,825~~	~~acfm~~	~~16.81~~	~~lb/s~~	DAW said n/a for Run 1
	Blowdown silencer Suct BDSL-3-01-06 (SW)	39.2	F	0.0472	lbm/ft3	376,024	acfm	295.81	lb/s	pg15 of 2019/02/17 DAW
	Blowdown silencer Disc BDSL-03-01-07 (SW)	36.1	F	0.0474	lbm/ft3	155,802	acfm	123.08	lb/s	pg15 of 2019/02/17 DAW
	Reboiler and TO (SW)	1500	F	0.0186	lb/ft3	871	scfm	1.06	lb/s	not operational (GasTech Manual, 4.75 MMBTU/HR max input - ALB)
	Dehydration Tower (SW)	n/a		n/a		n/a				DAW
	Heaters (SW)	n/a		n/a		n/a				DAW
								1,209	lb/s	**total flow rate of CH4 in model**

Model Boundary Conditions

SOW 2.1.1.2 - 12" Straight Pipes for BDSL-3-01-06 and -07

Plant	What	T	unit	Density	units	flow	units	mdot	units	Source
	Weather -4F, 29.94inHG, 10:25am									from DAW 2019/02/27
	Wind 17-24 mph WSW									
1	Suct/Disc Blowdown Vent 1 (NW)	5.6	F	0.3684	lb/ft3	31,052	acfm	190.66	lb/s	pg 12 of 2019/03/14 DAW
	Suct/Disc Blowdown Vent 2 (NW)	5.6	F	0.3684	lb/ft3	31,052	acfm	190.66	lb/s	pg 12 of 2019/03/14 DAW
	Reboiler & TO (NW)	1500	F	0.0186	lb/ft3	917	scfm	1.11	lb/s	OIM Manual Firecat 2.4.8 - assume max firing rate of 5000 SCFH, 10:1 air fuel, and exhaust density equal to air
	Dehydration Tower (NW)	n/a		n/a		n/a				DAW
	Heaters (NW)	n/a		n/a		n/a				DAW
2	Suct/Disc blowdown vents 1 (SW)	5.6	F	0.3684	lb/ft3	31,052	acfm	190.66	lb/s	pg 12 of 2019/03/14 DAW
	Suct/Disc blowdown vents 2 (SW)	5.6	F	0.3684	lb/ft3	31,052	acfm	190.66	lb/s	pg 12 of 2019/03/14 DAW
	Unit 2-7 Blowdown mute (SW)	48.2	F	0.0463	lb/ft3	33,606	acfm	25.93	lb/s	pg 12 of 2019/03/15 DAW
	Unit 2-6 & 2-5 combo blowdown vent (SW)	n/a		n/a		n/a				may need for 2.2.1.5
	Reboiler and TO (SW)	1500	F	0.0186	lb/ft3	916.7	scfm	1.11	lb/s	OIM Manual Firecat 2.4.8 - assume max firing rate of 5000 SCFH, 10:1 air fuel, and exhaust density equal to air
	Dehydration Tower (SW)	n/a		n/a		n/a				DAW
	Heaters (SW)	n/a		n/a		n/a				DAW
3	~~Blowdown silencers BDSL-3-01-01 (NW)~~	~~49.2~~	~~F~~	~~0.0462~~	~~lbm/ft3~~	~~21,825~~	~~acfm~~	~~16.81~~	~~lb/s~~	DAW said n/a for Run 2
	~~Blowdown silencers BDSL-3-01-02 (NW)~~	~~49.2~~	~~F~~	~~0.0462~~	~~lbm/ft3~~	~~21,825~~	~~acfm~~	~~16.81~~	~~lb/s~~	DAW said n/a for Run 2
	~~Blowdown silencers BDSL-3-01-03 (NW)~~	~~49.2~~	~~F~~	~~0.0462~~	~~lbm/ft3~~	~~21,825~~	~~acfm~~	~~16.81~~	~~lb/s~~	DAW said n/a for Run 2
	~~Blowdown silencers BDSL-3-01-04 (NW)~~	~~49.2~~	~~F~~	~~0.0462~~	~~lbm/ft3~~	~~21,825~~	~~acfm~~	~~16.81~~	~~lb/s~~	DAW said n/a for Run 2
	~~Blowdown silencers BDSL-3-01-05 (NW)~~	~~49.2~~	~~F~~	~~0.0462~~	~~lbm/ft3~~	~~21,825~~	~~acfm~~	~~16.81~~	~~lb/s~~	DAW said n/a for Run 2
	Blowdown silencer Suct BDSL-3-01-06 (SW)	56.9	F	0.3323	lbm/ft3	49,995	acfm	276.89	lb/s	pg10 of 2019/03/16 DAW
	Blowdown silencer Disc BDSL-03-01-07 (SW)	43.2	F	0.1358	lbm/ft3	54,846	acfm	124.13	lb/s	pg12 of 2019/03/16 DAW
	Reboiler and TO (SW)	1500	F	0.0186	lb/ft3	871	scfm	1.06	lb/s	not operational (GasTech Manual, 4.75 MMBTU/HR max input - ALB)
	Dehydration Tower (SW)	n/a		n/a		n/a				DAW
	Heaters (SW)	n/a		n/a		n/a				DAW

Model Boundary Conditions

SOW 2.1.1.3a - Normal for BDSL-3-01-01 through BDSL-3-01-05, 12" pipe for -06 & -07

Plant	What	T	unit	Density	units	flow	units	mdot	units	Source
	Weather -4F, 29.94inHG, 10:25am									from DAW 2019/02/27
	Wind 17-24 mph WSW									
1	Suct/Disc Blowdown Vent 1 (NW)	5.6	F	0.3684	lb/ft3	31,052	acfm	190.66	lb/s	pg 12 of 2019/03/14 DAW
	Suct/Disc Blowdown Vent 2 (NW)	5.6	F	0.3684	lb/ft3	31,052	acfm	190.66	lb/s	pg 12 of 2019/03/14 DAW
	Reboiler & TO (NW)	1500	F	0.0186	lb/ft3	917	scfm	1.11	lb/s	OIM Manual Firecat 2.4.8 - assume max firing rate of 5000 SCFH, 10:1 air fuel, and exhaust density equal to air
	Dehydration Tower (NW)	n/a		n/a		n/a				DAW
	Heaters (NW)	n/a		n/a		n/a				DAW
2	Suct/Disc blowdown vents 1 (SW)	5.6	F	0.3684	lb/ft3	31,052	acfm	190.66	lb/s	pg 12 of 2019/03/14 DAW
	Suct/Disc blowdown vents 2 (SW)	5.6	F	0.3684	lb/ft3	31,052	acfm	190.66	lb/s	pg 12 of 2019/03/14 DAW
	Unit 2-7 Blowdown mute (SW)	48.2	F	0.0463	lb/ft3	33,606	acfm	25.93	lb/s	pg 12 of 2019/03/15 DAW
	Unit 2-6 & 2-5 combo blowdown vent (SW)	n/a		n/a		n/a				may need for 2.2.1.5
	Reboiler and TO (SW)	1500	F	0.0186	lb/ft3	916.7	scfm	1.11	lb/s	OIM Manual Firecat 2.4.8 - assume max firing rate of 5000 SCFH, 10:1 air fuel, and exhaust density equal to air
	Dehydration Tower (SW)	n/a		n/a		n/a				DAW
	Heaters (SW)	n/a		n/a		n/a				DAW
3	Blowdown silencers BDSL-3-01-01 (NW)	49.2	F	0.0462	lbm/ft3	21,825	acfm	16.81	lb/s	pg 11 of 2019/03/13 DAW
	Blowdown silencers BDSL-3-01-02 (NW)	49.2	F	0.0462	lbm/ft3	21,825	acfm	16.81	lb/s	pg 11 of 2019/03/13 DAW
	Blowdown silencers BDSL-3-01-03 (NW)	49.2	F	0.0462	lbm/ft3	21,825	acfm	16.81	lb/s	pg 11 of 2019/03/13 DAW
	Blowdown silencers BDSL-3-01-04 (NW)	49.2	F	0.0462	lbm/ft3	21,825	acfm	16.81	lb/s	pg 11 of 2019/03/13 DAW
	Blowdown silencers BDSL-3-01-05 (NW)	49.2	F	0.0462	lbm/ft3	21,825	acfm	16.81	lb/s	pg 11 of 2019/03/13 DAW
	Blowdown silencer Suct BDSL-3-01-06 (SW)	39.2	F	0.0472	lbm/ft3	376,024	acfm	295.81	lb/s	pg15 of 2019/02/17 DAW
	Blowdown silencer Disc BDSL-3-01-07 (SW)	36.1	F	0.0474	lbm/ft3	155,802	acfm	123.08	lb/s	pg15 of 2019/02/17 DAW
	Reboiler and TO (SW)	1500	F	0.0186	lb/ft3	871	scfm	1.06	lb/s	not operational (GasTech Manual, 4.75 MMBTU/HR max input - ALB)
	Dehydration Tower (SW)	n/a		n/a		n/a				DAW
	Heaters (SW)	n/a		n/a		n/a				DAW

Model Boundary Conditions

SOW 2.1.1.3b - 12" Pipes for BDSL-3-01-06 through -07, 6" for BDSL-3-01-01 through BDSL-3-01-05										
Plant	**What**	**T**	**unit**	**Density**	**units**	**flow**	**units**	**mdot**	**units**	**Source**
	Weather -4F, 29.94inHG, 10:25am									from DAW 2019/02/27
	Wind 17-24 mph WSW									
1	Suct/Disc Blowdown Vent 1 (NW)	5.6	F	0.3684	lb/ft3	31,052	acfm	190.66	lb/s	pg 12 of 2019/03/14 DAW
	Suct/Disc Blowdown Vent 2 (NW)	5.6	F	0.3684	lb/ft3	31,052	acfm	190.66	lb/s	pg 12 of 2019/03/14 DAW
	Reboiler & TO (NW)	1500	F	0.0186	lb/ft3	917	scfm	1.11	lb/s	OIM Manual Firecat 2.4.8 - assume max firing rate of 5000 SCFH, 10:1 air fuel, and exhaust density equal to air
	Dehydration Tower (NW)	n/a		n/a		n/a				DAW
	Heaters (NW)	n/a		n/a		n/a				DAW
2	Suct/Disc blowdown vents 1 (SW)	5.6	F	0.3684	lb/ft3	31,052	acfm	190.66	lb/s	pg 12 of 2019/03/14 DAW
	Suct/Disc blowdown vents 2 (SW)	5.6	F	0.3684	lb/ft3	31,052	acfm	190.66	lb/s	pg 12 of 2019/03/14 DAW
	Unit 2-7 Blowdown mute (SW)	48.2	F	0.0463	lb/ft3	33,606	acfm	25.93	lb/s	pg 12 of 2019/03/15 DAW
	Unit 2-6 & 2-5 combo blowdown vent (SW)	n/a		n/a		n/a				may need for 2.2.1.5
	Reboiler and TO (SW)	1500	F	0.0186	lb/ft3	916.7	scfm	1.11	lb/s	OIM Manual Firecat 2.4.8 - assume max firing rate of 5000 SCFH, 10:1 air fuel, and exhaust density equal to air
	Dehydration Tower (SW)	n/a		n/a		n/a				DAW
	Heaters (SW)	n/a		n/a		n/a				DAW
3	Blowdown silencers BDSL-3-01-01 (NW)	52.2	F	0.0548	lbm/ft3	18,394	acfm	16.80	lb/s	pg 10 of 2019/03/18 DAW
	Blowdown silencers BDSL-3-01-02 (NW)	52.2	F	0.0548	lbm/ft3	18,394	acfm	16.80	lb/s	pg 10 of 2019/03/18 DAW
	Blowdown silencers BDSL-3-01-03 (NW)	52.2	F	0.0548	lbm/ft3	18,394	acfm	16.80	lb/s	pg 10 of 2019/03/18 DAW
	Blowdown silencers BDSL-3-01-04 (NW)	52.2	F	0.0548	lbm/ft3	18,394	acfm	16.80	lb/s	pg 10 of 2019/03/18 DAW
	Blowdown silencers BDSL-3-01-05 (NW)	52.2	F	0.0548	lbm/ft3	18,394	acfm	16.80	lb/s	pg 10 of 2019/03/18 DAW
	Blowdown silencer Suct BDSL-3-01-06 (SW)	56.9	F	0.3323	lbm/ft3	49,995	acfm	276.89	lb/s	pg15 of 2019/02/17 DAW
	Blowdown silencer Disc BDSL-03-01-07 (SW)	43.2	F	0.1358	lbm/ft3	54,846	acfm	124.13	lb/s	pg15 of 2019/02/17 DAW
	Reboiler and TO (SW)	1500	F	0.0186	lb/ft3	871	scfm	1.06	lb/s	not operational (GasTech Manual, 4.75 MMBTU/HR max input - ALB)
	Dehydration Tower (SW)	n/a		n/a		n/a				DAW
	Heaters (SW)	n/a		n/a		n/a				DAW

Model Boundary Conditions

SOW 2.1.1.5a - 12" Pipes for BDSL-3-01-06 through -07, 10" for BDSL-3-01-01 through BDSL-3-01-05

Plant	What	T	unit	Density	units	flow	units	mdot	units	Source
	Weather -4F, 29.94inHG, 10:25am									from DAW 2019/02/27
	Wind 17-24 mph WSW									
1	Suct/Disc Blowdown Vent 1 (NW)	5.6	F	0.3684	lb/ft3	31,052	acfm	190.66	lb/s	pg 12 of 2019/03/14 DAW
	Suct/Disc Blowdown Vent 2 (NW)	5.6	F	0.3684	lb/ft3	31,052	acfm	190.66	lb/s	pg 12 of 2019/03/14 DAW
	Reboiler & TO (NW)	1500	F	0.0186	lb/ft3	917	scfm	1.11	lb/s	OIM Manual Firecat 2.4.8 - assume max firing rate of 5000 SCFH, 10:1 air fuel, and exhaust density equal to air
	Dehydration Tower (NW)	n/a		n/a		n/a				DAW
	Heaters (NW)	n/a		n/a		n/a				DAW
2	Suct/Disc blowdown vents 1 (SW)	5.6	F	0.3684	lb/ft3	31,052	acfm	190.66	lb/s	pg 12 of 2019/03/14 DAW
	Suct/Disc blowdown vents 2 (SW)	5.6	F	0.3684	lb/ft3	31,052	acfm	190.66	lb/s	pg 12 of 2019/03/14 DAW
	Unit 2-7 Blowdown mute (SW)	48.2	F	0.0463	lb/ft3	33,606	acfm	25.93	lb/s	pg 12 of 2019/03/15 DAW
	Unit 2-6 & 2-5 combo blowdown vent (SW)	59.1	F	0.0687	lb/ft3	35,294	acfm	40.41	lb/s	pg 12 of 2019/03/18 DAW
	Reboiler and TO (SW)	1500	F	0.0186	lb/ft3	916.7	scfm	1.11	lb/s	OIM Manual Firecat 2.4.8 - assume max firing rate of 5000 SCFH, 10:1 air fuel, and exhaust density equal to air
	Dehydration Tower (SW)	n/a		n/a		n/a				DAW
	Heaters (SW)	n/a		n/a		n/a				DAW
3	Blowdown silencers BDSL-3-01-01 (NW)	52.2	F	0.0548	lbm/ft3	18,394	acfm	16.80	lb/s	pg 10 of 2019/03/18 DAW
	Blowdown silencers BDSL-3-01-02 (NW)	52.2	F	0.0548	lbm/ft3	18,394	acfm	16.80	lb/s	pg 10 of 2019/03/18 DAW
	Blowdown silencers BDSL-3-01-03 (NW)	52.2	F	0.0548	lbm/ft3	18,394	acfm	16.80	lb/s	pg 10 of 2019/03/18 DAW
	Blowdown silencers BDSL-3-01-04 (NW)	52.2	F	0.0548	lbm/ft3	18,394	acfm	16.80	lb/s	pg 10 of 2019/03/18 DAW
	Blowdown silencers BDSL-3-01-05 (NW)	52.2	F	0.0548	lbm/ft3	18,394	acfm	16.80	lb/s	pg 10 of 2019/03/18 DAW
	Blowdown silencer Suct BDSL-3-01-06 (SW)	56.9	F	0.3323	lbm/ft3	49,995	acfm	276.89	lb/s	pg15 of 2019/02/17 DAW
	Blowdown silencer Disc BDSL-03-01-07 (SW)	43.2	F	0.1358	lbm/ft3	54,846	acfm	124.13	lb/s	pg15 of 2019/02/17 DAW
	Reboiler and TO (SW)	1500	F	0.0186	lb/ft3	871	scfm	1.06	lb/s	GasTech Manual, 4.75 MMBTU/HR max input - ALB
	Dehydration Tower (SW)	n/a		n/a		n/a				DAW
	Heaters (SW)	n/a		n/a		n/a				DAW

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Appendix B:

Simulation Results

Model Geometry

Isometric View - Looking South-West - Domain

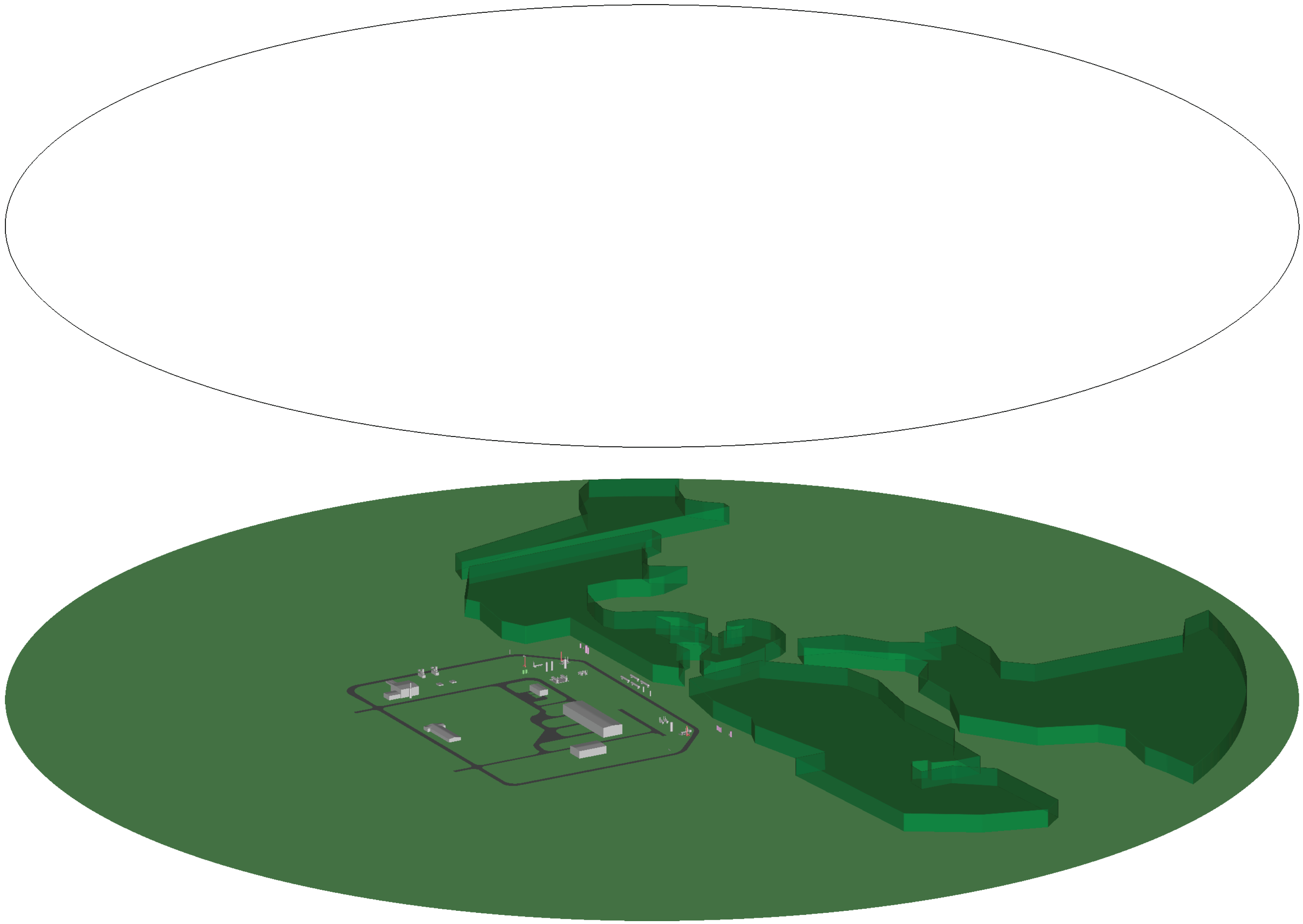

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Figure 1

Model Geometry

Isometric View - Looking South-West - Plant Site

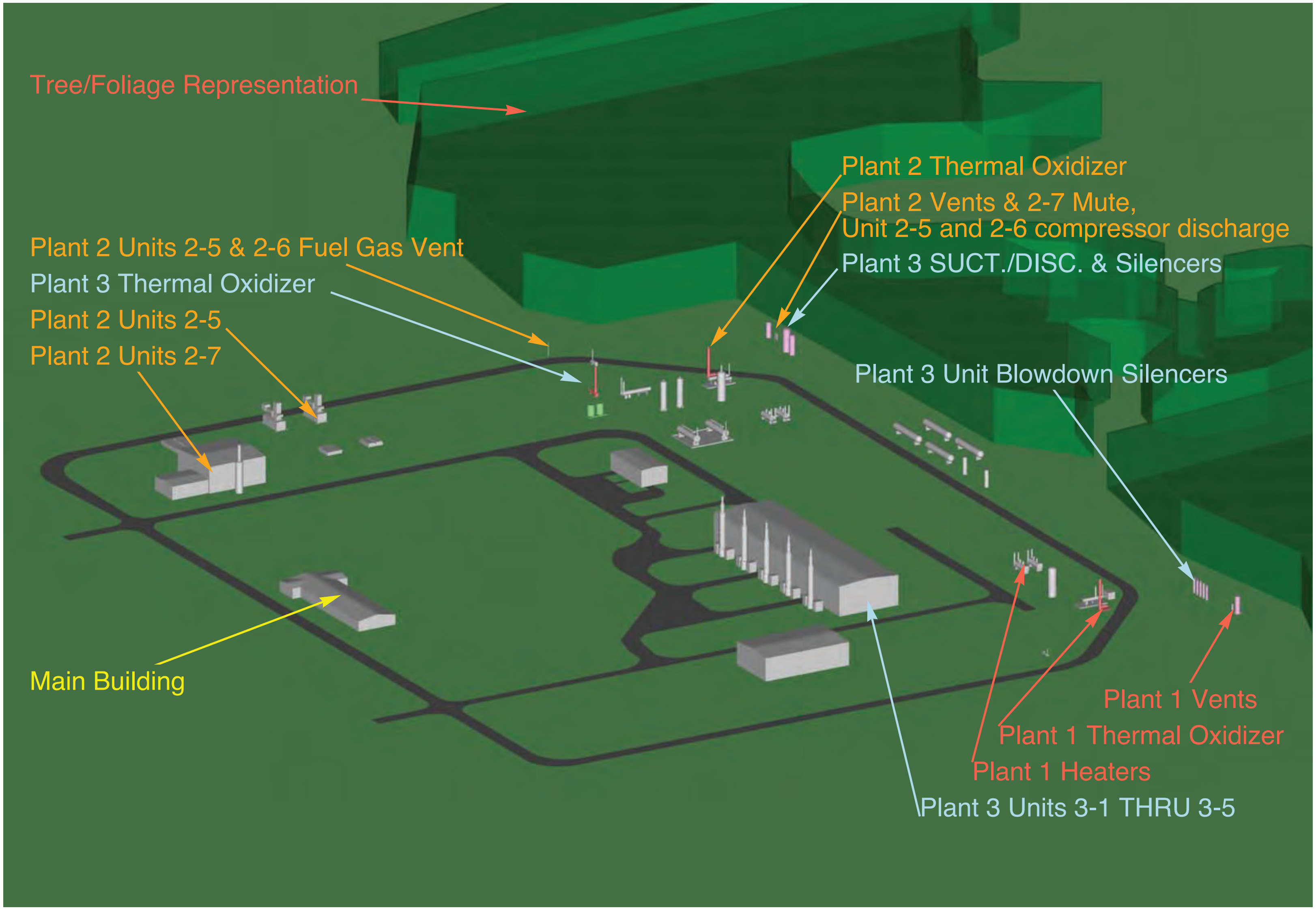

Figure 2

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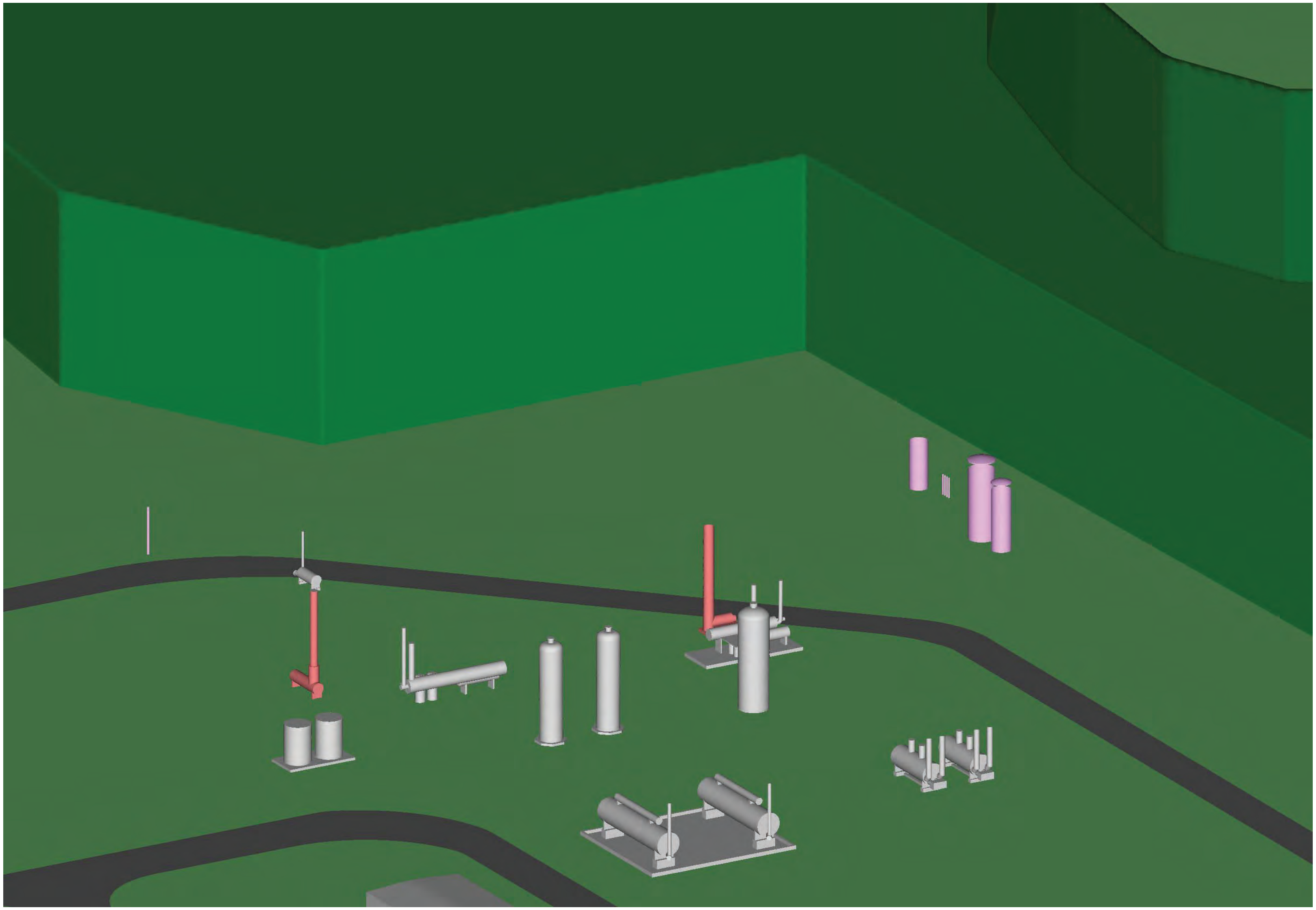
Model Geometry

Isometric View - Looking South-West - South-West Corner of Plant



Airflow Sciences Corporation

Figure 3

Model Geometry

Isometric View - Looking South-West - North-West Corner of Plant

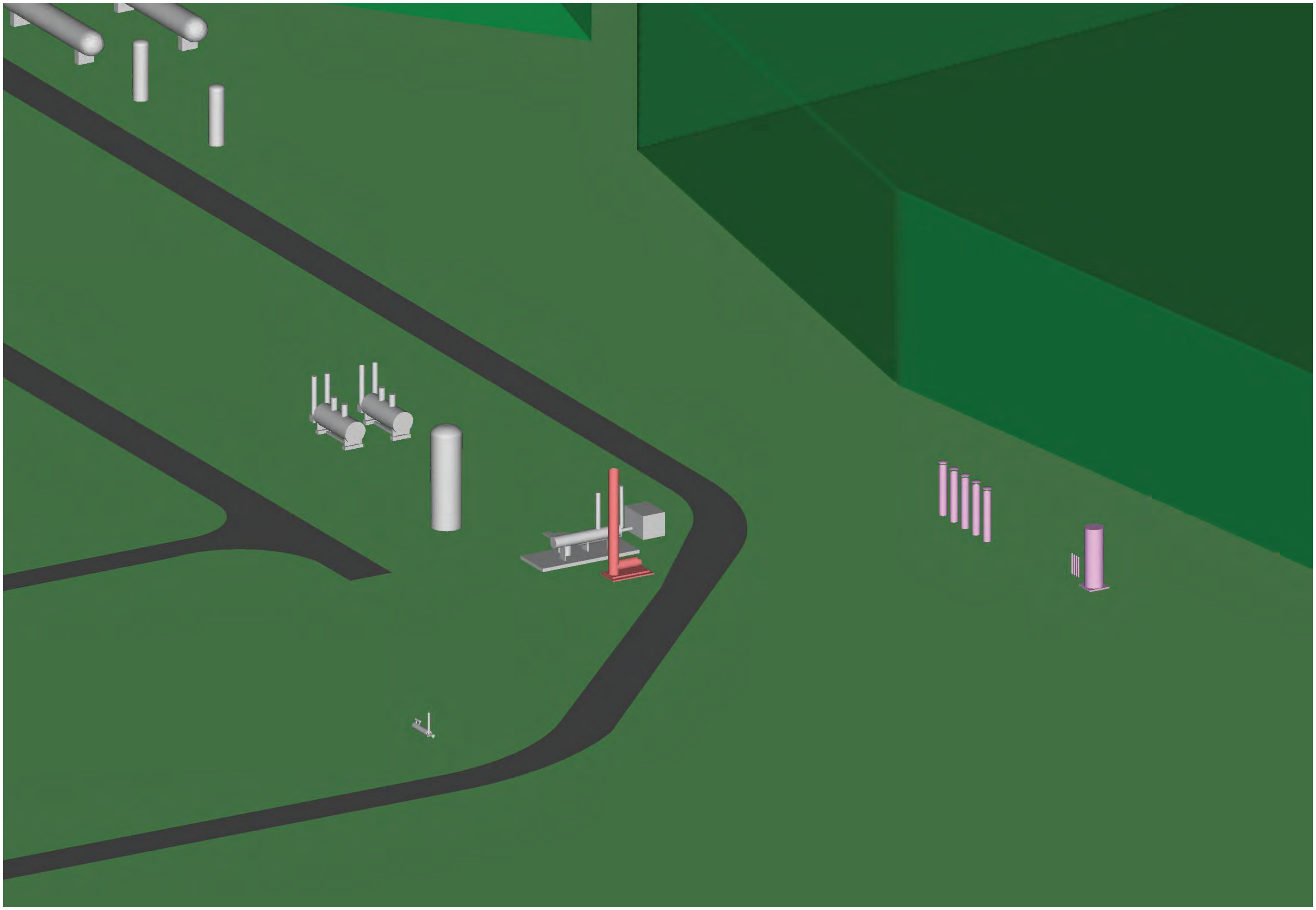


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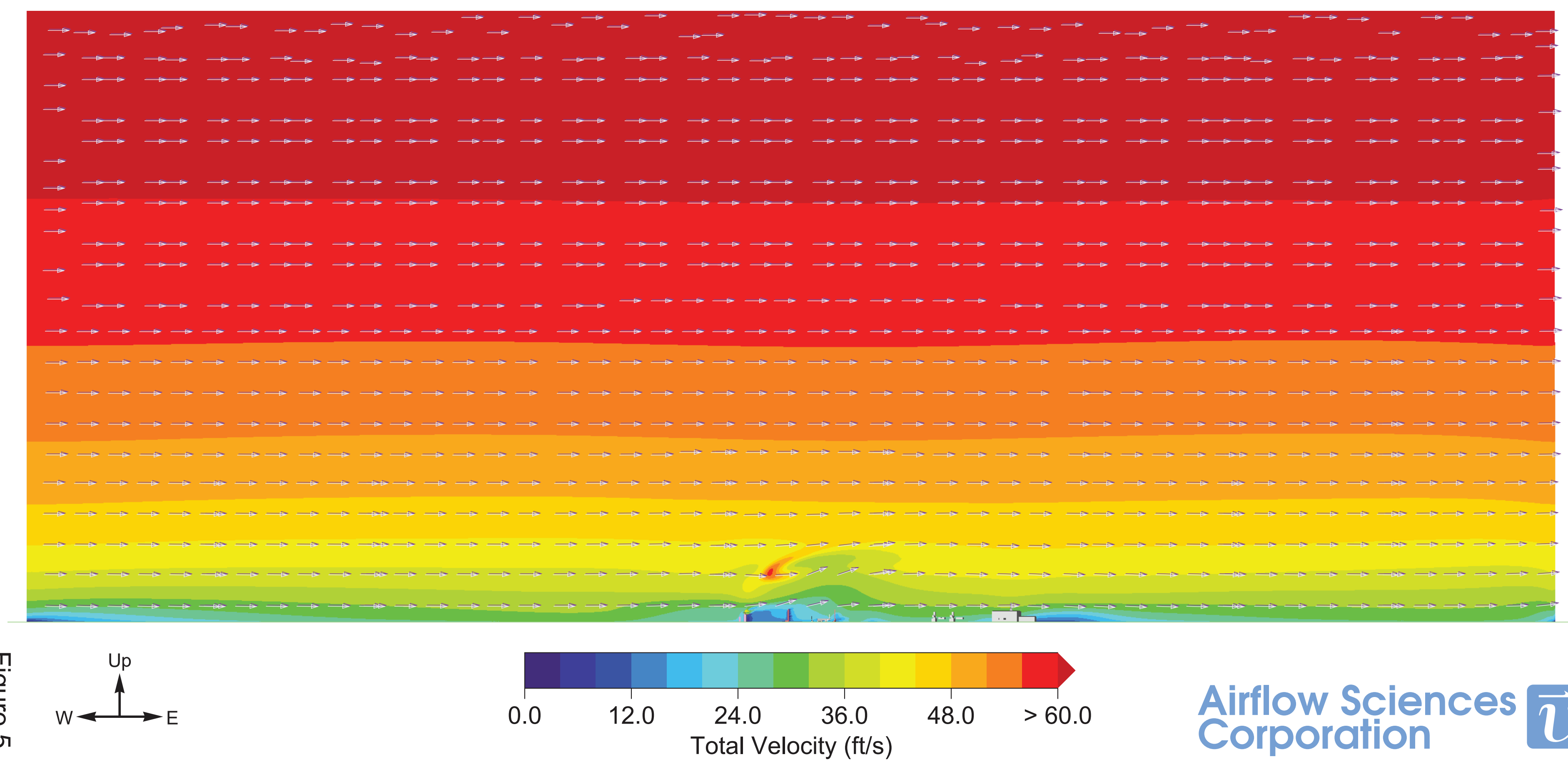
Figure 4

Velocity - SOW 2.1.1.1

Side View - Through BDSL 3-1-7 & Thermal Oxidizer

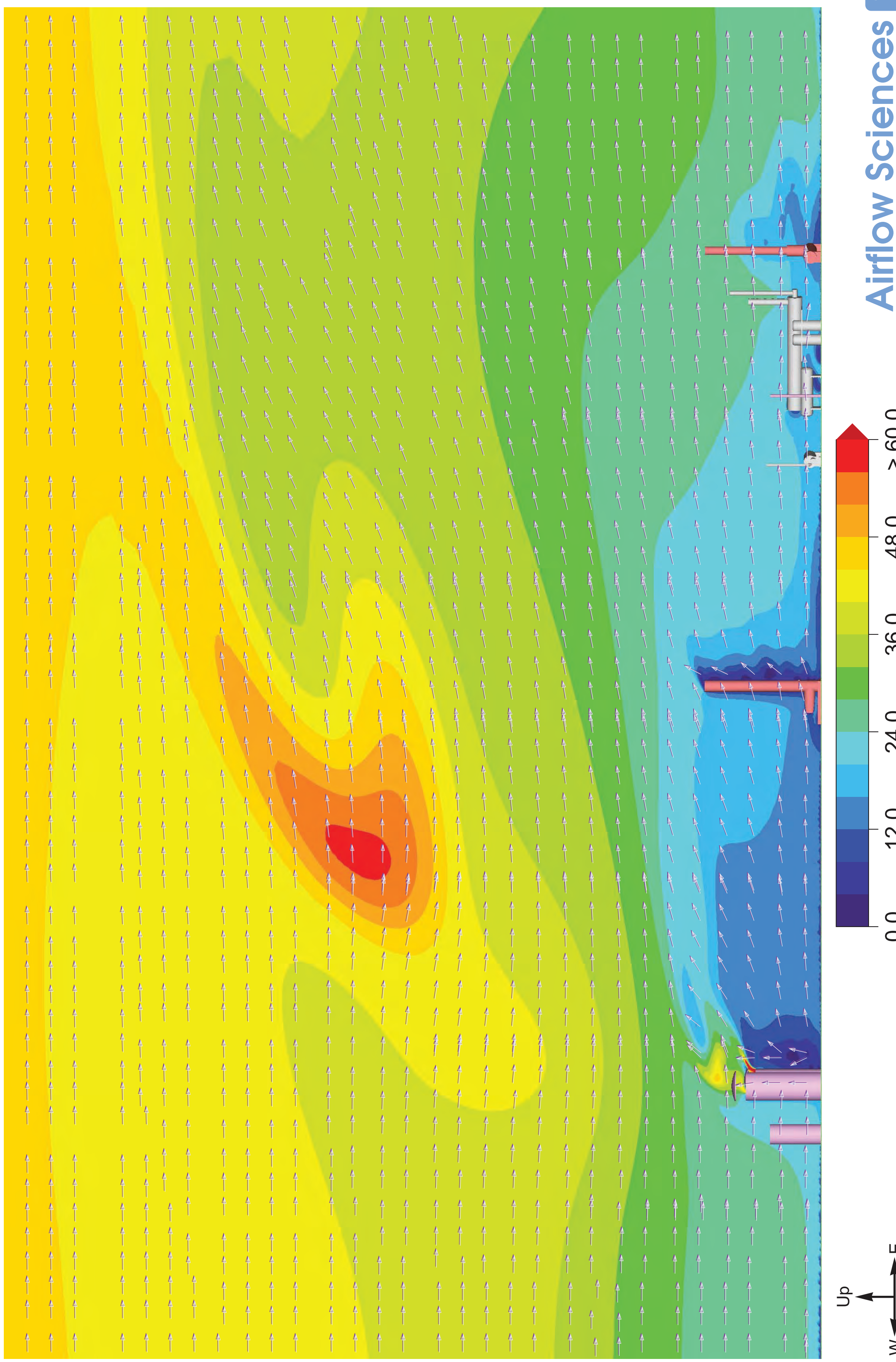


Airflow Sciences Corporation

Figure 5

Velocity - SOW 2.1.1.1

Side View - Through BDSL 3-1-7 & Thermal Oxidizer

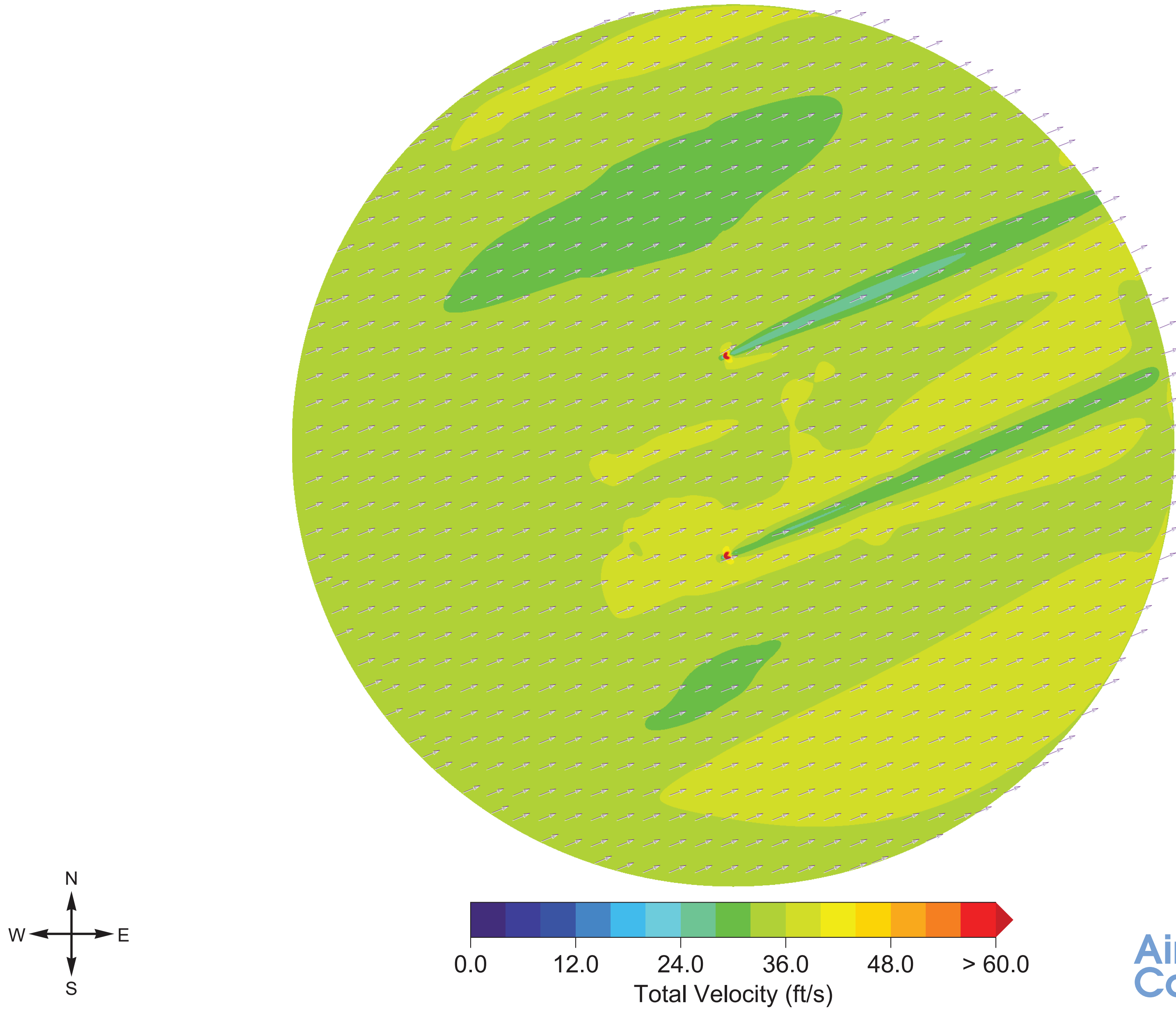


Airflow Sciences Corporation

Figure 6

Velocity - SOW 2.1.1.1

Top View - Domain - 100' Above ground



Airflow Sciences Corporation

Figure 7

Velocity - SOW 2.1.1.1

Top View - Domain - 20' Above ground

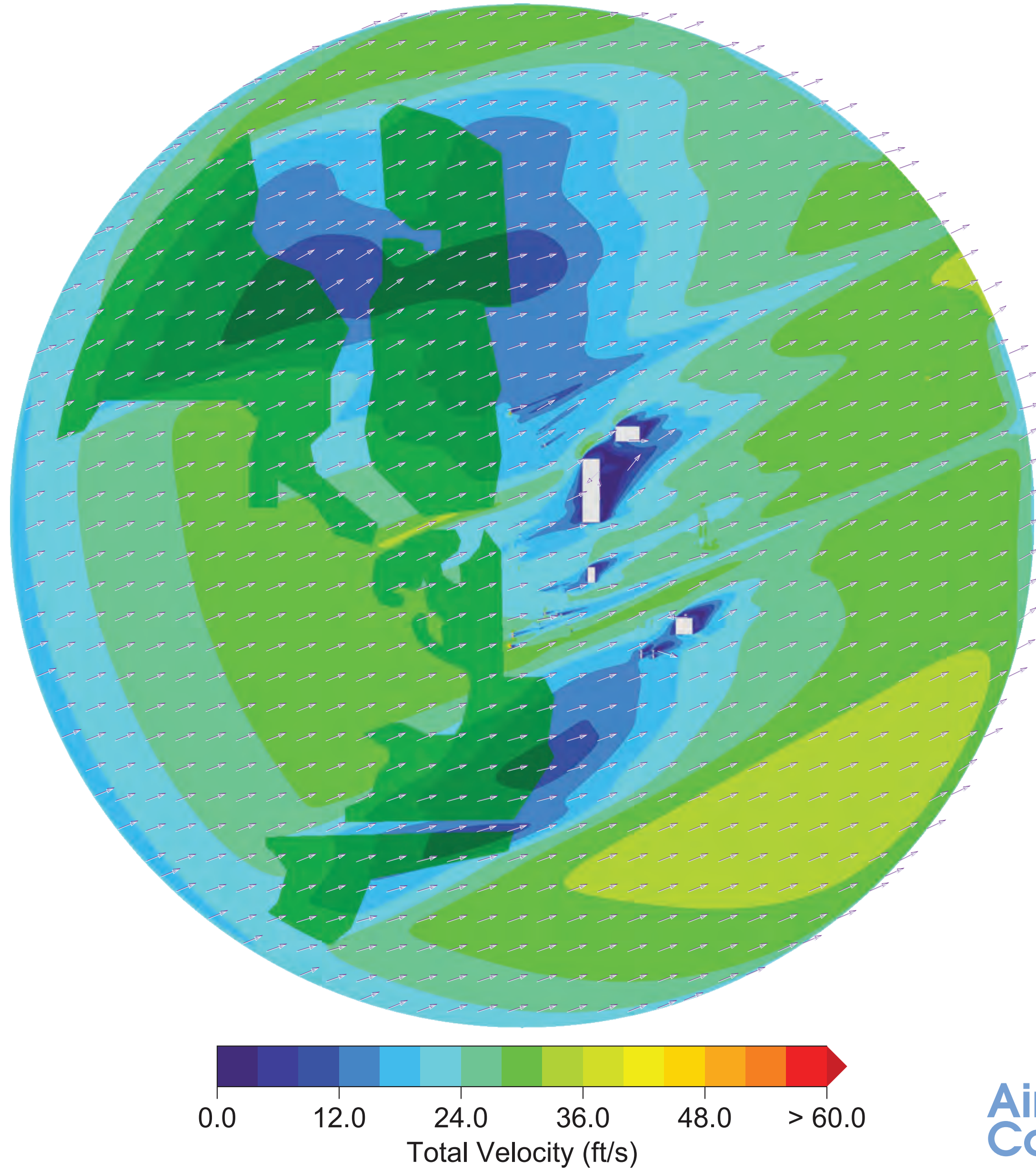
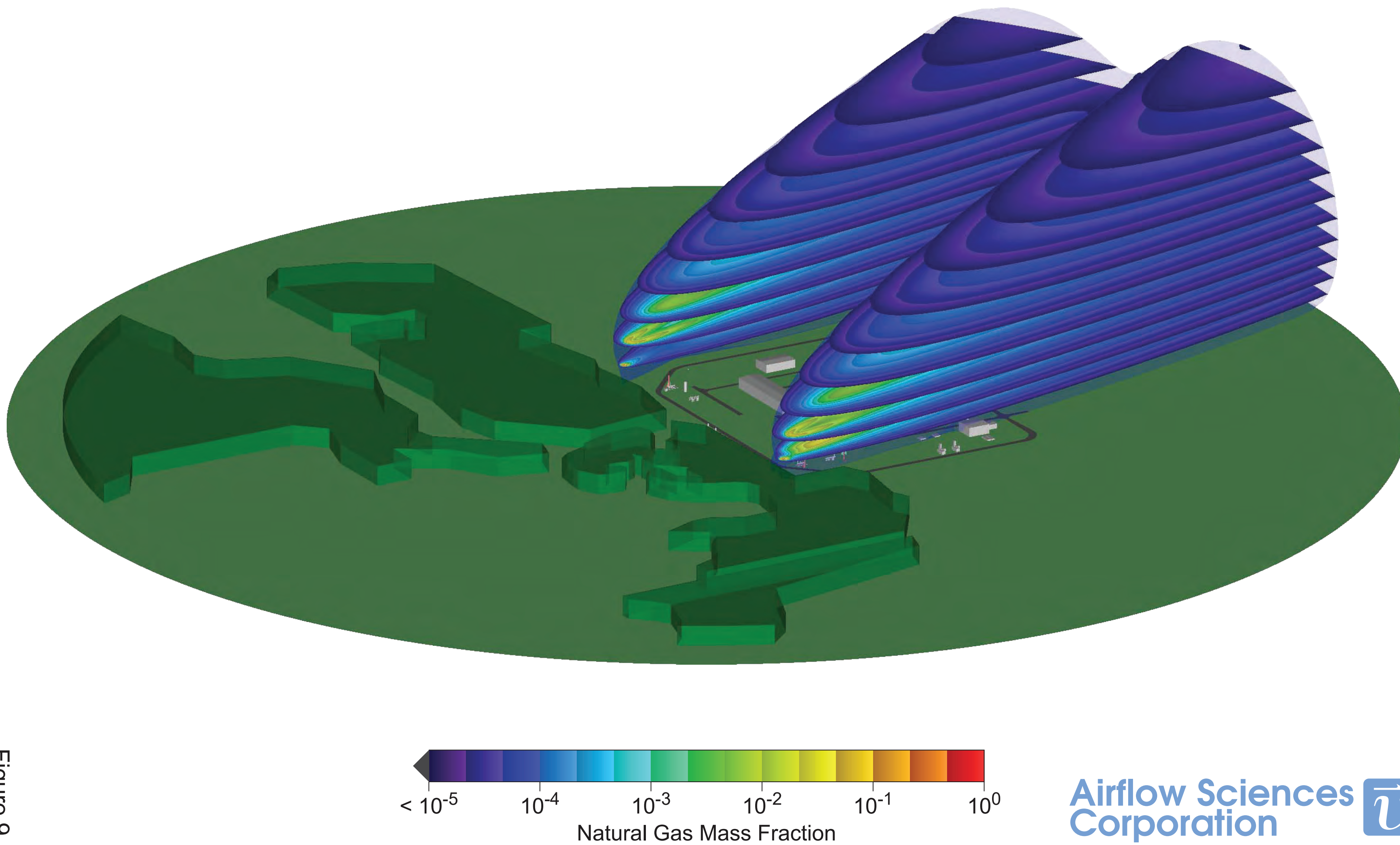


Figure 8

Natural Gas Mass Fraction - SOW 2.1.1.1

Isometric View - Looking North-East - Domain - Value > 10^{-5} - Every 80'

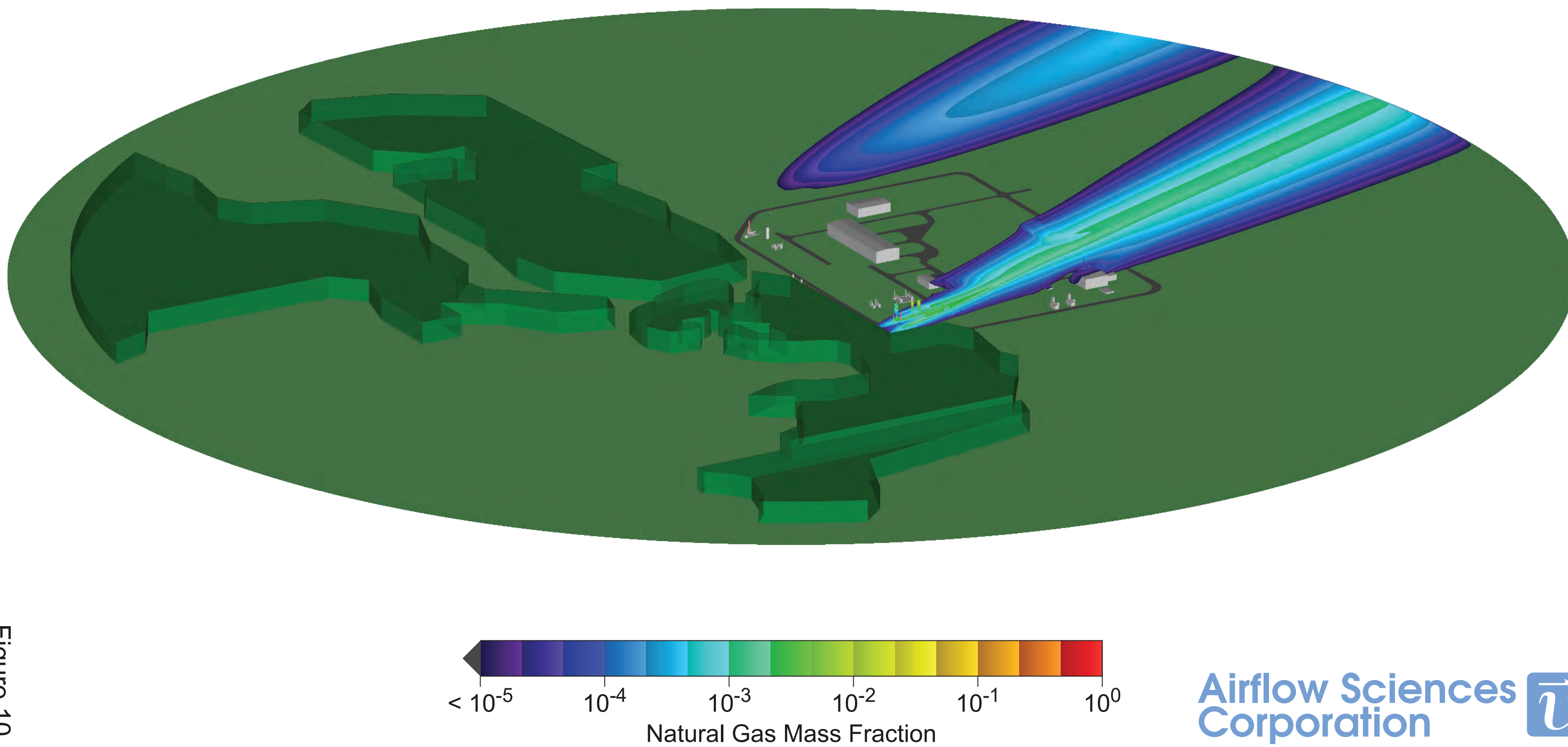


Airflow Sciences Corporation

Figure 9

Natural Gas Mass Fraction - SOW 2.1.1.1

Isometric View - Looking North-East - Domain - Value > 10^{-5} - Ground & Building Surfaces

