NATIONAL TRANSPORTATION SAFETY BOARD
Office of Railroad, Pipeline, and Hazardous Materials Investigations
Washington, D.C. 20594

Survival Factors

Group Chairman's Factual Report of the Investigation

– Emergency Preparedness / Emergency Response [1]

Report Date: July 17, 2017

A. ACCIDENT

Location:	Silver Spring, MD [2]
Date:	August 10, 2016 [3]
Time (approximate):	11:50:57 p.m. EDT [4]
Event Type:	multiple-story building explosion and fire; natural gas release
Property site:	a structure at 8701 Arliss Street, Silver Spring, MD
GPS coordinates	N38.998699, W77.001072
NTSB Accident Number:	DCA16FP003

B. SYNOPSIS OF THE ACCIDENT

See documentation as compiled by the Investigator-in-Charge.

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[1] The Survival Factors investigation exclusively addresses the emergency preparedness and emergency response, and injury causation elements of the accident.
[2] An unincorporated community of Montgomery County, Maryland
[3] NTSB initiated an investigation on the morning of August 18, 2016
[4] Eastern Daylight Time

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Note – photographs compiled during the investigation by the Survival Factors Technical Working Group will be forthcoming as separate Survival Factors factual report documentation.

Select abbreviations and acronym nomenclature used in this report

~	approximate, or approximately
ATF	Bureau of Alcohol, Tobacco, Firearms and Explosives (for further information, see [Internet] https://www.atf.gov/)
CFR	Code of Federal Regulations
EDT	Eastern Daylight Time
F	Fahrenheit [temperature scale]
hrs	hours (ref to 4-digit, or 6-digit military time)
MCFRS	Montgomery County Fire Rescue Service

MCPD	Montgomery County Police Department
mph	miles per hour [speed]
OEMHS	Montgomery County Office of Emergency Management and Homeland Security
OPS	Office of Pipeline Safety, within the PHMSA
PHMSA	U.S. Department of Transportation, Pipeline and Hazardous Materials Safety Administration (see [Internet] http://www.phmsa.dot.gov/)
ref	reference
SF	Survival Factors [investigation]
WG	Washington Gas

C. SURVIVAL FACTORS -- TECHNICAL WORKING GROUP PARTICIPANTS

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D. DETAILS OF THE INVESTIGATION

1.0 Relevant Background Factors

1.1 Locality of the Accident / Civil Jurisdiction, and Property Identification

The accident (explosion and fire) occurred in a multiple-story, multiple-family, residential dwelling structure, originally constructed in 1955[5], which was located at 8701 Arliss Street, in Silver Spring, Maryland, which is an unincorporated community of Montgomery County, Maryland. A similarly constructed, multi-story / multi-family, residential dwelling structure, located at 8703 Arliss Street, which partially shared a common wall with the 8701 Arliss Street structure, also sustained substantial explosion and fire damage. The two structures involved in the accident are real-property assets of a privately owned, commercial residential property site that was formally identified (by the property owner) as the Kay Apartment Communities. The property site was also known locally as the "Flower Branch Apartments", in which all of the

[5] Ref building permit documentation [original construction / renovations] issued by Montgomery County, MD; for further information, see [Internet] http://permittingservices.montgomerycountymd.gov/DPS/general/Home.aspx.

residential units were rental properties. Arliss Street intersects with Piney Branch Road immediately adjacent to the two residential structures involved in the accident. The area of accident site is a moderately dense [populated] [6, 7], suburban neighborhood, generally consisting of multiple-occupancy residential structures, and small, to medium-sized, retail establishments.

1.2 Site Characterization – Pre-Event

1.2.1 Overall Physical Configuration

The explosion site (i.e., the 8701 Arliss Street structure) was a three-story plus basement, brick veneer, wood-framed construction, residential-use, garden-apartment style structure. The structure was comprised of a utility / storage room (which contained the gas pressure regulator and metering equipment; see § 1.2.2), a property management office, a storage area (room), and one apartment on the basement level, with four individual apartments on each of the first, second, and third floor levels of the building, which totaled 13 apartments in the building. The northern end of the building partially shared common wall with a structure located at 8703 Arliss Street.

The adjacent residential structure (i.e., the 8703 Arliss Street building) was a similarly constructed, three-story plus basement, brick veneer, wood-framed construction, garden-apartment style structure. The common wall, which was located at the southern end of the structure, which was also partially shared with the 8701 Arliss Street structure, was constructed of cement block (a structural / masonry material that functions as a fire-block). The structure was comprised of a utility room (which contained the gas pressure regulator and metering equipment; see § 1.2.2), a storage area (room), and two apartments on the basement level, with four individual apartments on each of the first, second, and third floor levels of the building, which totaled 14 apartments in the building.