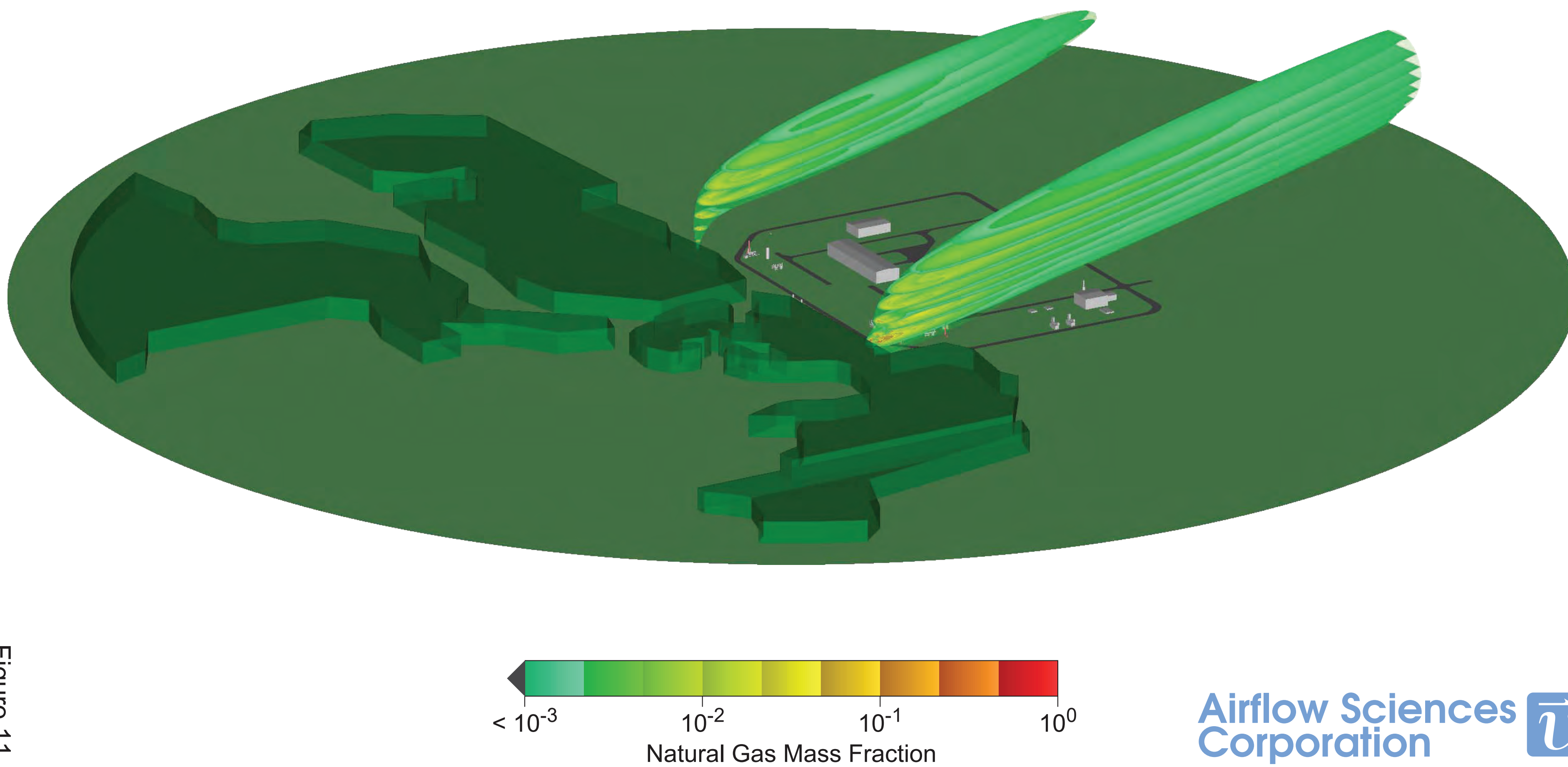


Airflow Sciences Corporation

Figure 10

Natural Gas Mass Fraction - SOW 2.1.1.1

Isometric View - Looking North-East - Domain - Value > 10^{-3} - Every 40’

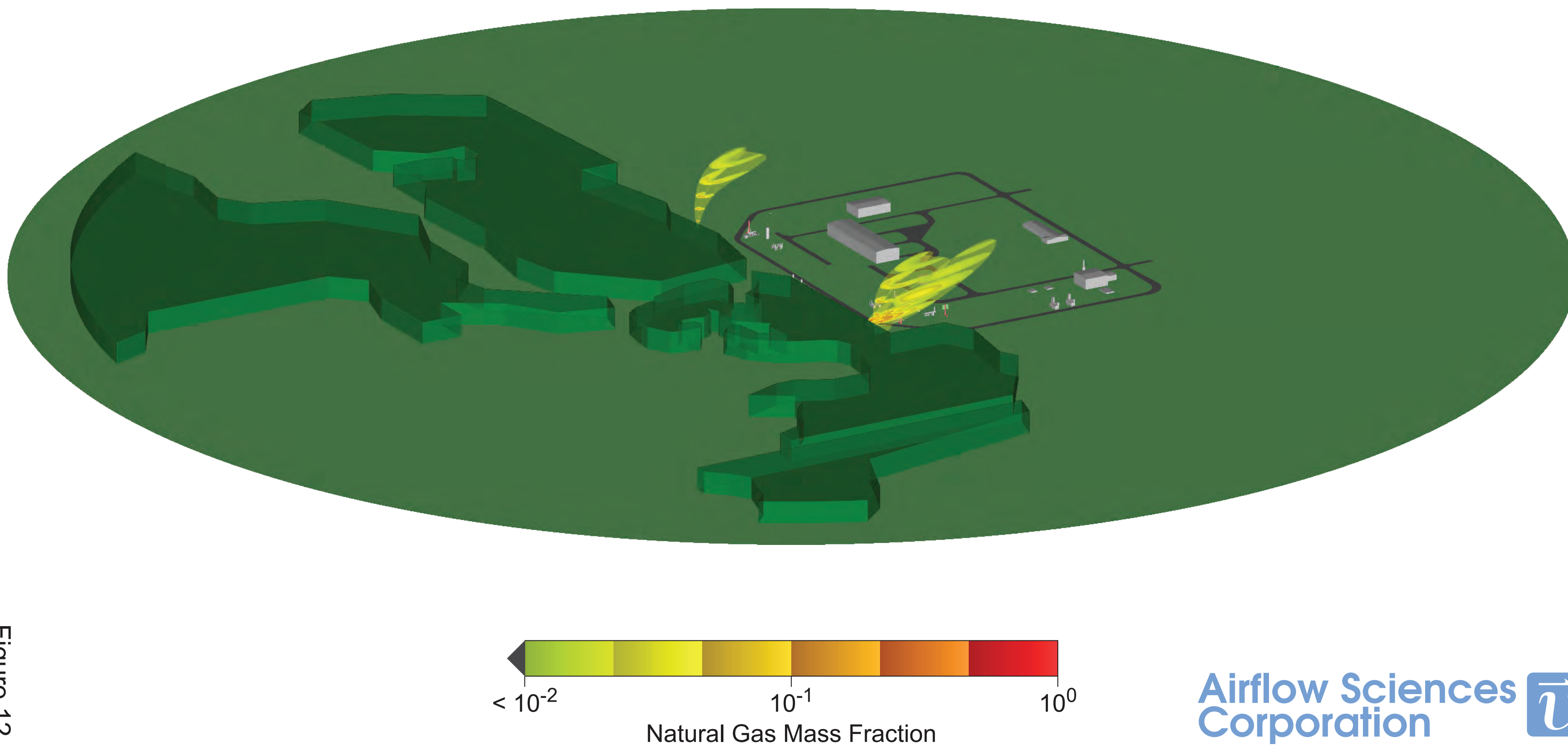


Airflow Sciences Corporation

Figure 11

Natural Gas Mass Fraction - SOW 2.1.1.1

Isometric View - Looking North-East - Domain - Value > 10^{-2} - Every 40'

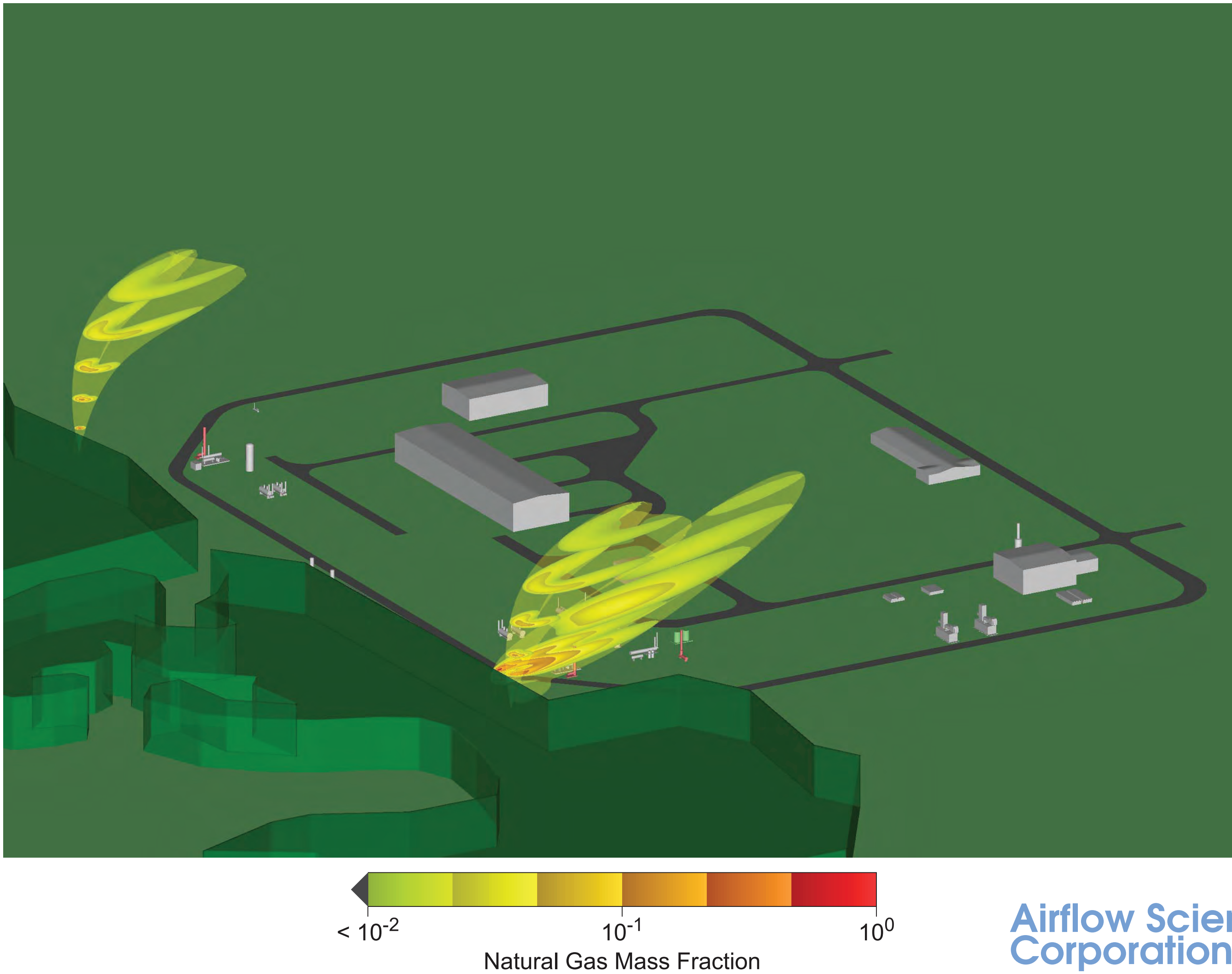


Airflow Sciences Corporation

Figure 12

Natural Gas Mass Fraction - SOW 2.1.1.1

Isometric View - Looking North-East - Plant Site - Value > 10^{-2} - Every 40’

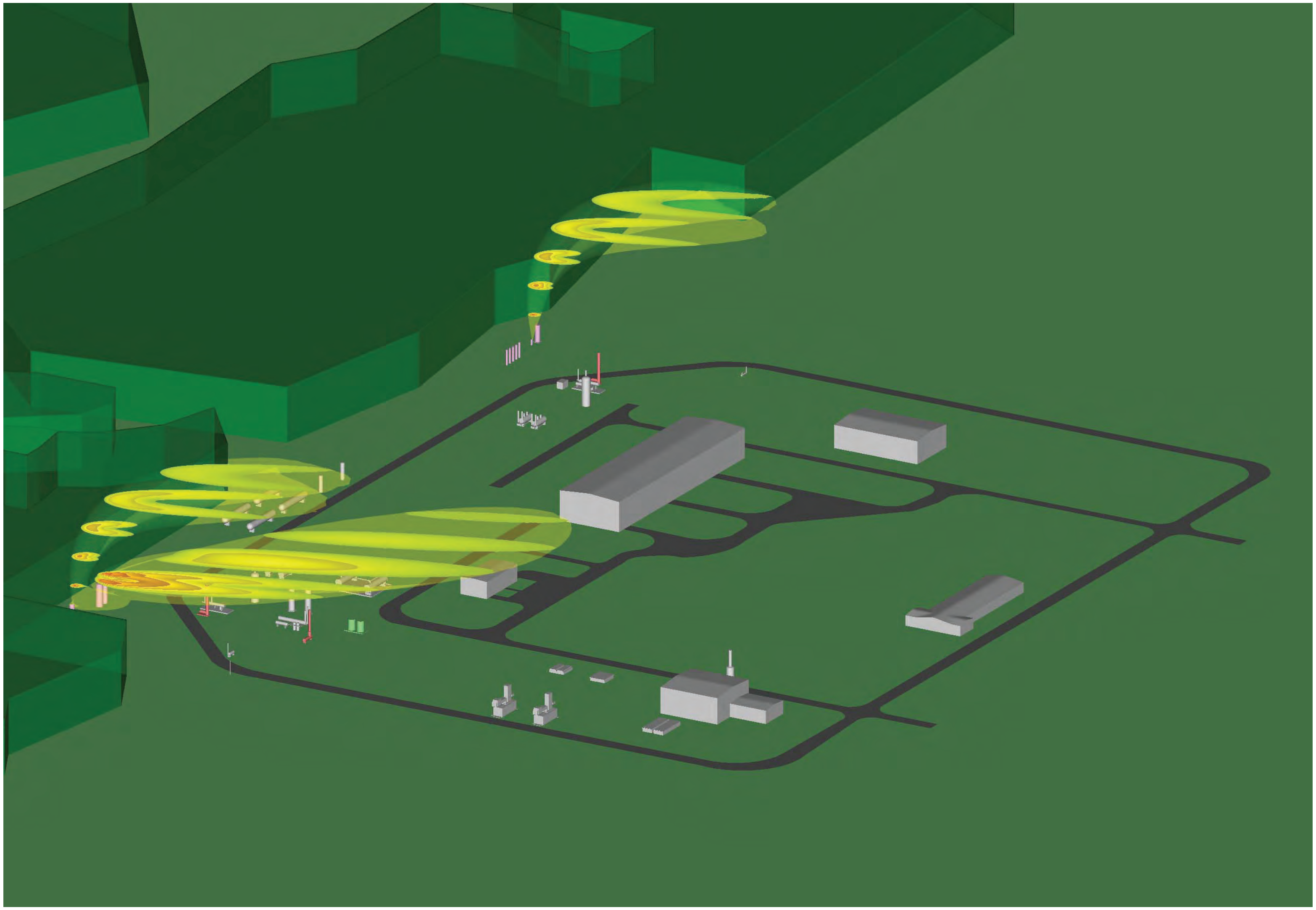


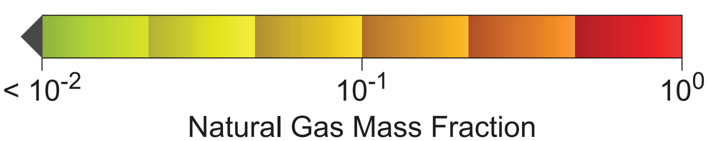
Airflow Sciences Corporation

Figure 13

Natural Gas Mass Fraction - SOW 2.1.1.1

Isometric View - Looking North-West - Plant Site - Value > 10^{-2} - Every 40'



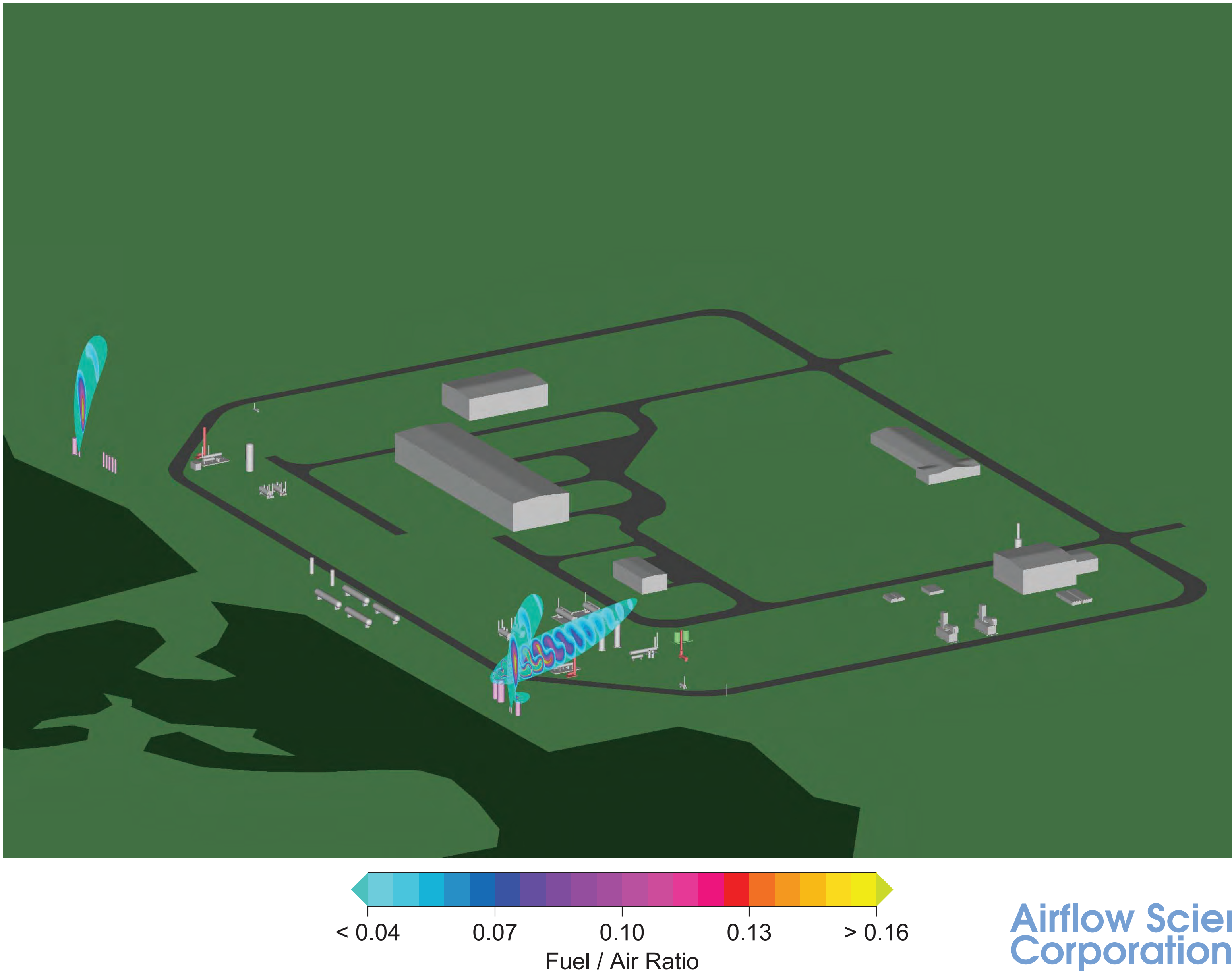


Airflow Sciences Corporation

Figure 14

Fuel / Air Ratio - SOW 2.1.1.1

Isometric View - Looking North-East - Plant Site - Value > 4%

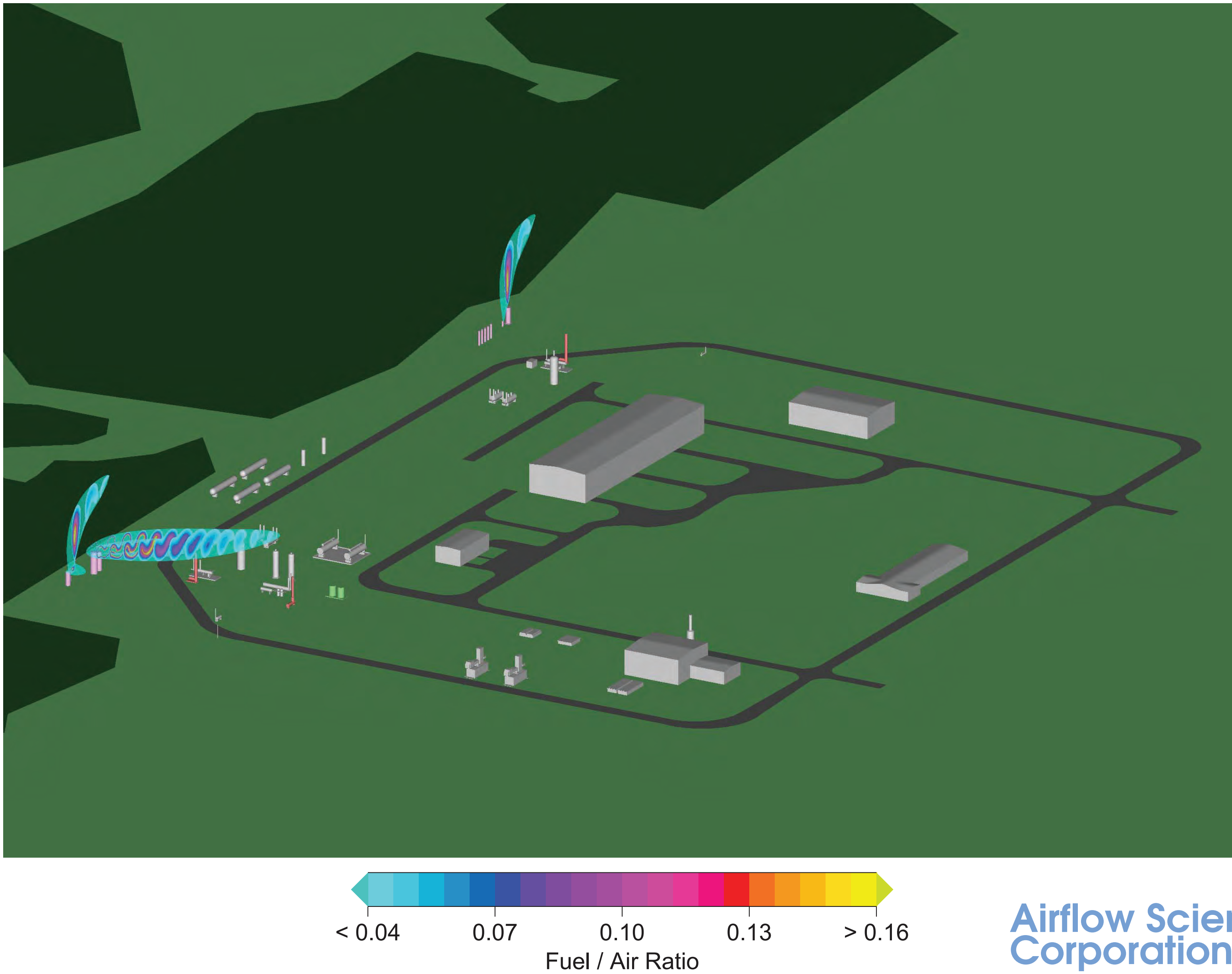


Airflow Sciences Corporation

Figure 15

Fuel / Air Ratio - SOW 2.1.1.1

Isometric View - Looking North-West - Plant Site - Value > 4%

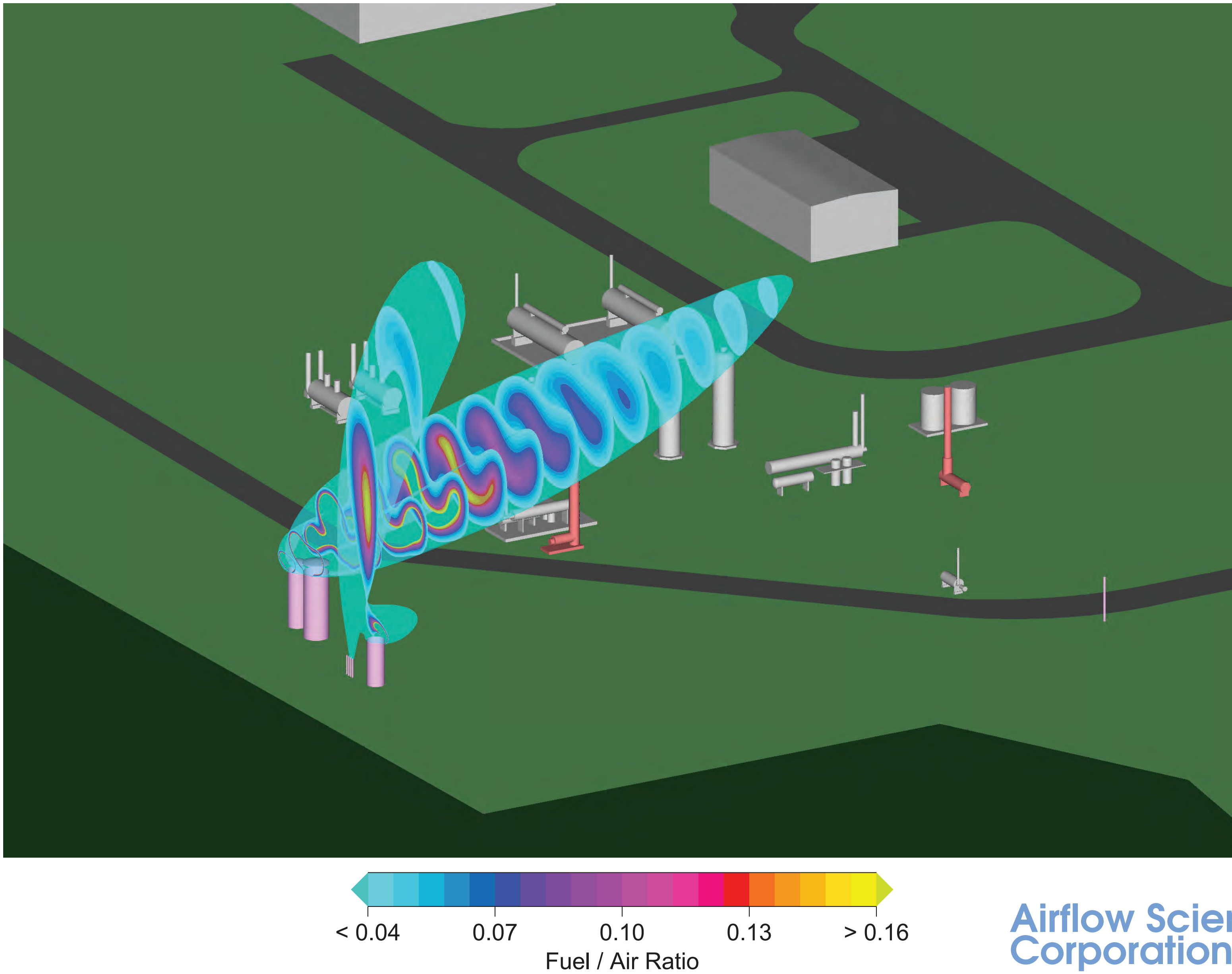


Airflow Sciences Corporation

Figure 16

Fuel / Air Ratio - SOW 2.1.1.1

Isometric View - Looking North-East - South-West Corner of Plant - Value > 4%

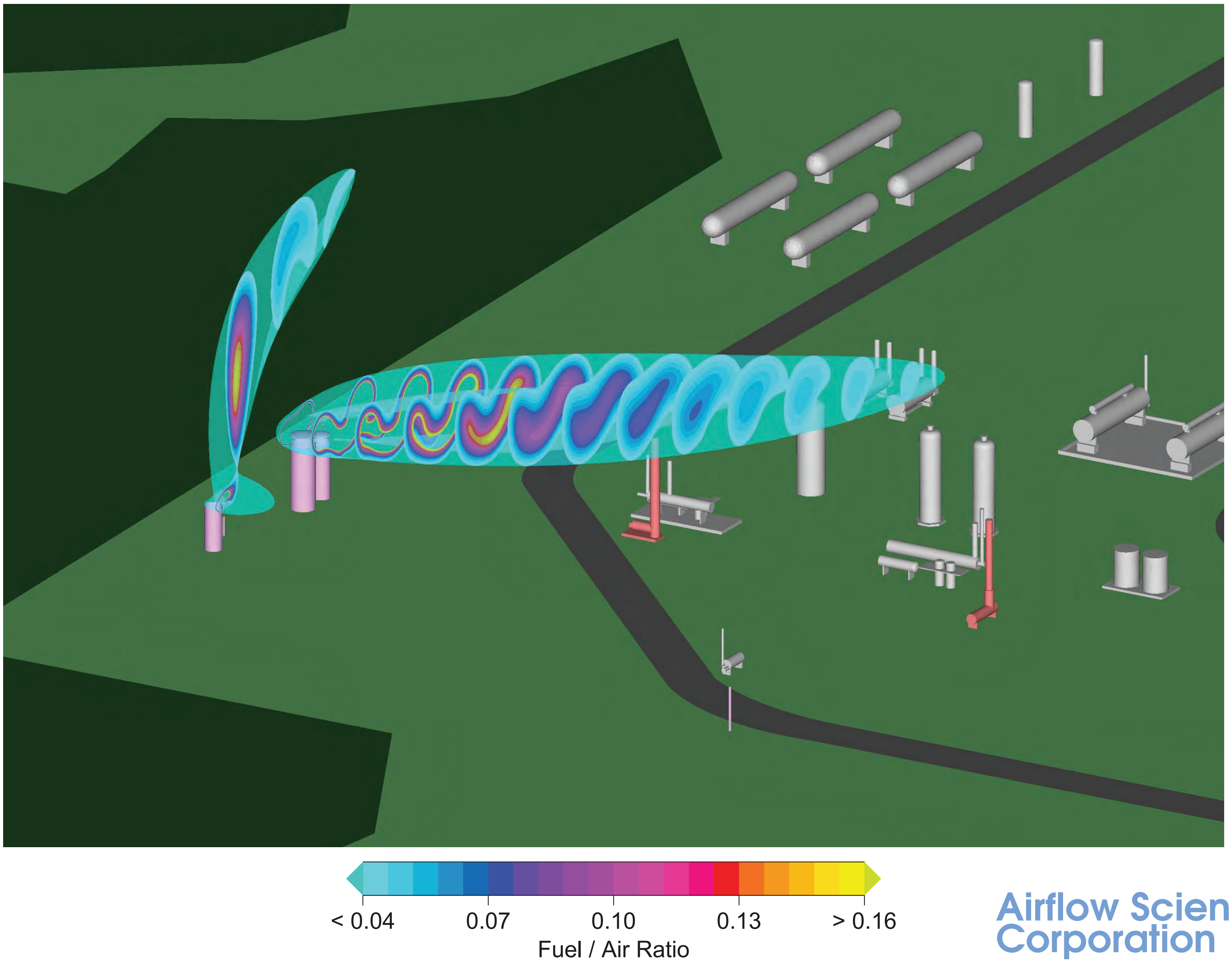


Airflow Sciences Corporation

Figure 17

Fuel / Air Ratio - SOW 2.1.1.1

Isometric View - Looking North-West - South-West Corner of Plant - Value > 4%

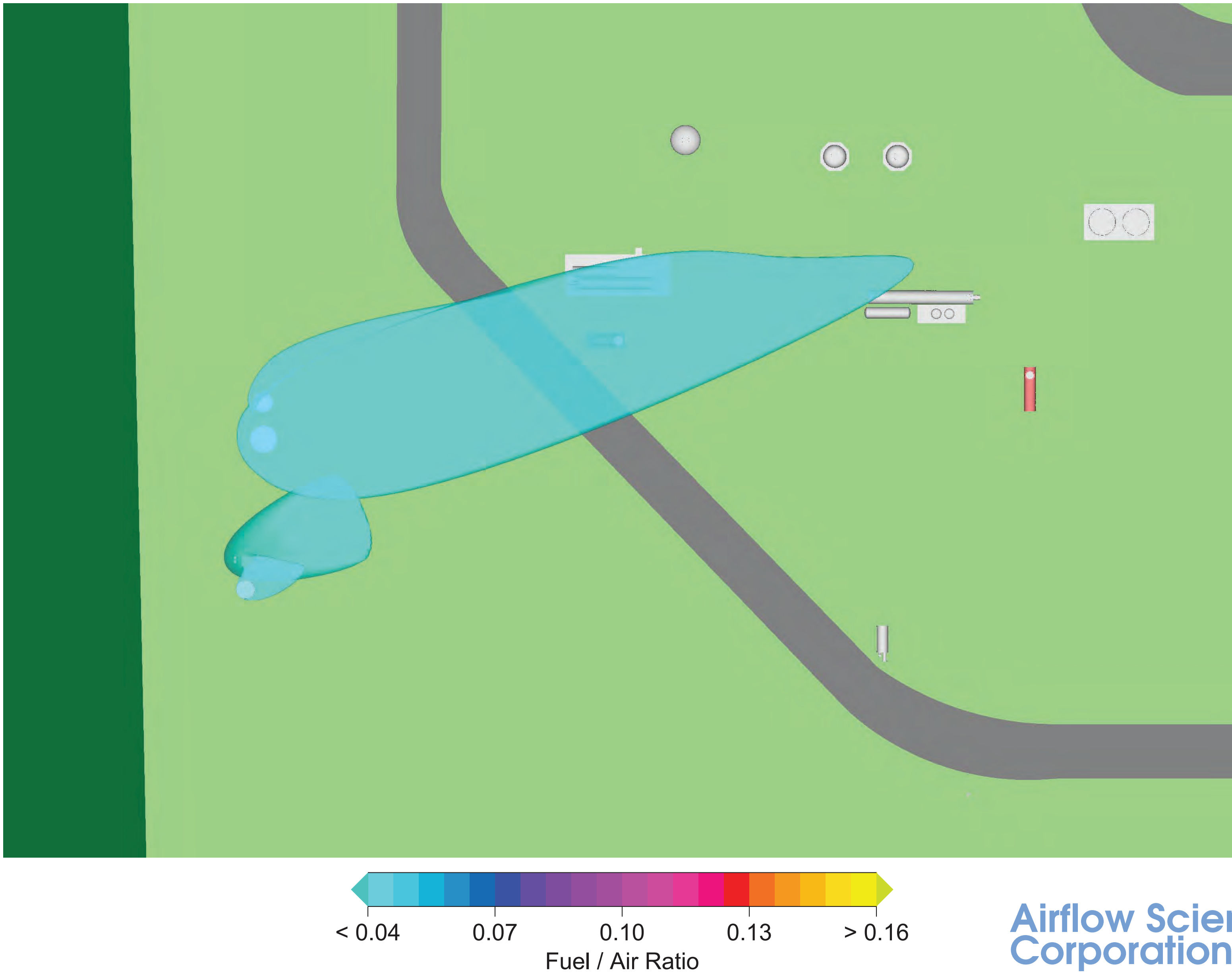


Airflow Sciences Corporation

Figure 18

Fuel / Air Ratio - SOW 2.1.1.1

Top View - South-West Corner of Plant - Value > 4%

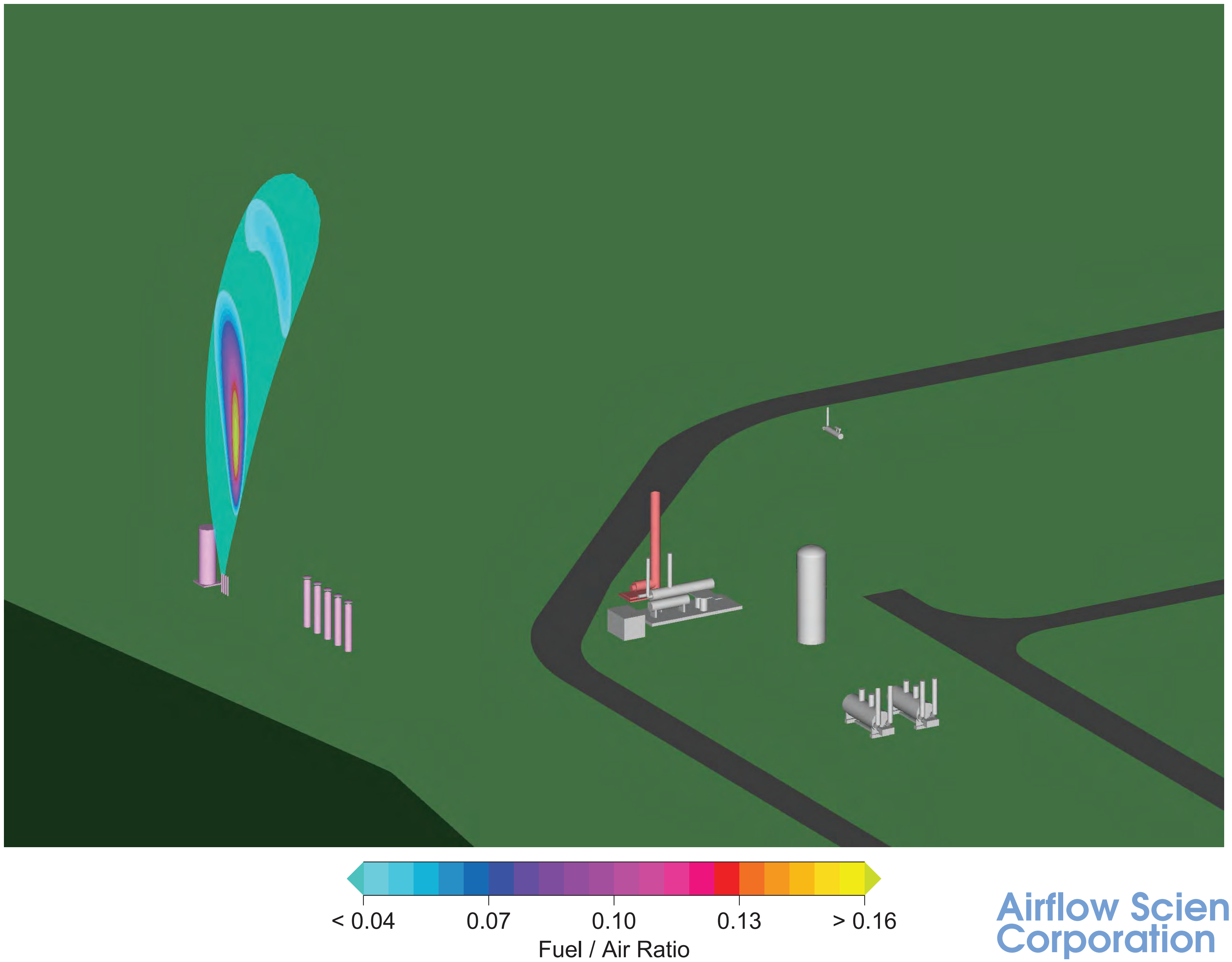


Airflow Sciences Corporation

Figure 19

Fuel / Air Ratio - SOW 2.1.1.1

Isometric View - Looking North-East - North-West Corner of Plant - Value > 4%

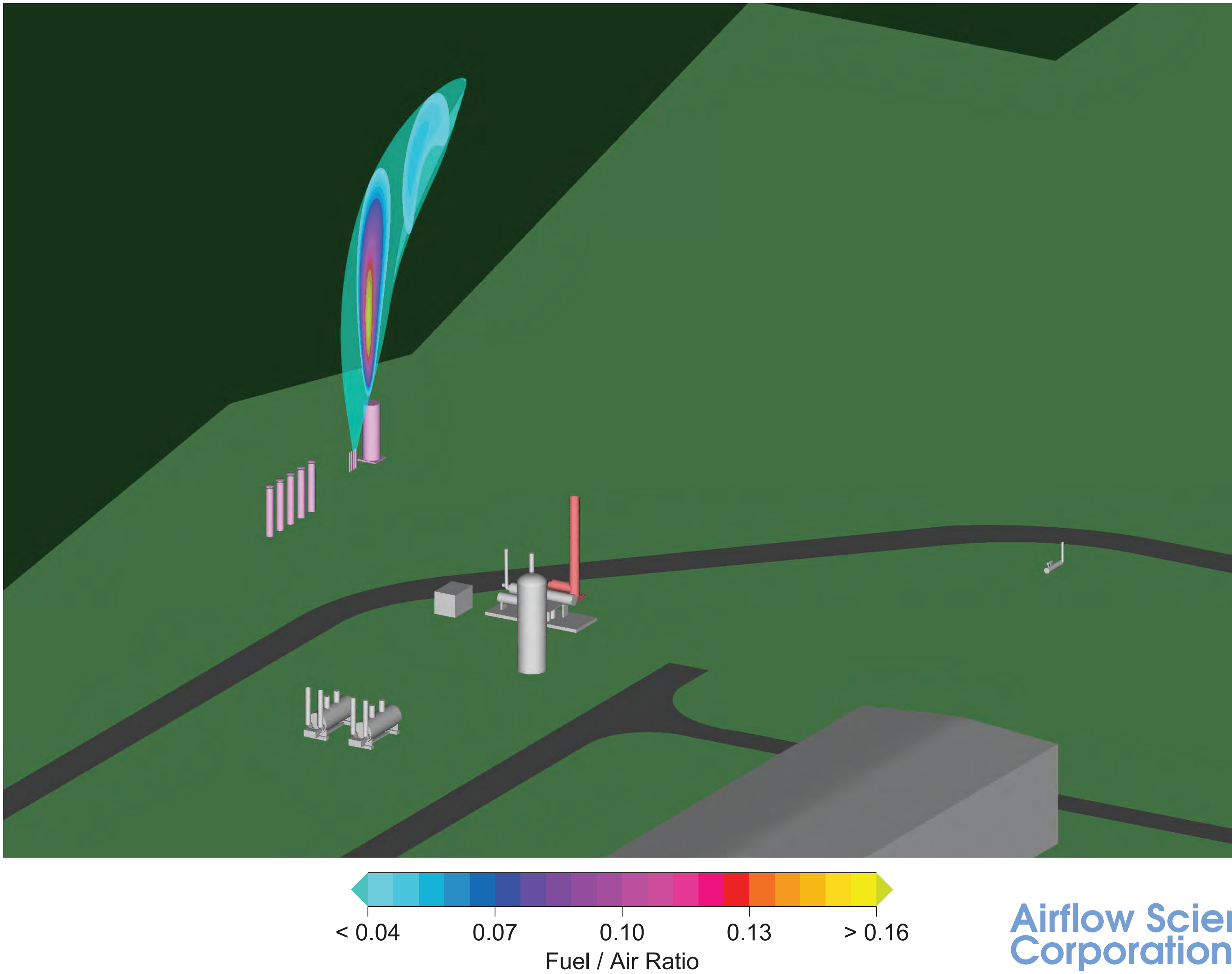


Airflow Sciences Corporation

Figure 20

Fuel / Air Ratio - SOW 2.1.1.1

Isometric View - Looking North-West - North-West Corner of Plant - Value > 4%



Airflow Sciences Corporation

Figure 21

Fuel / Air Ratio - SOW 2.1.1.1

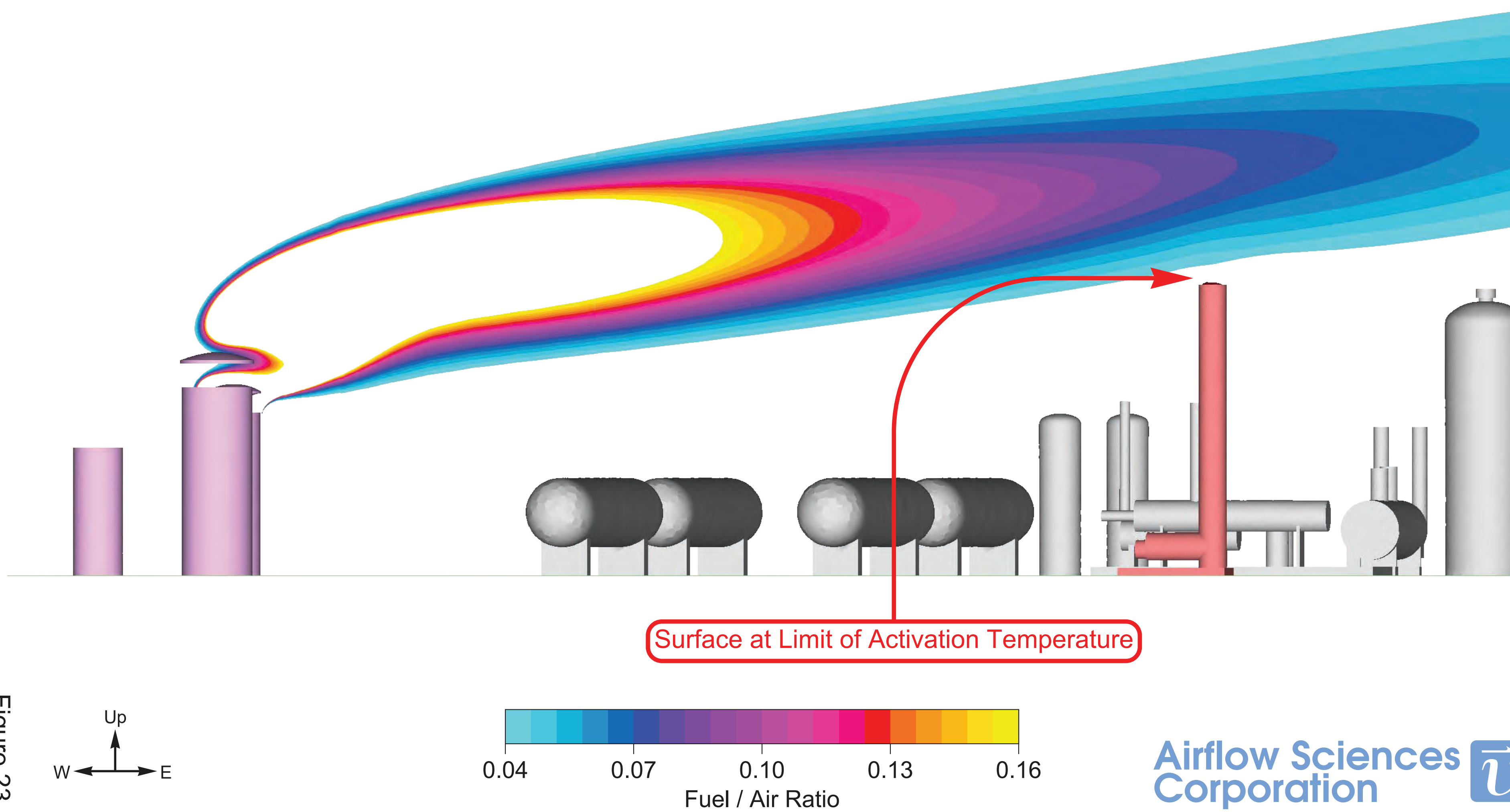
Top View - North-West Corner of Plant - Value > 4%

Airflow Sciences Corporation

Figure 22

Fuel / Air Ratio - SOW 2.1.1.1

Side View - Through BDSL 3-1-7 & Thermal Oxidizer

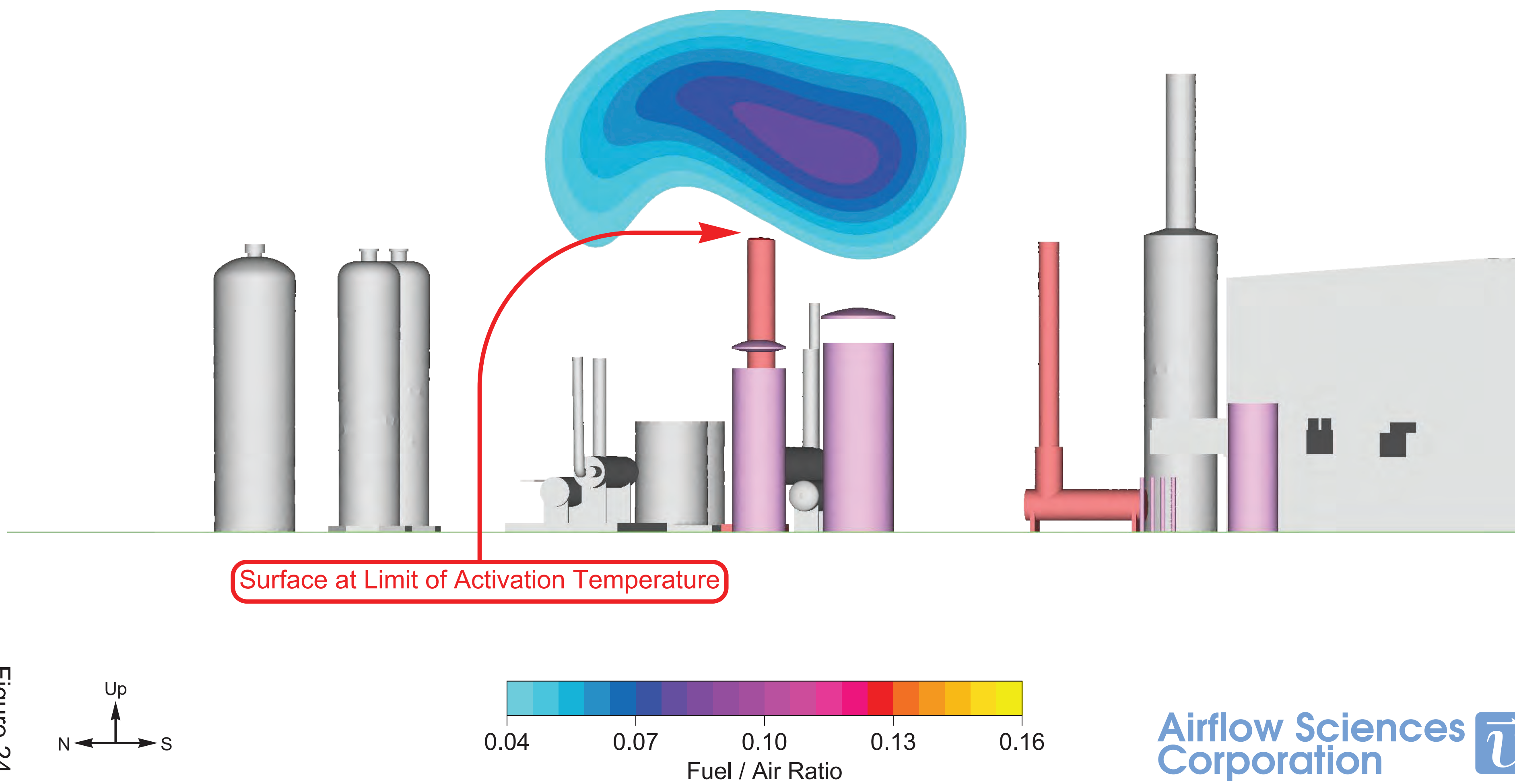


Airflow Sciences Corporation

Figure 23

Fuel / Air Ratio - SOW 2.1.1.1

End View - Through BDSL 3-1-7 & Thermal Oxidizer

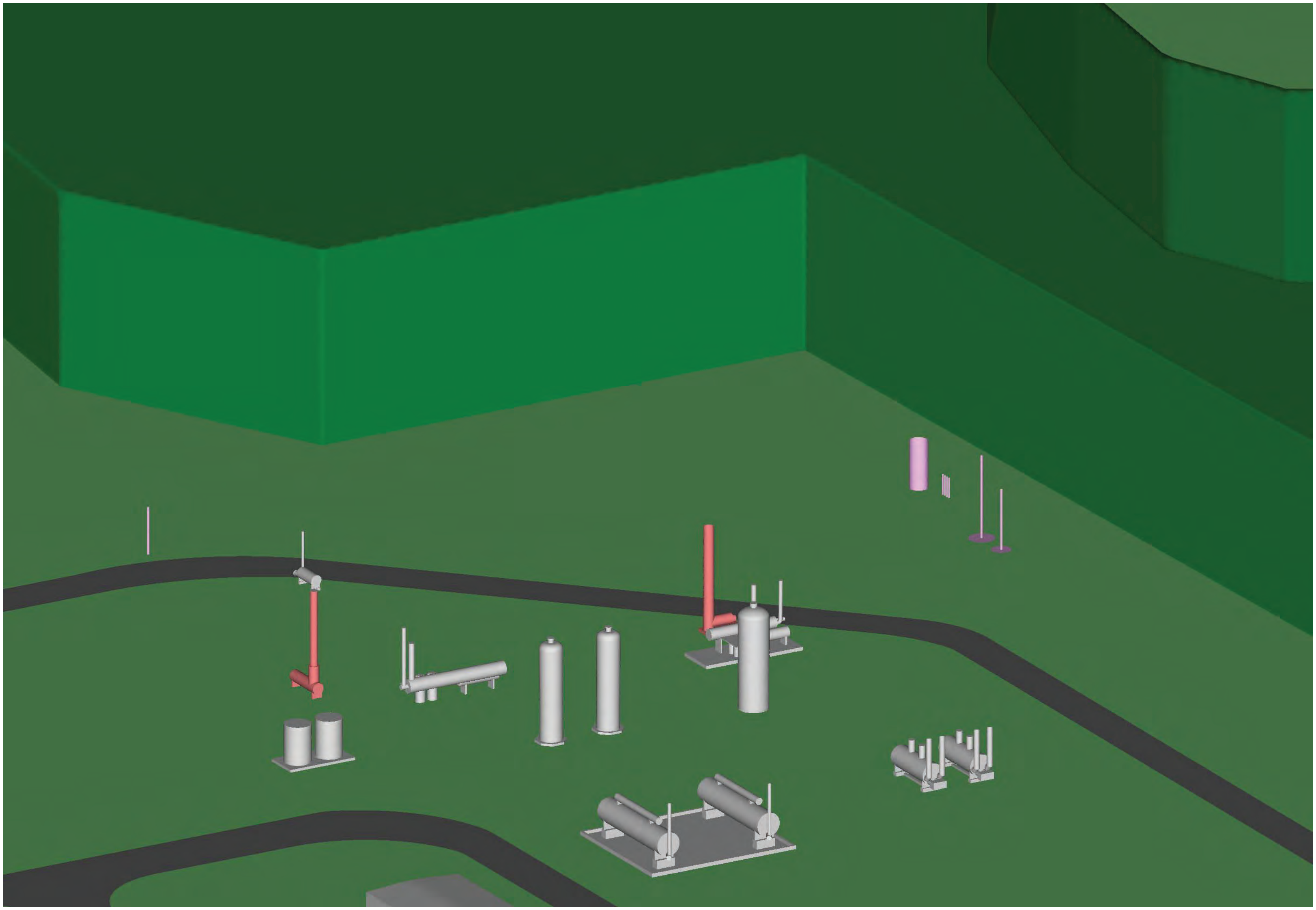


Airflow Sciences Corporation

Figure 24

Model Geometry

Isometric View - Looking South-West - South-West Corner of Plant



Airflow Sciences Corporation

Figure 25

Model Geometry

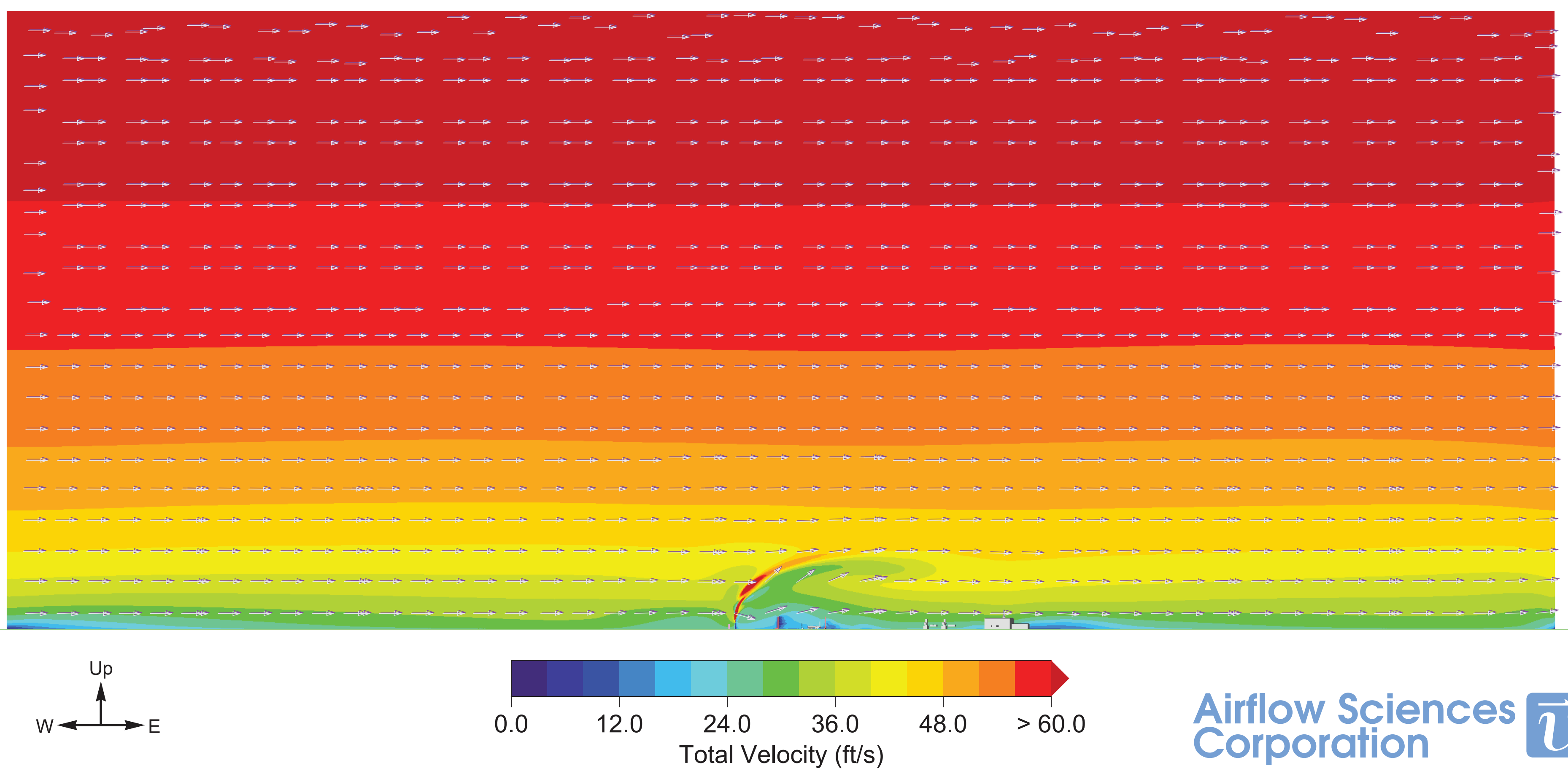
Isometric View - Looking South-West - North-West Corner of Plant

Airflow Sciences Corporation

Figure 26

Velocity - SOW 2.1.1.2

Side View - Through BDSL 3-1-7 & Thermal Oxidizer

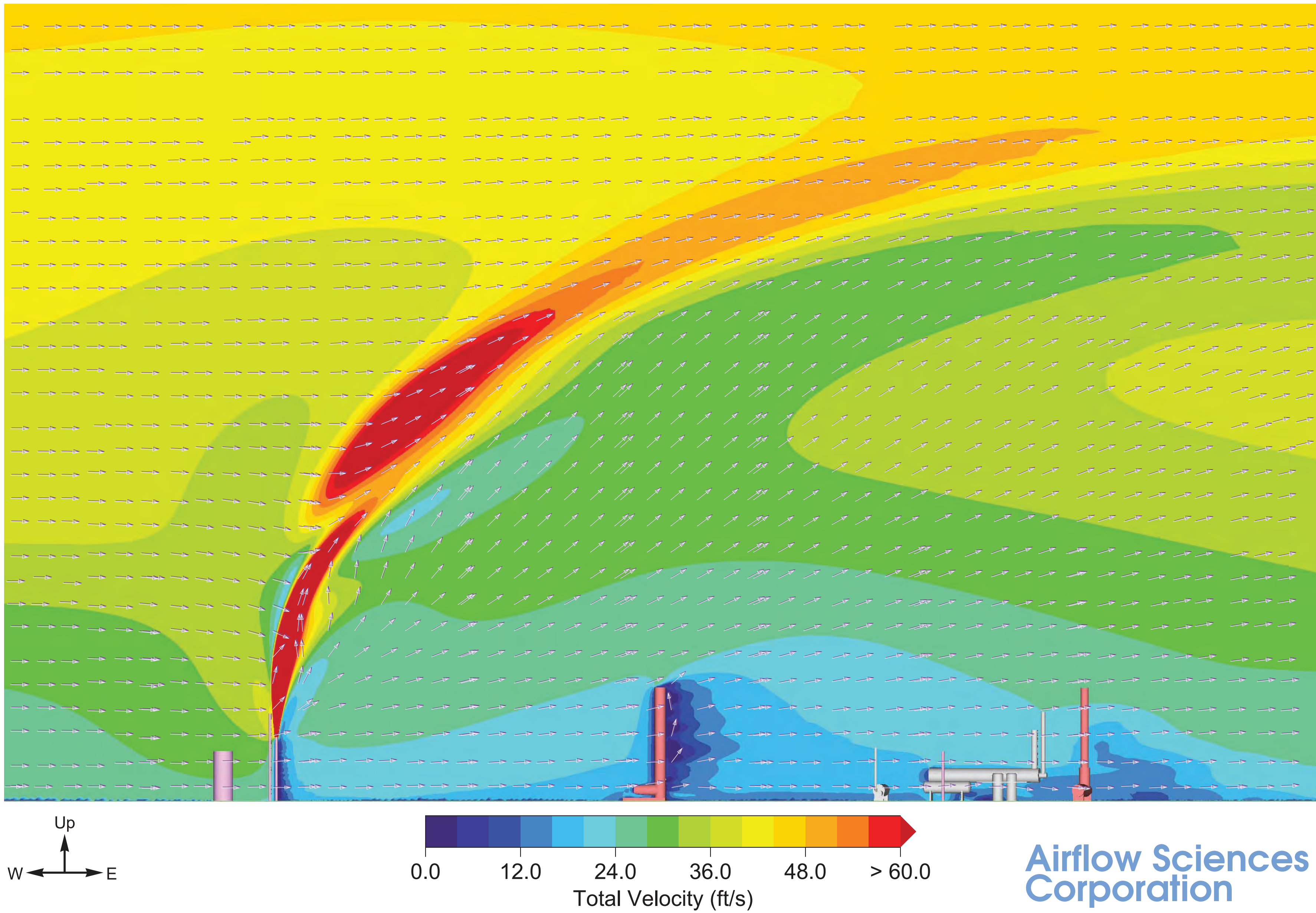


Airflow Sciences Corporation®

Figure 27

Velocity - SOW 2.1.1.2

Side View - Through BDSL 3-1-7 & Thermal Oxidizer

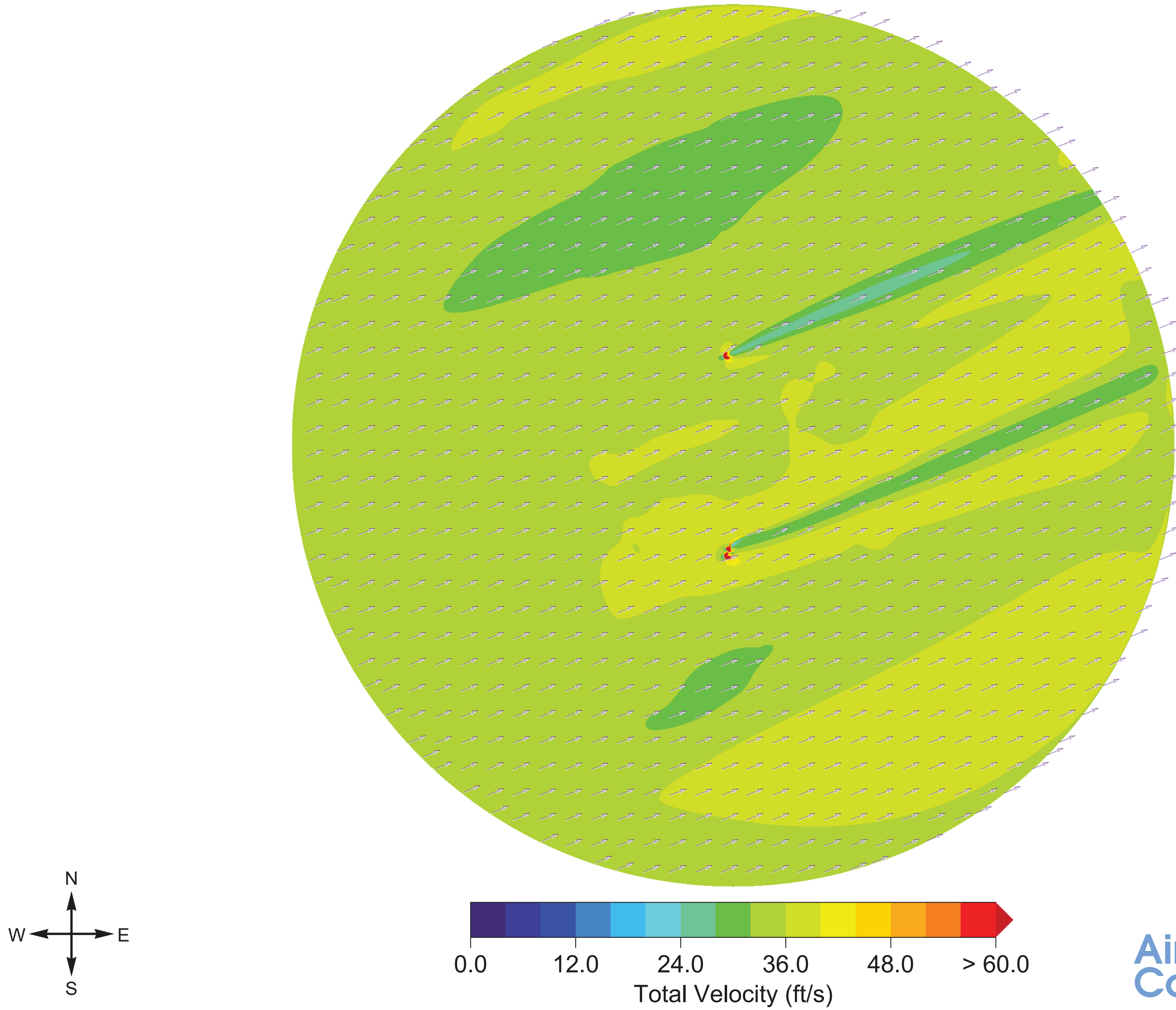


Airflow Sciences Corporation

Figure 28

Velocity - SOW 2.1.1.2

Top View - Domain - 100' Above ground



Airflow Sciences Corporation

Figure 29

Velocity - SOW 2.1.1.2

Top View - Domain - 20’ Above ground

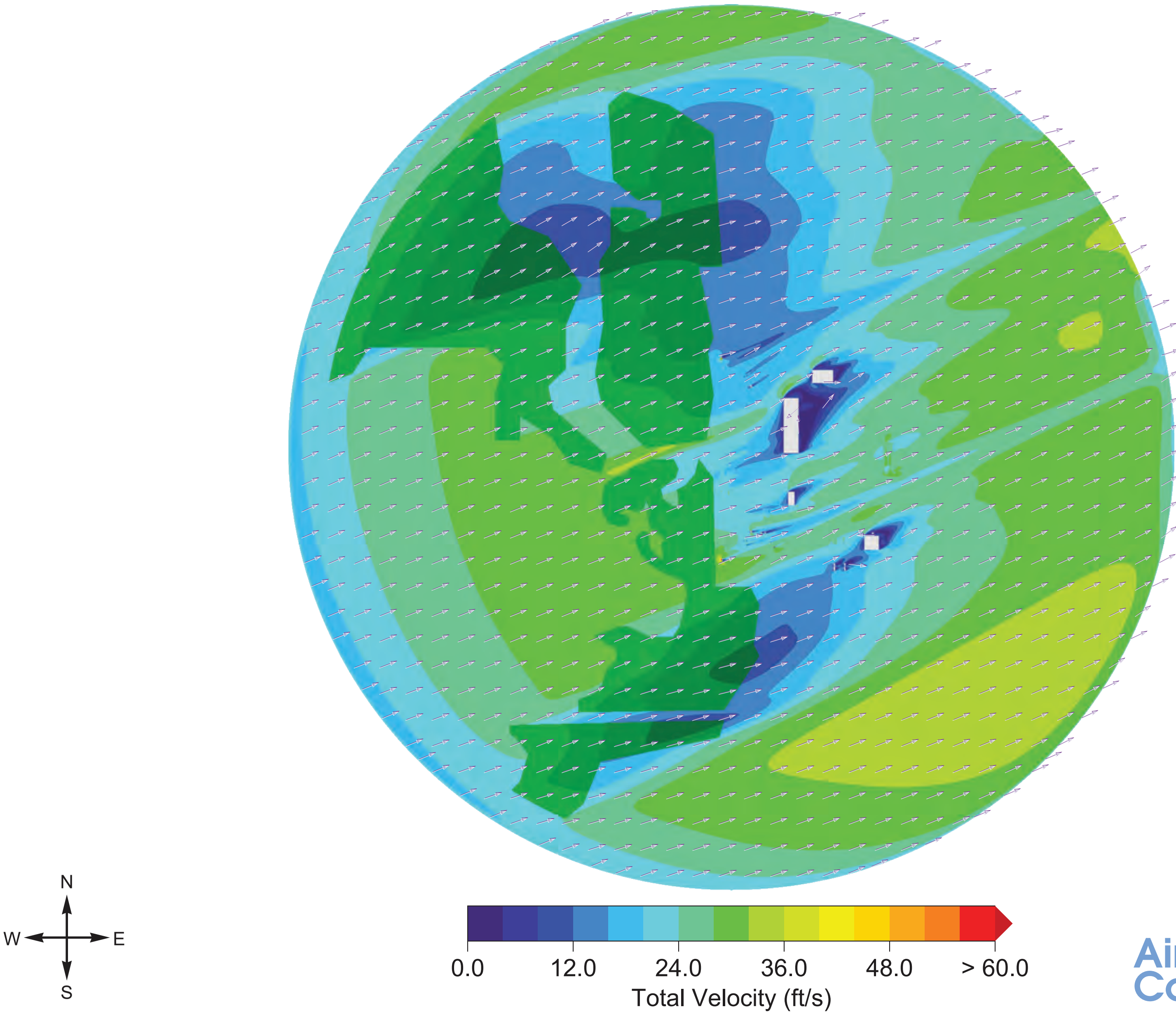
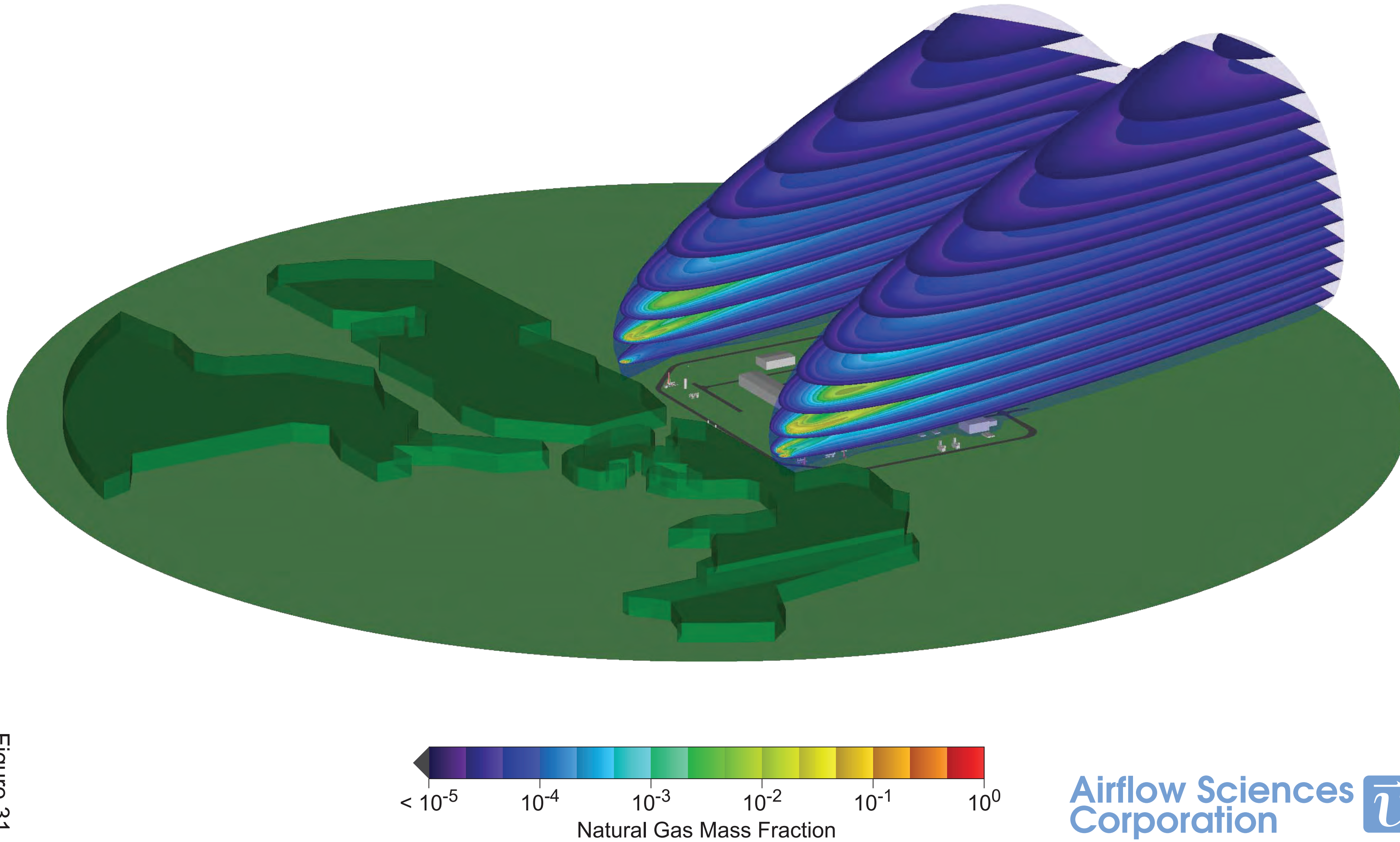


Figure 30

Airflow Sciences Corporation

Natural Gas Mass Fraction - SOW 2.1.1.2

Isometric View - Looking North-East - Domain - Value > 10^{-5} - Every 80’

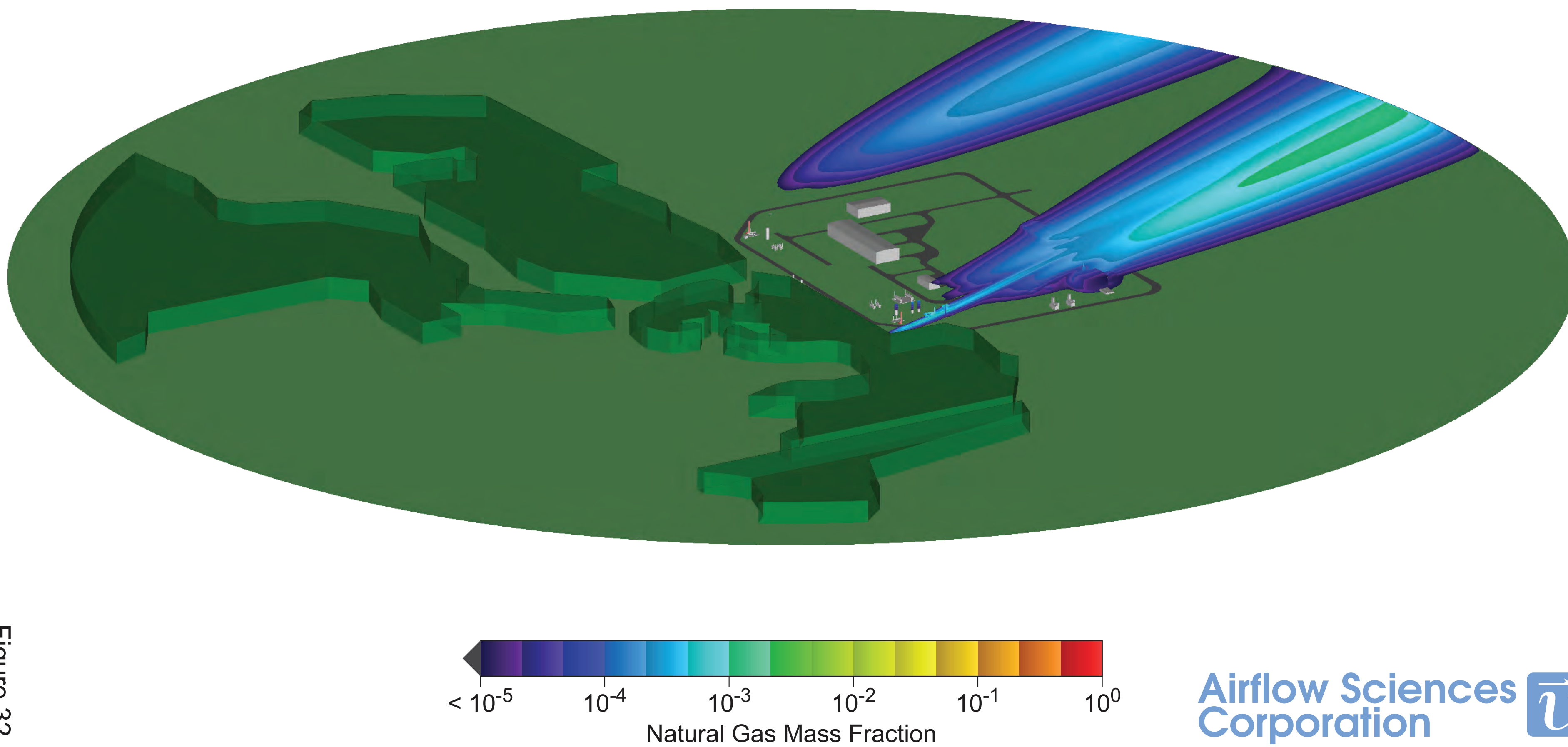


Airflow Sciences Corporation®

Figure 31

Natural Gas Mass Fraction - SOW 2.1.1.2

Isometric View - Looking North-East - Domain - Value > 10^{-5} - Ground & Building Surfaces



Airflow Sciences Corporation

Figure 32

Natural Gas Mass Fraction - SOW 2.1.1.2

Isometric View - Looking North-East - Domain - Value > 10^{-3} - Every 40’

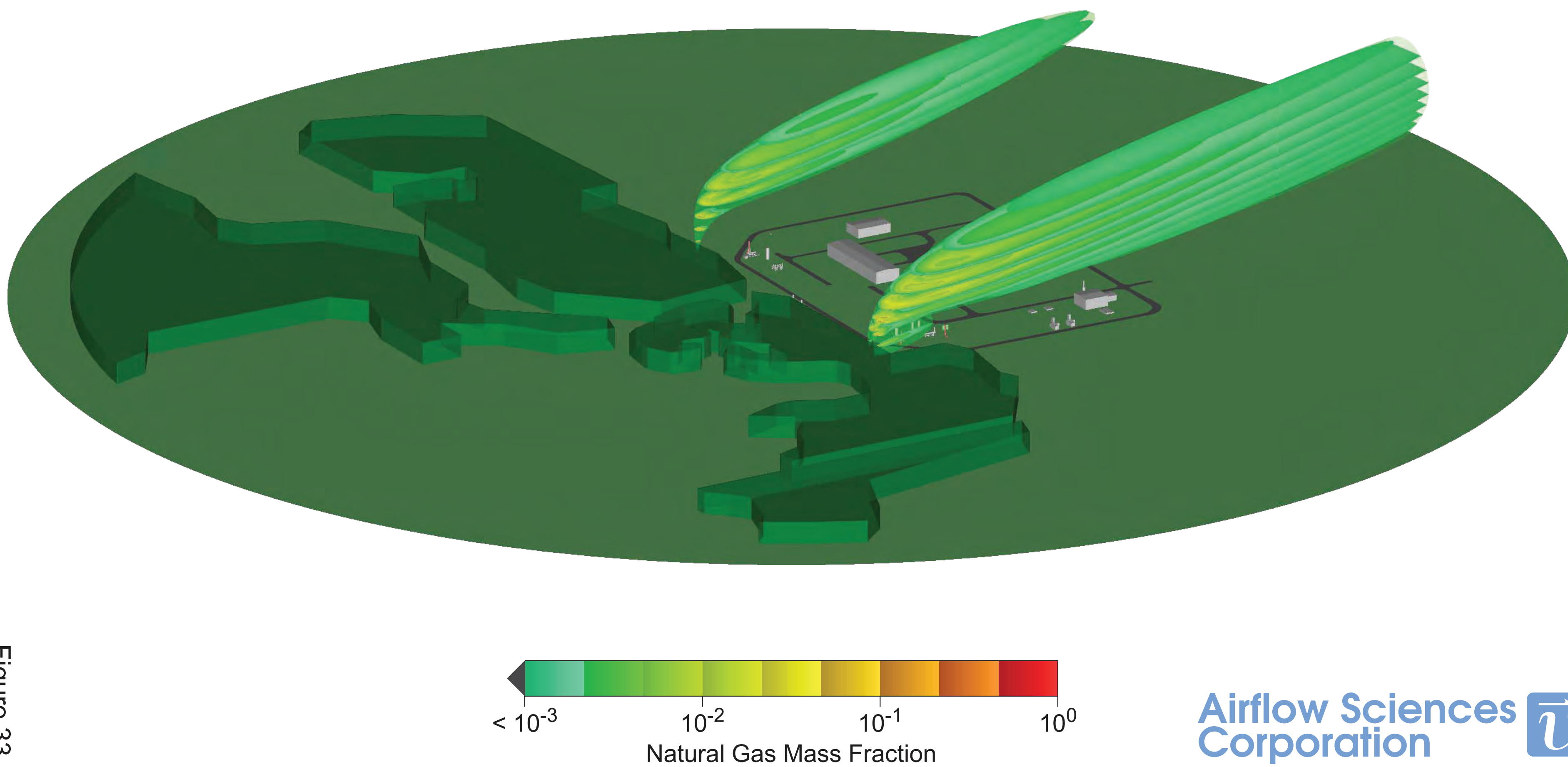


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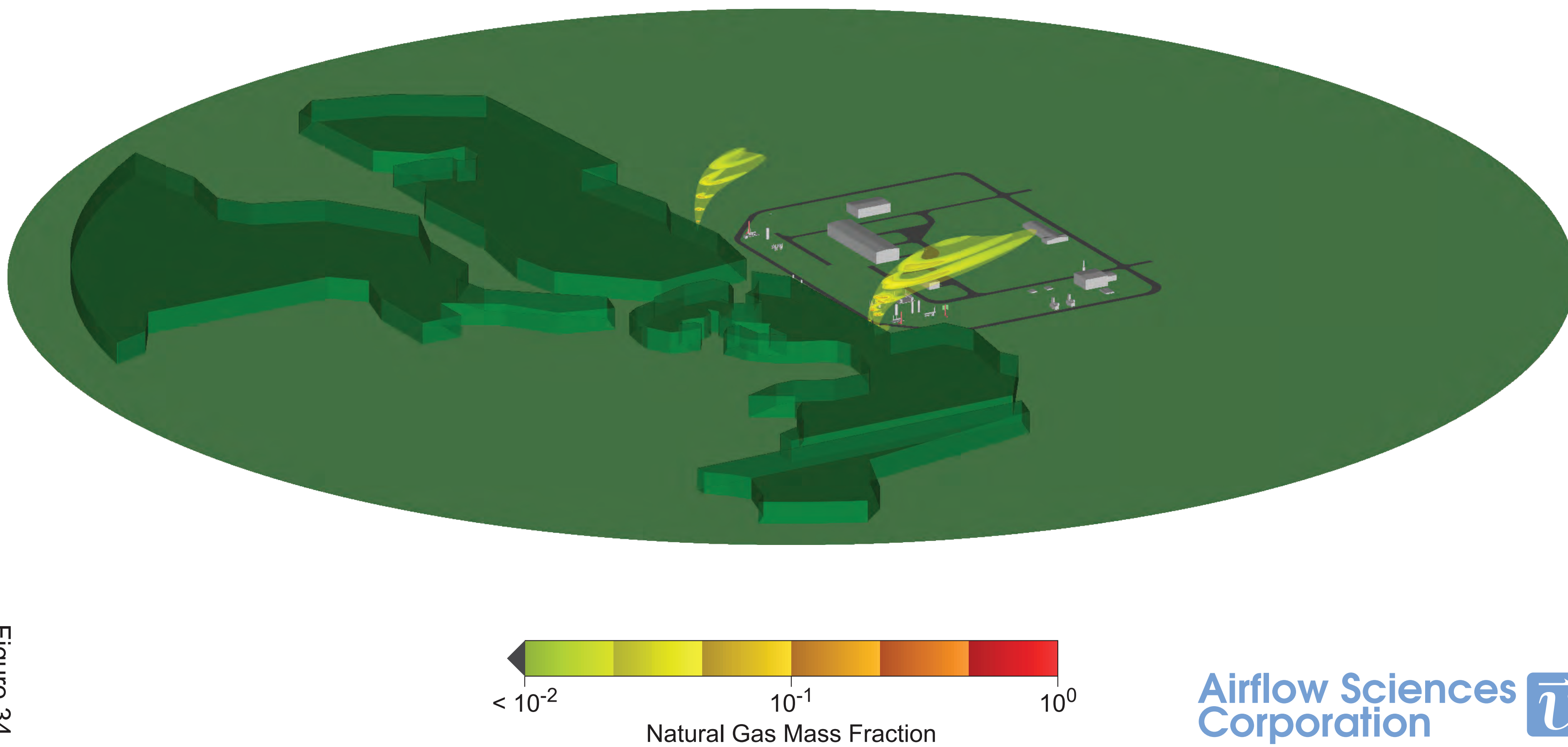
Figure 33

Consumers Energy - Ray Compressor Station *April 1, 2019*

L-19-CER-02

Natural Gas Mass Fraction - SOW 2.1.1.2

Isometric View - Looking North-East - Domain - Value > 10^{-2} - Every 40'

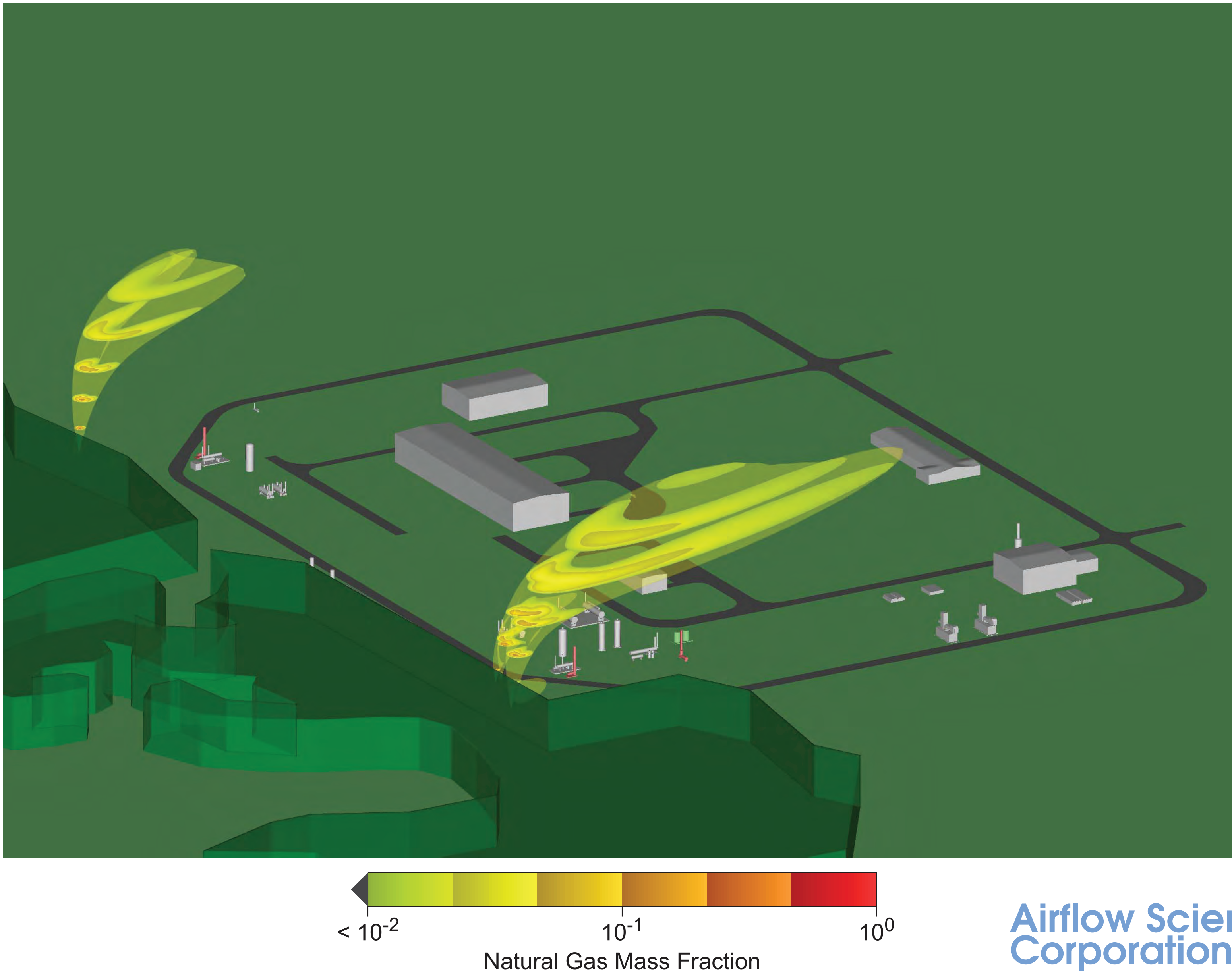


Airflow Sciences Corporation

Figure 34

Natural Gas Mass Fraction - SOW 2.1.1.2

Isometric View - Looking North-East - Plant Site - Value > 10^{-2} - Every 40'

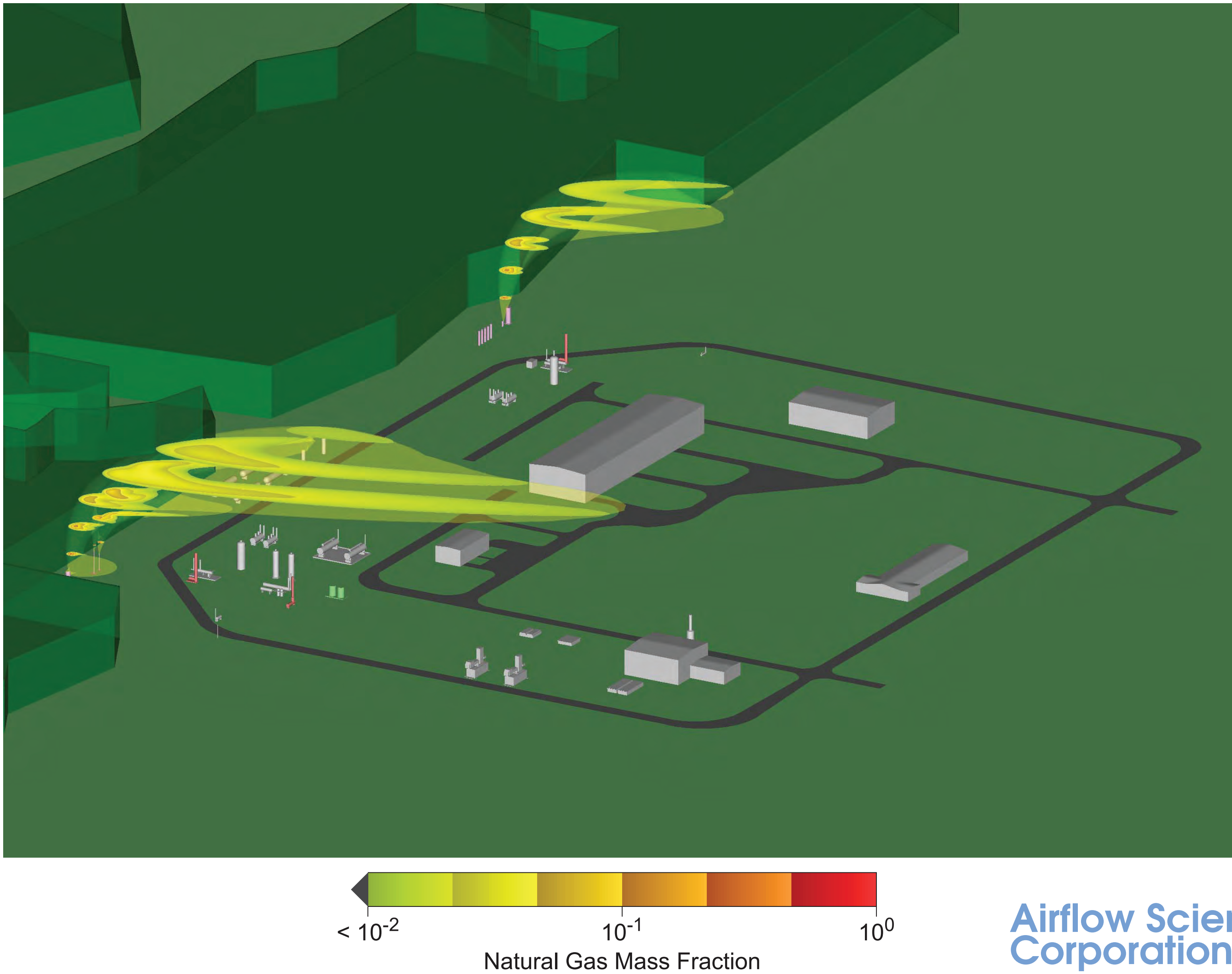


Airflow Sciences Corporation

Figure 35

Natural Gas Mass Fraction - SOW 2.1.1.2

Isometric View - Looking North-West - Plant Site - Value > 10^{-2} - Every 40’

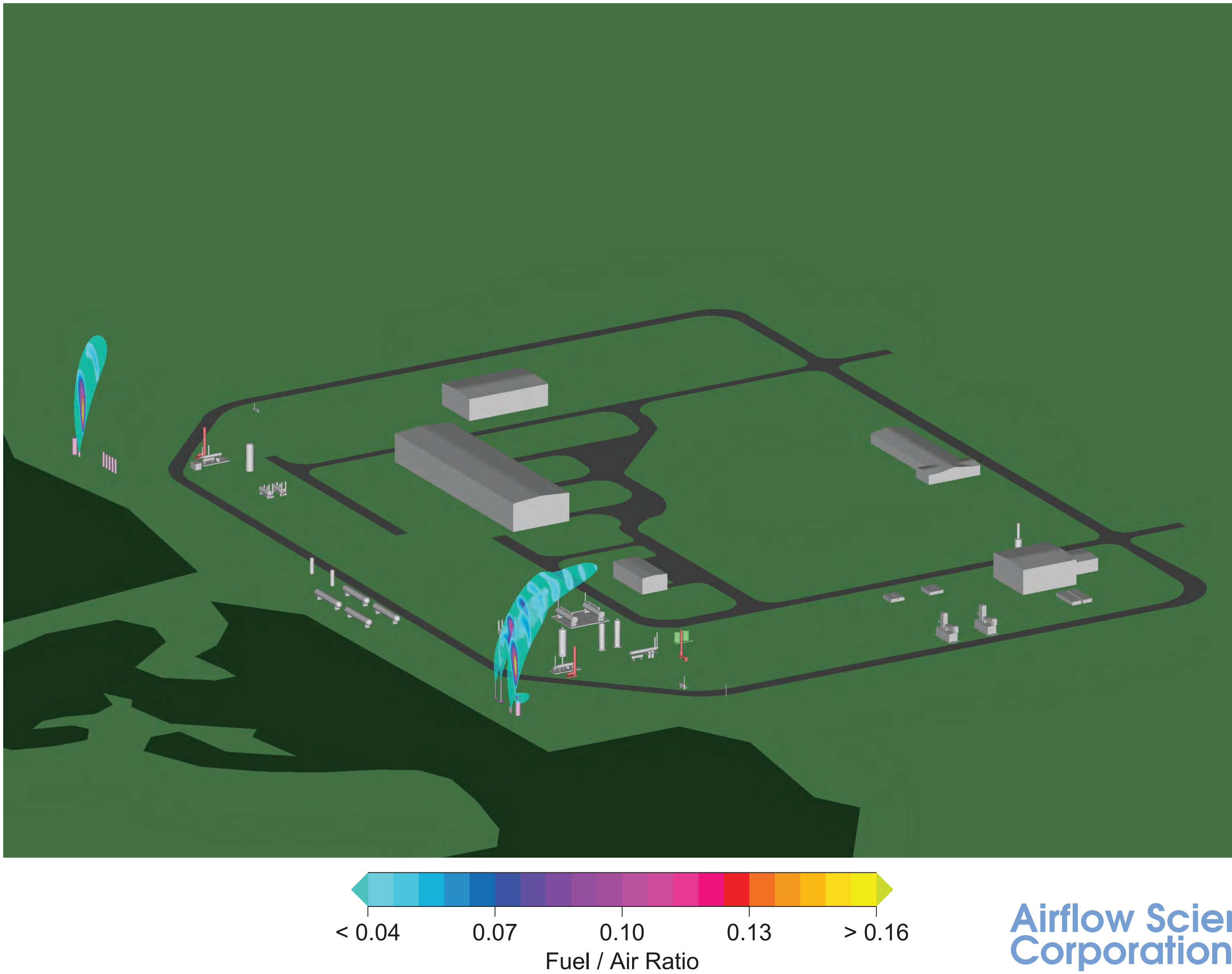


Airflow Sciences Corporation

Figure 36

Fuel / Air Ratio - SOW 2.1.1.2

Isometric View - Looking North-East - Plant Site - Value > 4%



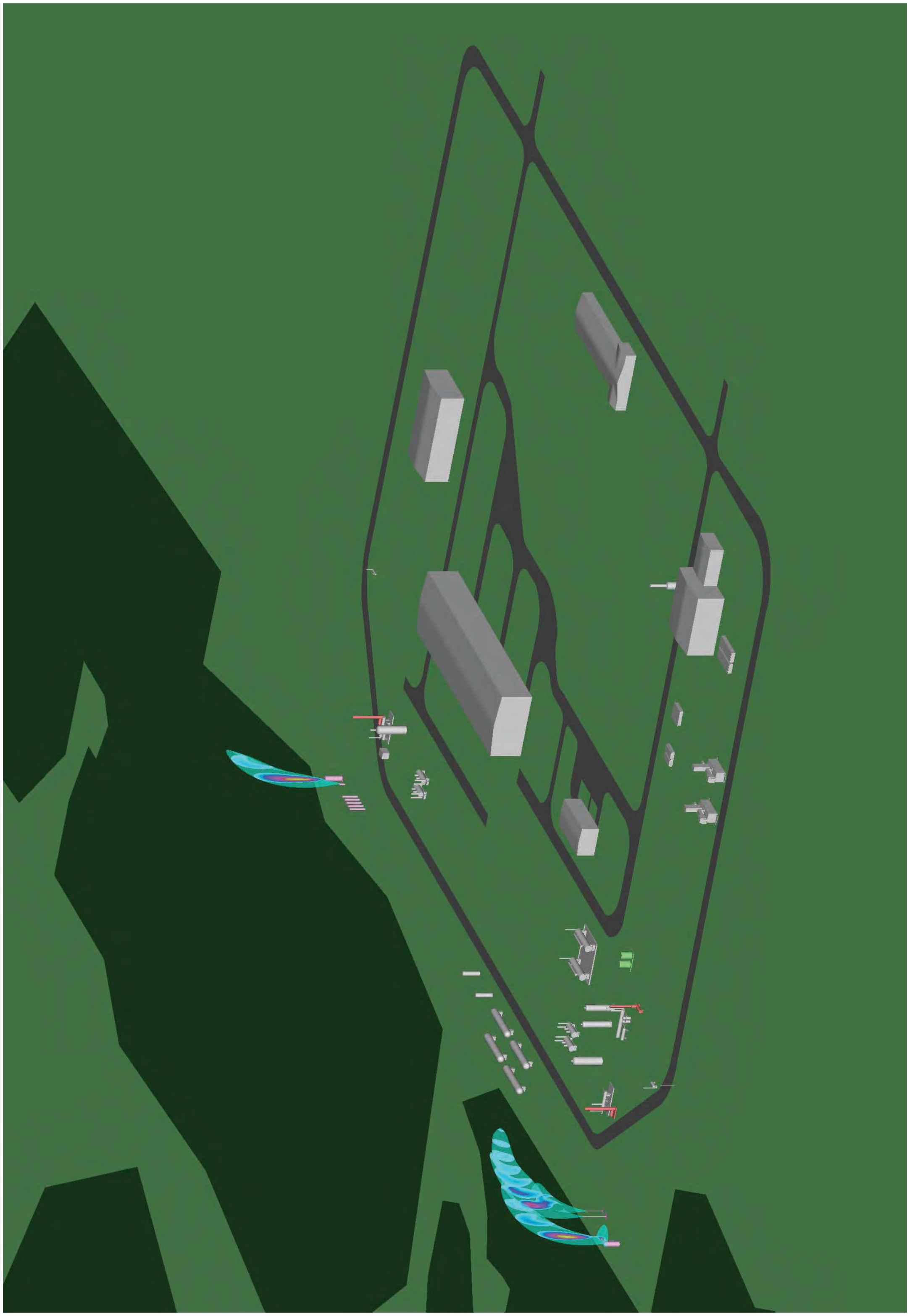
Airflow Sciences Corporation

Figure 37

Airflow Sciences Corporation

Fuel / Air Ratio - SOW 2.1.1.2

Isometric View - Looking North-West - Plant Site - Value > 4%

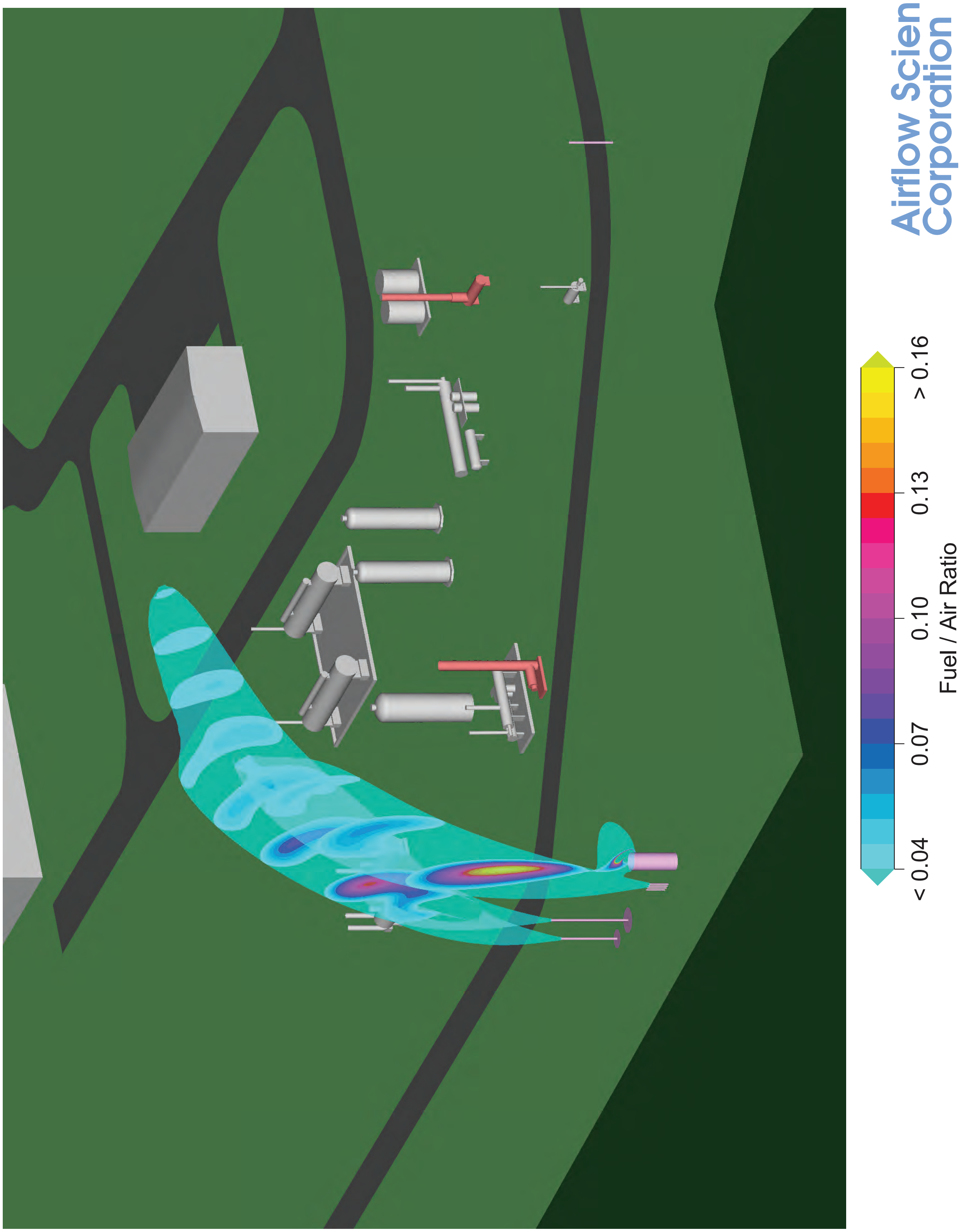


< 0.04
0.07
0.10
0.13
> 0.16
Fuel / Air Ratio

Figure 38

Fuel / Air Ratio - SOW 2.1.1.2

Isometric View - Looking North-East - South-West Corner of Plant - Value > 4%

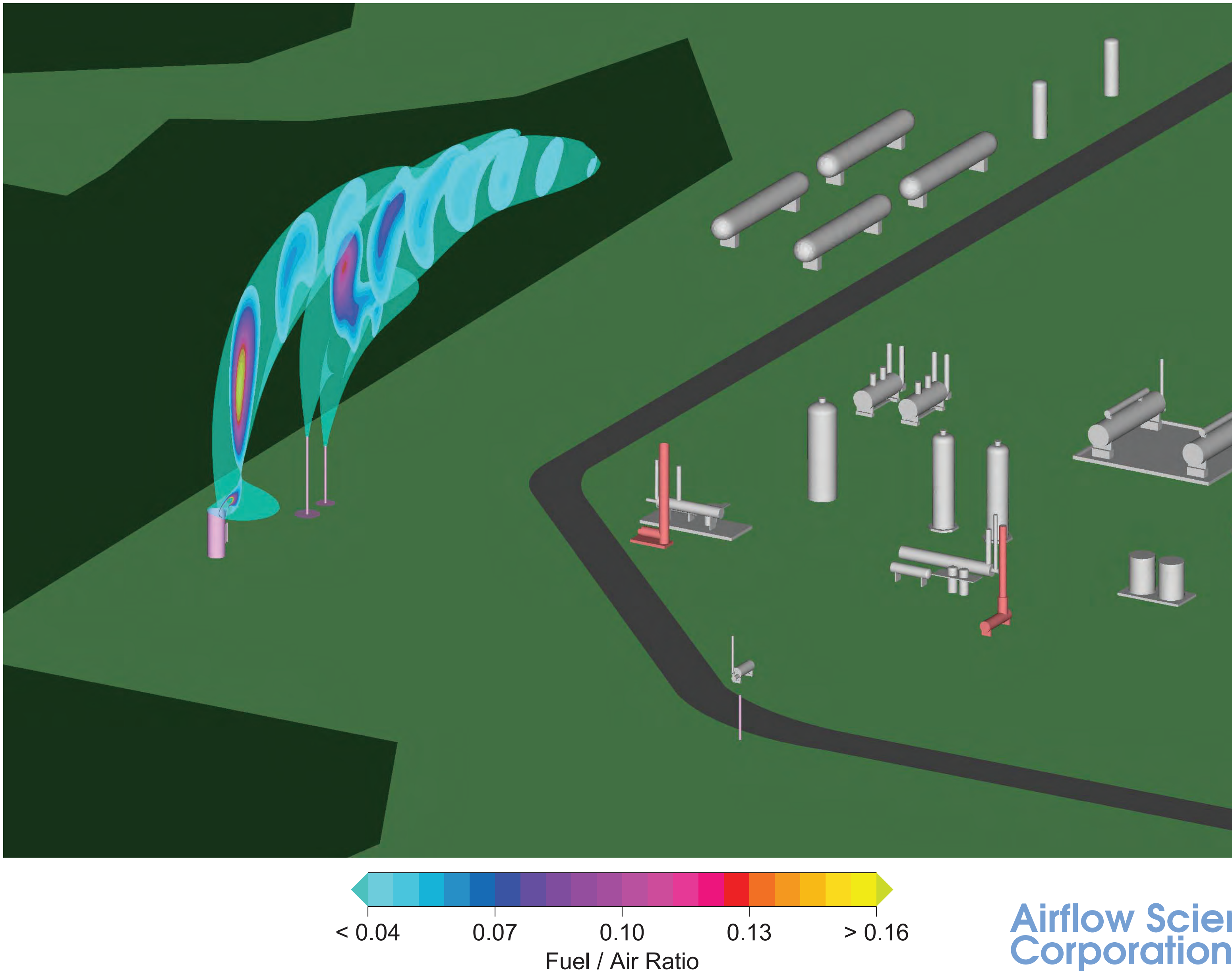


Airflow Sciences Corporation

Figure 39

Fuel / Air Ratio - SOW 2.1.1.2

Isometric View - Looking North-West - South-West Corner of Plant - Value > 4%



Airflow Sciences Corporation

Figure 40

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Fuel / Air Ratio - SOW 2.1.1.2

Top View - South-West Corner of Plant - Value > 4%

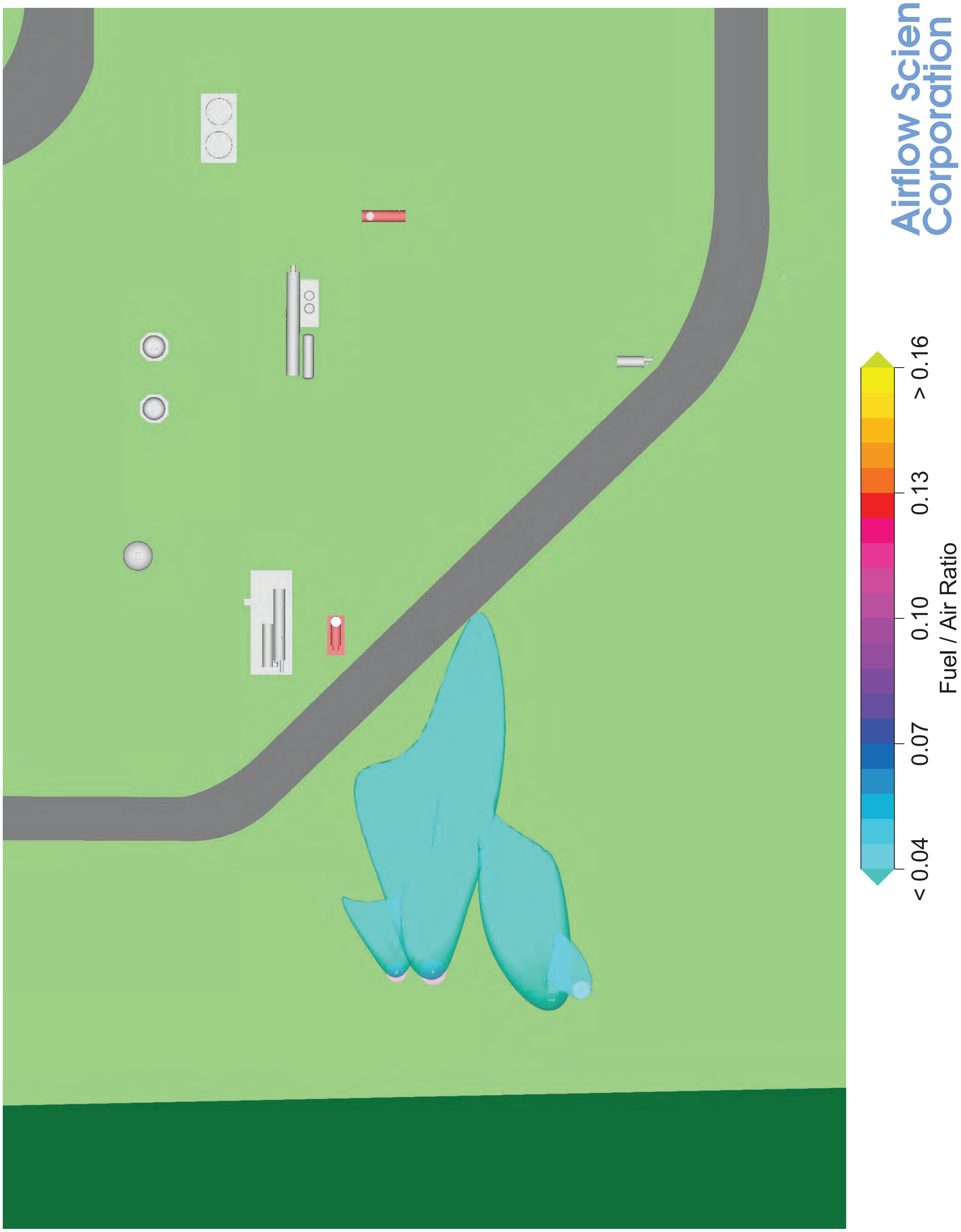


Figure 41

Fuel / Air Ratio - SOW 2.1.1.2

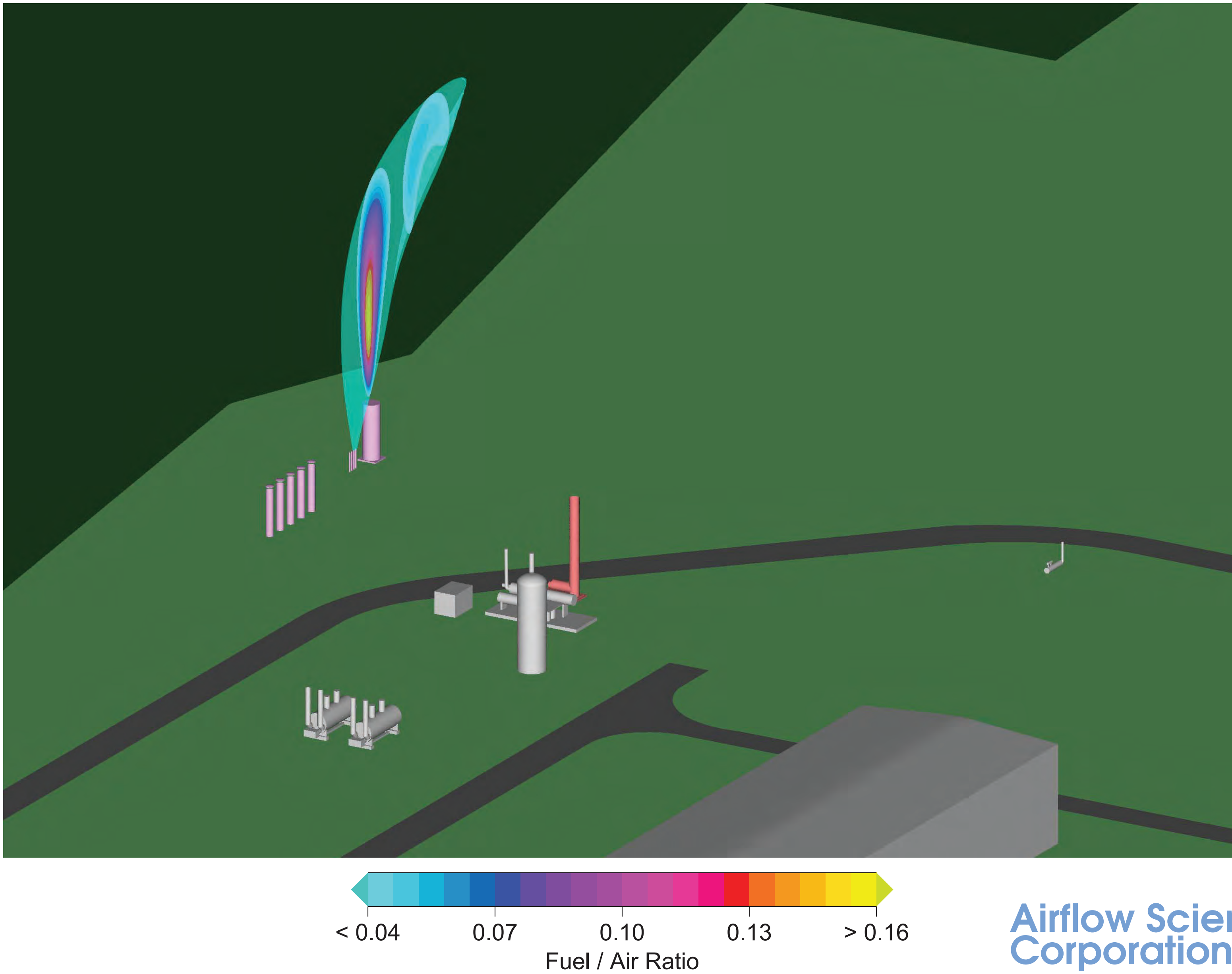
Isometric View - Looking North-East - North-West Corner of Plant - Value > 4%

Airflow Sciences Corporation

Figure 42

Fuel / Air Ratio - SOW 2.1.1.2

Isometric View - Looking North-West - North-West Corner of Plant - Value > 4%



Airflow Sciences Corporation

Figure 43

Fuel / Air Ratio - SOW 2.1.1.2

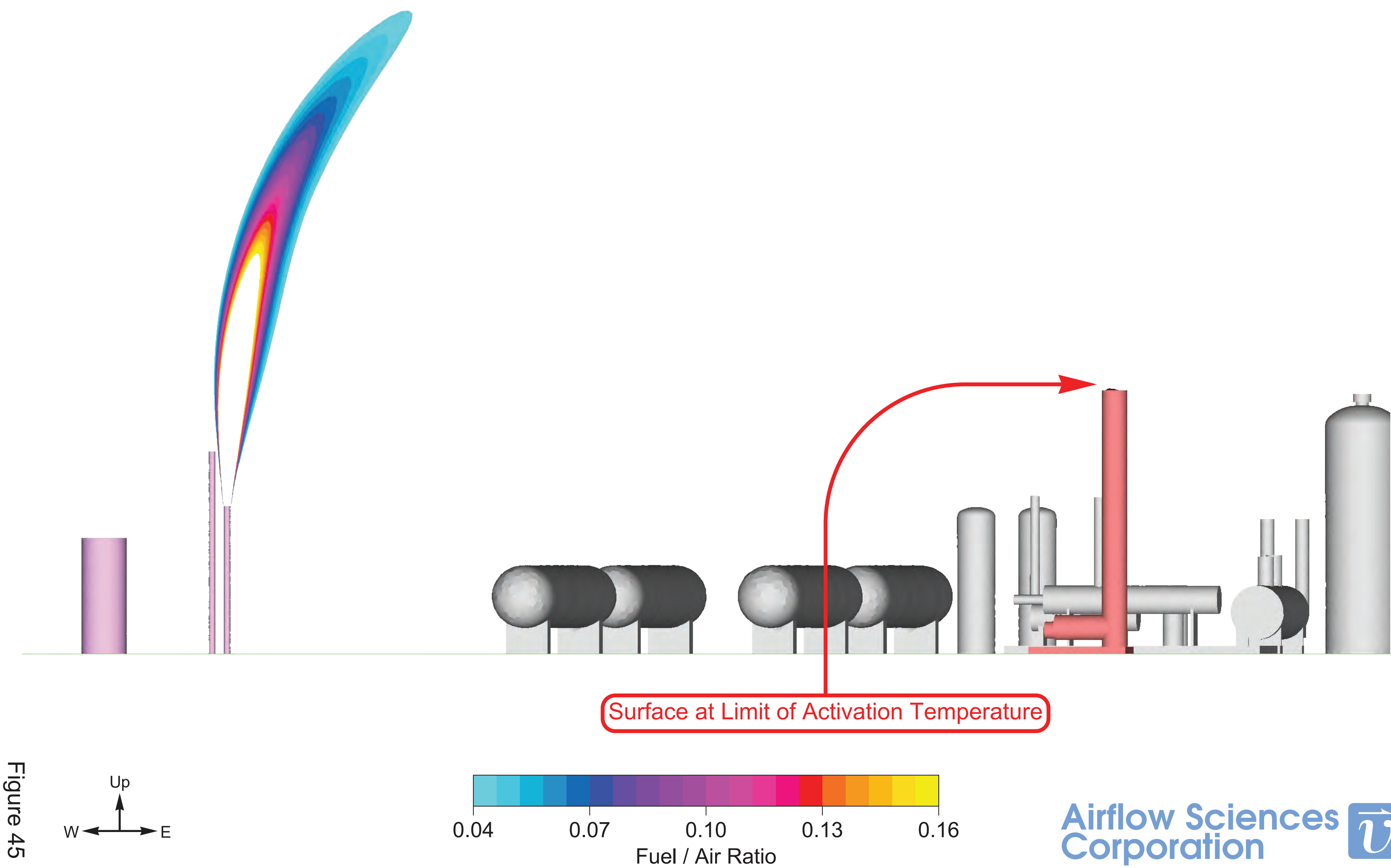
Top View - North-West Corner of Plant - Value > 4%

Airflow Sciences Corporation

Figure 44

Fuel / Air Ratio - SOW 2.1.1.2

Side View - Through BDSL 3-1-7 & Thermal Oxidizer

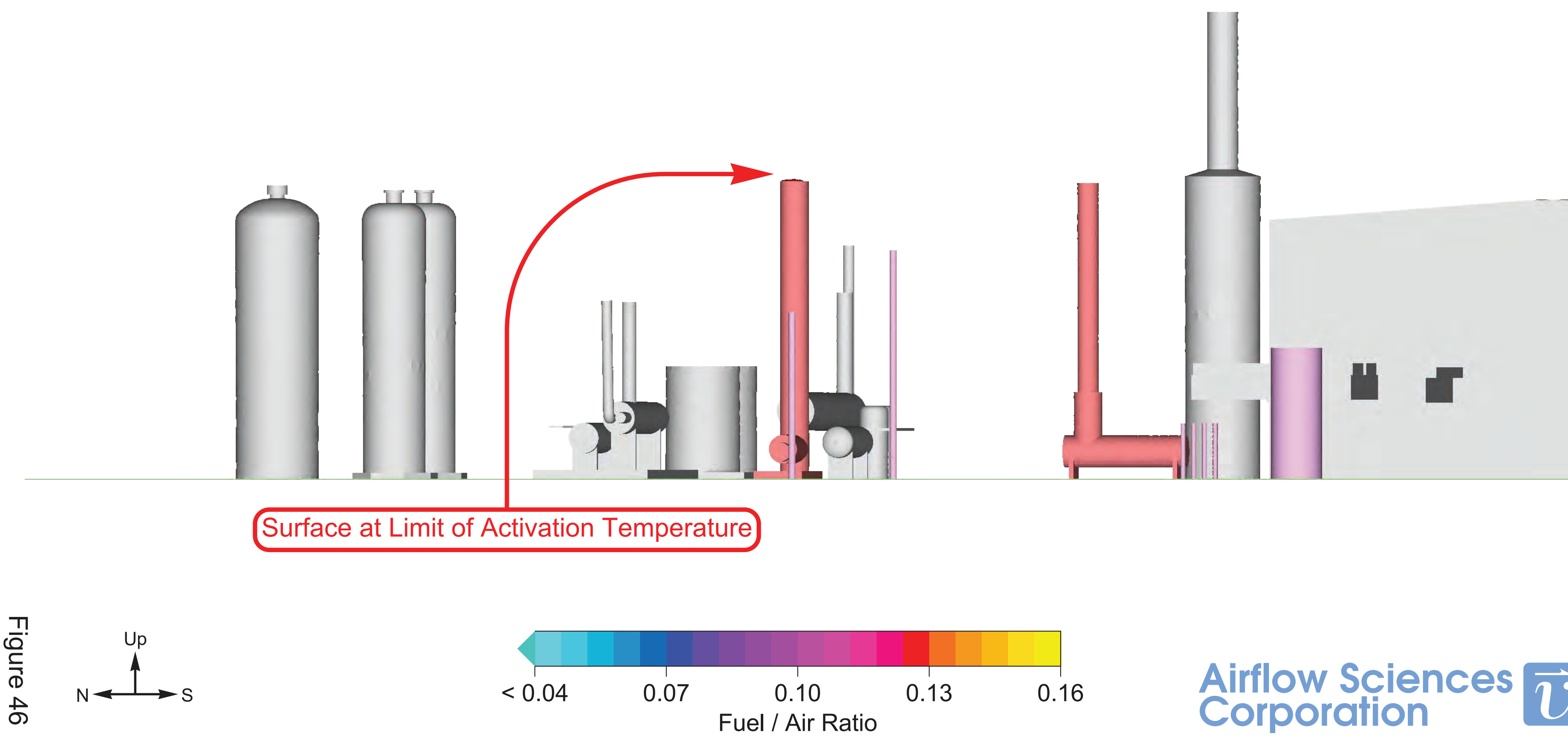


Airflow Sciences Corporation

Figure 45

Fuel / Air Ratio - SOW 2.1.1.2

End View - Through BDSL 3-1-7 & Thermal Oxidizer



Airflow Sciences Corporation

Figure 46

Model Geometry

Isometric View - Looking South-West - South-West Corner of Plant

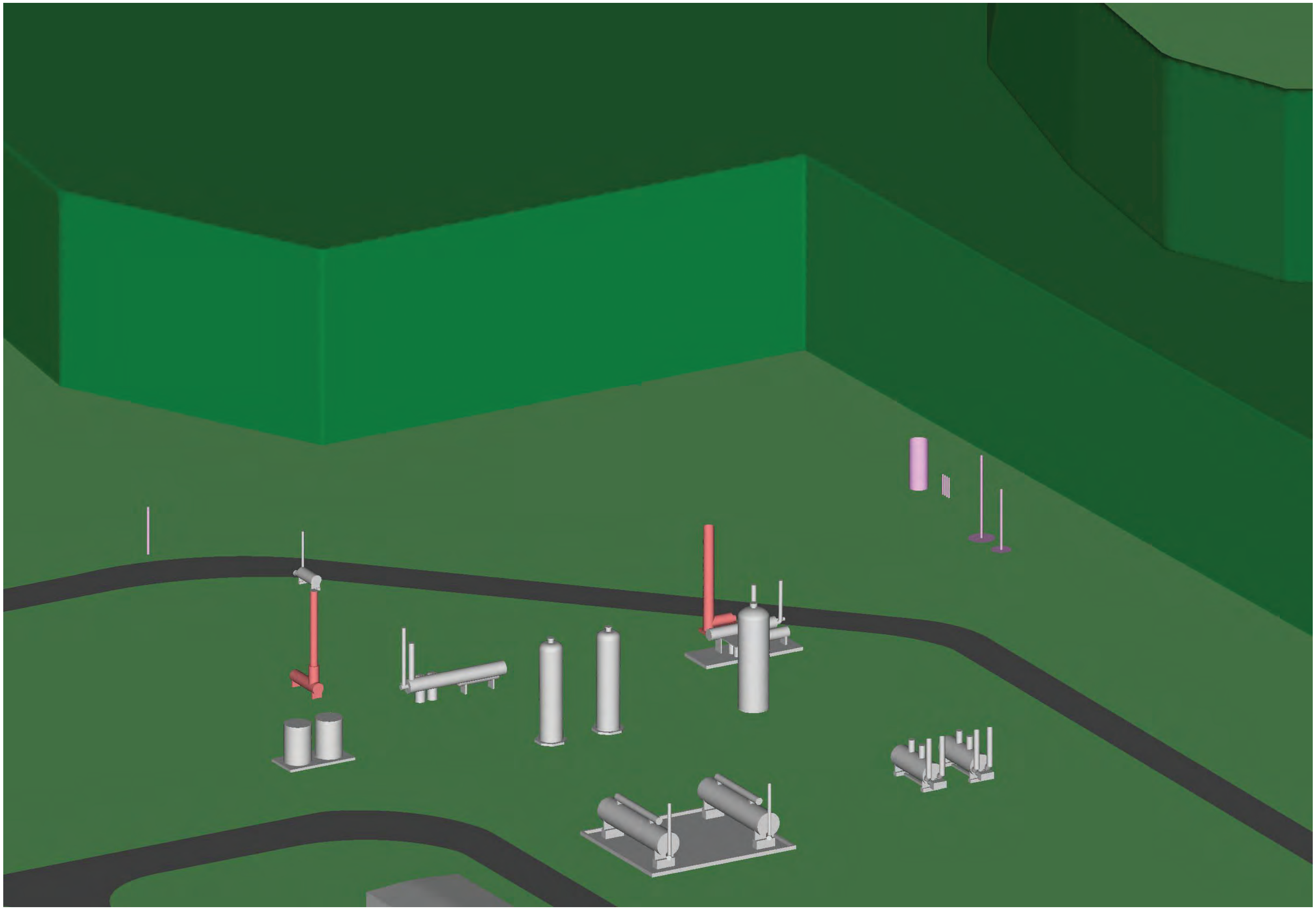
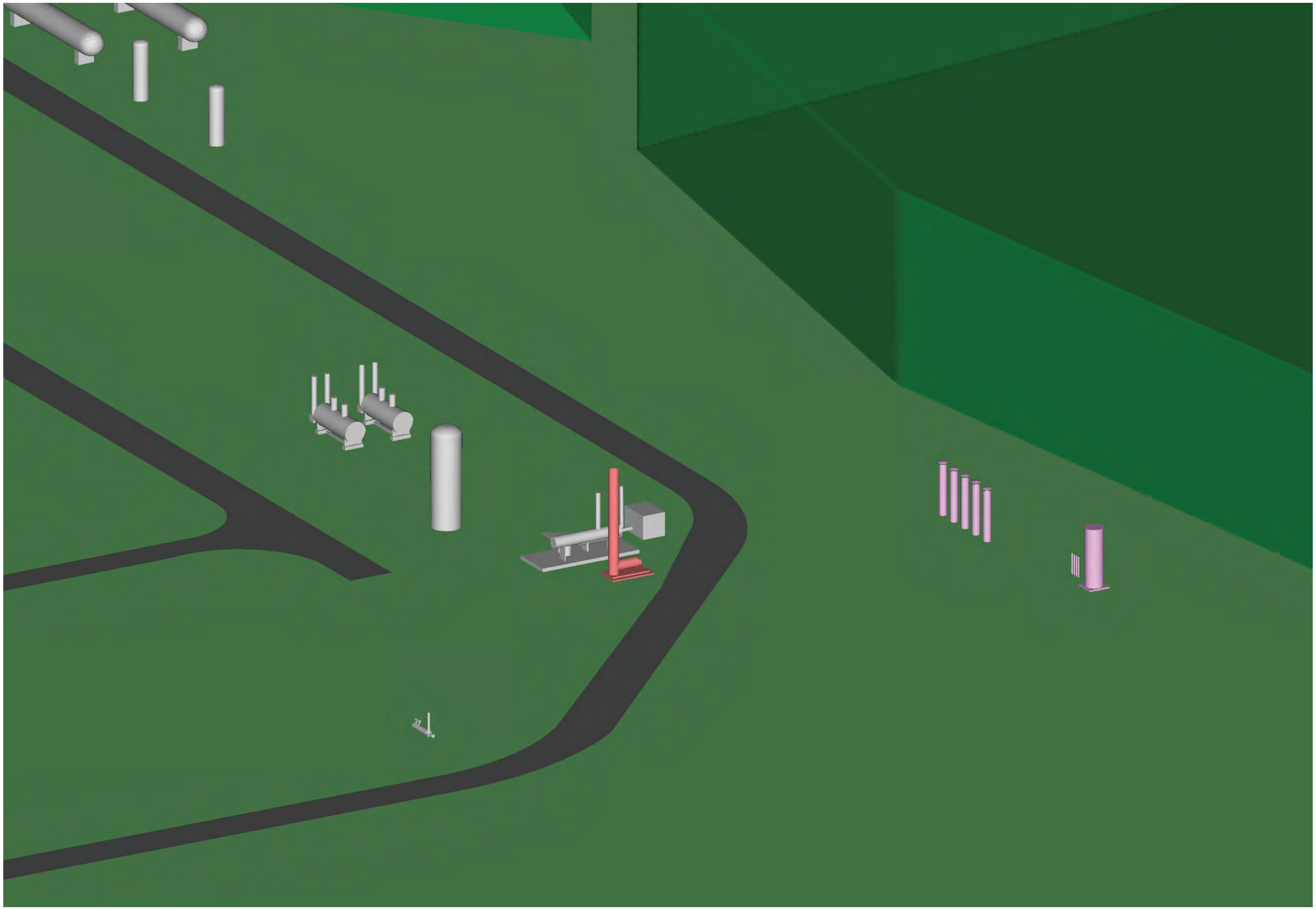


Figure 47

Model Geometry

Isometric View - Looking South-West - North-West Corner of Plant

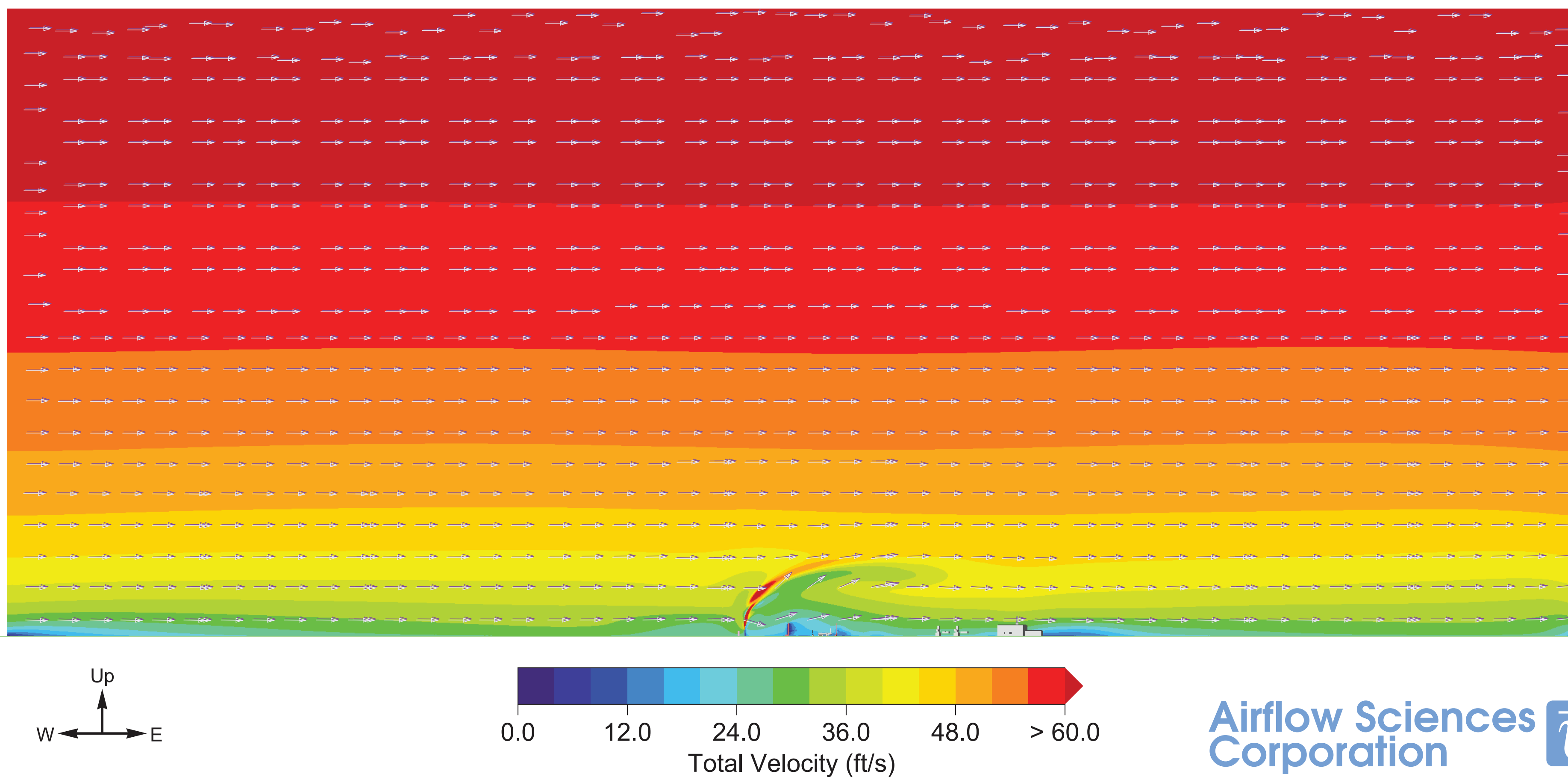


Airflow Sciences Corporation

Figure 48

Velocity - SOW 2.1.1.3A

Side View - Through BDSL 3-1-7 & Thermal Oxidizer

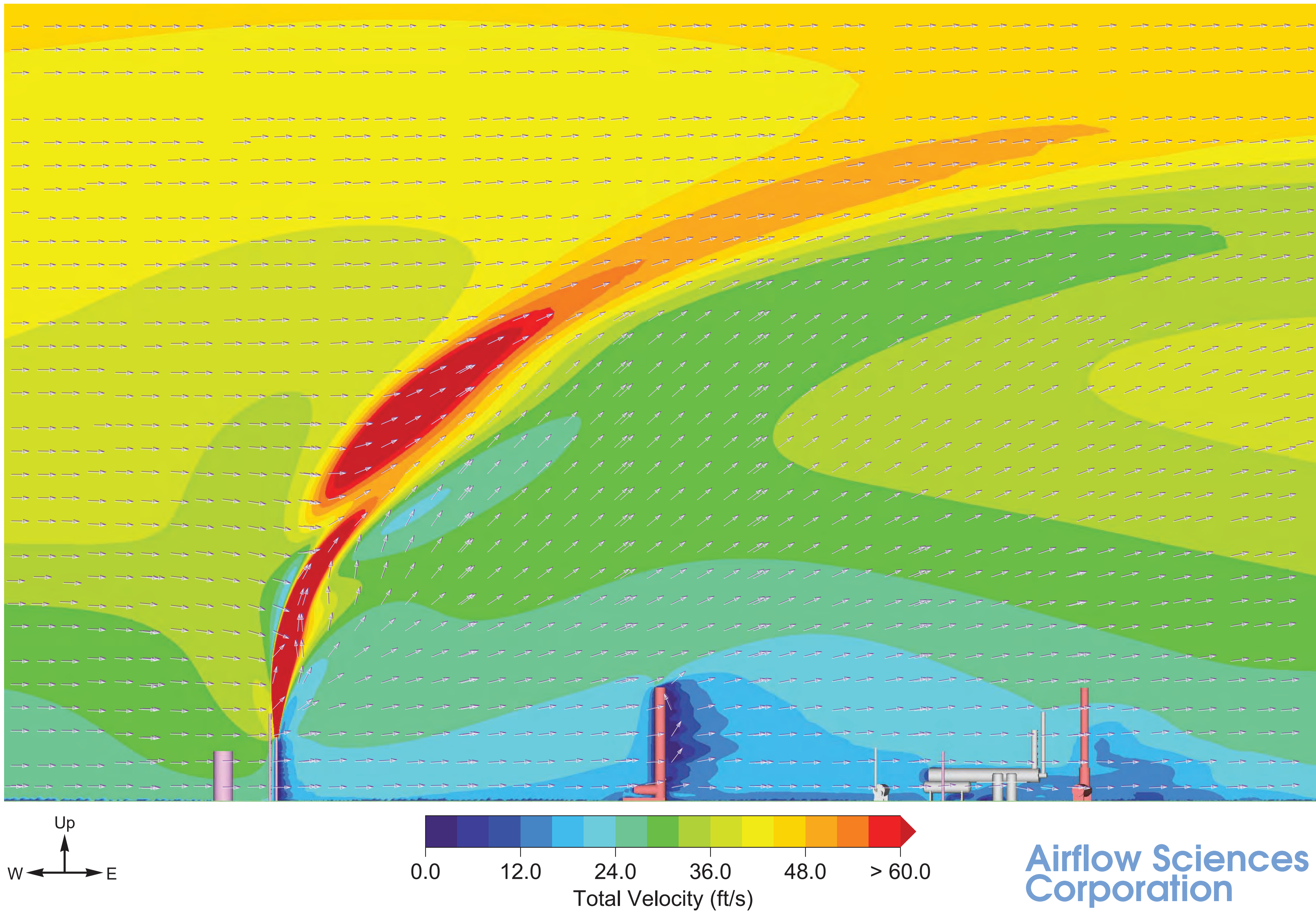


Airflow Sciences Corporation

Figure 49

Velocity - SOW 2.1.1.3A

Side View - Through BDSL 3-1-7 & Thermal Oxidizer

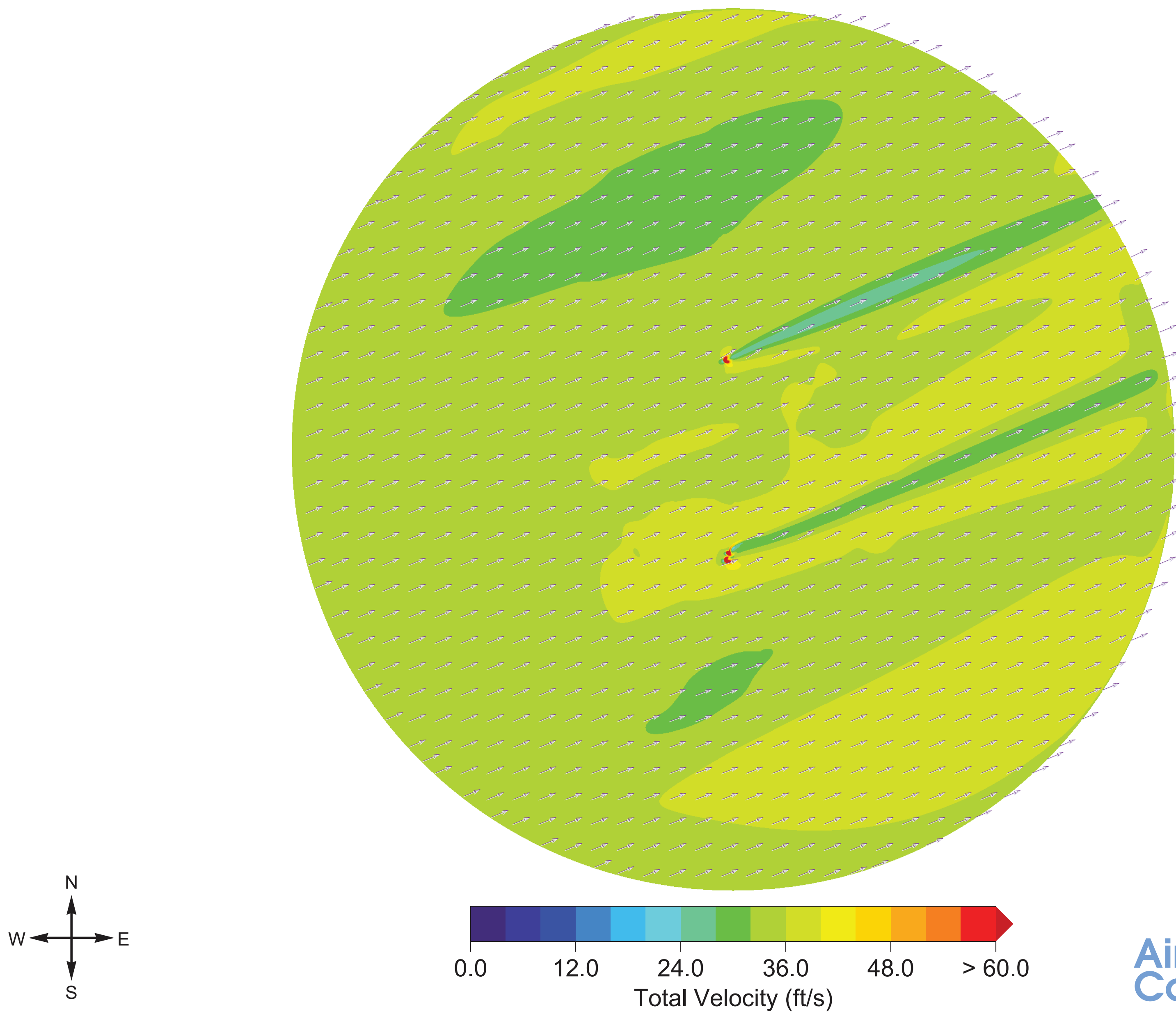


Airflow Sciences Corporation

Figure 50

Velocity - SOW 2.1.1.3A

Top View - Domain - 100' Above ground

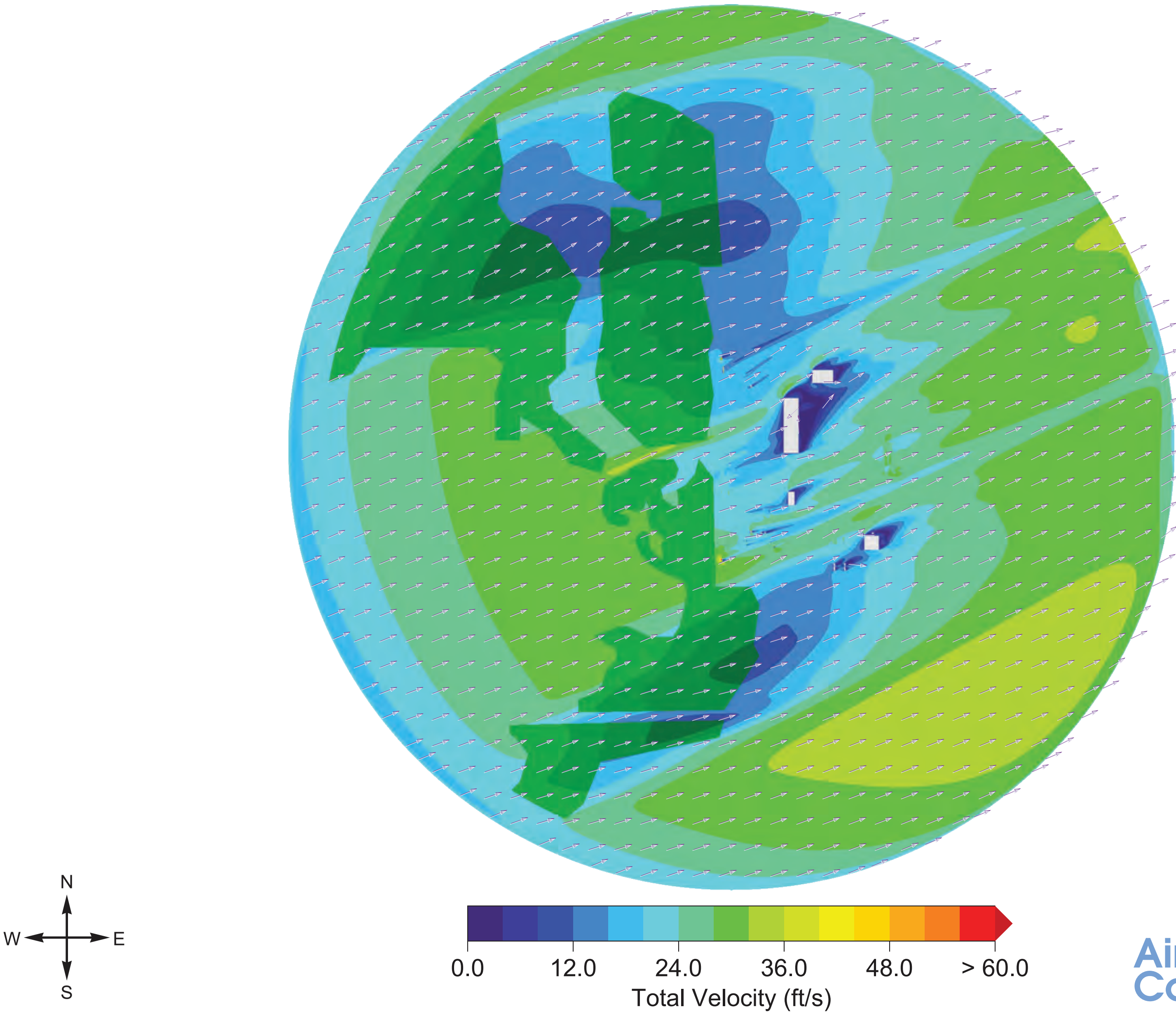


Airflow Sciences Corporation

Figure 51

Velocity - SOW 2.1.1.3A

Top View - Domain - 20' Above ground

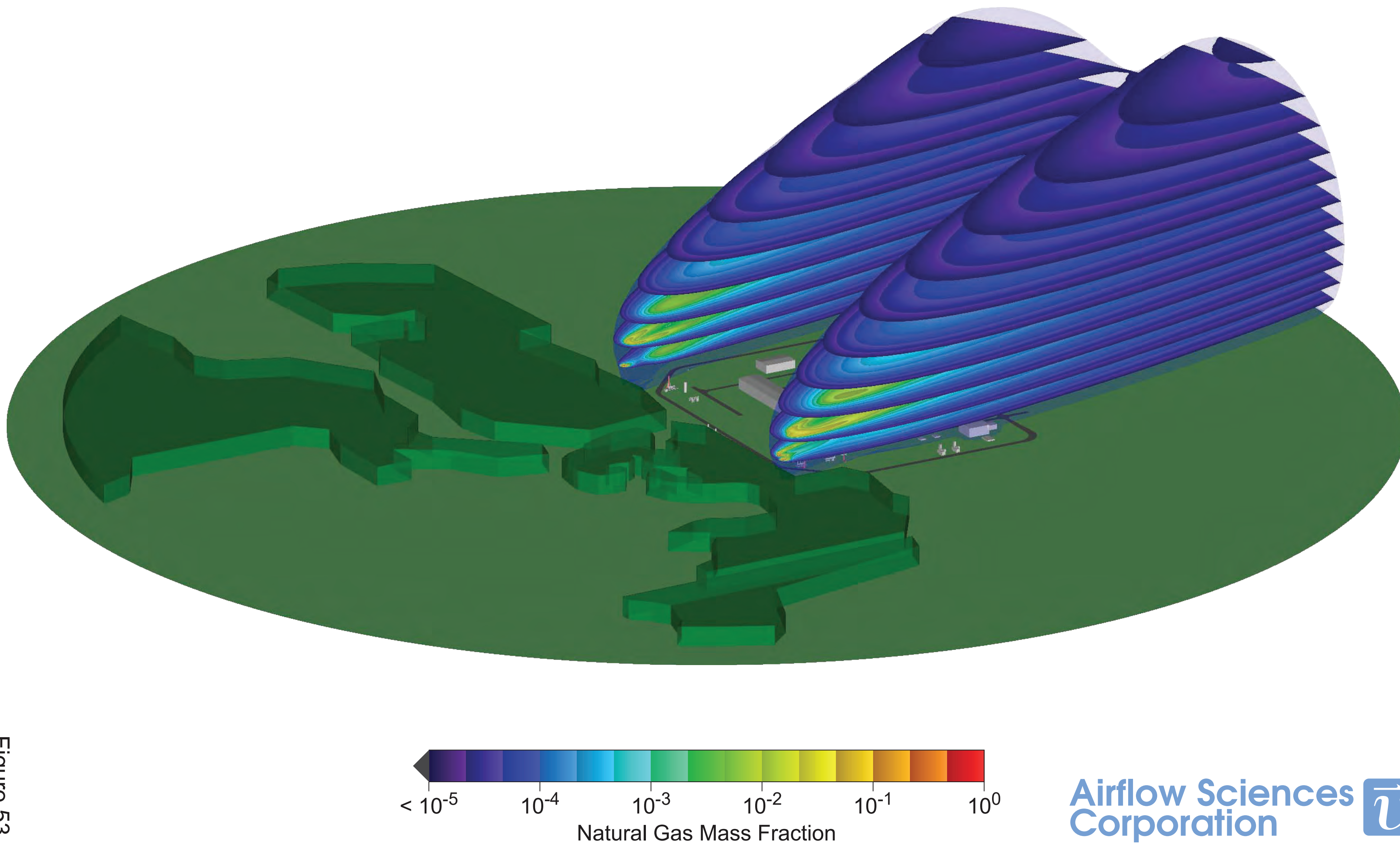


Airflow Sciences Corporation

Figure 52

Natural Gas Mass Fraction - SOW 2.1.1.3A

Isometric View - Looking North-East - Domain - Value > 10^{-5} - Every 80’

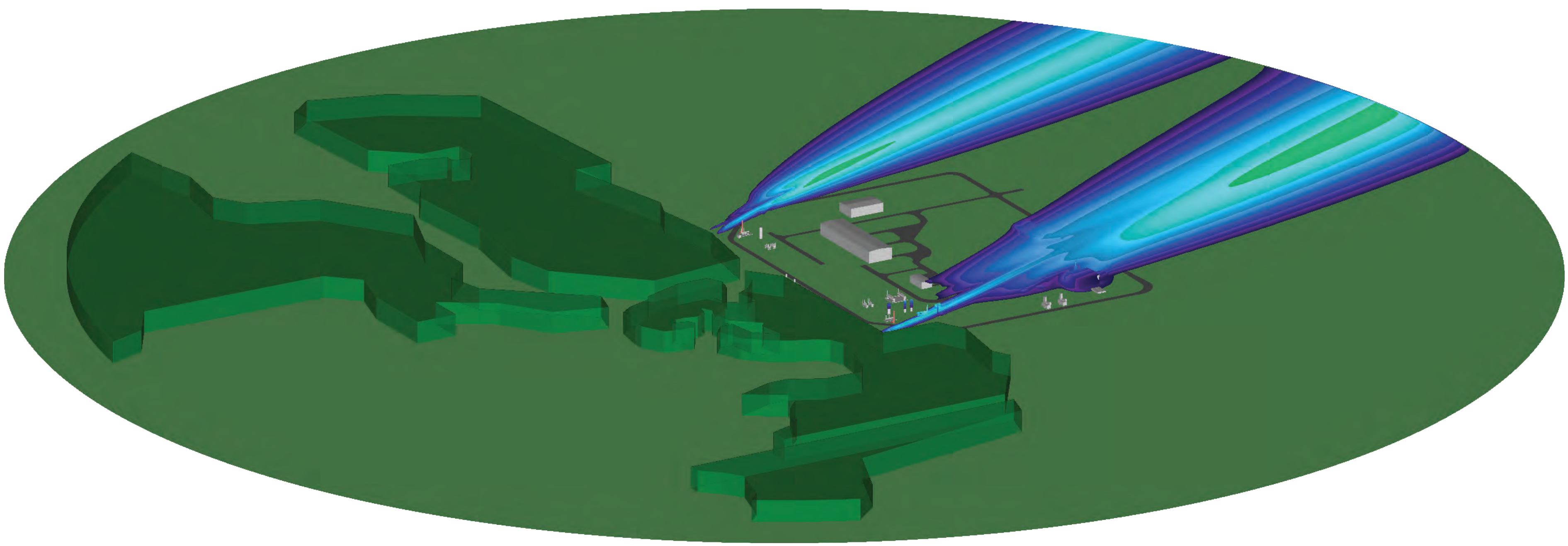


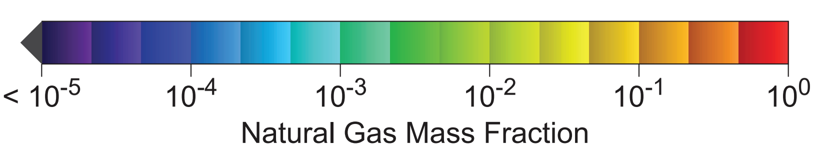
Airflow Sciences Corporation

Figure 53

Natural Gas Mass Fraction - SOW 2.1.1.3A

Isometric View - Looking North-East - Domain - Value > 10^{-5} - Ground & Building Surfaces



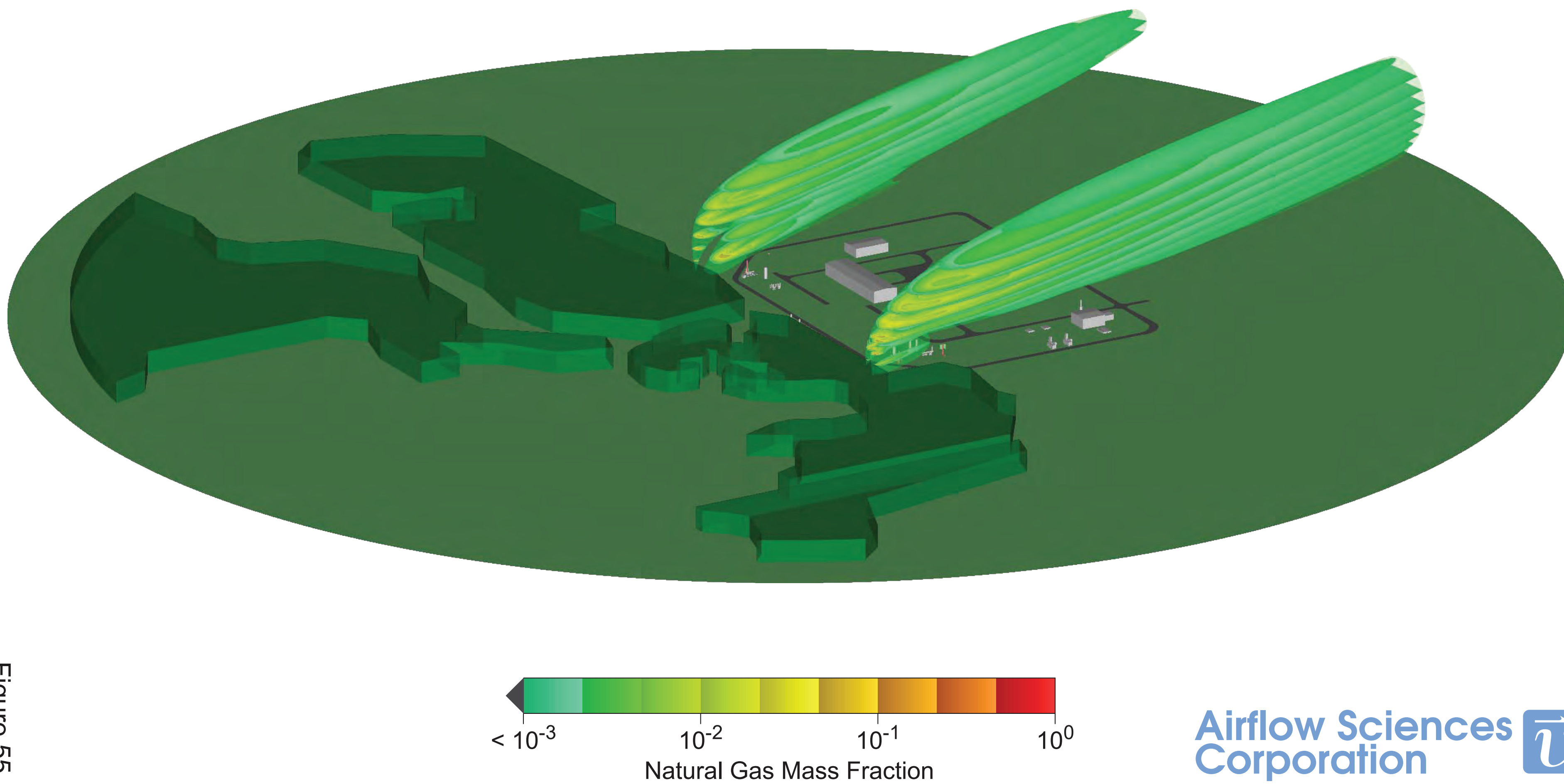


Airflow Sciences Corporation

Figure 54

Natural Gas Mass Fraction - SOW 2.1.1.3A

Isometric View - Looking North-East - Domain - Value > 10^{-3} - Every 40'

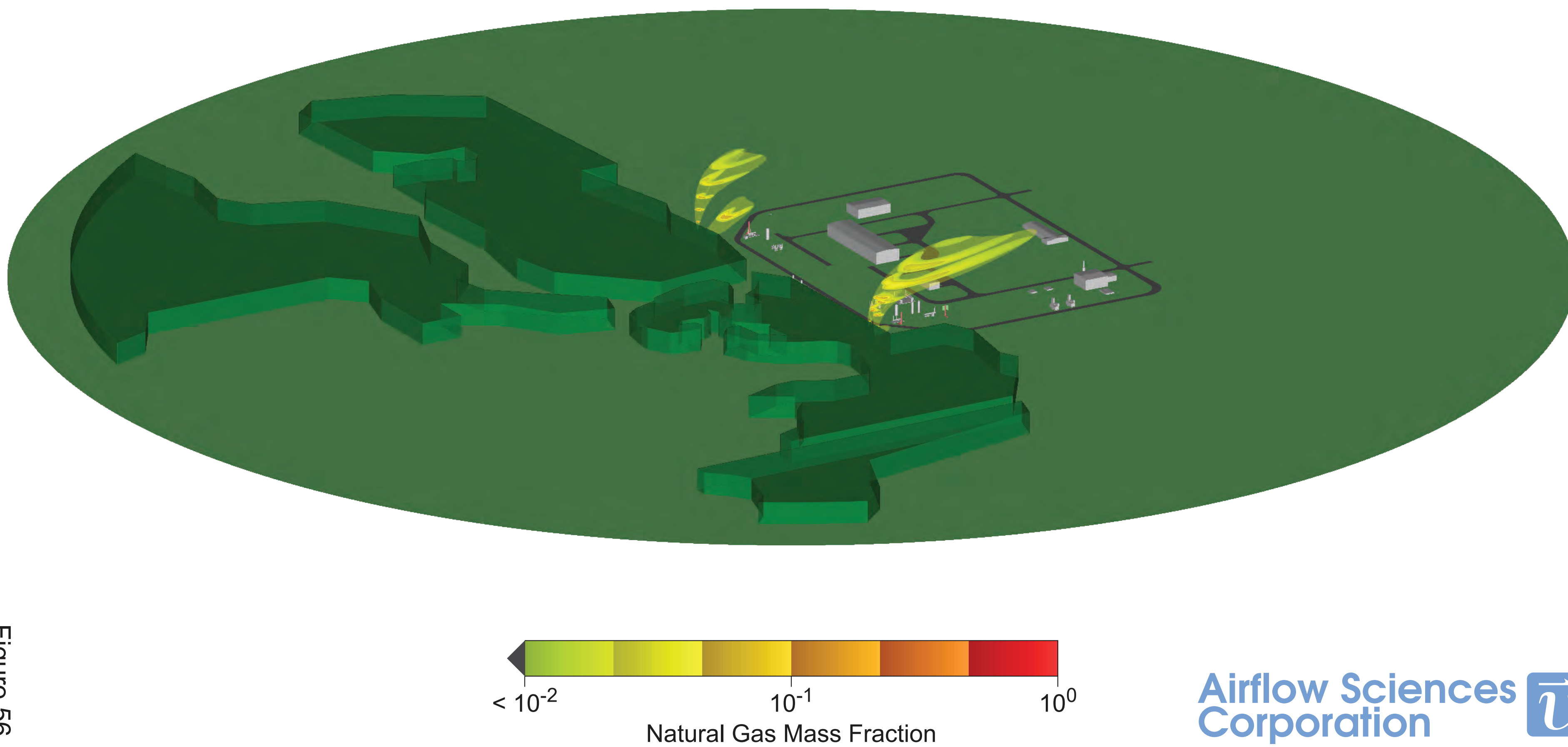


Airflow Sciences Corporation

Figure 55

Natural Gas Mass Fraction - SOW 2.1.1.3A

Isometric View - Looking North-East - Domain - Value > 10^{-2} - Every 40’

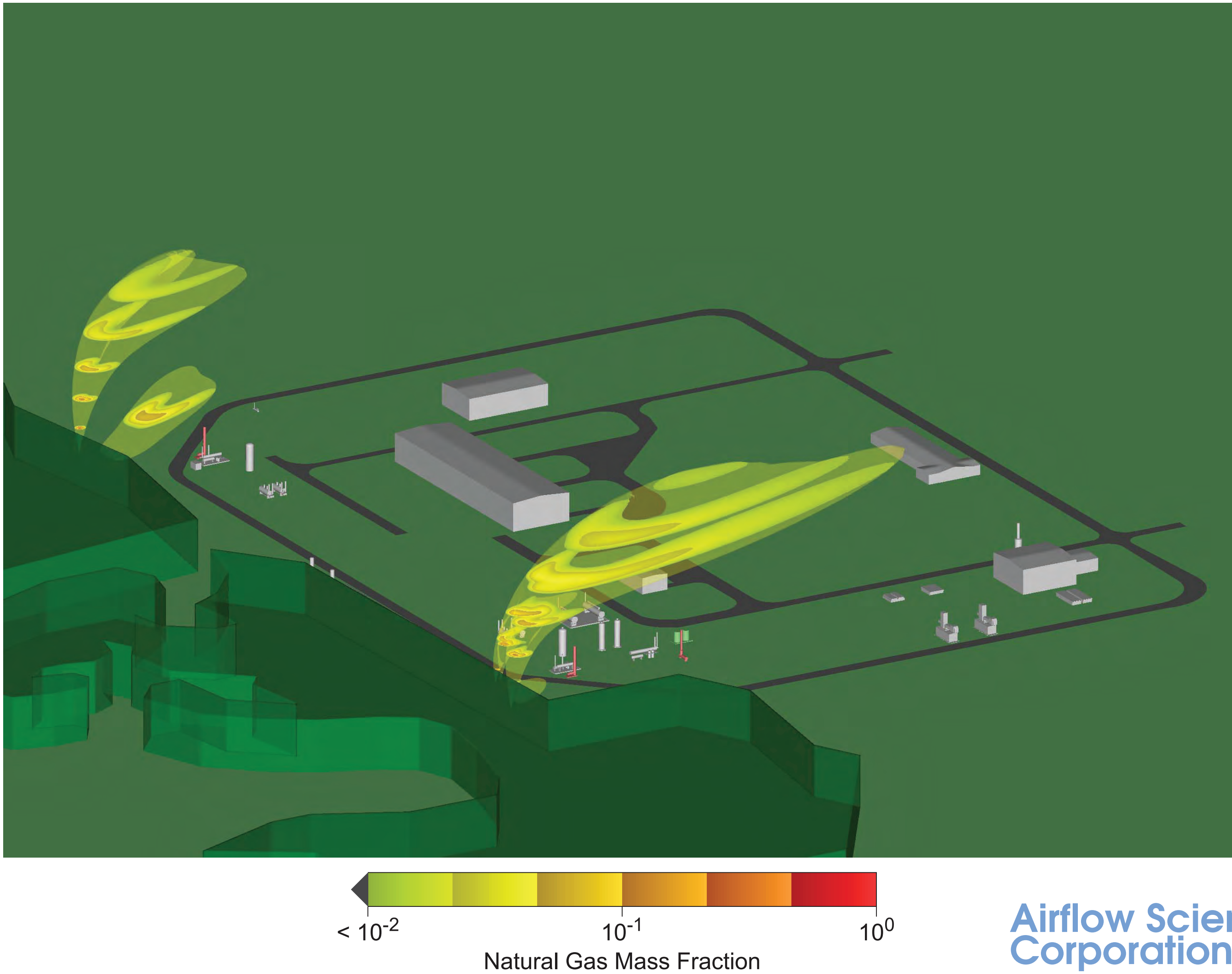


Airflow Sciences Corporation

Figure 56

Natural Gas Mass Fraction - SOW 2.1.1.3A

Isometric View - Looking North-East - Plant Site - Value > 10^{-2} - Every 40'

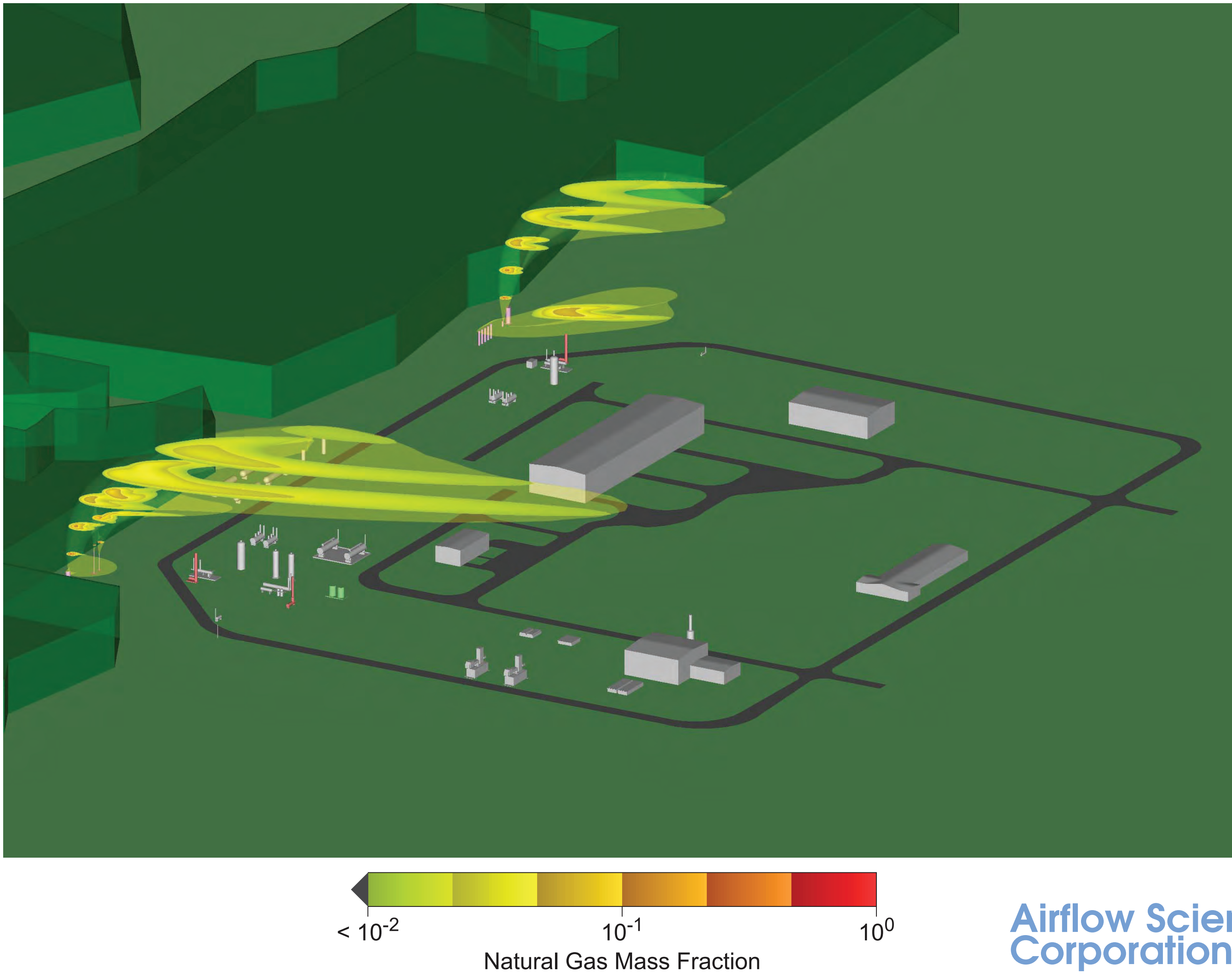


Airflow Sciences Corporation

Figure 57

Natural Gas Mass Fraction - SOW 2.1.1.3A

Isometric View - Looking North-West - Plant Site - Value > 10^{-2} - Every 40'

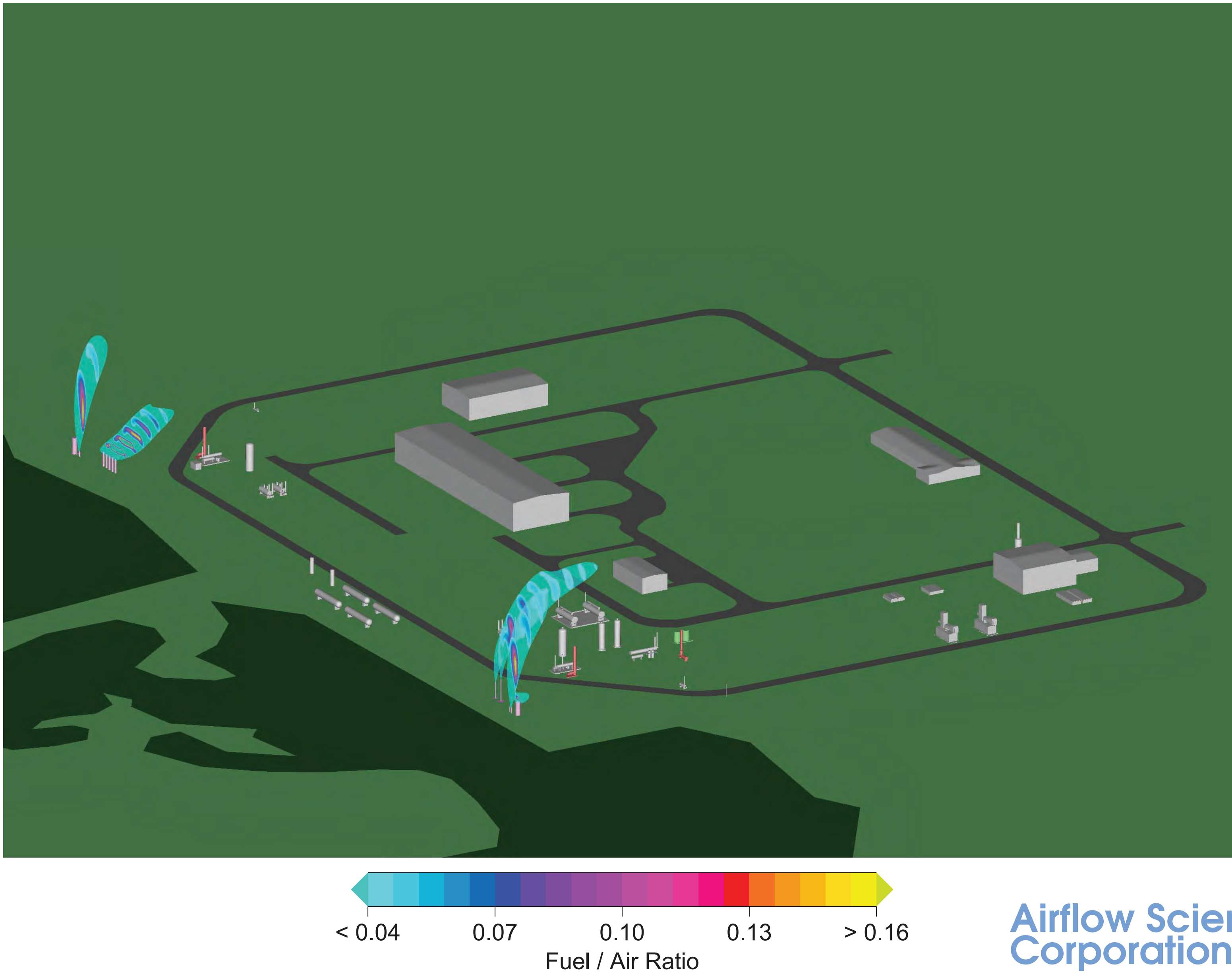


Airflow Sciences Corporation

Figure 58

Fuel / Air Ratio - SOW 2.1.1.3A

Isometric View - Looking North-East - Plant Site - Value > 4%

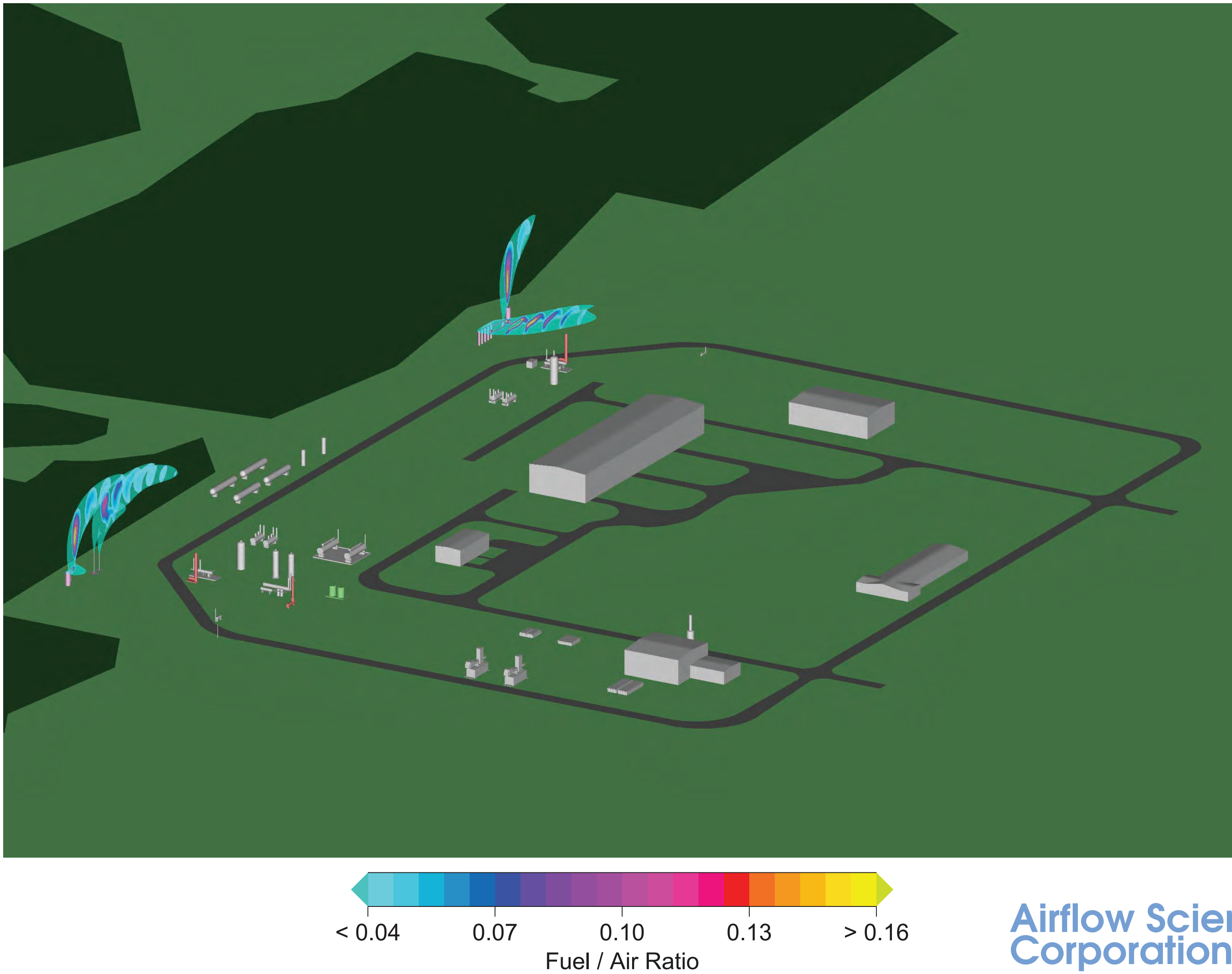


Airflow Sciences Corporation

Figure 59

Fuel / Air Ratio - SOW 2.1.1.3A

Isometric View - Looking North-West - Plant Site - Value > 4%



Airflow Sciences Corporation

Figure 60

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Fuel / Air Ratio - SOW 2.1.1.3A

Isometric View - Looking North-East - South-West Corner of Plant - Value > 4%

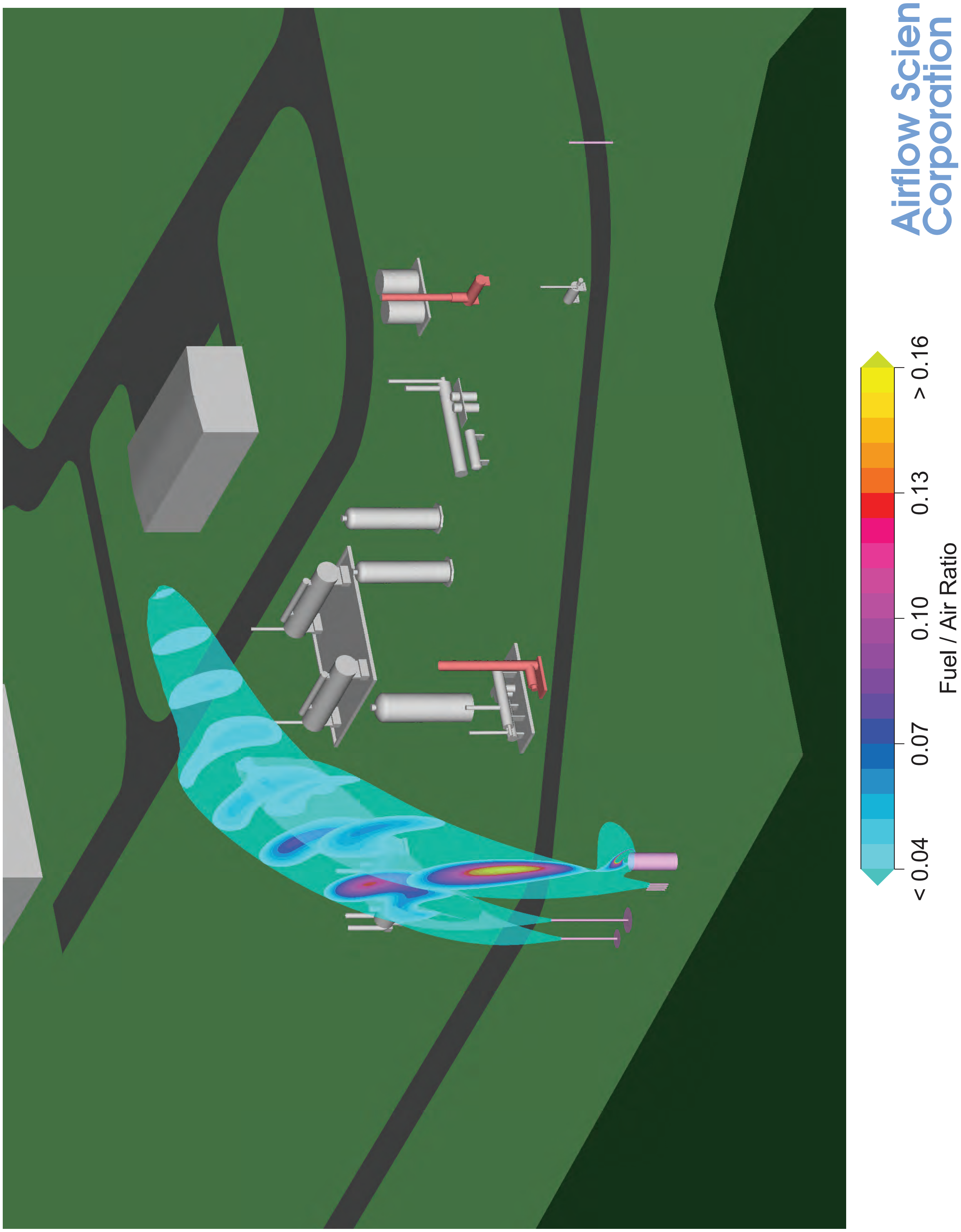

Figure 61

Fuel / Air Ratio - SOW 2.1.1.3A

Isometric View - Looking North-West - South-West Corner of Plant - Value > 4%

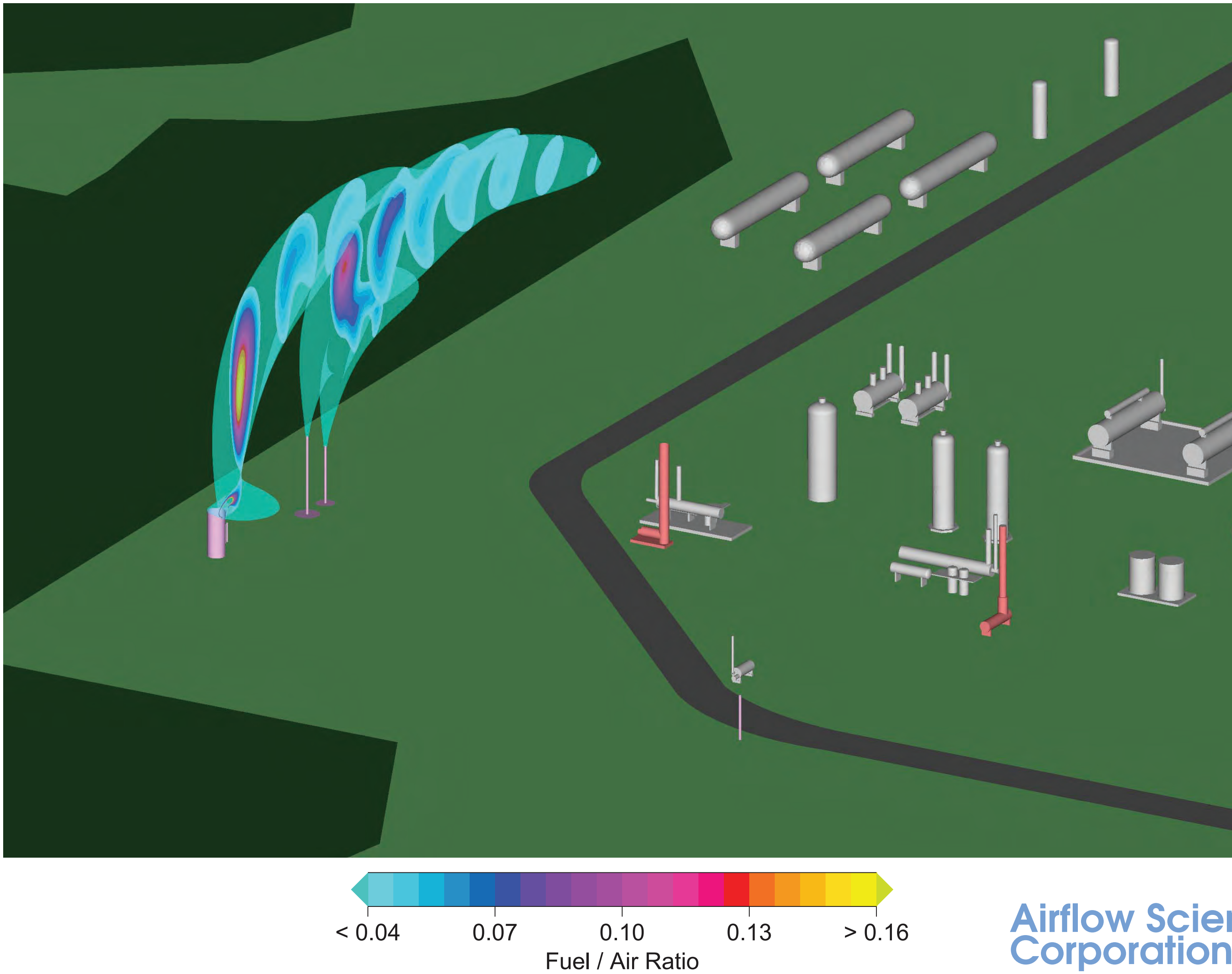

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Figure 62

Fuel / Air Ratio - SOW 2.1.1.3A

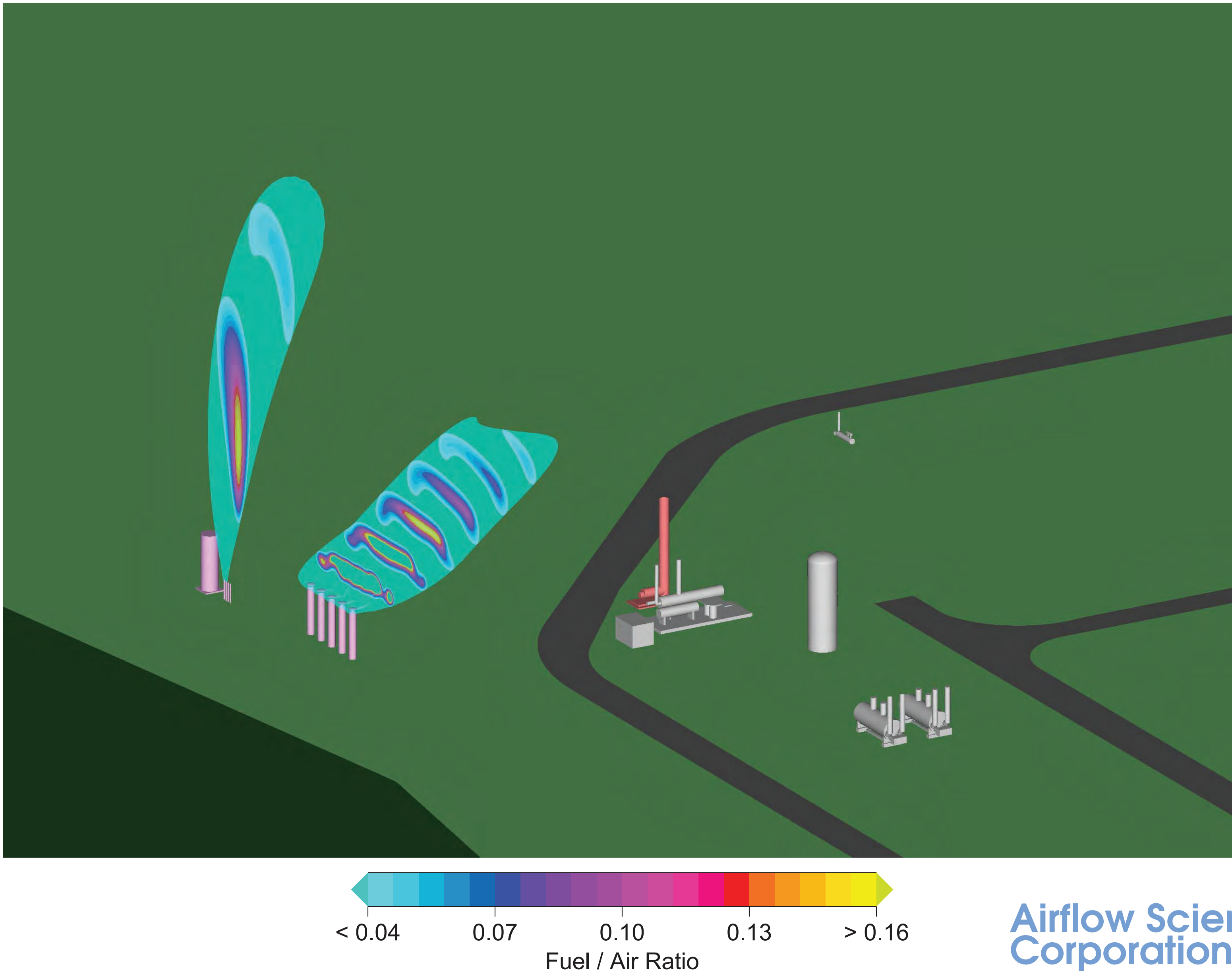
Top View - South-West Corner of Plant - Value > 4%

Airflow Sciences Corporation

Figure 63

Fuel / Air Ratio - SOW 2.1.1.3A

Isometric View - Looking North-East - North-West Corner of Plant - Value > 4%



Airflow Sciences Corporation

Figure 64

Fuel / Air Ratio - SOW 2.1.1.3A

Isometric View - Looking North-West - North-West Corner of Plant - Value > 4%

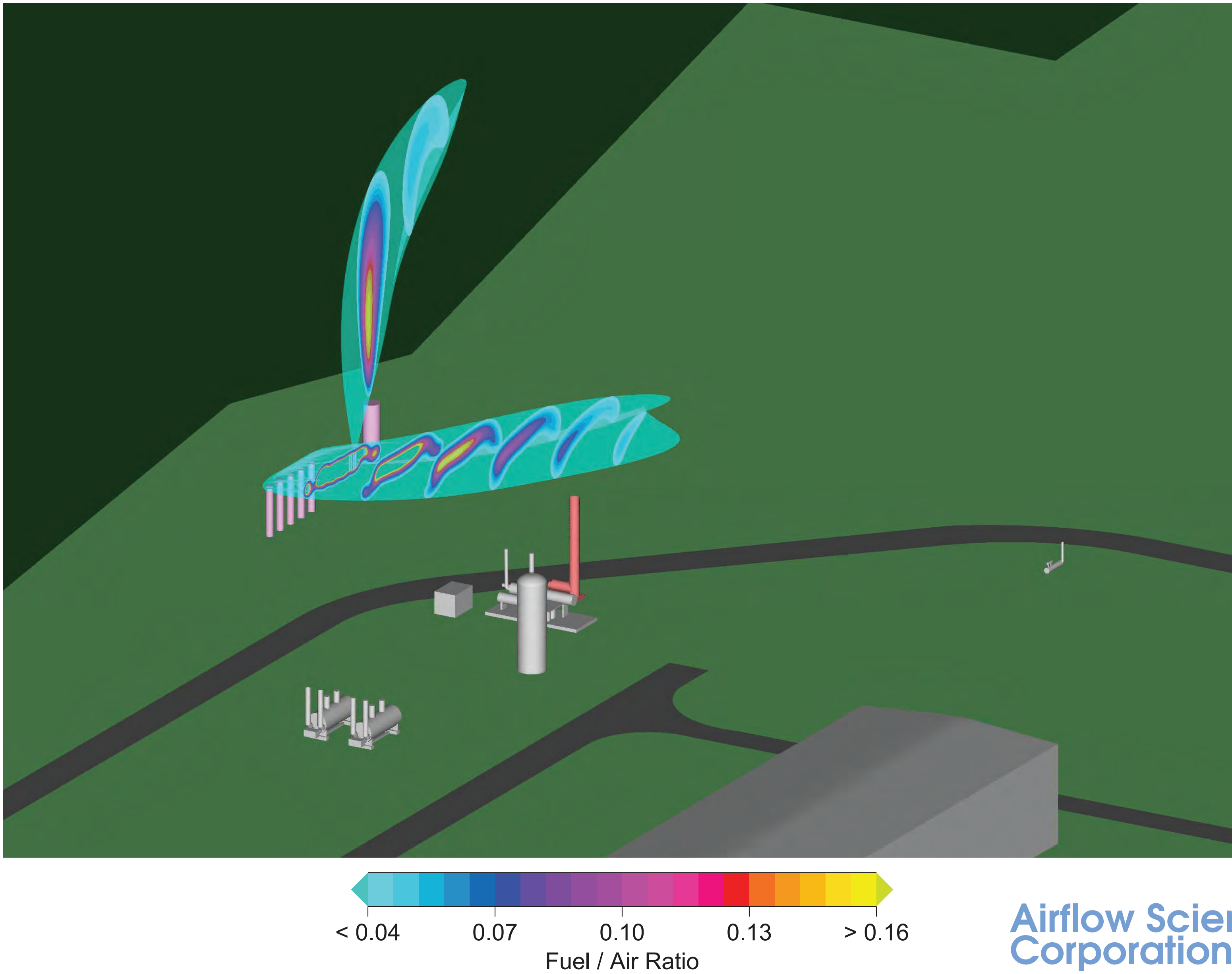


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Figure 65

Fuel / Air Ratio - SOW 2.1.1.3A

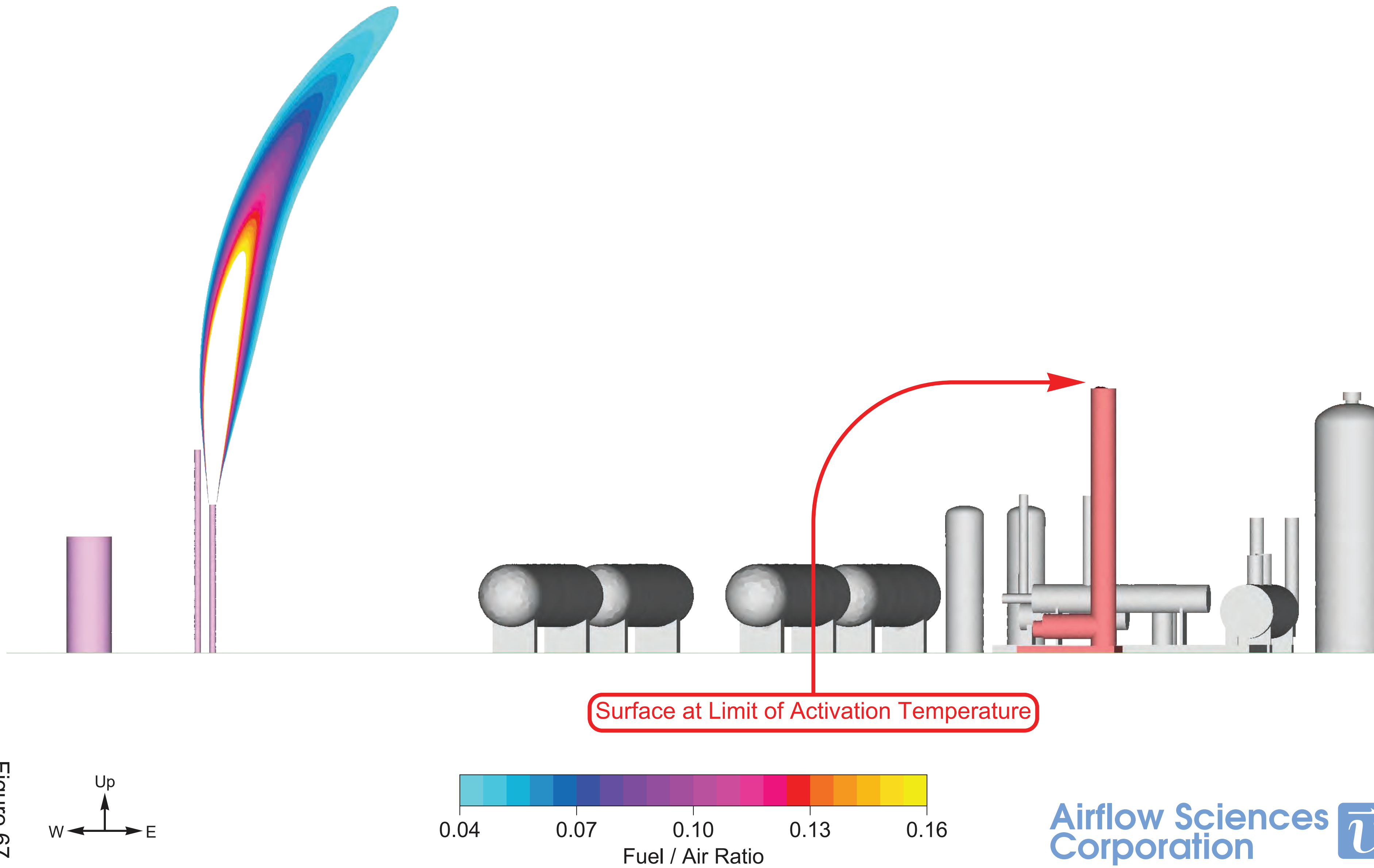
Top View - North-West Corner of Plant - Value > 4%

Airflow Sciences Corporation

Figure 66

Fuel / Air Ratio - SOW 2.1.1.3A

Side View - Through BDSL 3-1-7 & Thermal Oxidizer



Airflow Sciences Corporation

Figure 67

Fuel / Air Ratio - SOW 2.1.1.3A

End View - Through BDSL 3-1-7 & Thermal Oxidizer

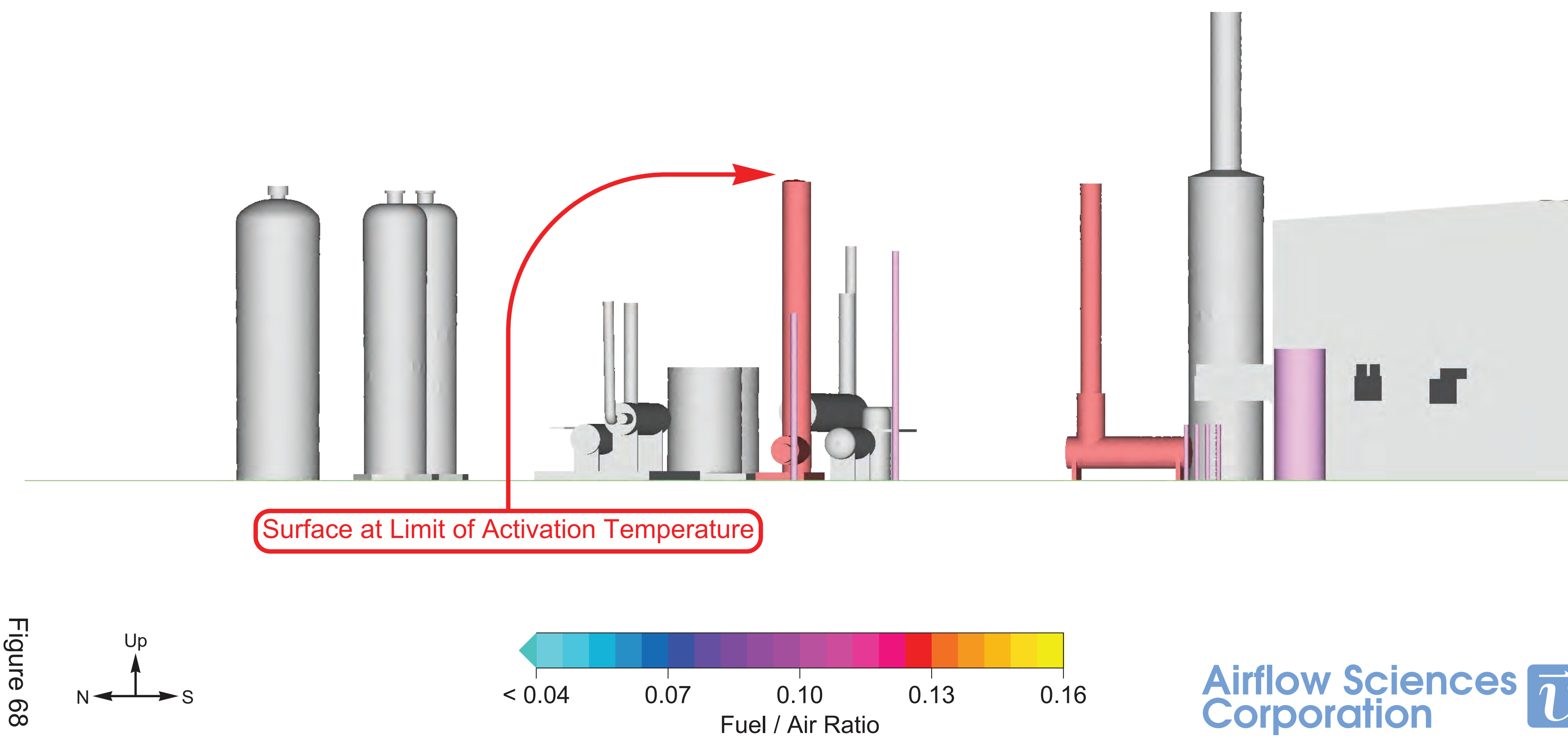
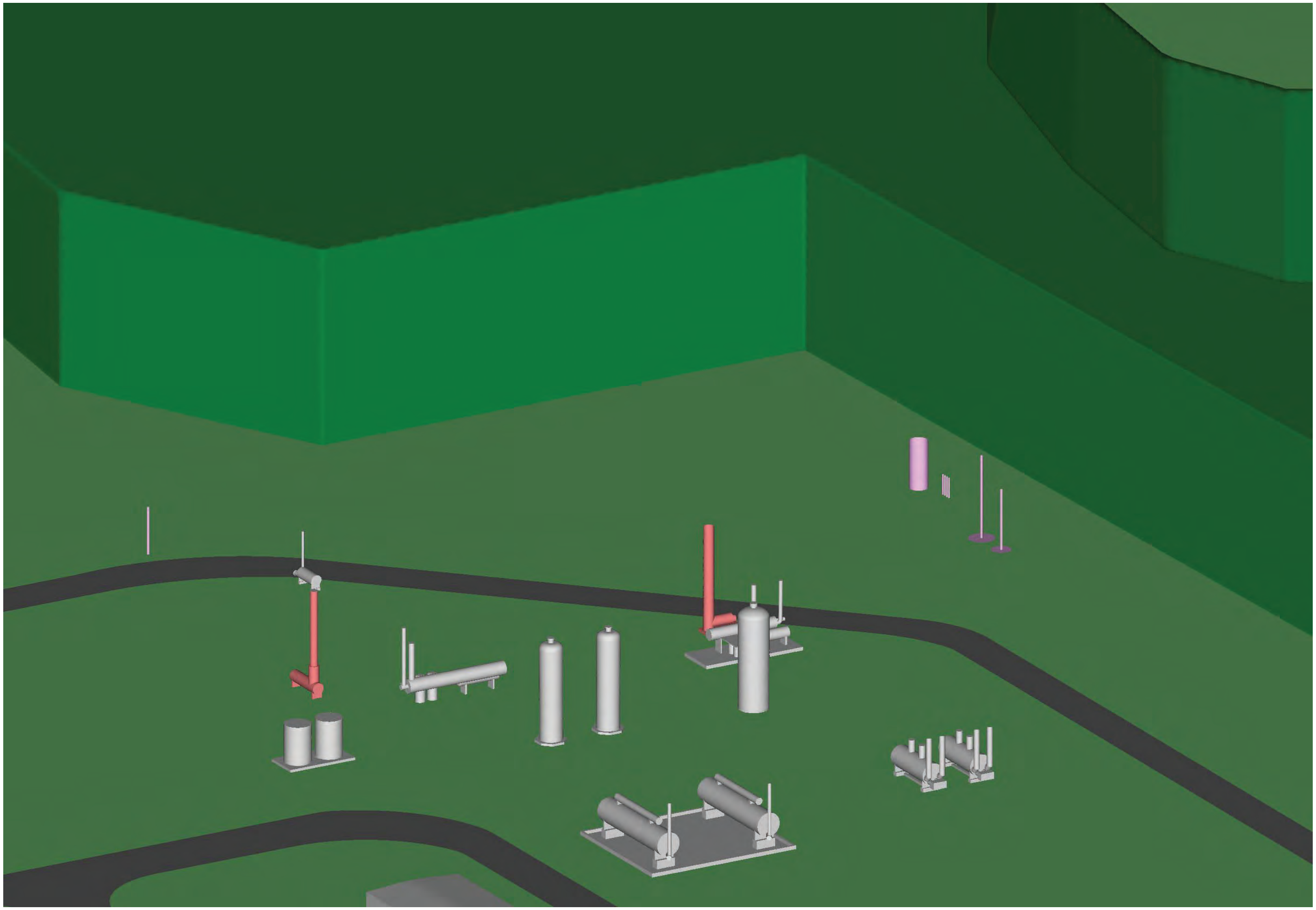


Figure 68

Airflow Sciences Corporation

Model Geometry

Isometric View - Looking South-West - South-West Corner of Plant



Airflow Sciences Corporation

Figure 69

Model Geometry

Isometric View - Looking South-West - North-West Corner of Plant

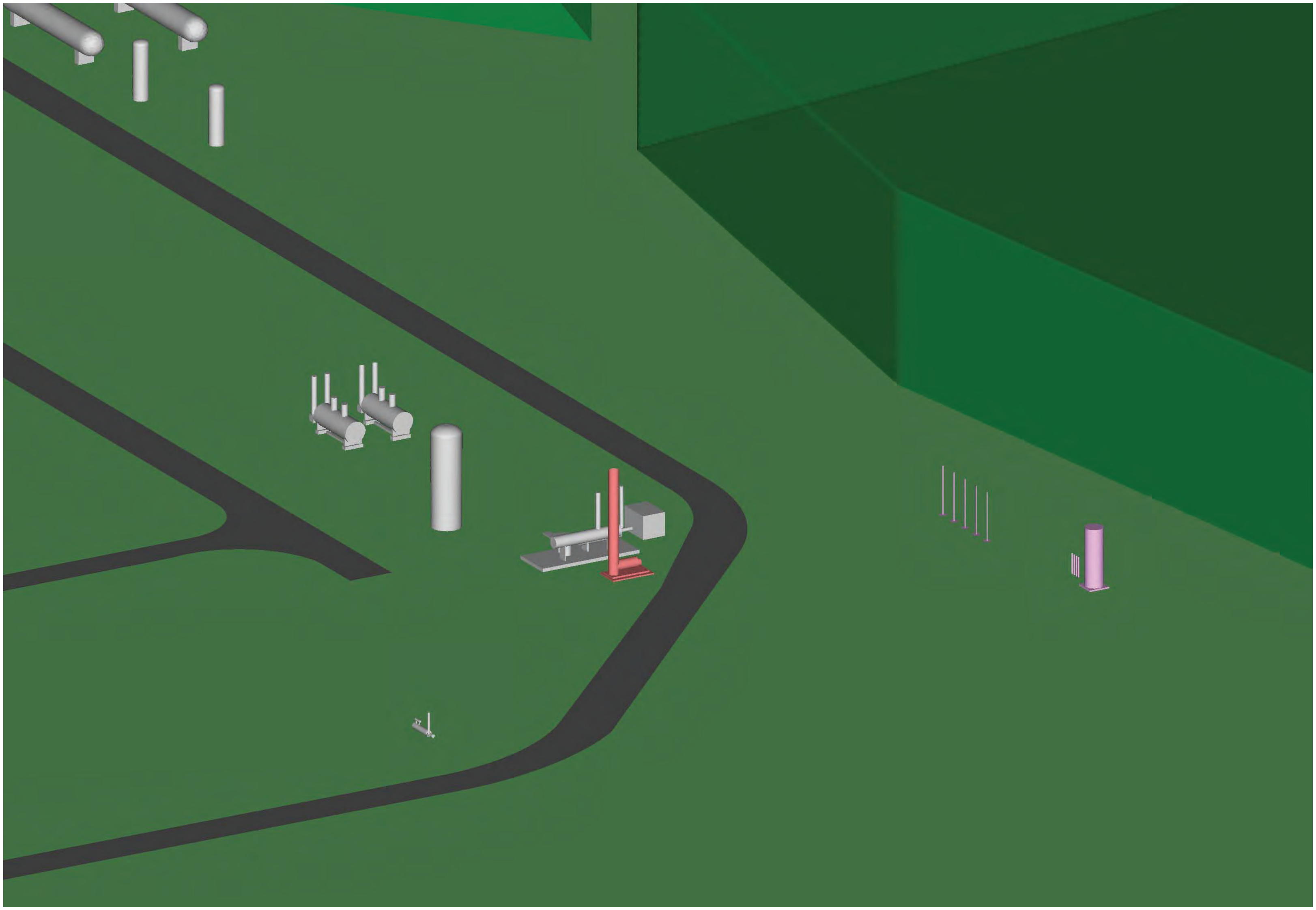


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Figure 70

Velocity - SOW 2.1.1.3B

Side View - Through BDSL 3-1-7 & Thermal Oxidizer

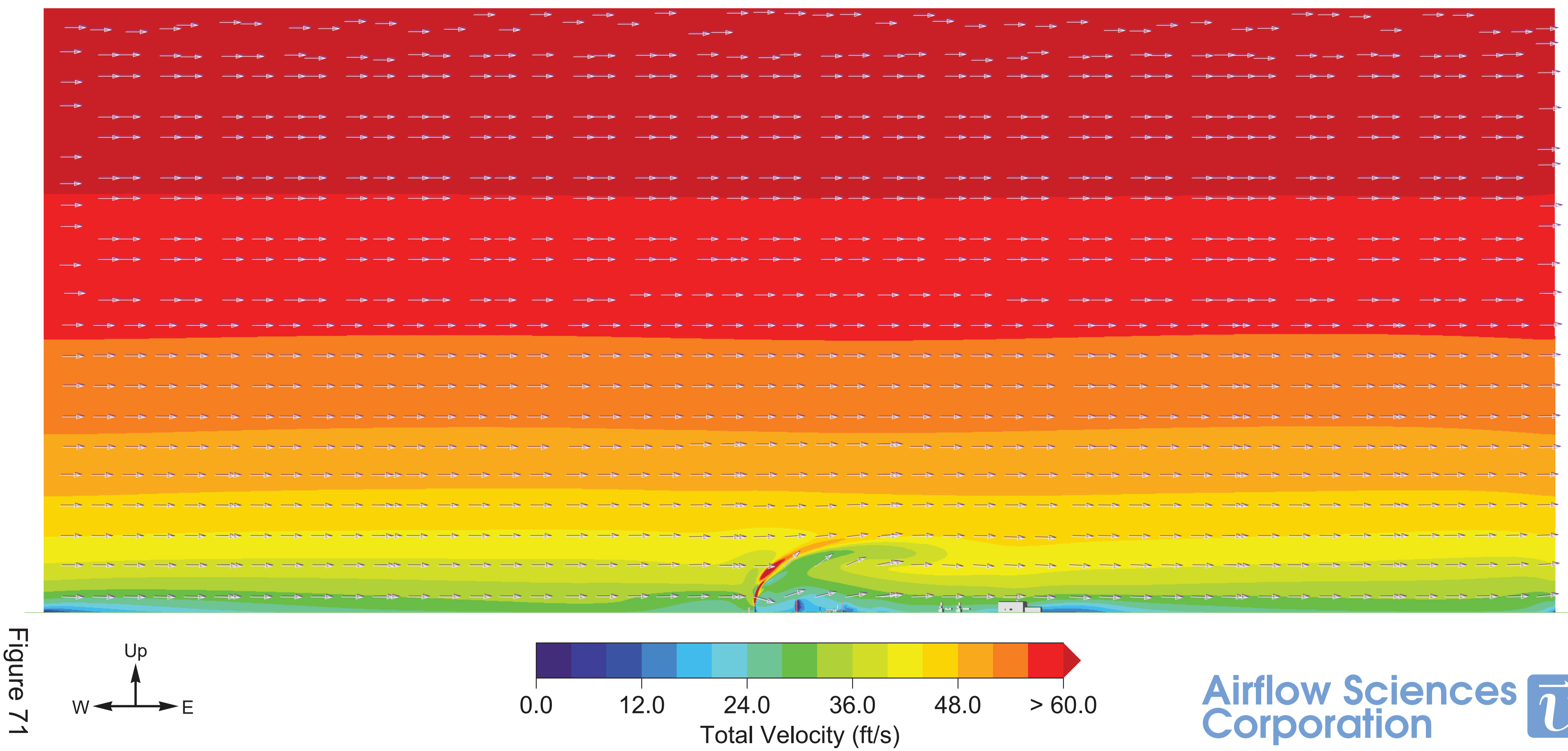

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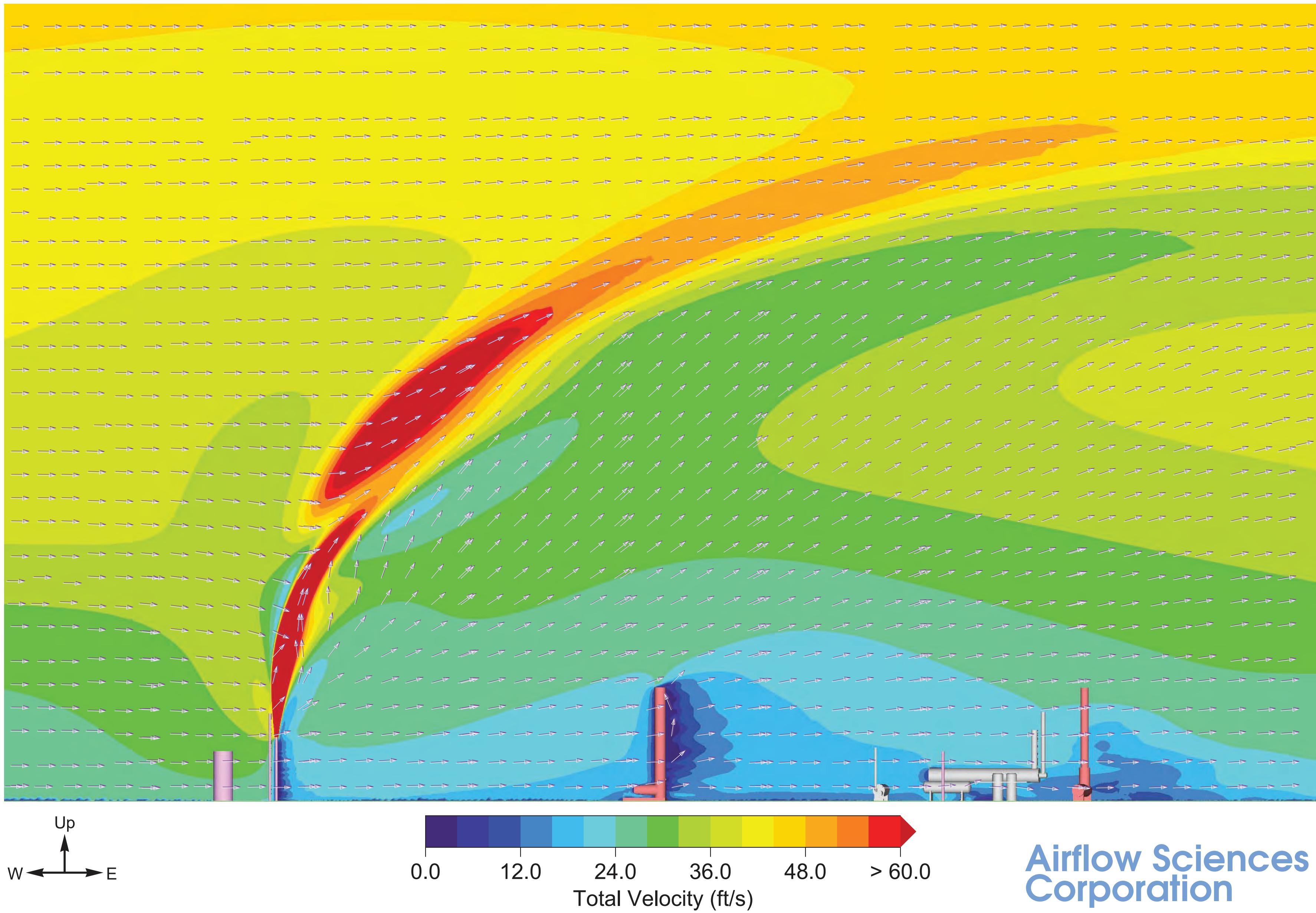
Figure 71

Velocity - SOW 2.1.1.3B

Side View - Through BDSL 3-1-7 & Thermal Oxidizer

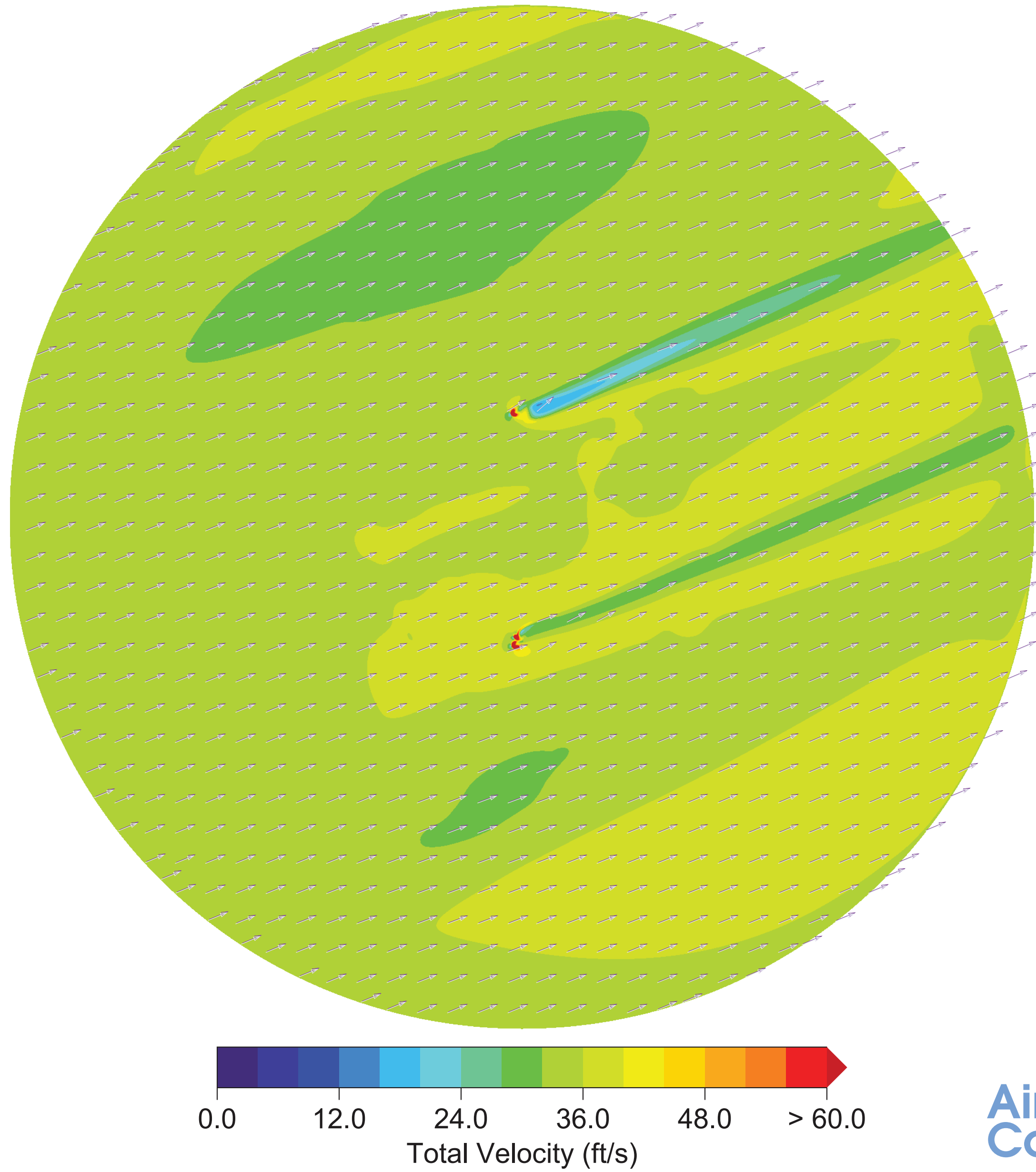


Airflow Sciences Corporation

Figure 72

Velocity - SOW 2.1.1.3B

Top View - Domain - 100' Above ground

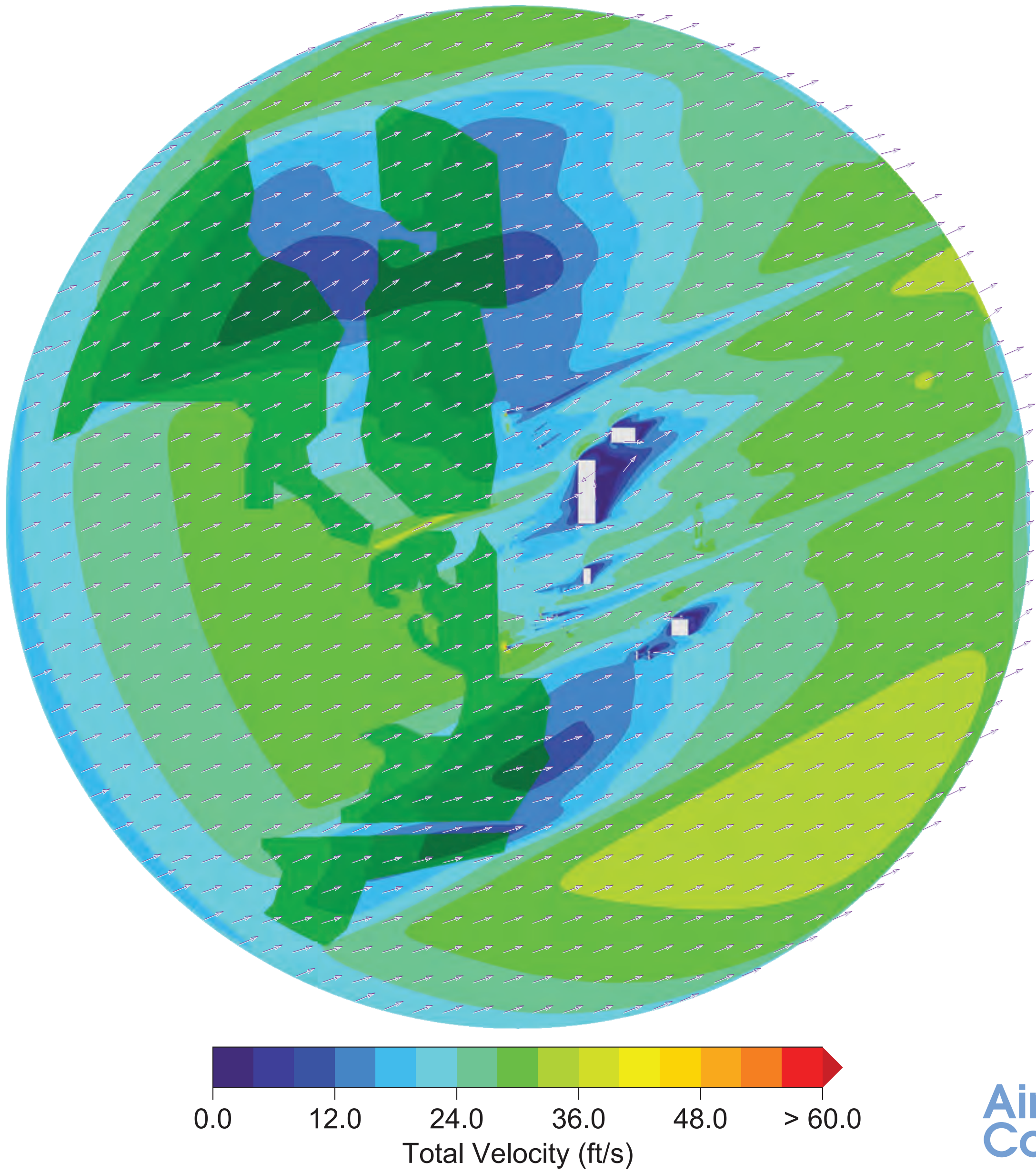


Airflow Sciences Corporation

Figure 73

Velocity - SOW 2.1.1.3B

Top View - Domain - 20' Above ground



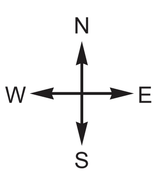


Figure 74

Airflow Sciences Corporation

Natural Gas Mass Fraction - SOW 2.1.1.3B

Isometric View - Looking North-East - Domain - Value > 10^{-5} - Every 80'

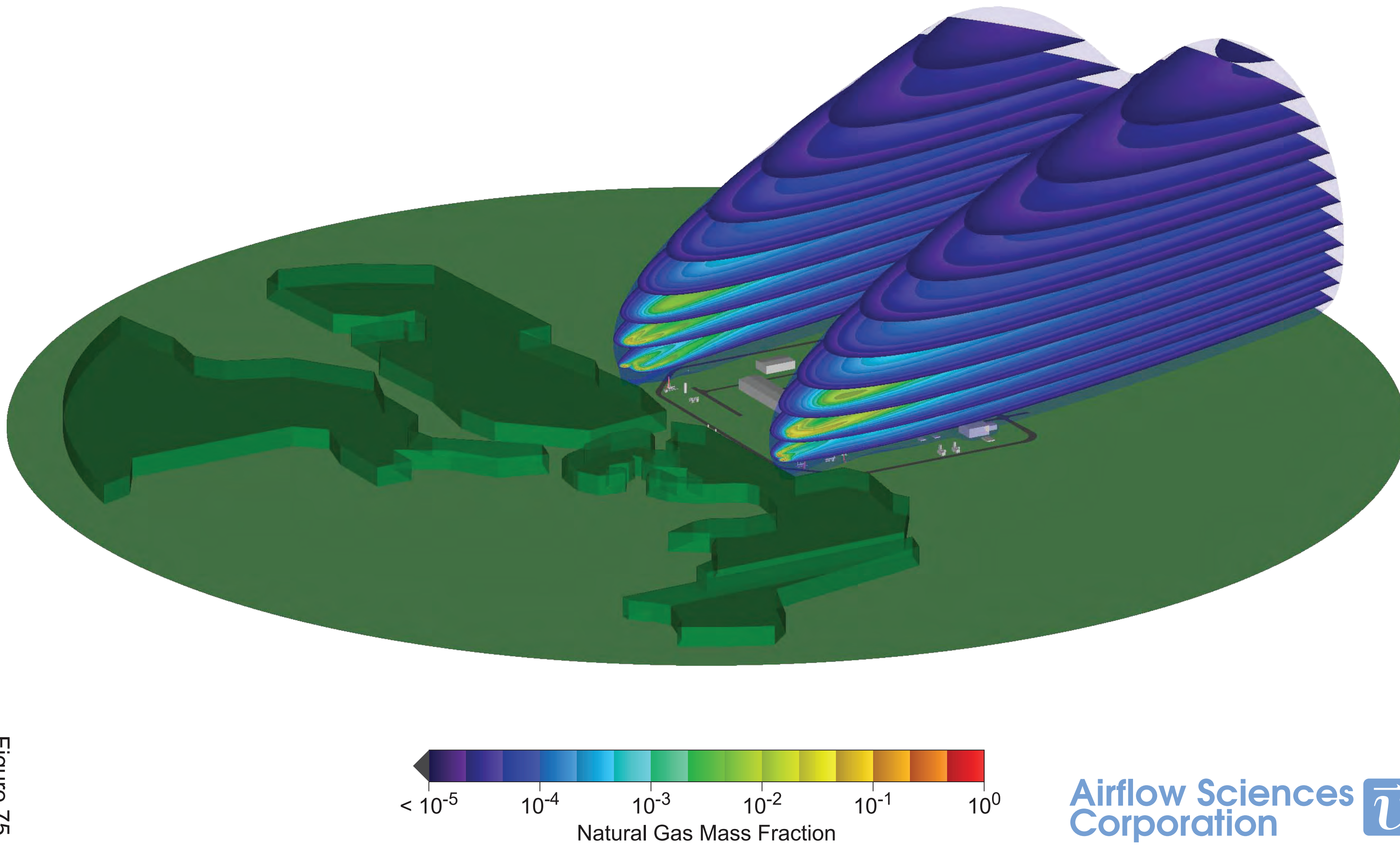
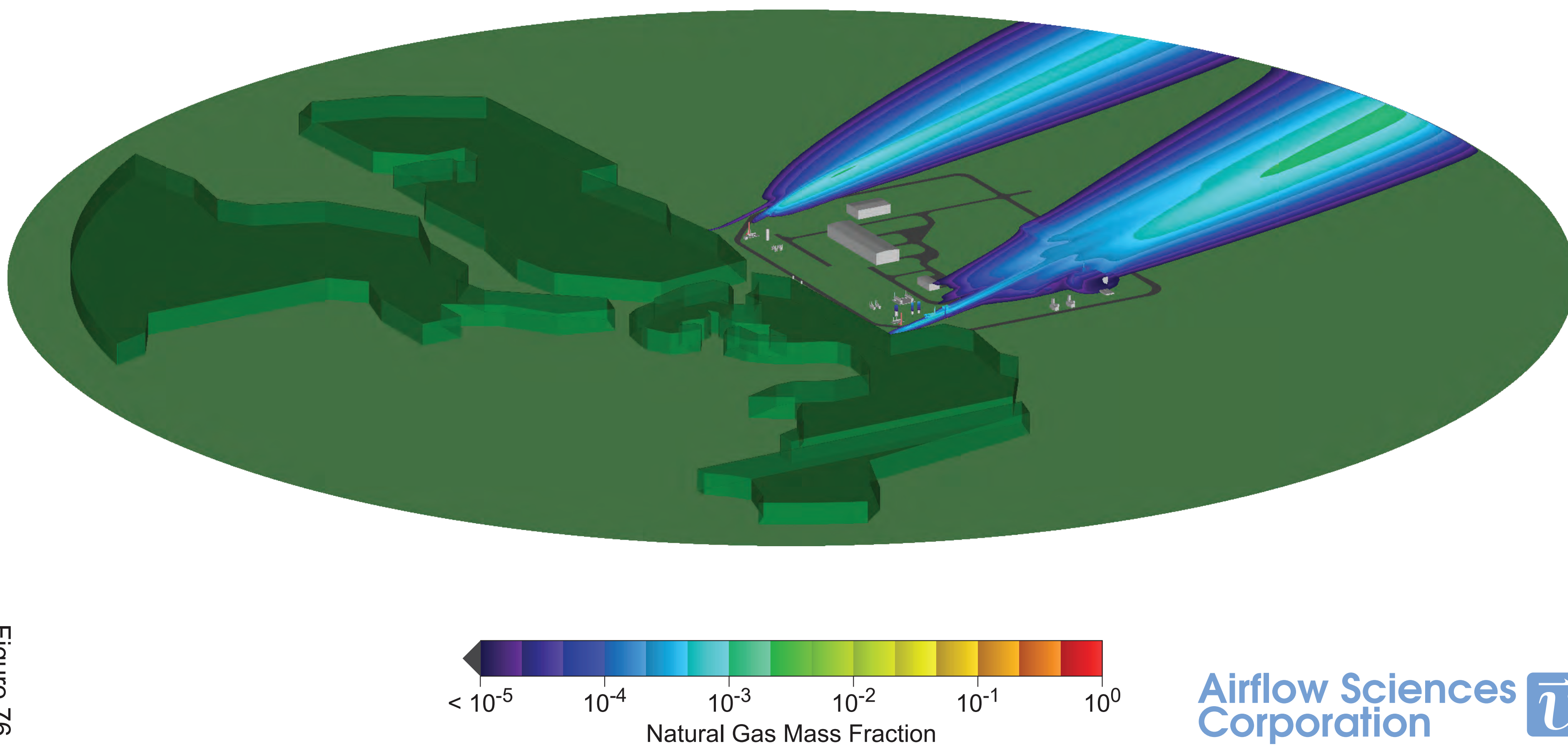


Figure 75

Natural Gas Mass Fraction - SOW 2.1.1.3B

Isometric View - Looking North-East - Domain - Value > 10^{-5} - Ground & Building Surfaces



Airflow Sciences Corporation

Figure 76

Natural Gas Mass Fraction - SOW 2.1.1.3B

Isometric View - Looking North-East - Domain - Value > 10^{-3} - Every 40'

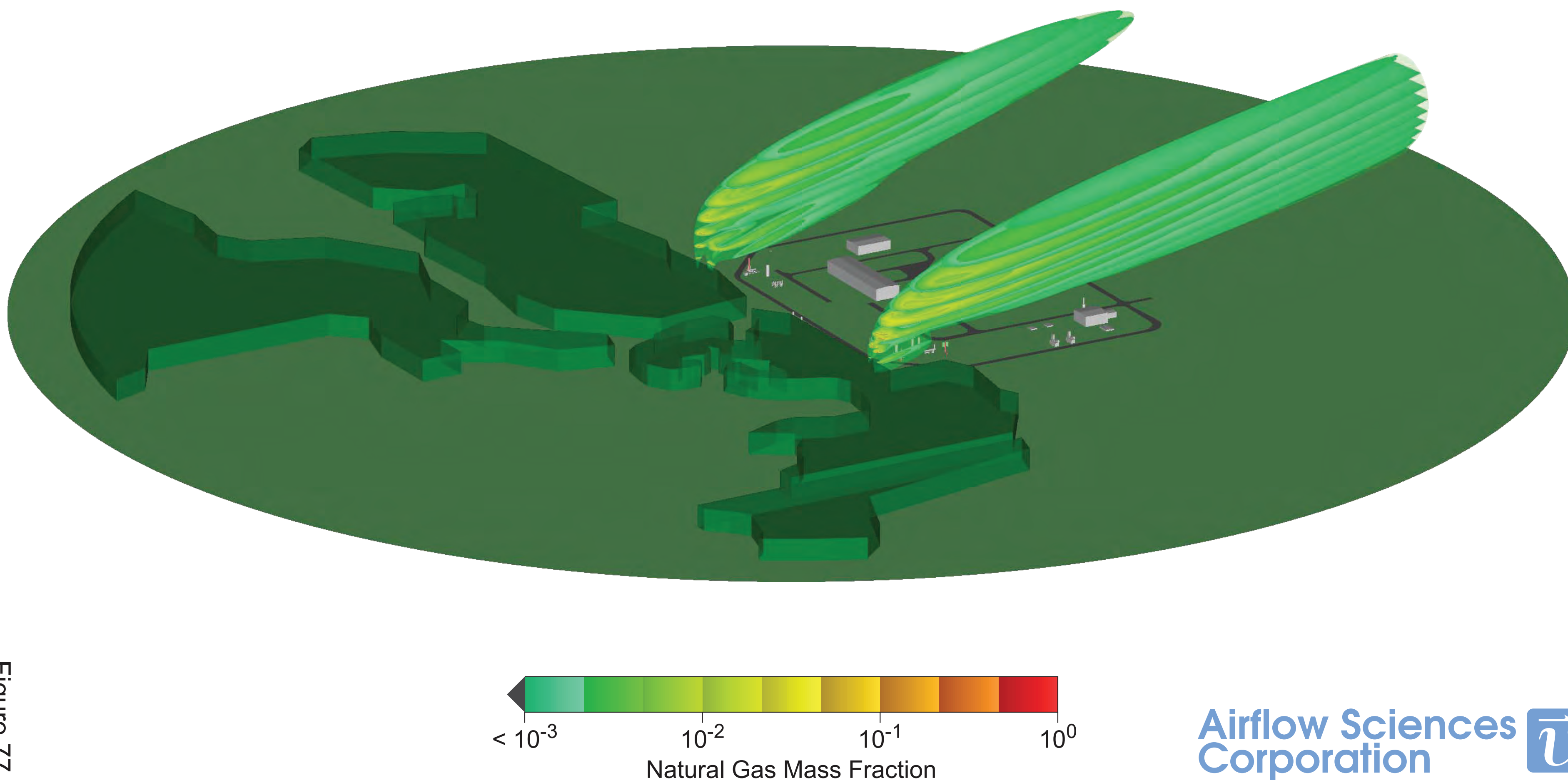
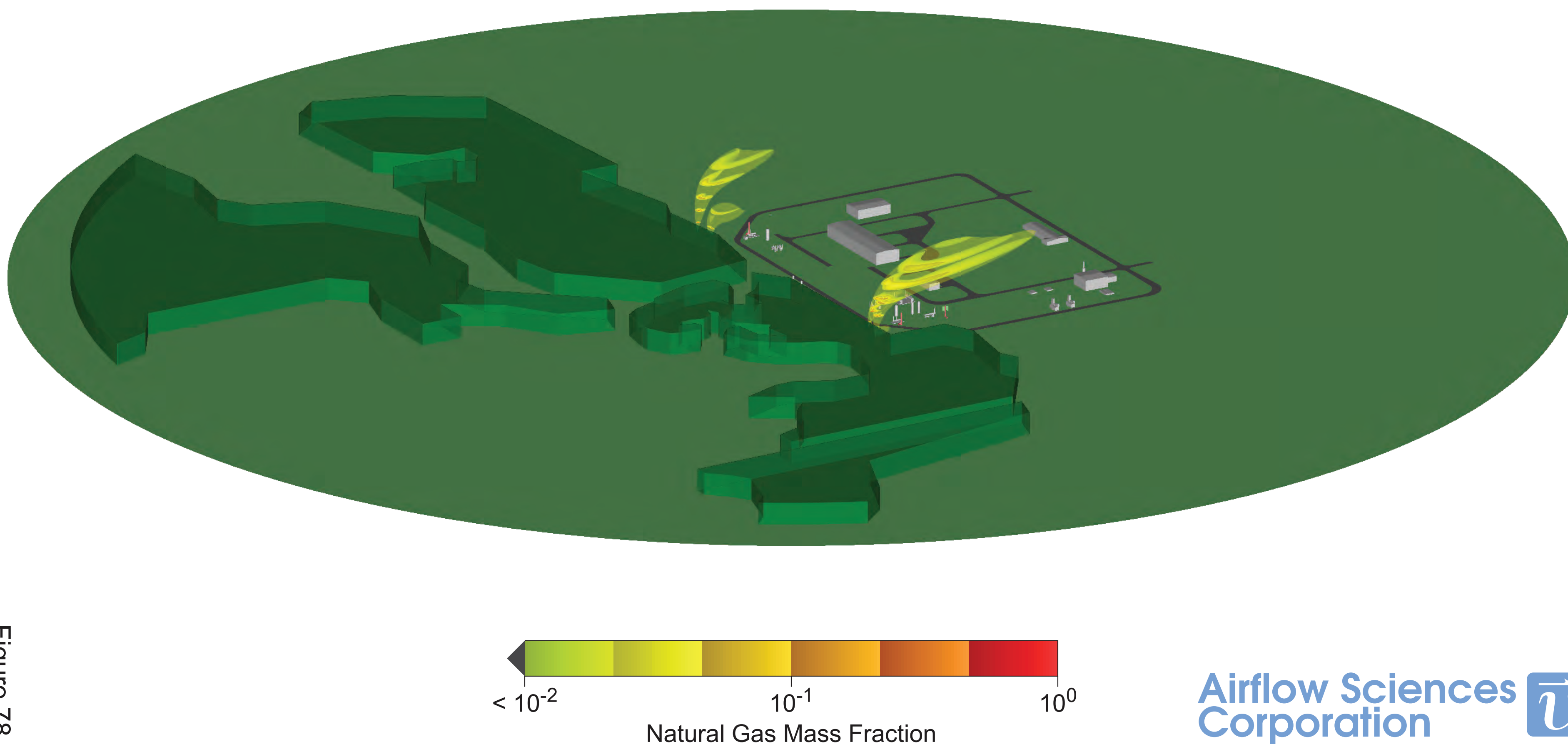


Figure 77

Natural Gas Mass Fraction - SOW 2.1.1.3B

Isometric View - Looking North-East - Domain - Value > 10^{-2} - Every 40'

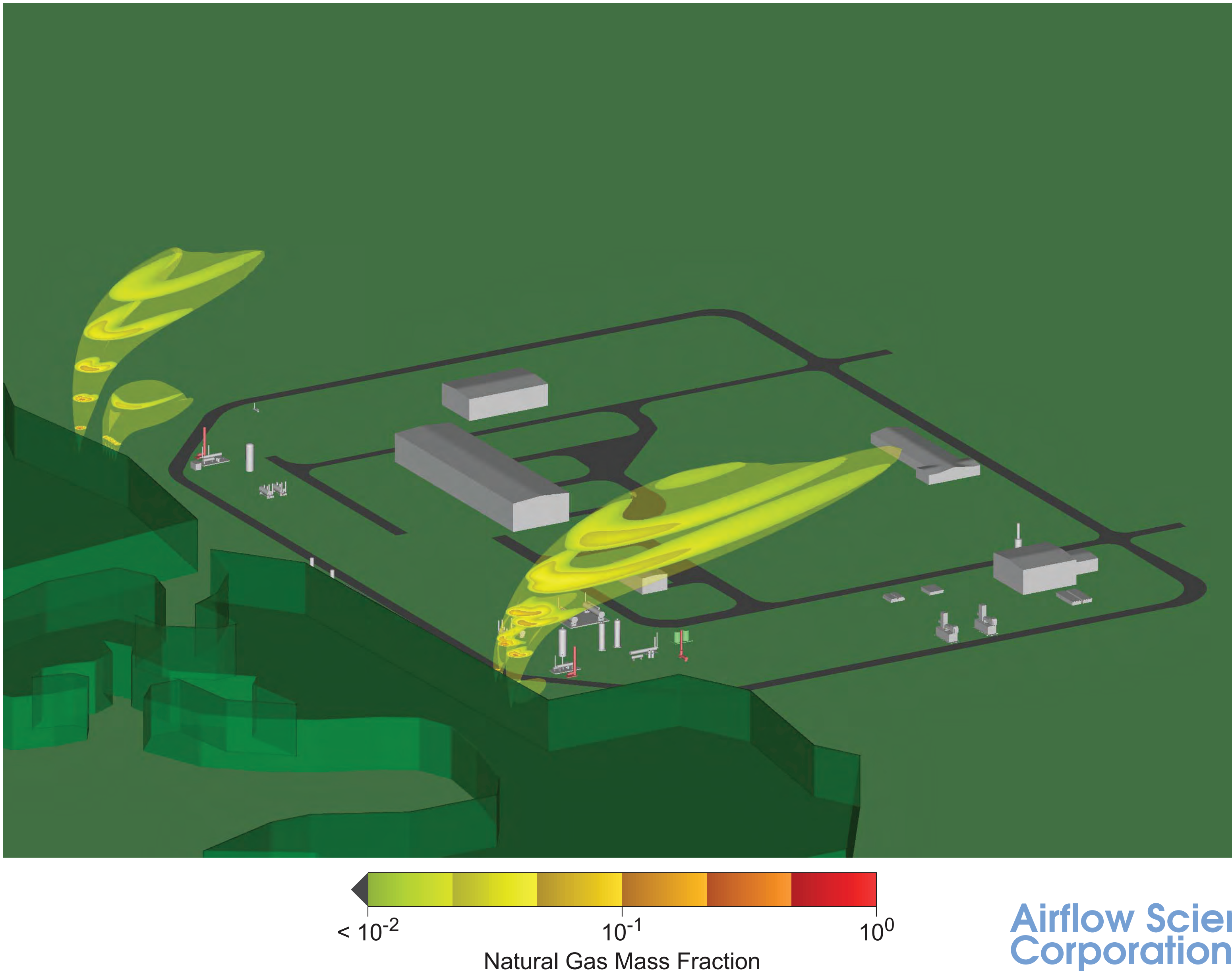


Airflow Sciences Corporation

Figure 78

Natural Gas Mass Fraction - SOW 2.1.1.3B

Isometric View - Looking North-East - Plant Site - Value > 10^{-2} - Every 40’

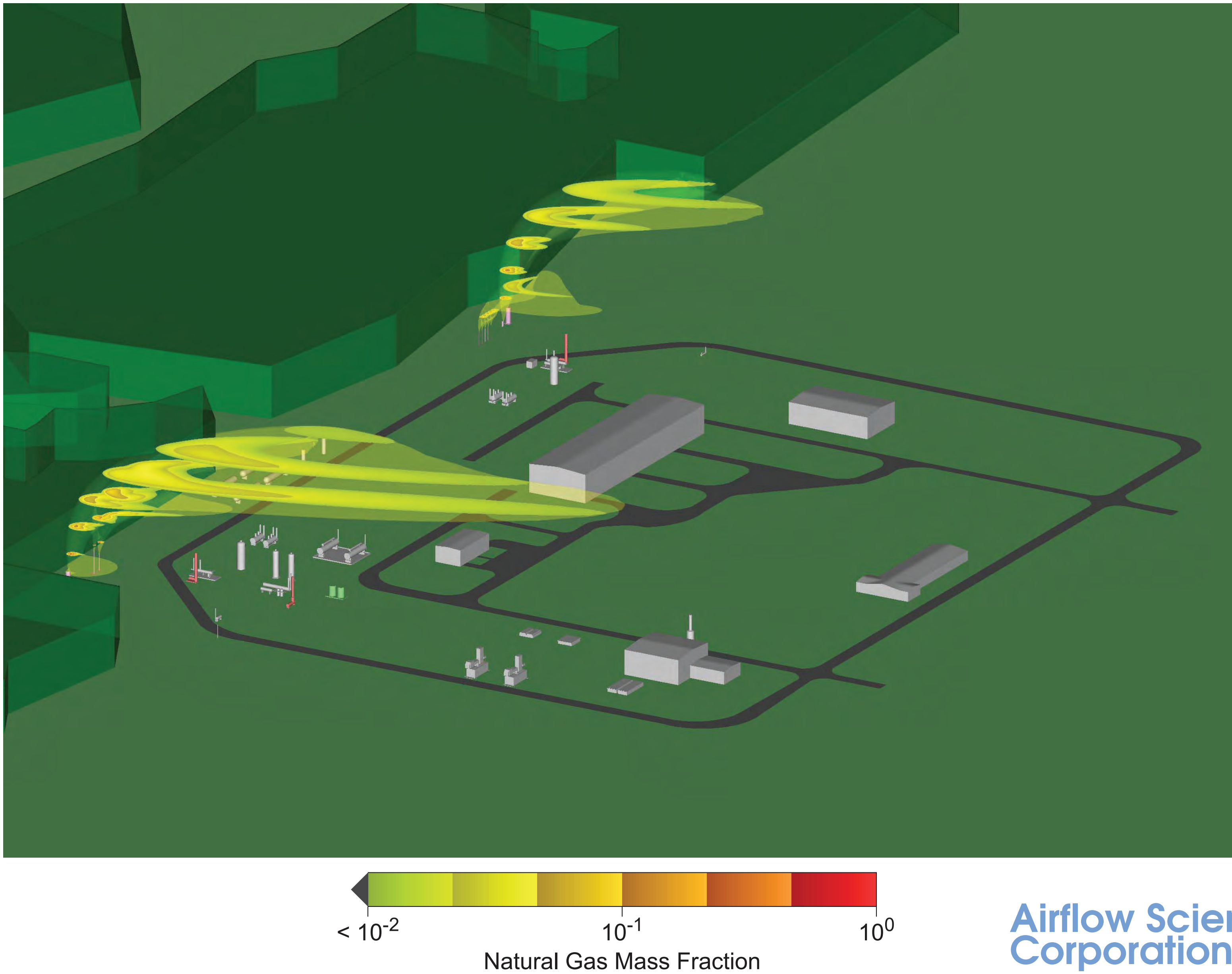


Airflow Sciences Corporation

Figure 79

Natural Gas Mass Fraction - SOW 2.1.1.3B

Isometric View - Looking North-West - Plant Site - Value > 10^{-2} - Every 40'

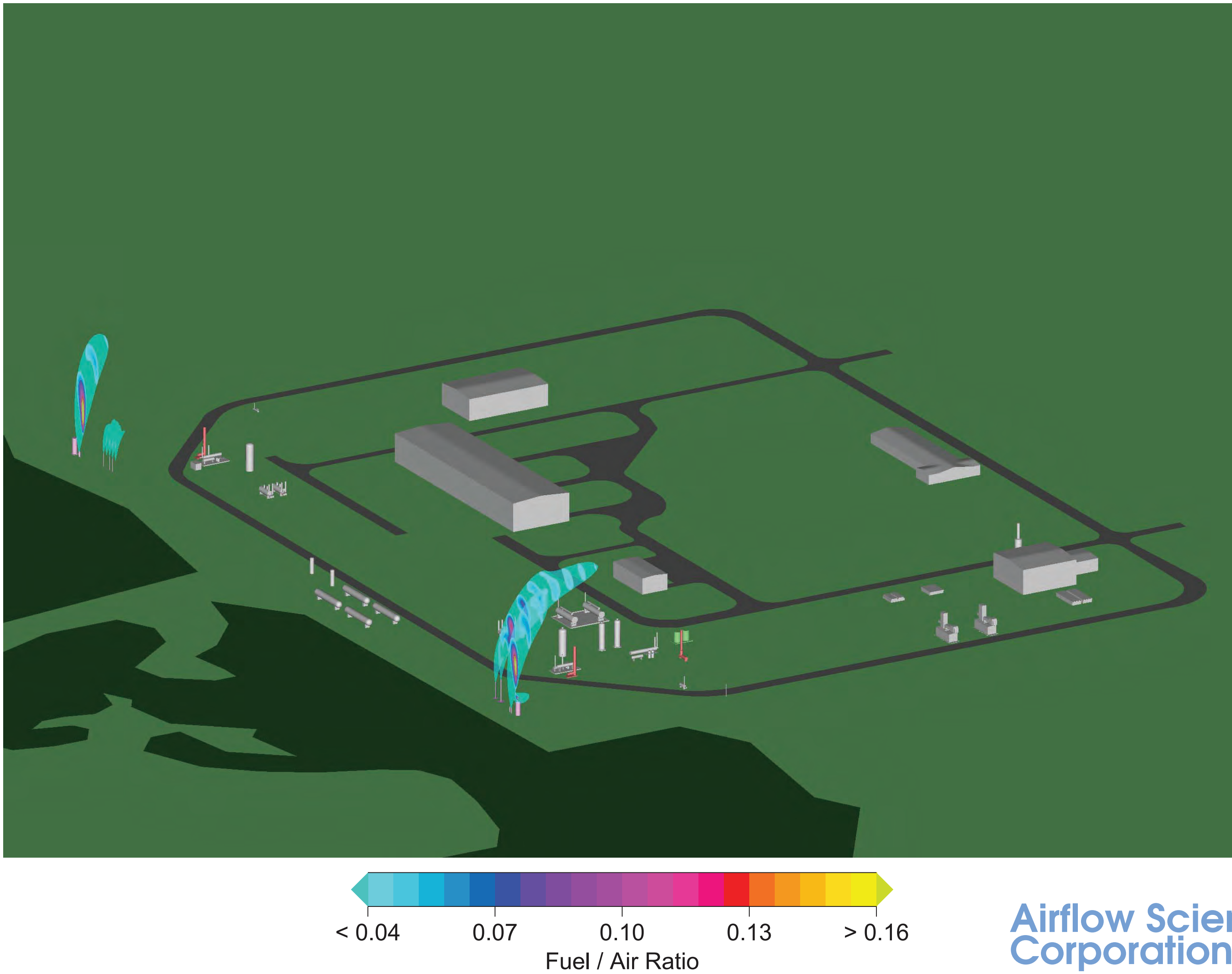


Airflow Sciences Corporation

Figure 80

Fuel / Air Ratio - SOW 2.1.1.3B

Isometric View - Looking North-East - Plant Site - Value > 4%

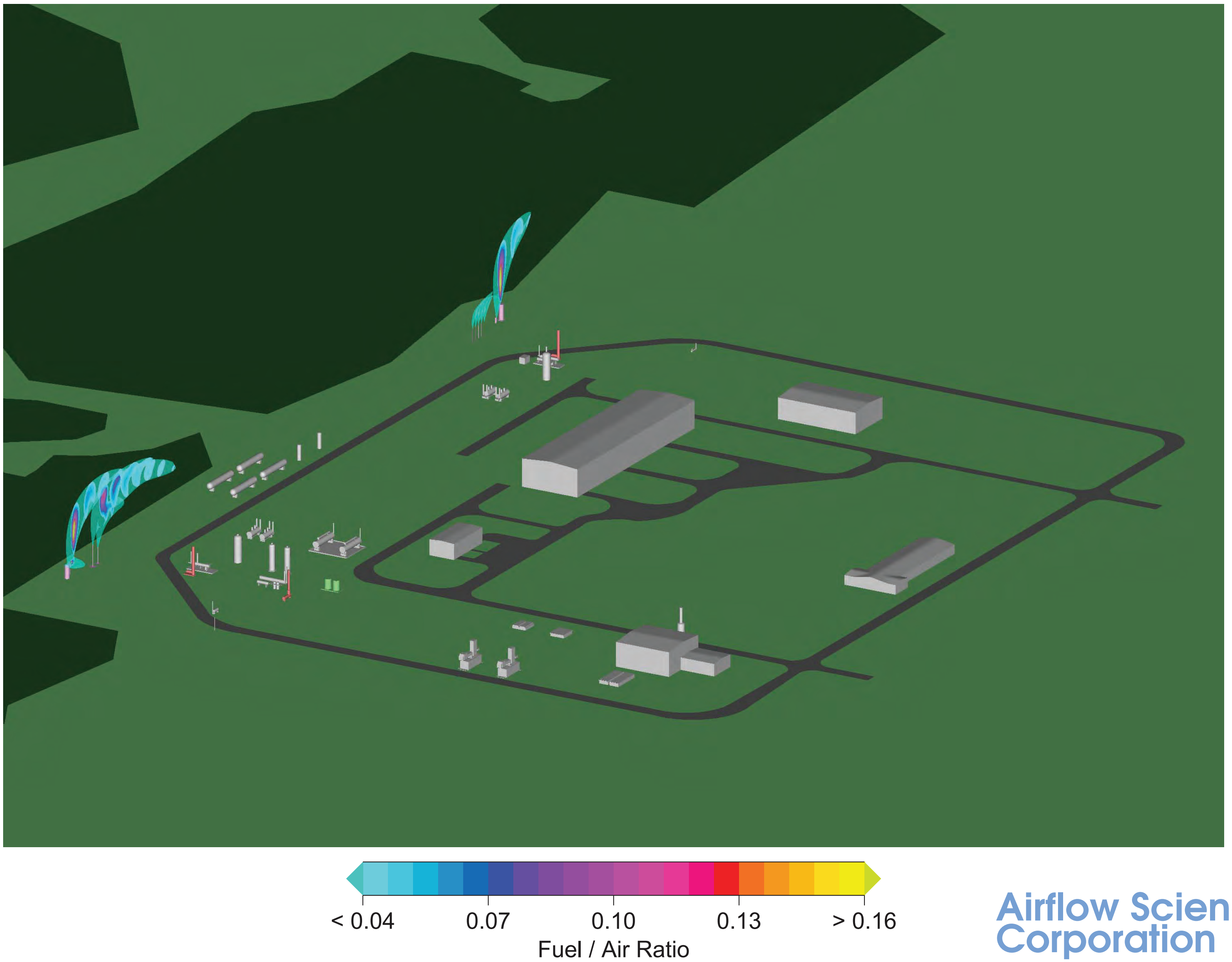


Airflow Sciences Corporation

Figure 81

Fuel / Air Ratio - SOW 2.1.1.3B

Isometric View - Looking North-West - Plant Site - Value > 4%



Airflow Sciences Corporation

Figure 82

Fuel / Air Ratio - SOW 2.1.1.3B

Isometric View - Looking North-East - South-West Corner of Plant - Value > 4%

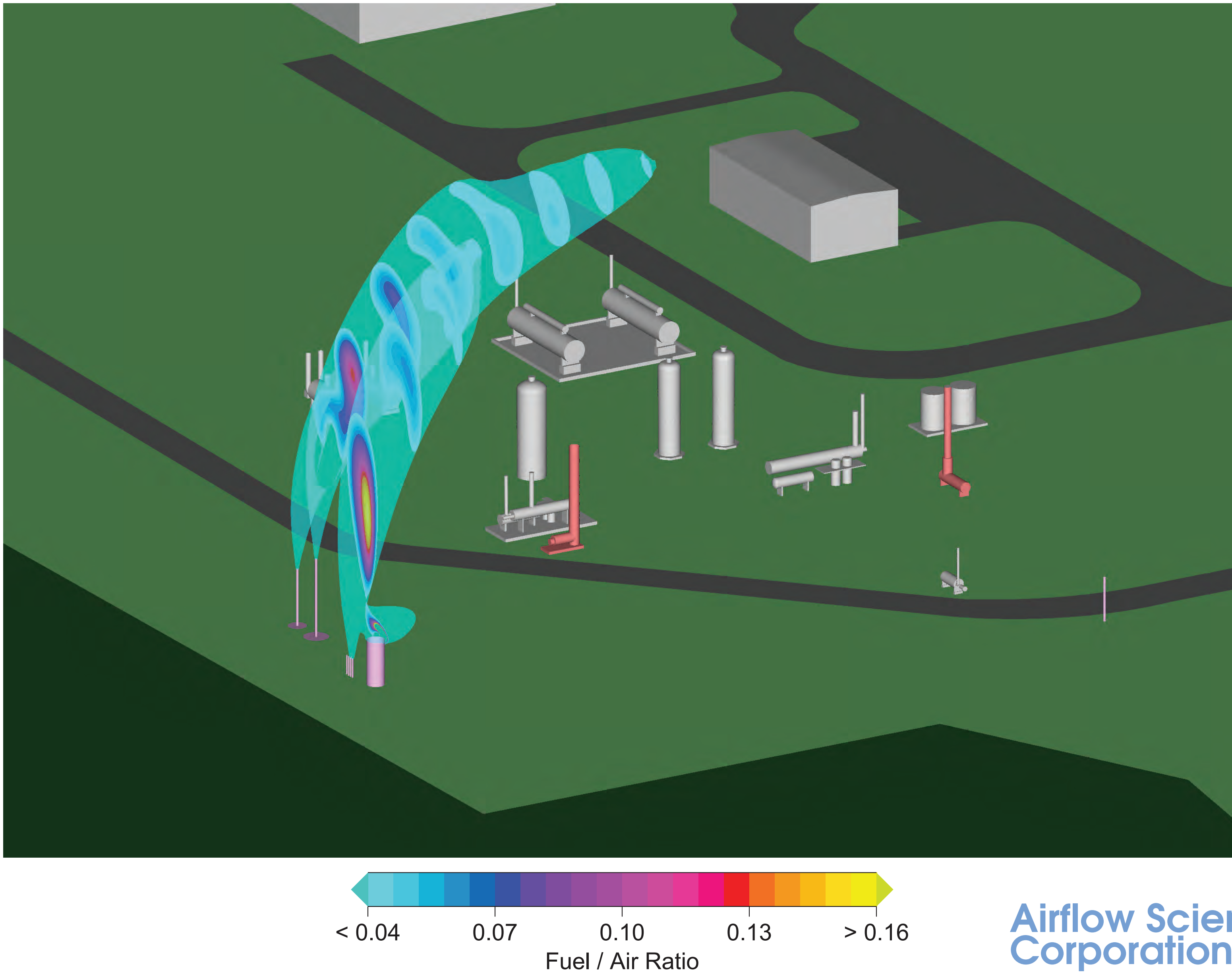
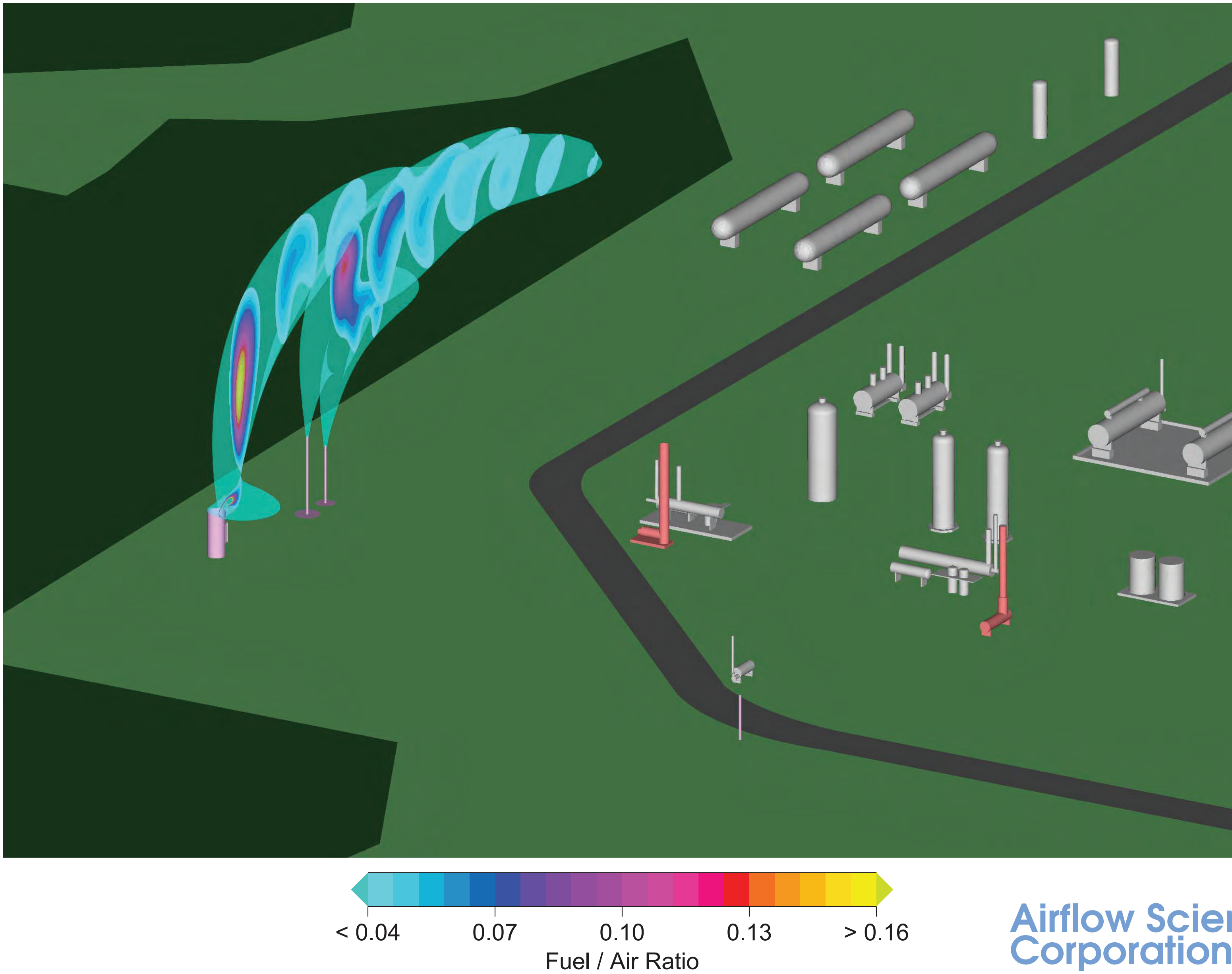


Figure 83

Fuel / Air Ratio - SOW 2.1.1.3B

Isometric View - Looking North-West - South-West Corner of Plant - Value > 4%



Airflow Sciences Corporation

Figure 84

Fuel / Air Ratio - SOW 2.1.1.3B

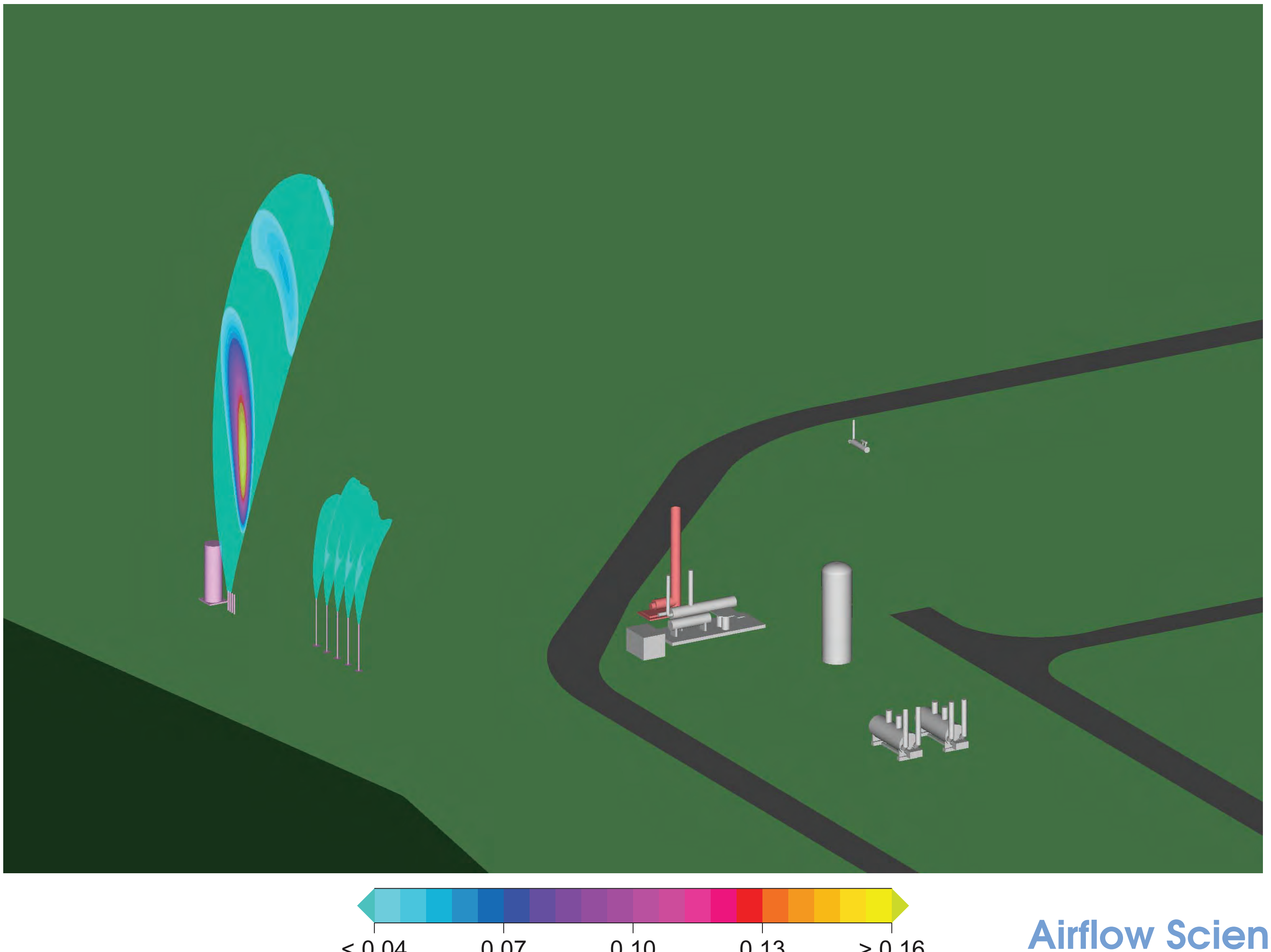
Top View - South-West Corner of Plant - Value > 4%

Airflow Sciences Corporation

Figure 85

Fuel / Air Ratio - SOW 2.1.1.3B

Isometric View - Looking North-East - North-West Corner of Plant - Value > 4%

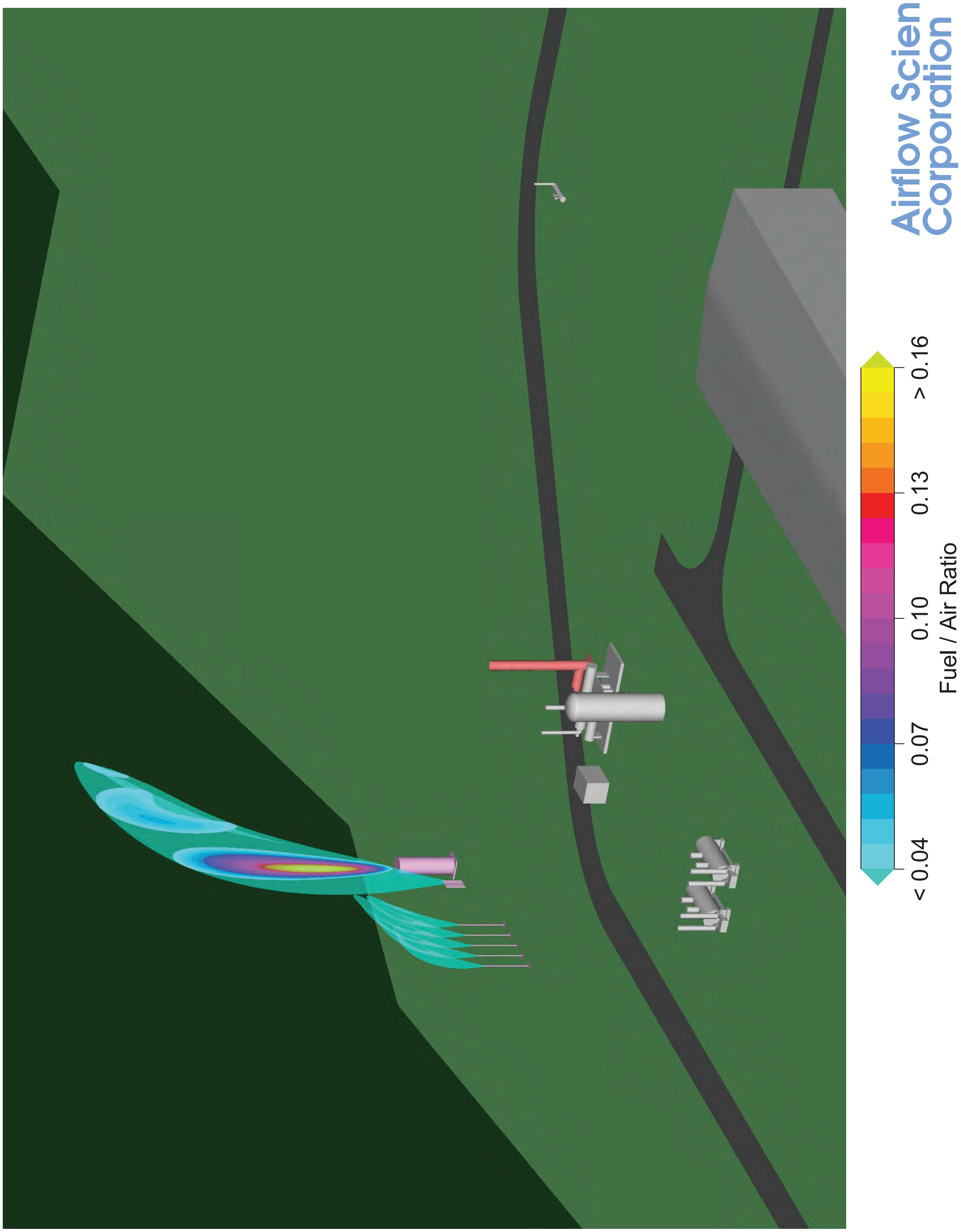


Airflow Sciences Corporation

Figure 86

Fuel / Air Ratio - SOW 2.1.1.3B

Isometric View - Looking North-West - North-West Corner of Plant - Value > 4%



Airflow Sciences Corporation

Figure 87

Fuel / Air Ratio - SOW 2.1.1.3B

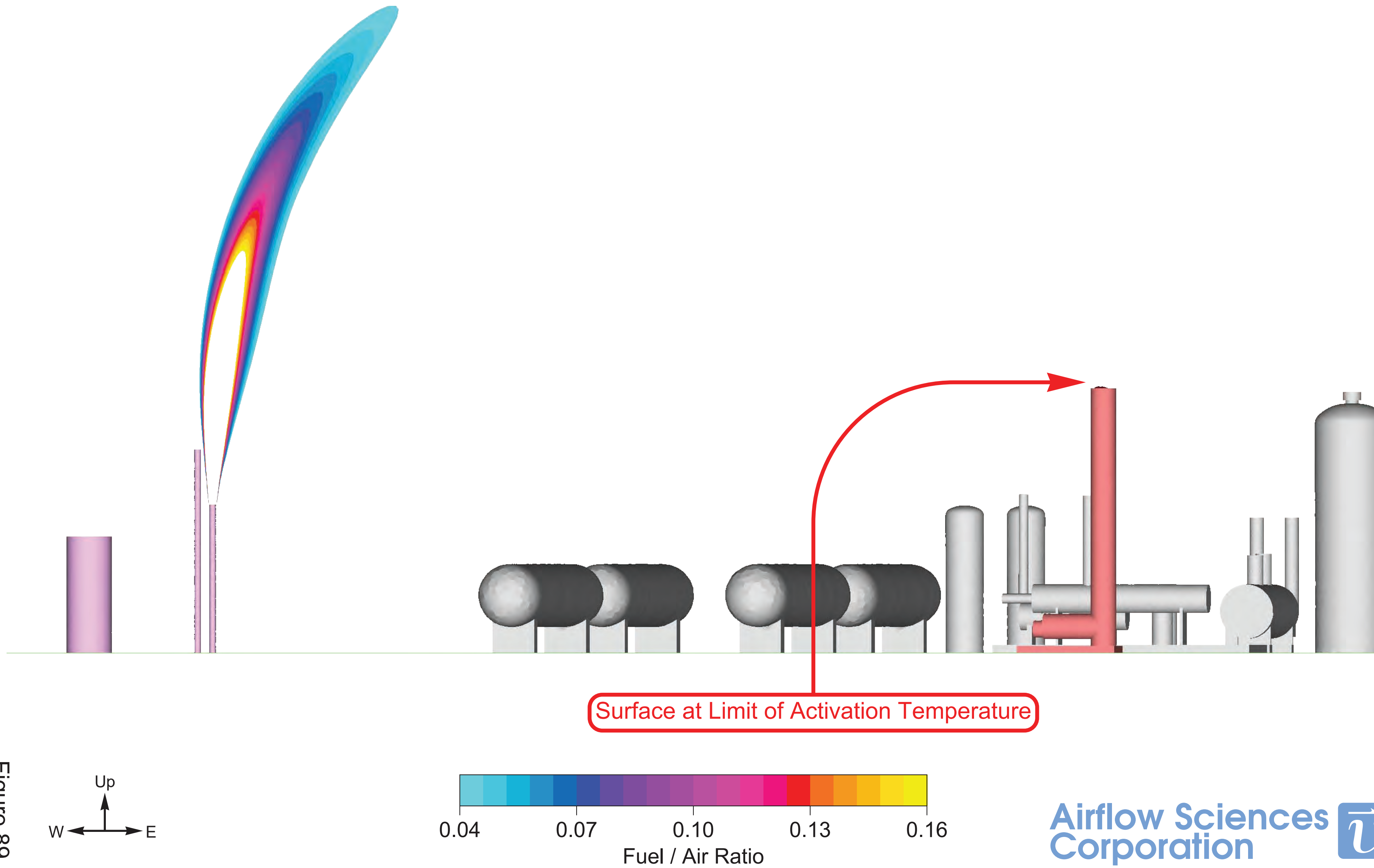
Top View - North-West Corner of Plant - Value > 4%

Airflow Sciences Corporation

Figure 88

Fuel / Air Ratio - SOW 2.1.1.3B

Side View - Through BDSL 3-1-7 & Thermal Oxidizer

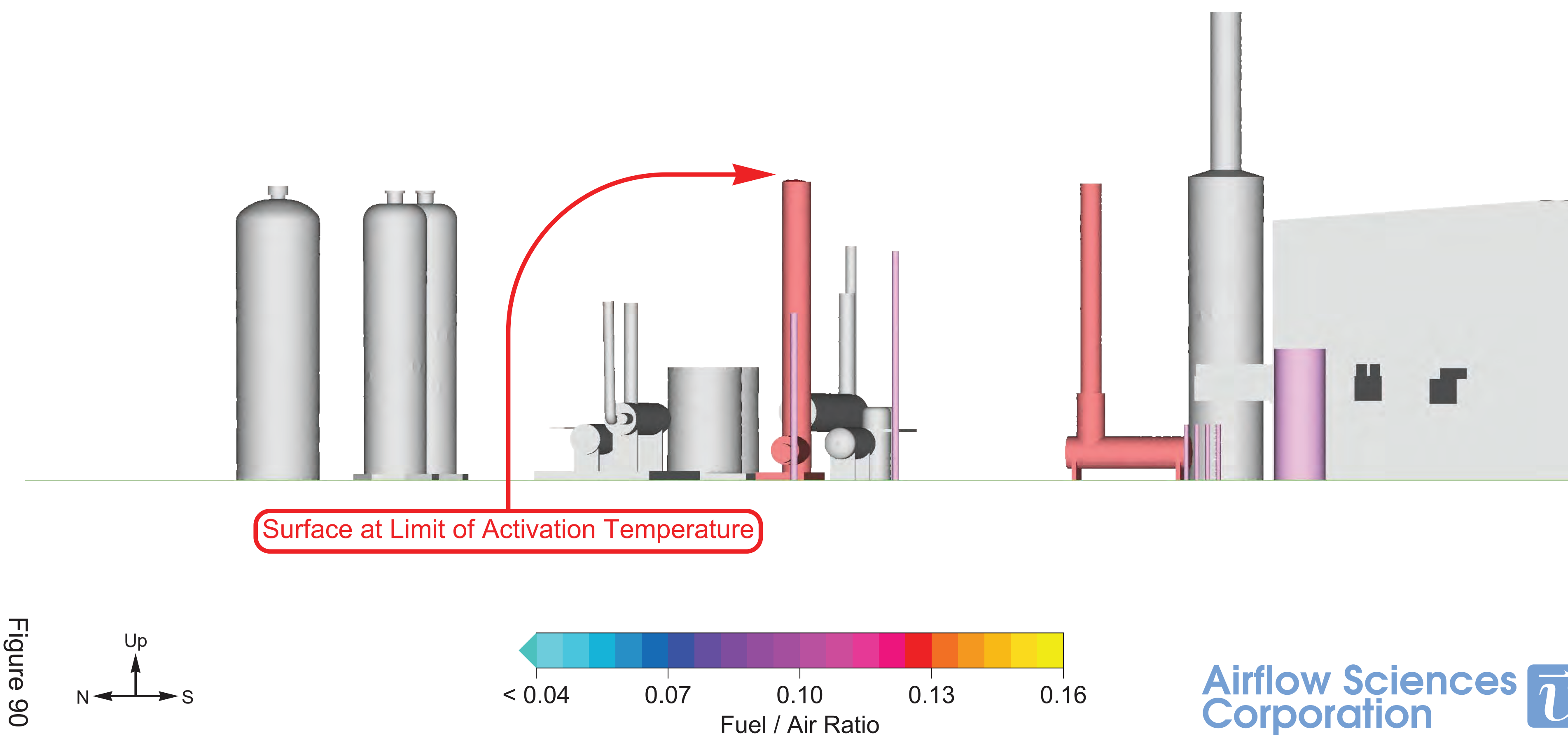


Airflow Sciences Corporation

Figure 89

Fuel / Air Ratio - SOW 2.1.1.3B

End View - Through BDSL 3-1-7 & Thermal Oxidizer

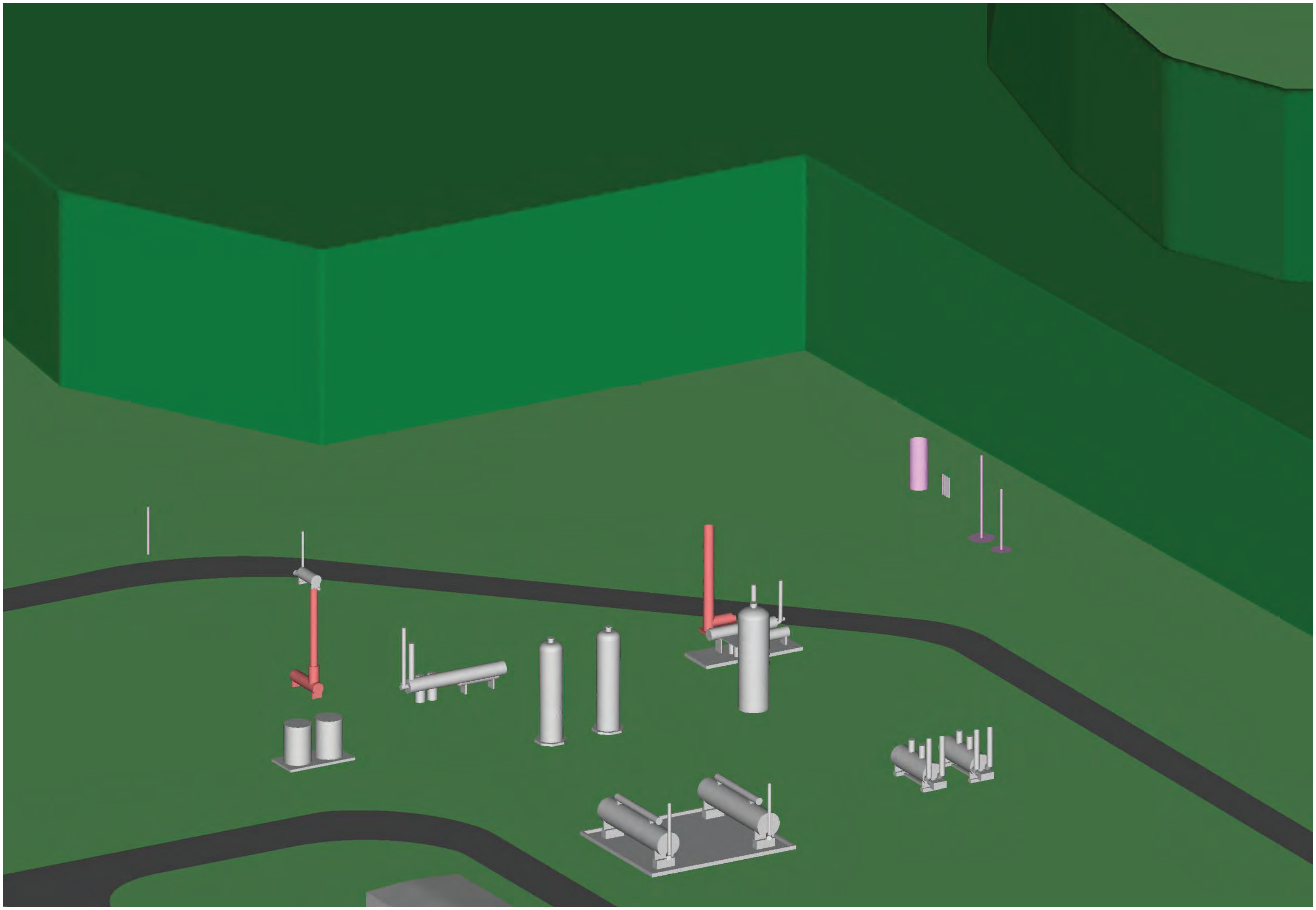


Airflow Sciences Corporation

Figure 90

Model Geometry

Isometric View - Looking South-West - South-West Corner of Plant

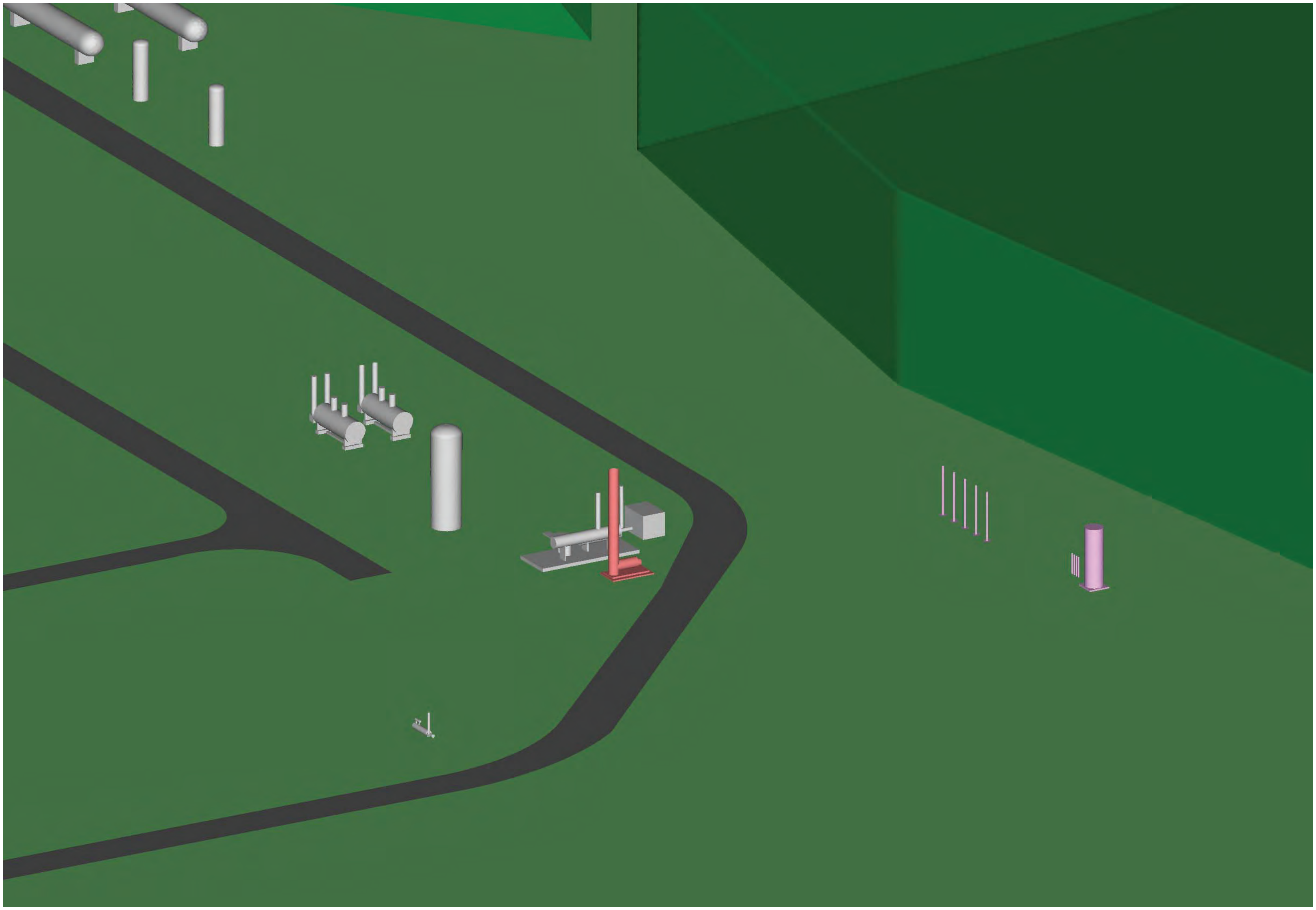


Airflow Sciences Corporation

Figure 91

Model Geometry

Isometric View - Looking South-West - North-West Corner of Plant

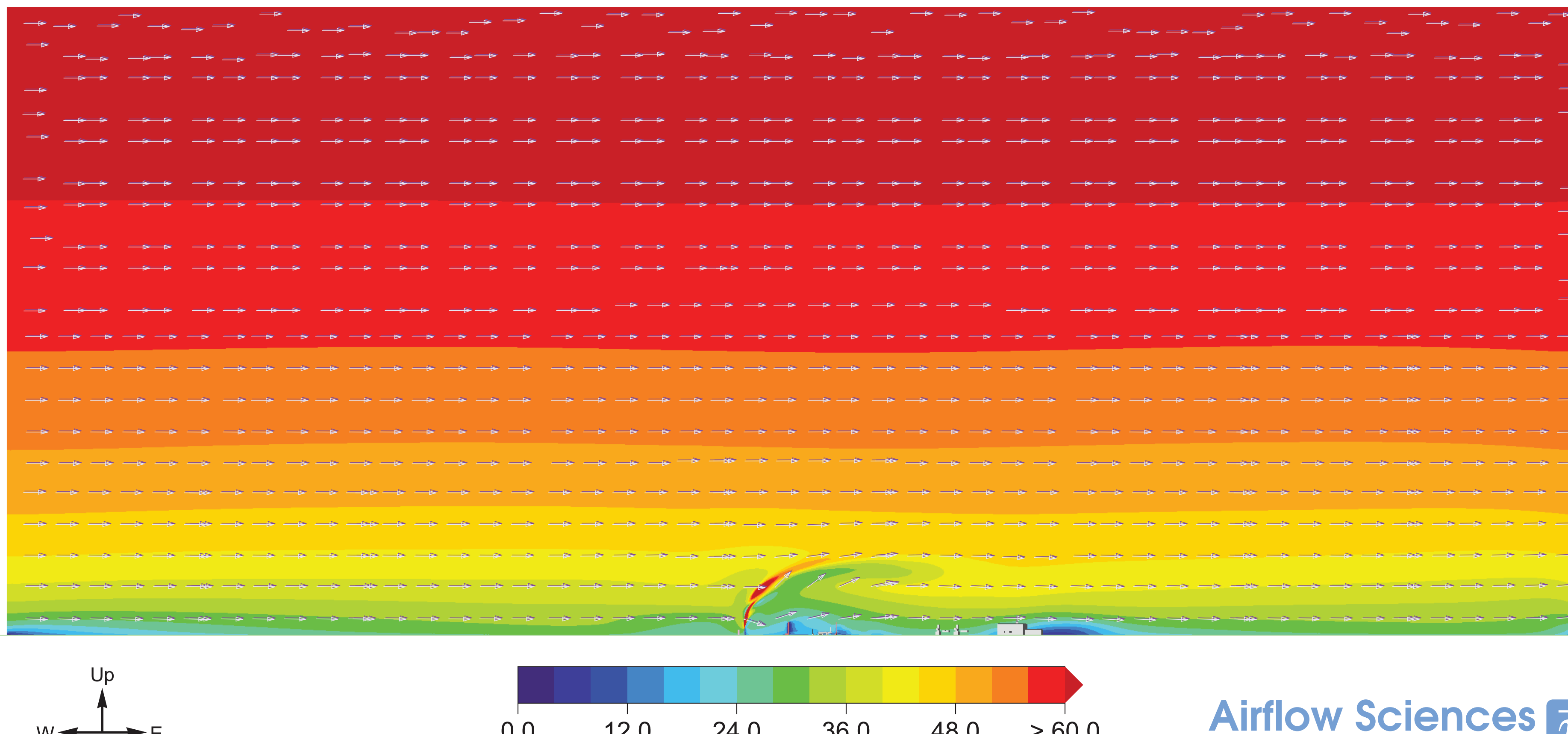


Airflow Sciences Corporation

Figure 92

Velocity - SOW 2.1.1.5A

Side View - Through BDSL 3-1-7 & Thermal Oxidizer

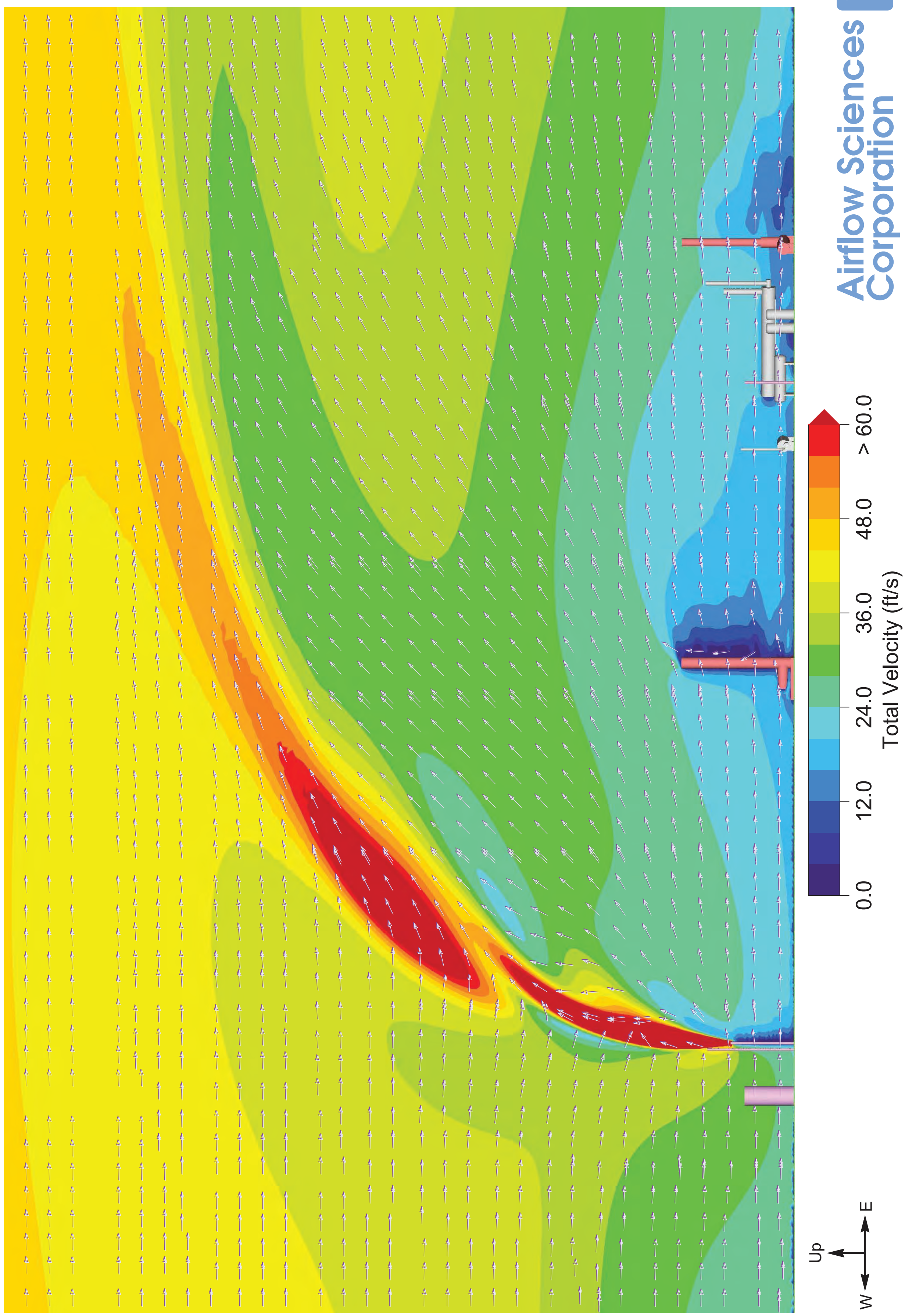


Airflow Sciences Corporation

Figure 93

Velocity - SOW 2.1.1.5A

Side View - Through BDSL 3-1-7 & Thermal Oxidizer

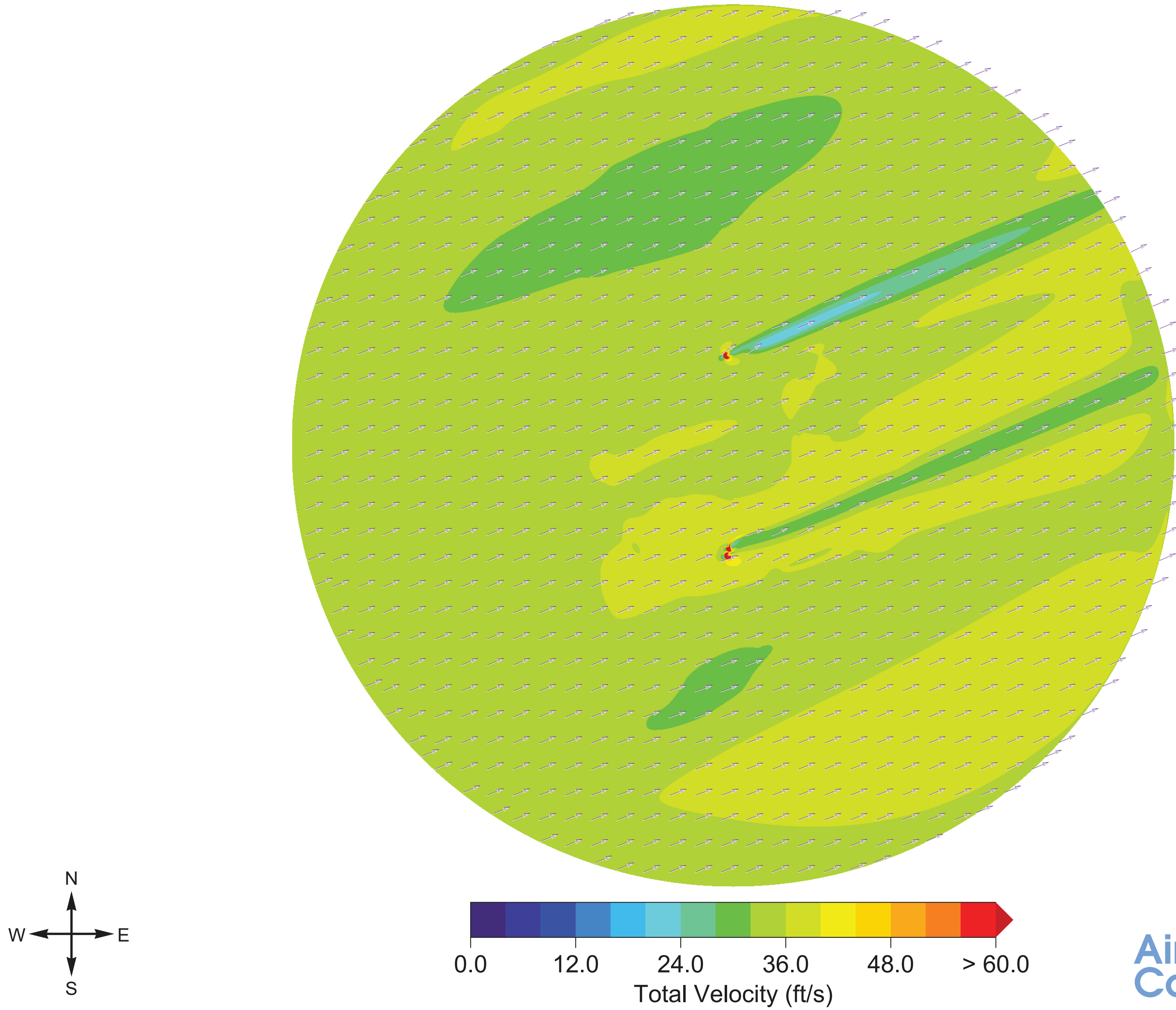


Airflow Sciences Corporation

Figure 94

Velocity - SOW 2.1.1.5A

Top View - Domain - 100' Above ground

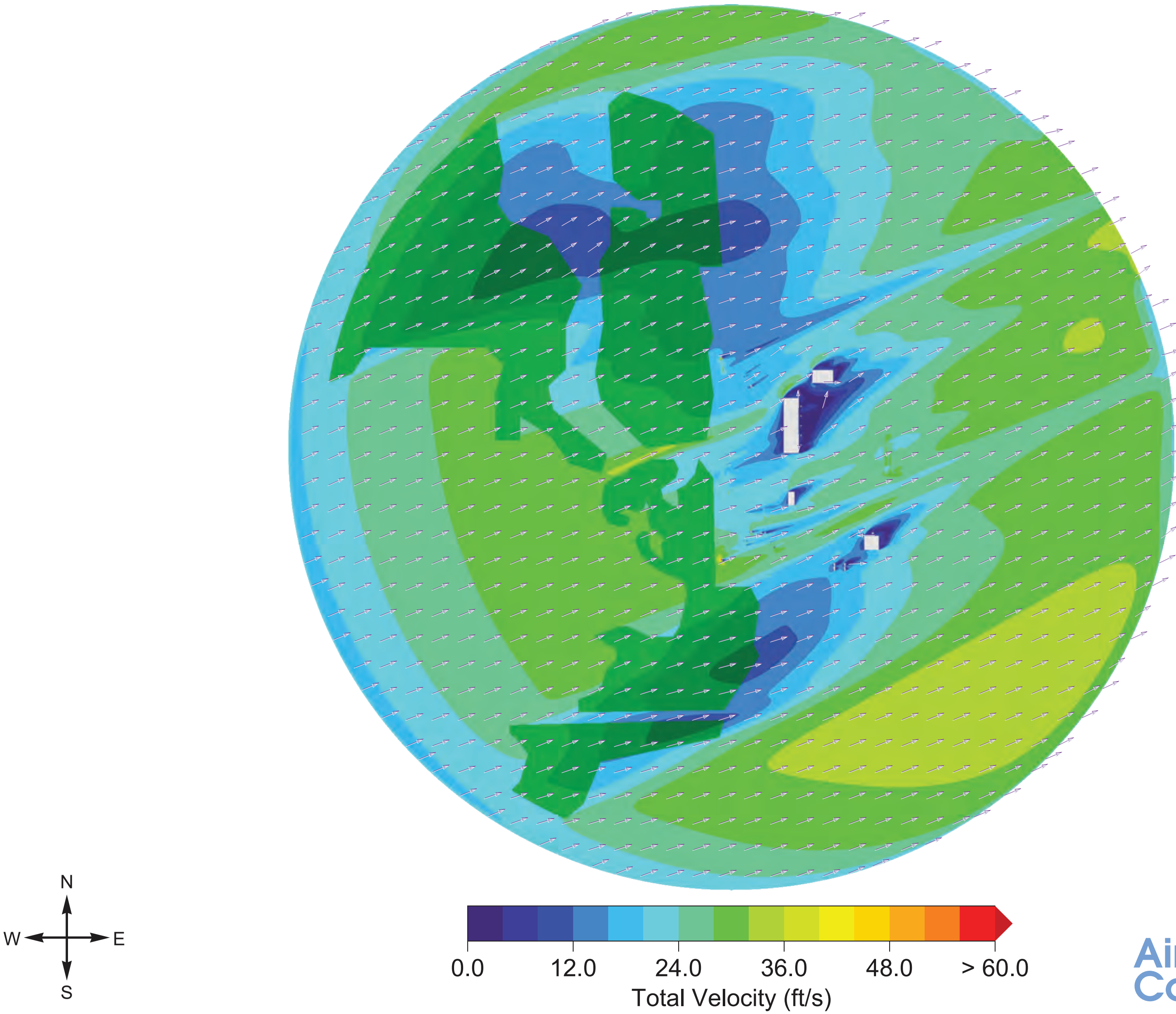


Airflow Sciences Corporation

Figure 95

Velocity - SOW 2.1.1.5A

Top View - Domain - 20' Above ground

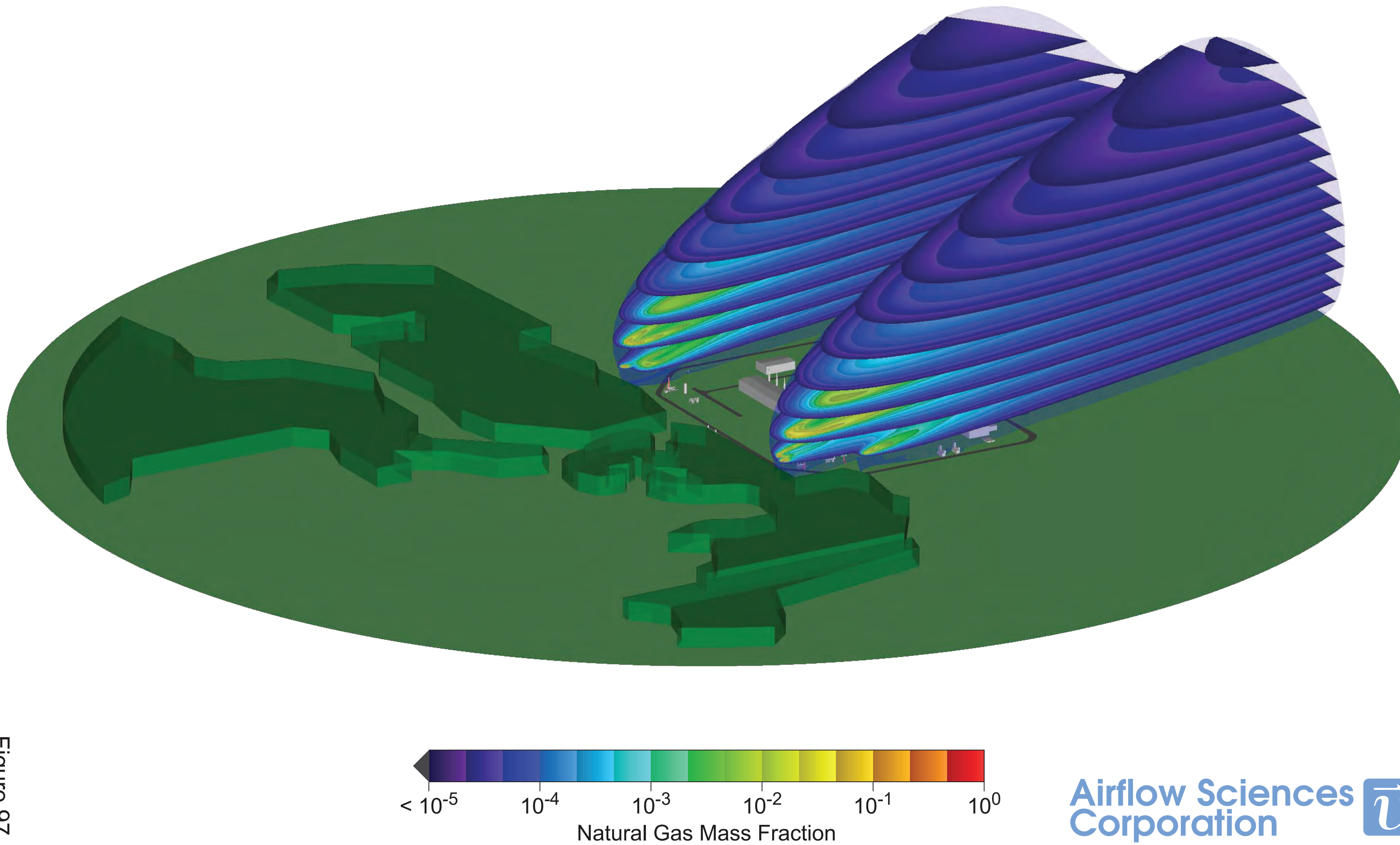


Airflow Sciences Corporation

Figure 96

Natural Gas Mass Fraction - SOW 2.1.1.5A

Isometric View - Looking North-East - Domain - Value > 10^{-5} - Every 80’



Airflow Sciences Corporation

Figure 97

Natural Gas Mass Fraction - SOW 2.1.1.5A

Isometric View - Looking North-East - Domain - Value > 10^{-5} - Ground & Building Surfaces

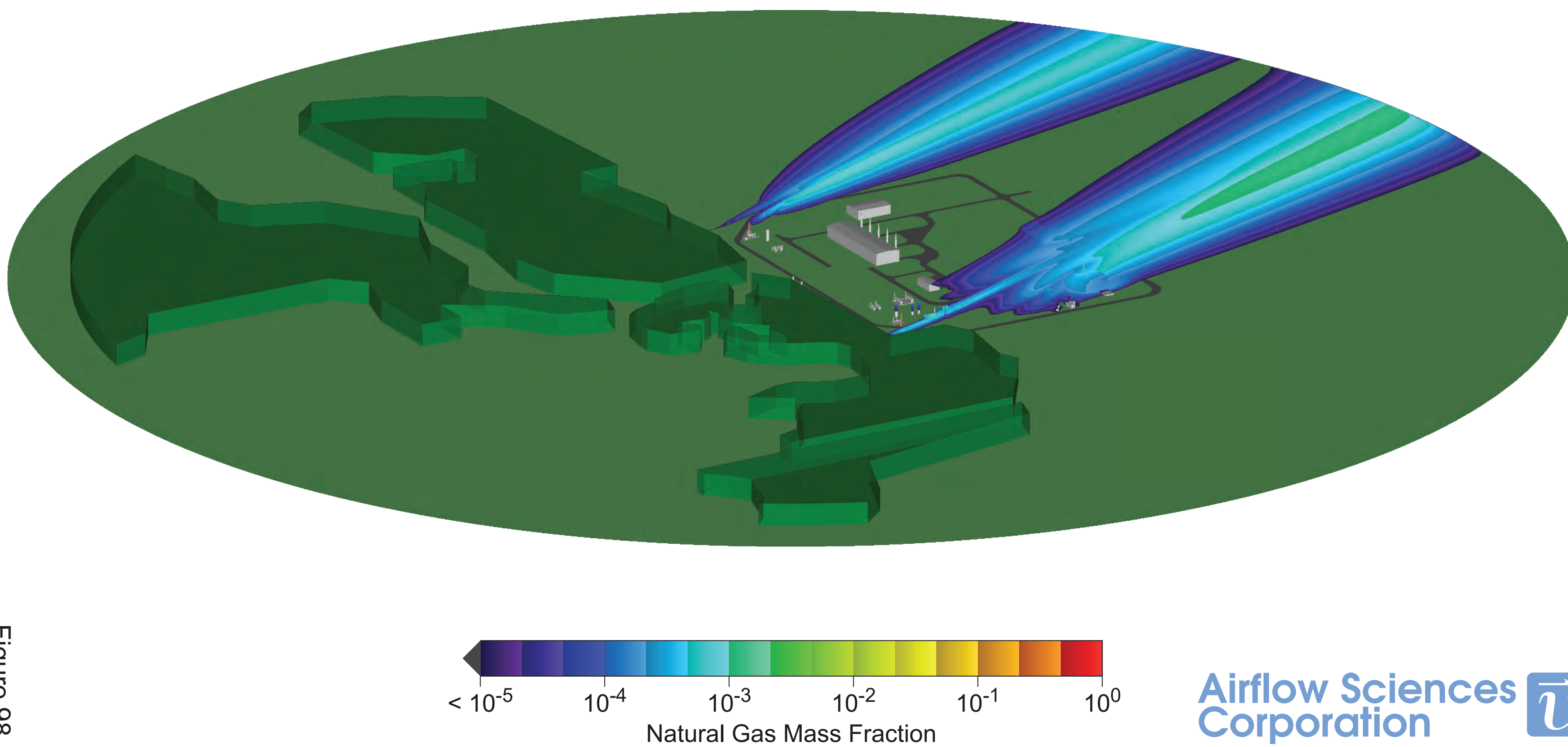
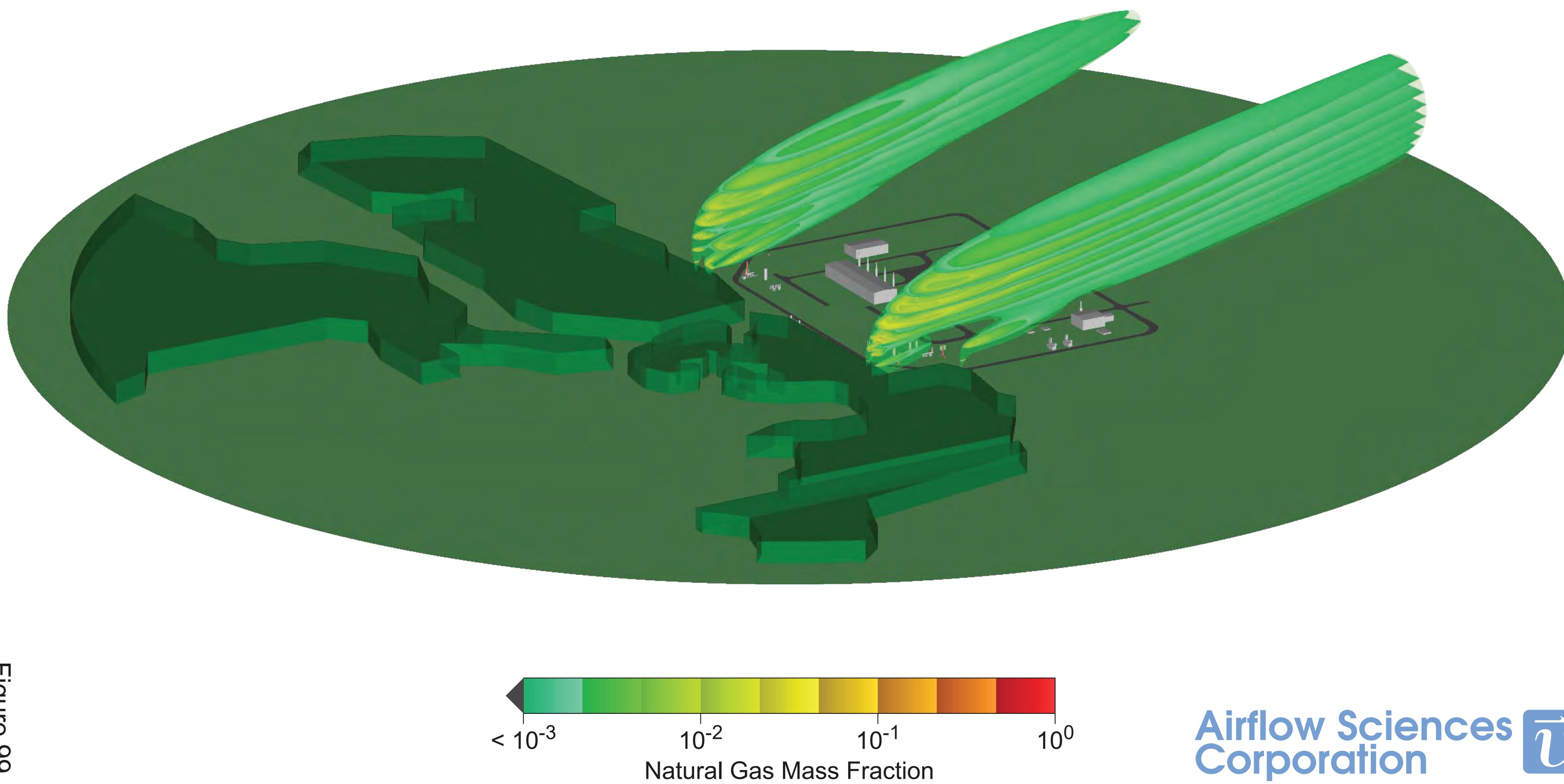


Figure 98

Natural Gas Mass Fraction - SOW 2.1.1.5A

Isometric View - Looking North-East - Domain - Value > 10^{-3} - Every 40'



Airflow Sciences Corporation

Figure 99

Natural Gas Mass Fraction - SOW 2.1.1.5A

Isometric View - Looking North-East - Domain - Value > 10^{-2} - Every 40'

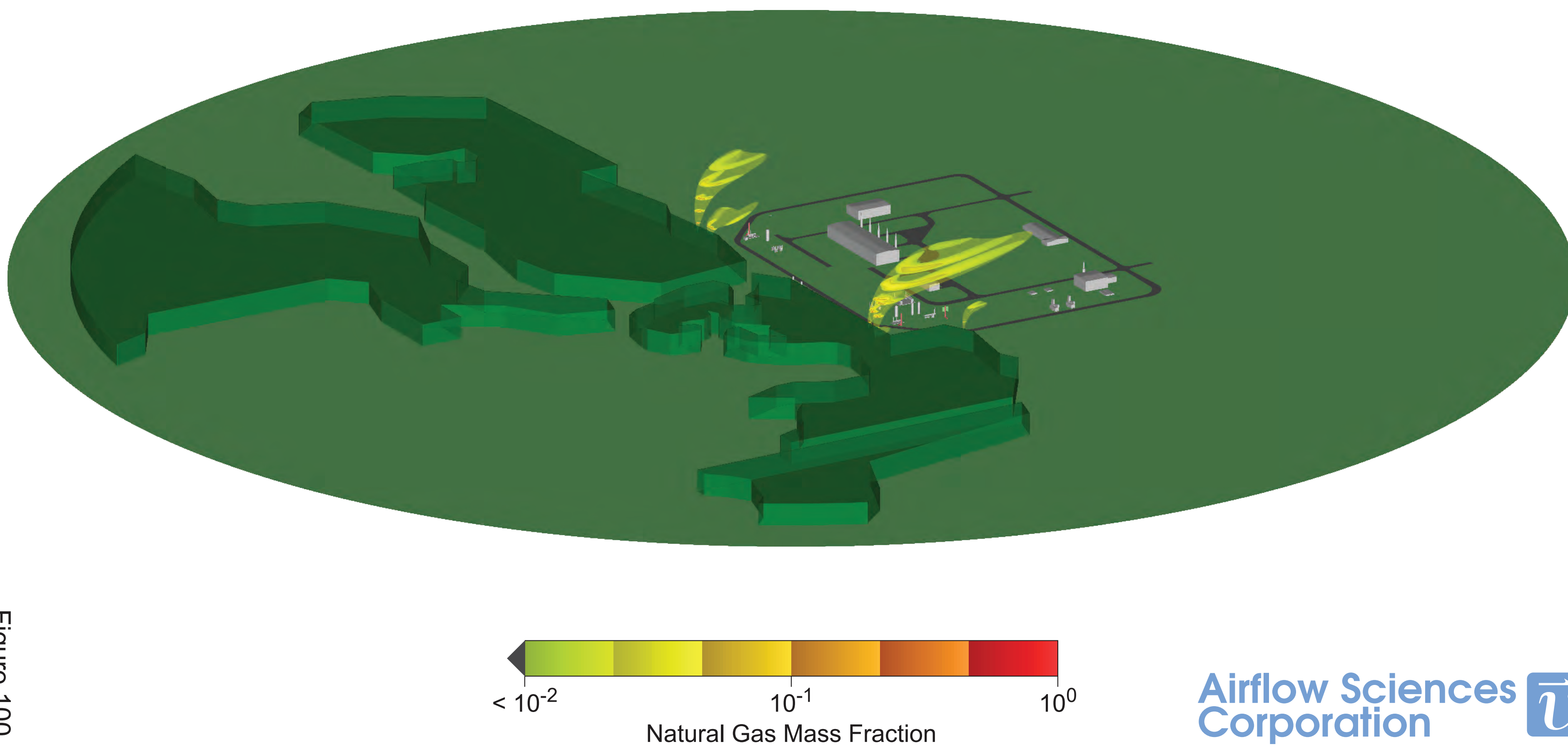


Figure 100

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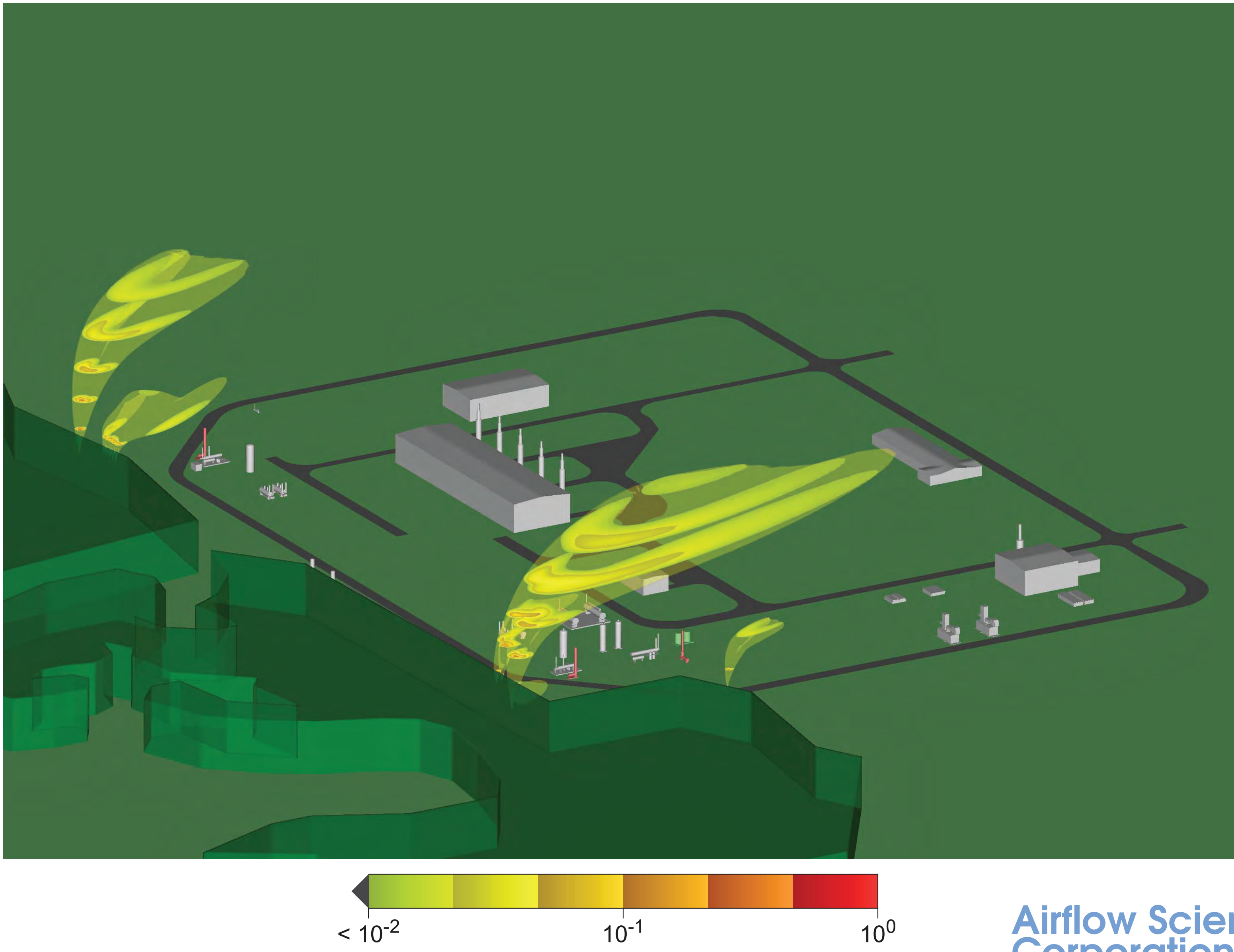
Natural Gas Mass Fraction - SOW 2.1.1.5A

Isometric View - Looking North-East - Plant Site - Value > 10^{-2} - Every 40'

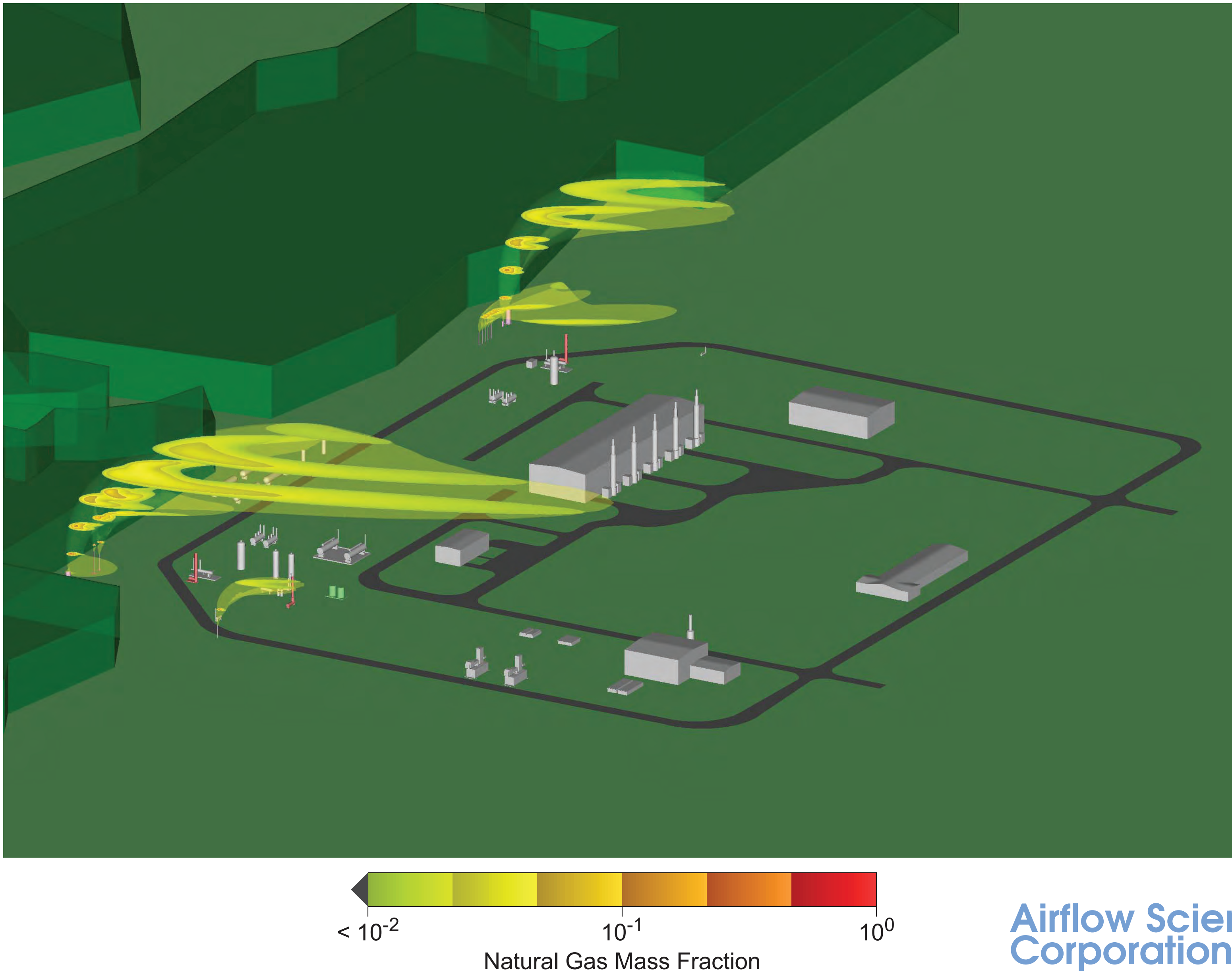


Airflow Sciences Corporation

Figure 101

Natural Gas Mass Fraction - SOW 2.1.1.5A

Isometric View - Looking North-West - Plant Site - Value > 10^{-2} - Every 40’

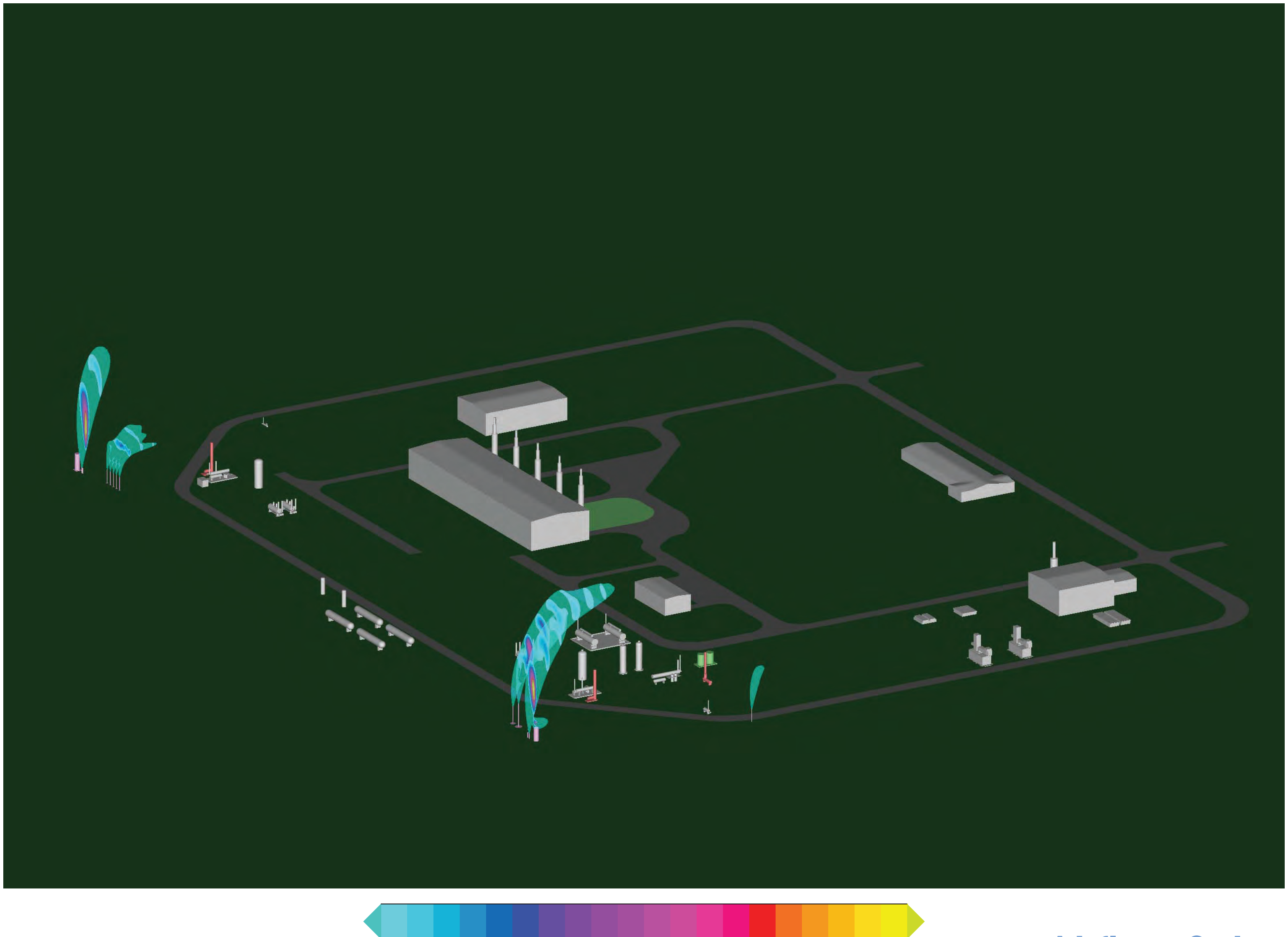


Airflow Sciences Corporation

Figure 102

Fuel / Air Ratio - SOW 2.1.1.5A

Isometric View - Looking North-East - Plant Site - Value > 4%

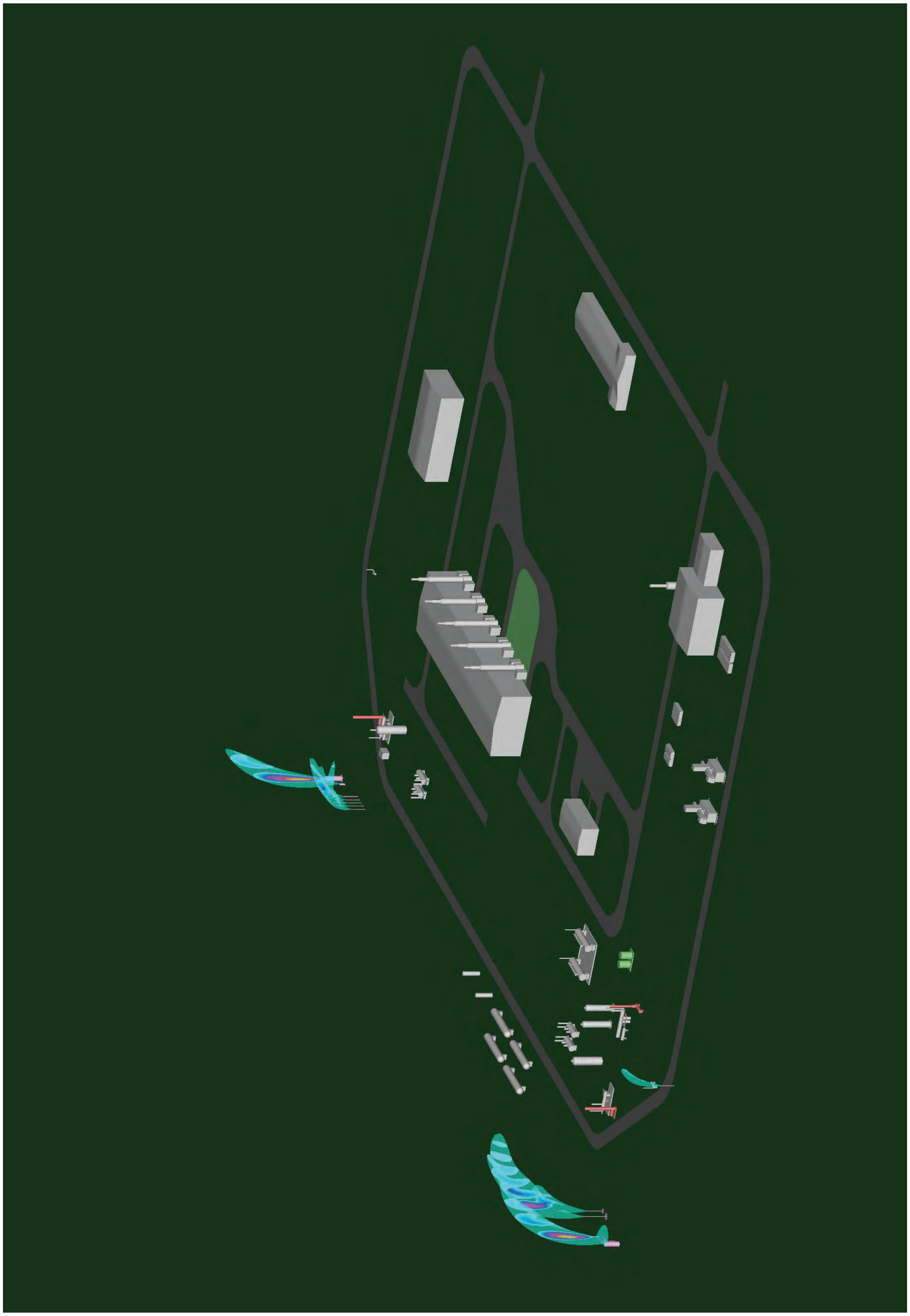


Airflow Sciences Corporation

Figure 103

Fuel / Air Ratio - SOW 2.1.1.5A

Isometric View - Looking North-West - Plant Site - Value > 4%



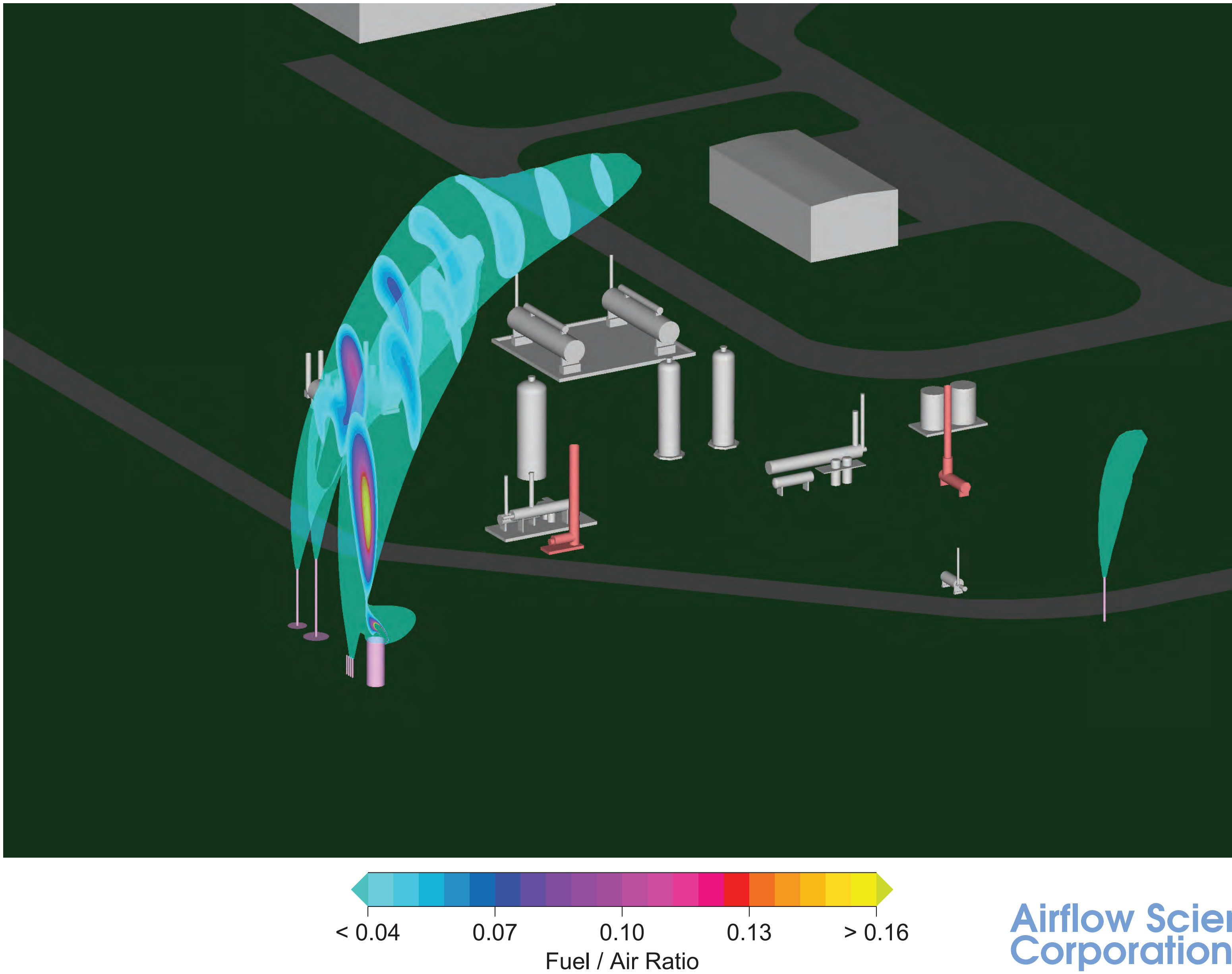
< 0.04
0.07
0.10
0.13
> 0.16
Fuel / Air Ratio

Airflow Sciences Corporation

Figure 104

Fuel / Air Ratio - SOW 2.1.1.5A

Isometric View - Looking North-East - South-West Corner of Plant - Value > 4%

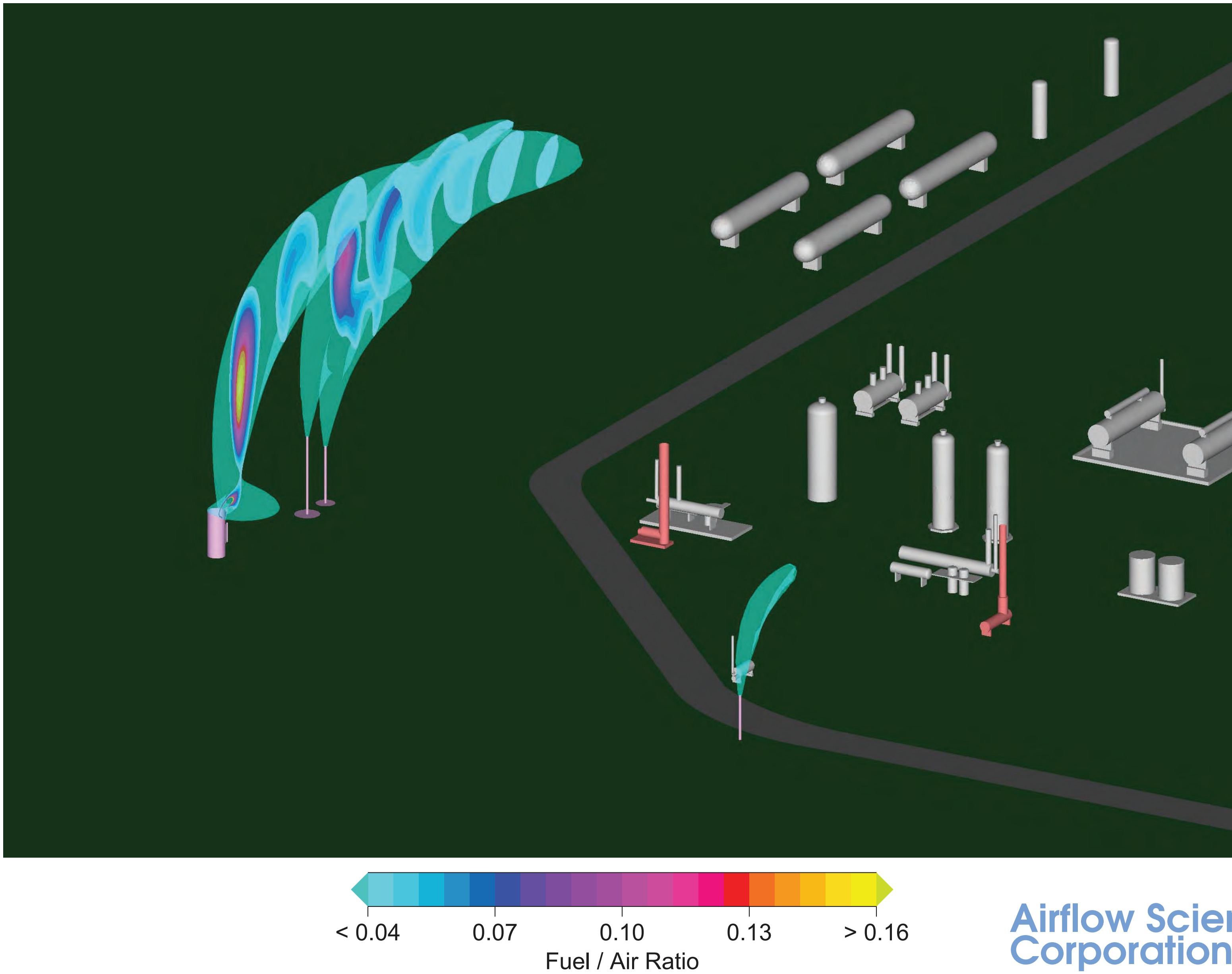


Airflow Sciences Corporation

Figure 105

Fuel / Air Ratio - SOW 2.1.1.5A

Isometric View - Looking North-West - South-West Corner of Plant - Value > 4%



Airflow Sciences Corporation

Figure 106

Fuel / Air Ratio - SOW 2.1.1.5A

Top View - South-West Corner of Plant - Value > 4%

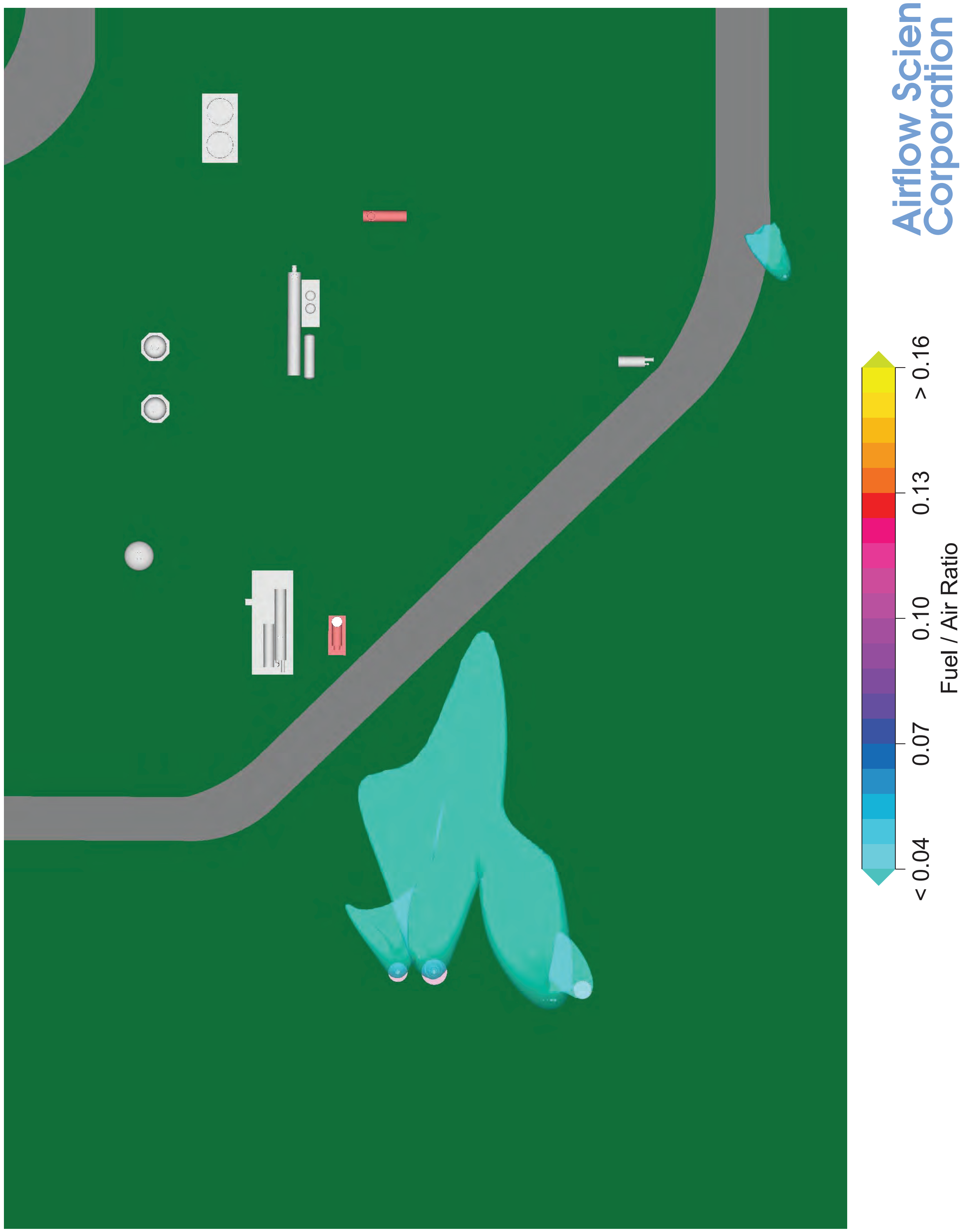
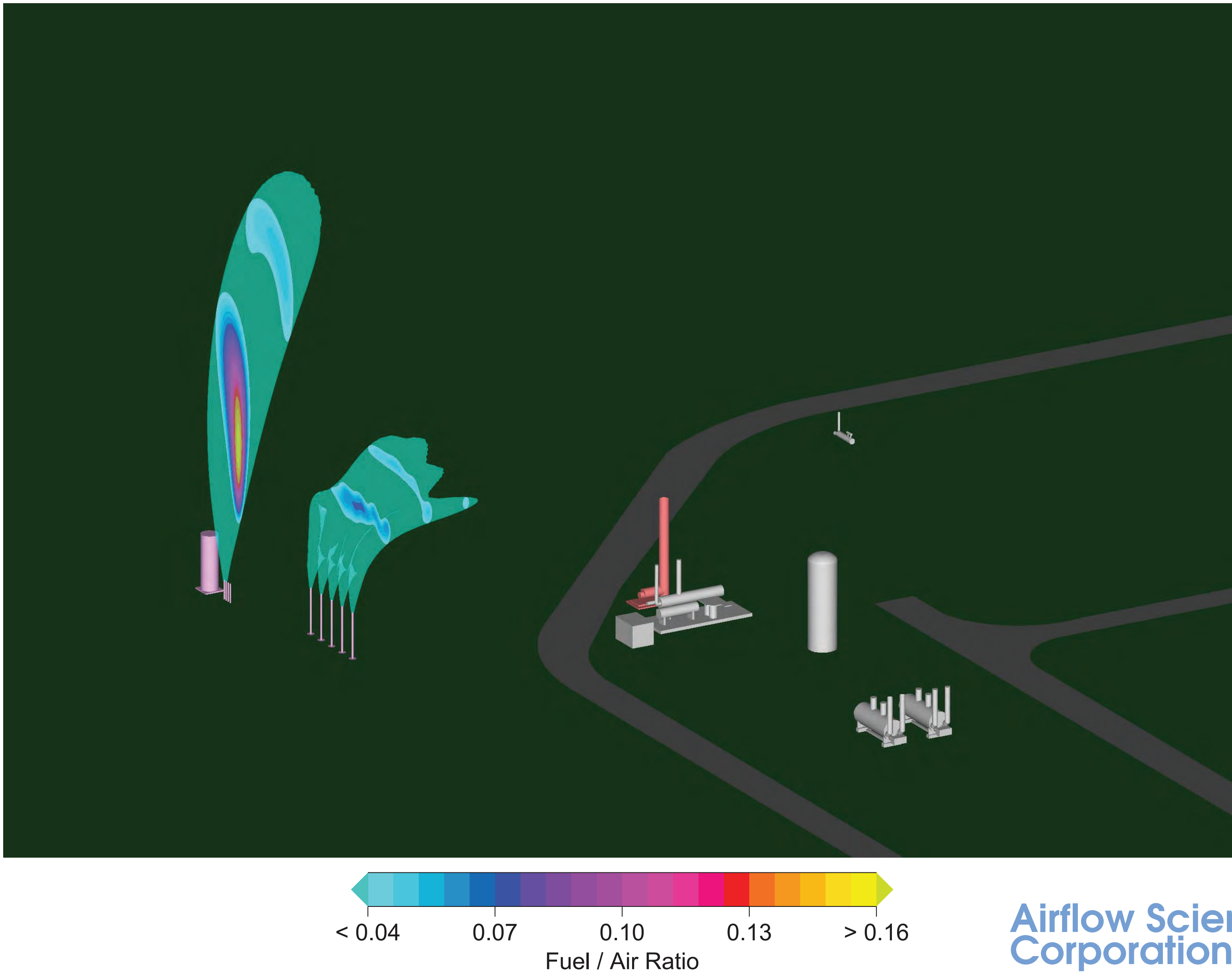


Figure 107

Fuel / Air Ratio - SOW 2.1.1.5A

Isometric View - Looking North-East - North-West Corner of Plant - Value > 4%

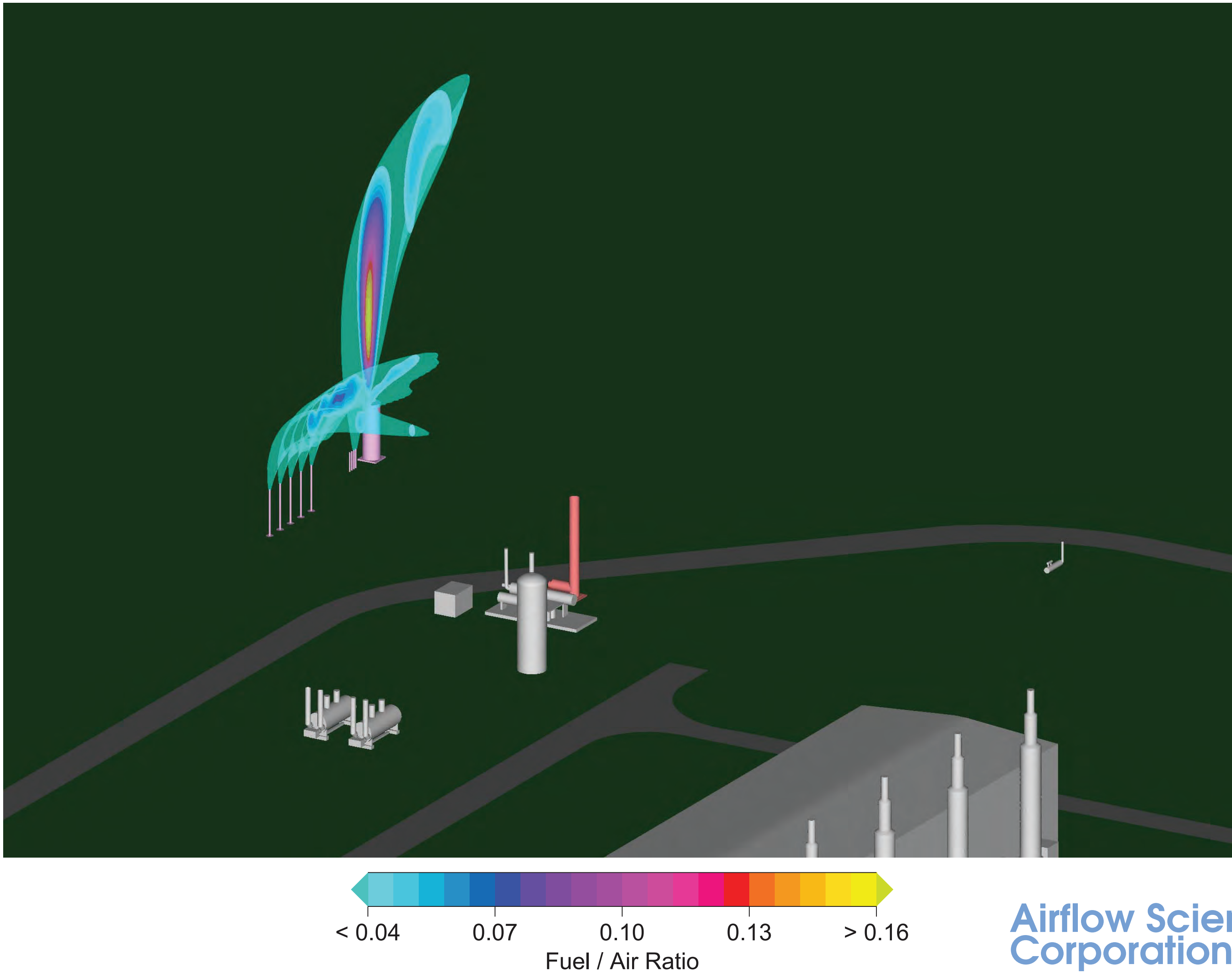


Airflow Sciences Corporation

Figure 108

Fuel / Air Ratio - SOW 2.1.1.5A

Isometric View - Looking North-West - North-West Corner of Plant - Value > 4%



Airflow Sciences Corporation

Figure 109

Fuel / Air Ratio - SOW 2.1.1.5A

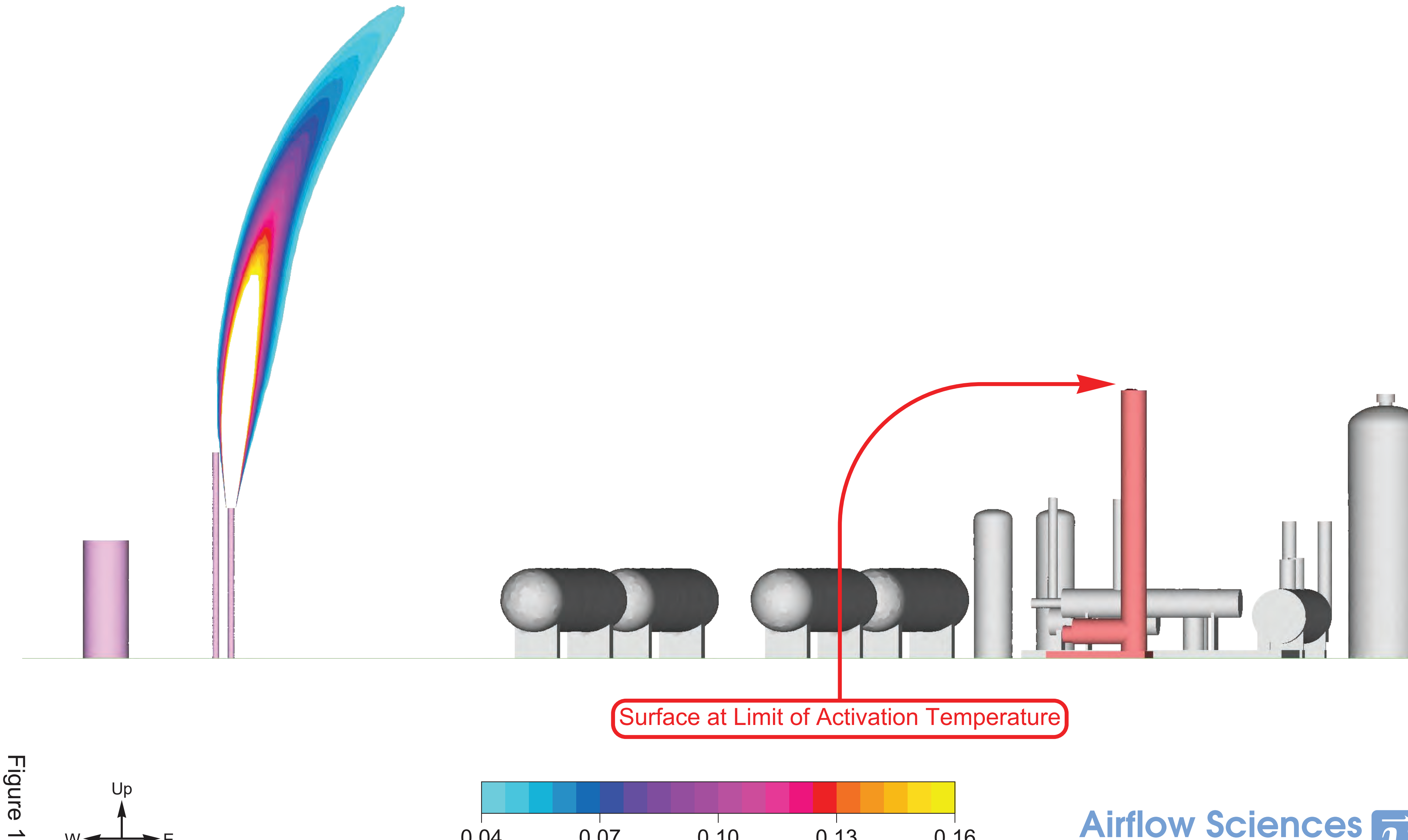
Top View - North-West Corner of Plant - Value > 4%

Airflow Sciences Corporation

Figure 110

Fuel / Air Ratio - SOW 2.1.1.5A

Side View - Through BDSL 3-1-7 & Thermal Oxidizer

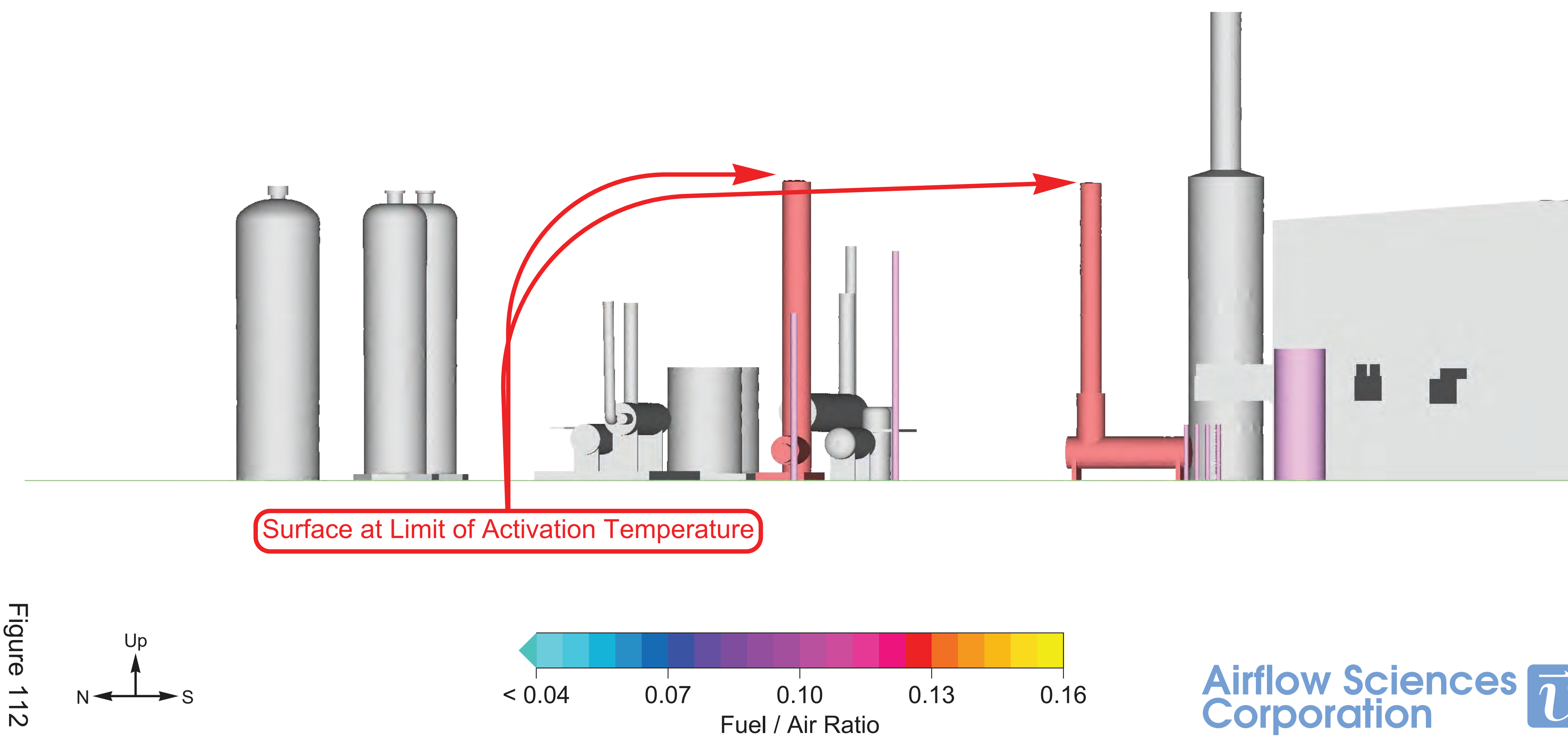


Airflow Sciences Corporation

Figure 111

Fuel / Air Ratio - SOW 2.1.1.5A

End View - Through BDSL 3-1-7 & Thermal Oxidizer

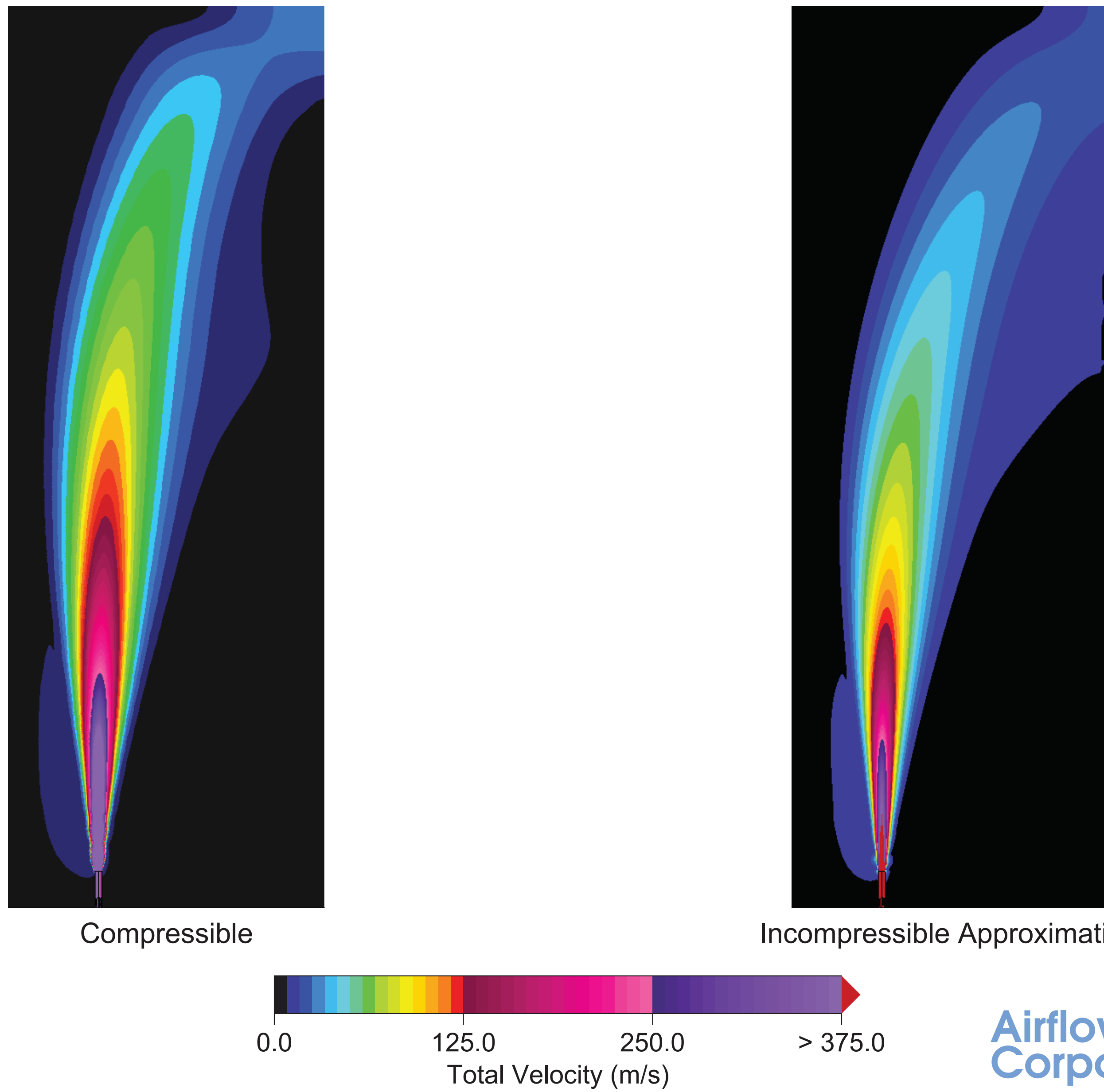


Airflow Sciences Corporation

Figure 112

Velocity - Compare Simulations

Jet from 8’’ Pipe - Side View - Centerline

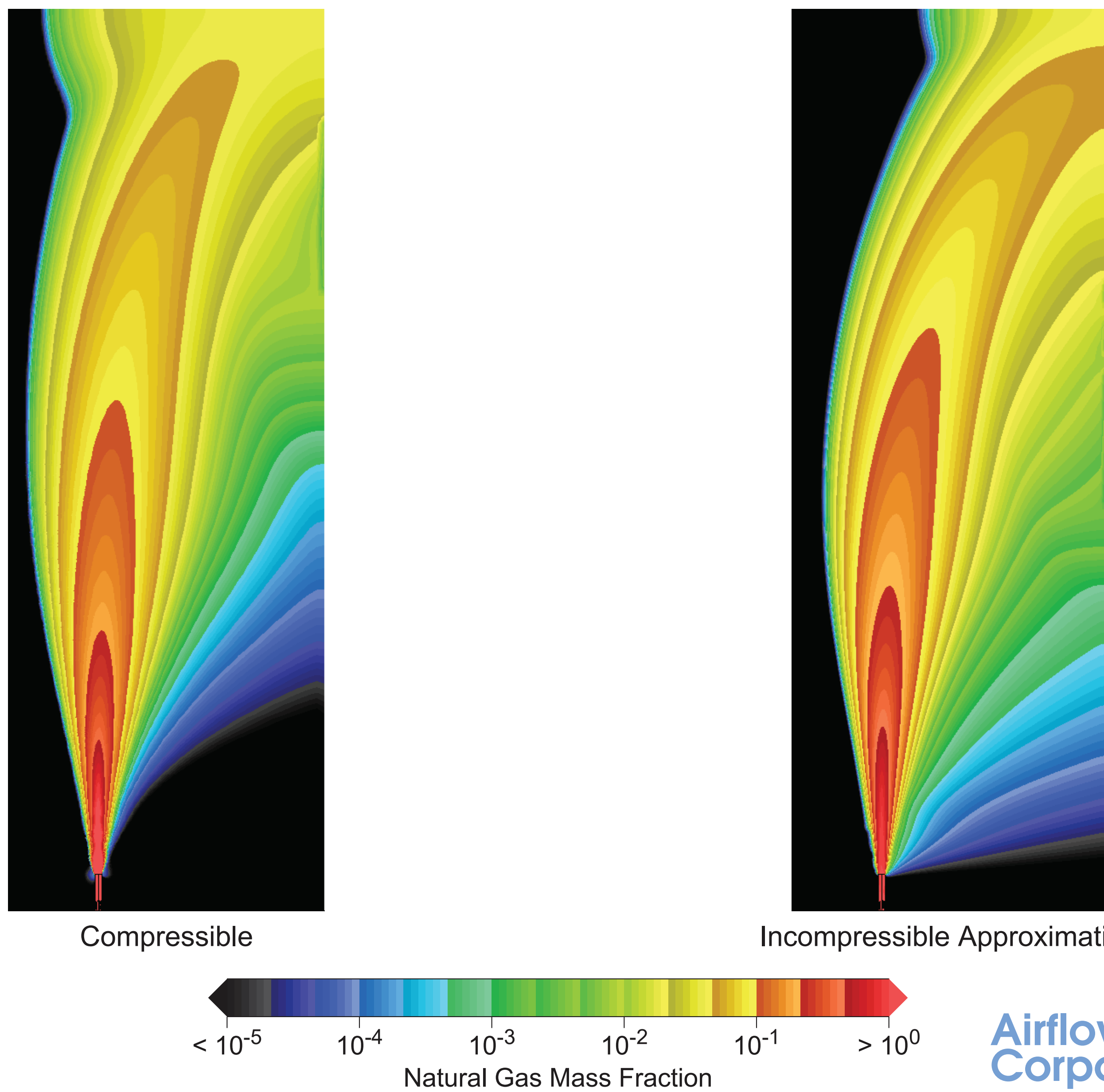


Airflow Sciences Corporation

Figure 113

Natural Gas Mass Fraction - Compare Simulations

Jet from 8" Pipe - Side View - Centerline



Airflow Sciences Corporation

Figure 114

APPENDIX 2 – BLOWDOWN EVALUATION MATRIX

						Risk Factor			Risk Analysis	
Station	Blowdown Type	Height	Competent Ignition Source	Distance from Blowdown (horizontal)	Ignition Source Height (vertical)	Is Blowdown Type the Same as Ray Event?	Is Ignitition Source within min. distance of Ray Dispersion Model Maximum plume (see Note)	Is Ignition Source higher than blowdown source from Ray?	Priority of Dispersion Modeling: 0 or 1 Risk Factor = Low 2 Risk Factors = Medium 3 Risk Factors = High	Single Point of Failure
Ray Plant 3	**Silencer**	**25'**	**P2 Thermal Oxidizer**	**135'**	**40'**	**Silencer**	**135'**	**+15'**	High	**Fire-gate Vent valve failure**
Muskegon River Plant 2	Straight Pipe	10'	Thermal Oxidizer	392'	35'-0"	No	No	Yes (+25')	Low	Fire-gate Vent valve failure
Northville	Silencer	~16'	Off-site Flare	341'	16'-6"	Yes	No	No	Low	Fire-gate Vent valve failure
St. Clair Plant 1	Straight Pipe	8'	P4 Thermal Oxidizer	718'	40'	No	No	Yes (+32')	Low	Fire-gate Vent valve failure
St. Clair Plant 1 Units	Silencer	22'6"	P4 Thermal Oxidizer	718'	40'	Yes	No	Yes (+18')	Medium*	Unit Vent valve failure
St. Clair Plant 2	Straight Pipe	8'	P4 Thermal Oxidizer	749'	40'	No	No	Yes (+32')	Low	Fire-gate Vent valve failure
St. Clair Plant 3	Silencer	10' to 16'	P4 Thermal Oxidizer	718'	40'	Yes	No	Yes (+30')	Medium*	Fire-gate Vent valve failure
St. Clair Plant 4	Silencer	12'	P4 Thermal Oxidizer	718'	40'	Yes	No	Yes (+28')	Medium*	Fire-gate Vent valve failure
White Pigeon Plant 1	Straight Pipe	15'	P3 Ancillary Building	416'	10'	No	No	No	Low	Fire-gate Vent valve failure
White Pigeon Plant 2	Straight Pipe	15'	P3 Ancillary Building	168'	10'	No	No	No	Low	Fire-gate Vent valve failure
White Pigeon Plant 3	Straight Pipe	10'	P3 Ancillary Building	152'	10'	No	No	No	Low	Fire-gate Vent valve failure
White Pigeon Plant 3 Units	Silencer	17'	P3 Aux Building	172'	10'	Yes	No	No	Low	Unit Vent valve failure
Overisel	Straight Pipe	15'	Gas analysis Building			No	No	N/a	Low	Fire-gate Vent valve failure
Freedom Plant 1	Straight Pipe	15'	Plant 2 Aux Building	300'	35'	No	No	Yes (+20')	Low	Fire-gate Vent valve failure
Freedom Plant 2	Straight Pipe	15'	Plant 1 Aux Building	300'	35'	No	No	Yes (+20')	Low	Fire-gate Vent valve failure
Huron	Silencer	13'	Aux Building	50'	9'	Yes	Yes	No	Medium	Vent Valve Failure

* Denotes the caveat to the Medium designations. While up to 2 risk factors were identified, the source to ignition point is nearly 6X the distance from the Ray event. Making this unlikely. Additionally, as each blowdown silencer at White Pigeon 3 and St. Clair Plants 3, and 4 were installed less than 10 years ago, these two facilities were elected to be evaluated first based on lack of operating history.

Note:

Distance from Blowdown: Greater than Ray (135') dispersion modeling indicated safe distance

Ignition Source: Dispersion modeling demonstrates that ignition source needs to be higher than blowdown to be a competent ignition source as plume is directed upwards

Ignition Source within min. distance Maximum plume examples:

- Unit silencer <153'
- Station Silencer <250'

A CMS Energy Company

General Offices:
One Energy Plaza Tel: (517) 788-0550
Jackson, MI 49201 Fax: (517) 768-3644

*Washington Office:
1730 Rhode Island Ave. N.W. Tel: (202) 778-3340
Suite 1007
Washington, DC 20036 Fax: (202) 778-3355

Writer's Direct Dial Number: (517) 788-0835
Writer's E-mail Address: bret.totoraitis@cmsenergy.com

LEGAL DEPARTMENT
SHAUN M. JOHNSON
Senior Vice President
and General Counsel

MELISSA M. GLEESPEN
Vice President, Corporate
Secretary and Chief
Compliance Officer

KELLY M. HALL
Vice President and Deputy
General Counsel

Eric V. Luoma
Adam C. Smith
Bret A. Totoraitis
Assistant General Counsel

Robert W. Beach
Ian F. Burgess
Don A. D'Amato
Robert A. Farr
Gary A. Gensch, Jr.
Matthew D. Hall
Emerson J. Hilton
Chantez P. Knowles
Jason M. Milstone
Rhonda M. Morris
Deborah A. Moss*
Michael C. Rampe
Scott J. Sinkwitts
Theresa A.G. Staley
Janae M. Thayer
Anne M. Uitvlugt
Aaron L. Vorce
Attorney

October 1, 2019

Ms. Lisa Felice
Executive Secretary
Michigan Public Service Commission
7109 West Saginaw Highway
P.O. Box 30221
Lansing, MI 48909

RE: **Case No. U-20463 - In the matter, on the Commission's own motion, to commence an investigation into a January 30, 2019 fire at Consumers Energy Company's Ray Compressor Station in Macomb County.**

Dear Ms. Felice:

Enclosed for electronic filing in the above-captioned case is **Consumers Energy Company's Ray Natural Gas Compressor Station Storage Field Capacity & Repair Status Updates.**

This is a paperless filing and is therefore being filed only in PDF format.

Sincerely,

Bret Totoraitis Digitally signed by Bret A. Totoraitis Date: 2019.10.01 09:47:37 -04'00'

Bret A. Totoraitis

Consumers Energy Company's Ray Natural Gas Compressor Station Storage Field Capacity & Repair Status Updates

MPSC Order in Case No. U-20463

October 1, 2019

I. INTRODUCTION

In its July 2, 2019 Order ("Order") the Michigan Public Service Commission ("MPSC" or the "Commission") directed Consumers Energy Company ("Consumers Energy" or the "Company") to file a report detailing the injection timeline for the natural gas storage field at the Ray Compressor Station ("Ray"), and a status update on the repairs completed to the facility to date.

Repairs to the Ray facility are underway and have been prioritized in such a way as to minimize their impact on system operations, meet peak summertime injection demand, and ensure that the natural gas storage field can be filled to capacity by October 31, 2019, prior to the start of the 2019-2020 heating season. The October 31, 2019 target for Ray's working gas inventory is 47.1 Bcf. As of September 29, 2019, Ray is 99% full, with approximately 0.4 Bcf of injection remaining for summer.

On August 2, 2019, the Company filed a report providing the status of equipment repairs that impact injection and withdrawal operations to date. This October 1, 2019 report provides updates on the status of repairs since that filing, noting the changes that have been made to the repair timeline provided earlier. These are reflected in Key Dates, Figure 1, below. Changes from the previously filed timeline are as follows:

1. The August 2, 2019 report forecasted Plant 2 injection capability by August 14, 2019, and Plant 2 was restored to full injection capability on August 16, 2019. The outstanding Plant 2 injection flow path repairs are still scheduled for completion by October 1, 2019, and do not impact the facility's ability to inject into storage;
2. The "Construction Repairs Complete (Planned)" date previously provided for Plant 3 withdrawal was September 16, 2019. The Plant 3 withdrawal construction repairs were complete on September 9, 2019. After completing start-up and live systems testing, Plant 3's withdrawal service will be fully restored on October 8, 2019;
3. The planned "Engineering and Procurement Complete" date for Plant 2 withdrawal was previously forecasted to be August 15, 2019, but has since been revised to September 30, 2019. Final engineering and procurement activities required more time, but do not impact the "Construction Repairs Complete (Planned)" date of December 20, 2019. The Company has deployed a phased approach to construction and procurement that allows us to complete as much work as possible while awaiting final engineering; and

4. The previously filed Key Dates table listed "Plant 2 withdrawal restored to service – December 20, 2019". That date represented the completion of construction repairs. Once construction repairs are complete, a facility is required to undergo start-up and live testing before it can be considered fully operational. The date for "Plant 2 withdrawal restored to service" has been updated to December 30, 2019 to account for the required start-up and live testing period.

II. REPAIR TIMELINE

A. INJECTION EQUIPMENT REPAIR

All critical equipment was repaired in order to restore Plant 2's injection capability on August 16, 2019. Plant 2 is available for injection service. The non-critical repairs required for the remaining Plant 2 injection flow path equipment continue to be on pace for completion by October 1, 2019.

B. BACKUP GENERATOR AND FUEL GAS SYSTEM REPAIR

The equipment is repaired and available with no change in status.

C. WITHDRAWAL EQUIPMENT REPAIR

The Company completed the necessary engineering and procurement for the withdrawal repairs for Plant 3 on May 30, 2019. The Plant 3 withdrawal equipment repairs were completed on September 9, 2019; system pressurization and live testing is forecasted for completion and to be returned to service on October 8, 2019. Necessary engineering and procurement for the withdrawal repairs for Plant 2 are complete; repairs are on schedule to be completed by December 20, 2019 with a planned return-to-service date of December 30, 2019. (This date was previously reported as December 31, 2019, but has been changed to reflect the last working day of the year.)

For reference, the compression equipment needed to withdraw gas from the Ray field varies depending on its inventory and associated pressure. Ray's inventory level is primarily impacted by winter weather and associated customer demand. When weather is normal or warmer than normal, a lower amount of inventory is cycled from Ray in the winter. Under these weather conditions, compression may not be needed until March or for the entire winter. When weather is colder than normal, more inventory is cycled from Ray and compression is not typically required until around mid-February to boost field pressures to the level necessary to facilitate delivery of the gas into the transmission system.

III. KEY DATES

Important operational dates, both past and future, include:

- Fire at Ray Compressor Station – January 30, 2019
- Initial damage assessment & repair prioritization – February 8, 2019
- Plant 3 restored to injection service – May 16, 2019
- Plant 2 fuel gas system and back-up generator restored – June 14, 2019
- Plant 2 injection capability – August 16, 2019
- Plant 2 injection balance of repairs – October 1, 2019
- Plant 3 restored to withdrawal service – October 8, 2019
- Ray Storage field inventory at target – October 31, 2019
- Plant 2 withdrawal restored to service – December 30, 2019

The table below illustrates milestones on the facility repair timeline.

Phase	System	Damage Assessment Complete	Scope Document Approved	Engineering and Procurement Complete*	Construction Repairs Complete*
1	Plant 3 Injection Path	6-Apr	12-Apr	19-Apr	3-May
2	Plant 2 Fuel Gas	26-Apr	30-Apr	15-May	14-Jun
3	Plant 3 Withdrawal	7-May	24-May	30-May	9-Sep
4**	Plant 2 Injection**	7-May	17-May	15-Jul	1-Oct
5	Plant 2 Withdrawal	14-May	7-Jun	30-Sept	20-Dec
F	Facilities/ Buildings	3-May	10-May	17-May	31-Jul

*Planned dates are future dates (post September 13) and are denoted in faded font.
** Plant 2 Injection ability was pulled ahead to August 16th; however all non-injection critical scope (remaining repairs in this system) will be complete by October 1st per the original schedule.

Figure 1. Repair Progress at Ray Compressor Station

IV. CONCLUSION

Consumers Energy is committed to ensuring that its facilities are safe and that they are capable of reliably delivering energy needed to serve Consumers Energy's customers. The Company continues to execute its thorough, prioritized work plan to ensure that Consumers Energy's customers enjoy warm, comfortable homes and businesses this coming winter. Consumers Energy remains confident that it will be able to meet the demands of the heating season safely and reliably.

General Offices:
One Energy Plaza Tel: (517) 788-0550
Jackson, MI 49201 Fax: (517) 768-3644

*Washington Office:
1730 Rhode Island Ave. N.W. Tel: (202) 778-3340
Suite 1007
Washington, DC 20036 Fax: (202) 778-3355

Writer's Direct Dial Number: (517) 788-0835
Writer's E-mail Address: bret.totoraitis@cmsenergy.com

LEGAL DEPARTMENT
SHAUN M. JOHNSON
Senior Vice President and General Counsel

MELISSA M. GLEESPEN
Vice President, Corporate Secretary and Chief Compliance Officer

KELLY M. HALL
Vice President and Deputy General Counsel

Eric V. Luoma
Adam C. Smith
Bret A. Totoraitis
Assistant General Counsel

Robert W. Beach
Ian F. Burgess
Don A. D'Amato
Robert A. Farr
Gary A. Gensch, Jr.
Matthew D. Hall
Emerson J. Hilton
Georgine R. Hyden
Chantez P. Knowles
Robert F. Marvin
Jason M. Milstone
Rhonda M. Morris
Deborah A. Moss*
Michael C. Rampe
Scott J. Sinkwitts
Theresa A.G. Staley
Janae M. Thayer
Anne M. Uitvlugt
Aaron L. Vorce
Attorney

November 1, 2019

Ms. Lisa Felice
Executive Secretary
Michigan Public Service Commission
7109 West Saginaw Highway
P.O. Box 30221
Lansing, MI 48909

RE: **Case No. U-20463 - In the matter, on the Commission's own motion, to commence an investigation into a January 30, 2019 fire at Consumers Energy Company's Ray Compressor Station in Macomb County.**

Dear Ms. Felice:

Enclosed for electronic filing in the above-captioned case is **Consumers Energy Company's Incident Command Structure During the Ray Compressor Station Fire: An Overview and Recommendations for Improvement.**

This is a paperless filing and is therefore being filed only in PDF format.

Sincerely,

Bret Totoraitis
Digitally signed by Bret A. Totoraitis
Date: 2019.11.01 08:36:06 -04'00'

Bret A. Totoraitis

Consumers Energy Company's Incident Command Structure During the Ray Compressor Station Fire: An Overview and Recommendations for Improvement

MPSC Order in Case No. U-20463

November 1, 2019

I. INTRODUCTION

On January 30, 2019, a fire occurred at Consumers Energy Company's ("Consumers Energy" or the "Company") Ray Natural Gas Compressor Station ("Ray Compressor Station" or "Ray") in Armada, Michigan ("Ray Compressor Station Fire," "the fire," or "the incident"). In response, the Company deployed the Incident Command System ("ICS"). The ICS is a scalable and flexible emergency response process and organization that is a component of the National Incident Management System ("NIMS") promulgated by the Federal Emergency Management Agency ("FEMA").[1] The purpose of NIMS is to promulgate a comprehensive approach to incident management that can be used by any community, government agency, or corporation. The system relies on common terminology, modular organization, comprehensive resource management and integrated communications so that time, resources and attention can be deployed as effectively as possible by as many people and entities as necessary during an emergency.[2]

This report will summarize how the Company responded to and managed the incident using ICS during the Ray Compressor Station Fire, review the strengths and weaknesses of the response, and summarize the third-party evaluation provided by the Michigan State Police ("MSP").

A. Incident Summary

The fire occurred during a cold-weather emergency that combined dangerously low temperatures and an interstate electric supply shortage. Accordingly, the incident was classified by the Company as a Level 3 ICS Full Scale Incident. A Level 3 incident calls for multiple levels of support: command post to coordinate the on-scene emergency response (located in this case at the Ray Compressor Station), an Emergency Operations Center ("EOC") to support the command post with personnel and resources (located at the Parnall Office Complex) and a Senior Management Team functioning as the Crisis Management Team (also located at the Parnall Office Complex - near the EOC), as shown in the

[1] https://training.fema.gov/emiweb/is/icsresource/assets/ics%20review%20document.pdf
[2] Id.

illustration below. The incident response launched on January 30, 2019 and was demobilized on February 6, 2019.

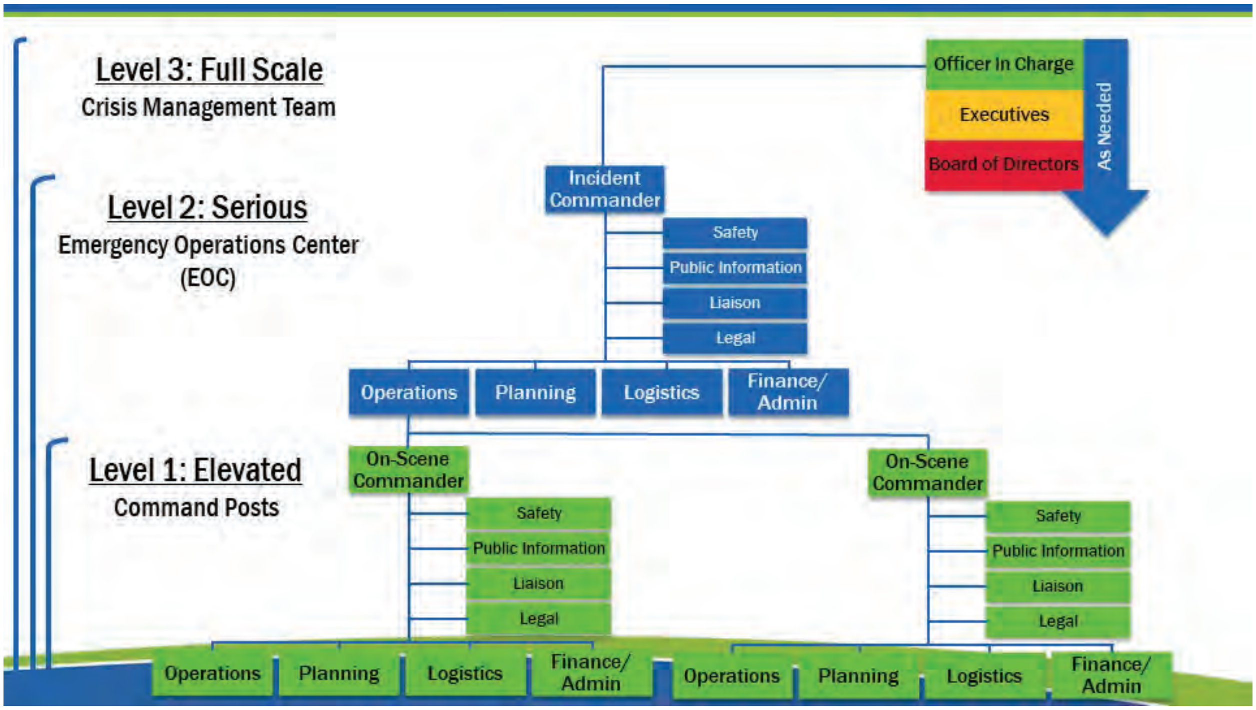


Figure 1. Full-Scale Incident Response Organizational Chart

The incident started locally at the Ray Compressor Station on January 30, 2019, and as support was needed from Gas Supply & Engineering, an EOC was implemented. Realizing the significance of the event, the Company assembled a Senior level executive team to perform stakeholder outreach and ensure sufficient resources were available to the teams working the incident. As the gas supply issue was resolved, the incident de-escalated with the EOC standing down on February 1, 2019, and the Ray Compressor Station on-scene command post demobilizing on February 6, 2019.

B. Evaluation of ICS Strengths and Areas for Improvement

Through review with both the incident responders and the Company's Emergency Management & Public Safety department, the Company identified decisions and activities that were executed well, in addition to inefficiencies or process defects that should be remedied. This section describes the strengths and needed improvements identified for two major segments of the ICS – the on-scene command post and the EOC– and some general discussion about making improvements during the ongoing maturation of ICS implementation at Consumers Energy.

1. <u>The On-Scene Command Post</u>

A key strength that bolstered the effectiveness of the response was the degree of previous experience that many of the employees staffing the various ICS roles at the on-scene command post had previously with ICS. Their familiarity with the fundamentals allowed the response to operate with immediate effectiveness and free from interruptions due to mistakes or confusion over process. The employees on site at Ray activated the ICS quickly and provided early notification of the fire, then ensured the availability of relief for restoration crews and external-facing ICS roles to enable 24-hour coverage and continued communication with local emergency officials during the response.

The Company has identified opportunities to improve internal communication activities at the on-scene command post. For instance, there was a lack of clear distinction between conference calls intended to provide situational updates and those arranged to drive incident action planning. Incident action planning is a critical component of ICS in which responders develop an incident action plan to establish and direct incident operations and identify and allocate required resources.

The Company is considering updates to its current internal communication process so that incident action planning meetings are only available to those assigned to active roles in the ICS. An alternate incident communication tool may be made available to all other employees seeking situational awareness but who are not part of the formal response. Discussions and plans are underway and will continue through 2020.

The Company also plans to reduce inefficiencies and eliminate potential confusion by developing the Incident Briefing Form (ICS 201) at the command post and elevating it to the EOC for updates and revisions, rather than having the same form developed in two versions at both locations during each period that the ICS is operational. The change will result in a single, current document for use by all involved. This will be addressed through training and exercising in 2020.

At the time of the incident, the Ray Compressor Station had been experiencing intermittent issues with the landline phone service somewhat limiting the capability to make and receive calls from the Ray Compressor Station. A couple of landline phones remained operational and mobile cellular phones were also used successfully. This experience demonstrated the importance of the valuable support that can be provided by the Company's Information Technology department. A process is being finalized to notify the Information Technology department of ICS incidents needing support from Information Technology.

In the response, administrative and planning roles were filled initially by those closest to the response. Efficiencies could have been improved at the on-scene command post by identifying and assigning appropriate staff to this type of role. This would have allowed operational personnel to focus solely on response and recovery. This will be addressed in training and exercising in 2020.

Some employees who were deployed to the Ray Compressor Station to assist with the ICS did not have the appropriate security credentials to access the facility, which created unnecessary logistical challenges. This flagged the need to enable the Company's security services to expedite temporary site access during emergencies. This will be addressed in training and exercising in 2020.

2. <u>The Emergency Operations Center</u>

While some Consumers Energy employees staffed the on-scene command post to oversee the incident response directly, others operated an EOC to support the command post's activities.

The purpose of an EOC is to coordinate information and resources to support the on-scene command post operations.[3] The personnel executing the Company's crisis communication efforts were primarily stationed at the EOC, and reviewing their efforts after the fact, revealed some key learnings to deploy in future incidents.

[3] https://training.fema.gov/programs/emischool/el361toolkit/glossary.htm

The unusually complex circumstances surrounding the incident meant that it was very important to ensure the Company communicated effectively with various emergency and government officials, other utilities, and members of the general public. Consumers Energy's ICS process calls for a multi-channel, multi-stakeholder crisis communications plan, administered by an individual designated as the ICS's public information officer ("PIO"). The PIO's job is to ensure timely communications and, where possible, communicate a transparent restoration schedule to help alleviate external stakeholders' concerns.

During the fire, the PIO attended ICS situational update meetings and calls, then followed up with the Communications Response Team comprised of representatives from the communications, governmental, regulatory, and public affairs departments. Internal stakeholders aligned on messaging and then communicated with their assigned audiences using owned media, earned media, paid media, direct phone calls and emails, and social media.

The review of Consumers Energy's communications activities at the EOC revealed several improvement opportunities. For instance, the fast-changing nature of the circumstances surrounding the fire and its unforeseeable consequences challenged the Company's efforts to organize its communications. A steady stream of new information from various sources and new inquiries from various internal and external stakeholders made it very difficult to ensure that every entity had all the facts at all times. The Company did learn, however, that adjusting the cadence of update calls and meetings will help mitigate this issue in the event of future emergencies.

Preliminary discussions have been held with the MSP and the Michigan Public Service Commission ("MPSC" or the "Commission") about adjusting the cadence of the Company update calls and external stakeholder update calls so that there is an improved flow of consistent information to external stakeholders at designated times. The use of a Joint Information Center, when established by the MSP, would also be helpful to coordinate outgoing public/private stakeholder messages to ensure alignment and avoid contradicting information. In addition, connecting the PIO from the MSP with the PIO from Consumers

Energy could also be beneficial to ensure messaging is aligned and consistent. The role-specific job aid for the PIO is targeted for review and potential revision in the first half of 2020.

The state government opened the State Emergency Operations Center (“SEOC”) in response to the extreme cold weather. While the Company made a knowledgeable representative available to the SEOC staff, it recognizes the need to make such a person available sooner in future emergencies.

During the incident response, Consumers Energy tasked a Liaison Officer with coordinating with the local fire departments and county emergency managers, while the Company’s Director of Emergency Management and Director of Security were in contact with the MSP/Emergency Management and Homeland Security Division (“MSP/EMHSD”). In the future, the use of a two-person liaison team will strengthen the Company’s ability to expand communication so that it is more timely and specific to the status of the incident and its potential impact. Feedback received from the MSP/EMHSD and county emergency managers indicates that providing the incident status and potential impact will allow emergency officials to fully prepare at the state and local levels. The ICS Liaison Officer job aid and procedures will be improved to incorporate this feedback which is targeted for Q2 2020.

3. The Continued Maturation of ICS Deployment at Consumers Energy

In addition to recommendations for improvement to the operations of the on-scene command post and EOC, the Company has identified further opportunities to improve its proficiency with the ICS more generally.

Developing Company-wide proficiency with ICS started with the organizations closest to the work, such as field operations, and has grown to include six organization-specific emergency response plans. The Ray incident spurred the development of a detailed action plan to expand formal ICS processes and procedures to the Gas Supply and Engineering organization. Having this formal training will allow employees to recognize emergencies and implement the ICS on-scene and, if needed at an EOC, more quickly in the future. An action plan to bring the Gas Supply and Engineering organization in-scope for ICS has been established. Employees are currently being identified for ICS training opportunities and onboarding will continue through Q4 2020.

Incident responses at Consumers Energy follow an all-hazards approach which means that an ICS standard response process can be used to manage incidents regardless of the incident type, size, or complexity. This concept is formalized in an All-Hazards Emergency Operations Plan. To supplement the all-hazards approach, the Company has developed documents to guide response activities for high likelihood and/or high impact natural gas incidents. These documents are referred to as hazard-specific annexes and action plans. Hazard-specific annexes and action plans are added to a department's overall Emergency Response Plan and identify a list of objectives, strategies, and tactics to improve the efficiency of incident response. The Company has begun to capture the response considerations of the Ray incident so that potential response actions can be referenced in the future in the form of a hazard-specific annex and/or action plan reflective of the circumstances surrounding the fire. The development of this documentation will continue into 2020.

The Company has also begun benchmarking its processes against other companies and to upgrade its current Crisis Management Guide into a more formal Crisis Management Plan. Finally, Consumers Energy will ensure that the senior executives who may be called upon to serve on a Crisis Management Team during a Level 3 Incident have the appropriate specialized training to ensure their effectiveness during emergencies. This is targeted for Q4 2020 completion.

The Company is also targeting the following actions for improvement:

- Identify a specific emergency contact from each Michigan utility so that information can be shared more quickly. Task the Liaison Officer with communicating with these individuals when incidents arise that could impact their customers or business. (During the Ray incident, Company personnel communicated with DTE Gas Company ("DTE") and SEMCo Energy Gas Company ("SEMCo"), coordinated operations with the DTE Gas Control team, and posted critical notices of an Operational Flow Order and Curtailment on Consumers Energy's Information Posting Website which triggered email notifications to all subscribers including Michigan Gas Utility, DTE, and SEMCo.) Liaison Officer role documentation is underway and is targeted for completion within the first half of 2020;

- Include external emergency officials in Consumers Energy ICS exercises, and identify opportunities to include Company personnel in first responder or community emergency response training. This strategy is now documented in our Emergency Management Strategy document;
- Develop and hold an exercise that spans various Consumers Energy organizations to enable better preparedness in the event of an incident similar to the Ray fire. This exercise is targeted for 2020;
- Investigate opportunities to implement the use of an Incident Management Team at Consumers Energy which includes highly specialized and trained personnel from various organizations to be able to assist in response during an ICS activation. This team would be different than our usual ICS-trained personnel in that that they would be a specialized team able to assist during any type of incident and for any department; and
- Investigate opportunities to build a designated facility where the EOC can operate and coordinate the Company-wide response. If confirmed, this would be a long-range goal with a five-year target.

C. Independent Third-Party Review of the Consumers Energy Emergency Management Program

The MPSC ordered Consumers Energy to conduct an evaluation, preferably by a third party, of its ICS and procedures and response to the Ray Compressor Station fire. Accordingly, the Company engaged MSP Lt. Col. Chris Kelenske to complete this review. Lt. Col. Kelenske's former role as commander of the MSP/EMHSD provided him with extensive emergency response experience.

Consumers Energy provided Lt. Col. Kelenske with its Emergency Management Strategy, Emergency Management Planning Framework, Master Business Continuity Plan, Master Exercise Calendar, Multi-Year Training and Exercise Plan, All-Hazards Emergency Operations Plan, Gas Emergency Response Plan, and Crisis Communications Plan. Then, on September 18, 2019, representatives from the Company and from the MPSC Staff met with Lt. Col. Kelenske to receive his evaluation. The review with Lt. Col. Kelenske proved to be very valuable. He offered several recommendations to enhance the Company's ICS process, some matching the improvements identified by the MPSC Staff and the Commission's

Statewide Energy Assessment Report or that the Company had also identified as part of its review, including recommendations that Consumers Energy:

- Adjust its communications strategy to enable faster notification for officials when incidents occur that potentially carry state-wide impact. This will allow for appropriate response planning on the officials' part;
- Adjust the communications strategy so that external stakeholders receive identical informational updates at the same time;
- Provide a knowledgeable Company representative to the SEOC earlier than was done during the Ray incident;
- Simplify the Company's emergency management program documents for ease of reference and applicability;
- Document a long-term strategy for the emergency management program, which currently runs on a three-year rolling plan broken out by department;
    - Note: The Company will develop a wholistic multi-year strategy for the program, targeting approval and implementation during the first half of 2020.
- Use Emergency Coordination Centers to provide a link to the EOC, handle the planning, operations, financial, and logistics activities for an incident and allow field teams to respond;
- Use an electronic incident management system software tool to help manage incidents. The Company currently relies on the same WebEOC resource used by the MSP/EMHSD. Consumers Energy has not fully implemented WebEOC due to resource constraints and realizes that use of such a tool would more effectively capture the Company's own response. The Company does provide informational updates to the MSP/EMHSD's version of WebEOC called Michigan Critical Incident Management System to provide informational updates to emergency officials whenever there is an applicable statewide incident announced by the SEOC; and
    - Note: Discussions and plans are underway to improve ease of use of the Company's WebEOC system, enhance the management of incident documentation and increase leadership visibility to incident status and documentation. This work to enhance the system's use will continue through year-end 2020.
- Install location devices on Company-owned emergency response equipment to facilitate resource tracking.

A follow-up meeting with the MSP/EMHSD staff was held on October 15, 2019 and included discussions of inter-agency coordination including preferred notification methods, emergency alert system use, opportunities to attend quarterly MSP/EMHSD meetings, reporting to the SEOC and future exercise participation.

II. CONCLUSION

The events of January 30, 2019 posed a considerable challenge and significant learning opportunity for Consumers Energy, emergency and government officials, and other utilities. Thanks to the proactive adoption of the ICS emergency response method, the Company was able to respond quickly to the fire and integrate its response with those of emergency officials statewide. Consumers Energy has reviewed its performance critically, begun implementing feedback from internal and external stakeholders, and identified learning opportunities that will shape its emergency response efforts into the future. These steps, taken in partnership with utility peers and public sector representatives, are expected to significantly improve the Company's ability to respond safely and effectively to future emergencies.