Natural gas, which was delivered to all of the structures [of this property site] via underground main and service pipelines (see § 1.2.2), was utilized as fuel for domestic heating (residential spaces), hot water heating (domestic use), and household cooking (kitchen stoves).

1.2.2 Gas Delivery Operations at the Accident Site

A 2-inch gas distribution main [pipeline], owned / operated by Washington Gas (WG), was located beneath the ground immediately adjacent to the 8701 Arliss Street structure. This distribution main supplied natural gas to the buildings located at 8701, 8703, 8701, 8707, 8709, and 8711 Arliss Street, with a main line valve located adjacent to the building located at 8701 Arliss Street. An underground service line extends from the distribution gas main to the structure at 8701 Arliss Street. The service line extends through the (basement) foundation wall into the utility / storage room on the basement level of the structure, and was connected to gas pressure regulator and metering equipment. A curb valve was located in the underground service

[6] US Census map data, dated 2010, shows Montgomery County, MD, to be 500.0 to 1,999.9 persons / square mile
[7] Ref [Map of] "2010 Census Results - United States and Puerto Rico Population, Density by County or County Equivalent", source: https://www.census.gov/2010census/popmap/

line that extends from the gas distribution main to the structure at 8701 Arliss Street. The curb valve is a flow control device that is provided to [allow appropriately qualified service personnel to] turn-off the flow of natural gas to the gas pressure regulator and metering equipment inside the building.

See the Operations Group Factual Report for additional information on this topic.

1.3 Natural Gas Supplier (Pipeline Owner / Operator) - Washington Gas [8, 9]

Washington Gas supplied natural gas to all of the structures that used natural gas in the subject community, including the structures involved in the explosion / fire, as further described (see § 3.6). The company maintains a business office and training facility in Springfield, VA, and also maintains a field service facility in Rockville, MD, to service customers in Montgomery County, which includes Silver Spring. The natural gas product of the company was purchased by Washington Gas from several wholesale suppliers, and was delivered to its customers through a network of underground pipelines of various diameters.

1.4 Natural Gas Product Delivered [10]

The principal constituent of the natural gas product that is delivered to WG customers is methane. An odorant, consisting of a sulfur-like material called mercaptan, is added, as a safety measure, to all natural gas traveling through WG distribution pipelines, to render it readily detectable by individuals with a normal sense of smell if a leak occurs.

A Safety Data Sheet (SDS [11]) for natural gas was made available to the investigation by WG [12], which provides information on the physical data, toxicity, health effects, first aid, reactivity, storage, disposal, protective equipment, and [unintended / uncontrolled] release-handling procedures of the product, as might be needed by emergency responders and any individual who might be exposed.[13]

1.5 Regulation Applicable to Emergency Preparedness / Emergency Response

1.5.1 Federal [14]

[8] Ref, and for further information, see [Internet] https://www.washingtongas.com/, and as otherwise indicated.
[9] The formal name of the company is the Washington Gas Light Company, which is a "utility subsidiary" of WGL Holdings, Inc. (ref, and for further information, see [Internet] http://wglholdings.com/, and http://newsroom.washingtongas.com/press-release/financial/wgl-holdings-inc-and-washington-gas-light-company-declare-dividends-20.
[10] Ref, and for further information, see [Internet] https://www.washingtongas.com/safety-education/education/about-natural-gas, and as otherwise indicated.
[11] Previously referred to as a Material Safety Data Sheet (MSDS).
[12] Ref, and for further information (as generic information on this topic); see [Internet] http://www.aga.org/SiteCollectionDocuments/KnowledgeCenter/OpsEng/SOS/2010/1001MSDSALTAGAS.pdf.
[13] The creation, publication, and use of SDS / MSDS documentation are governed by the Hazard Communication Standard (HCS) that is promulgated by the Occupational Safety and Health Administration (OSHA) of the U.S. Department of Labor.
[14] Ref, and for further information, see [Internet] http://phmsa.dot.gov/pipeline, and as otherwise indicated.

The federal government establishes minimum pipeline safety standards under the U.S. Code of Federal Regulations (CFR), Title 49 "Transportation", Parts 190 - 199. Regulation that addresses pipeline shipment of natural gas is addressed in 49 CFR Part 192. The Office of Pipeline Safety (OPS), within the U.S. Department of Transportation, Pipeline and Hazardous Materials Safety Administration (PHMSA), has overall regulatory responsibility for hazardous liquid and gas pipelines under its jurisdiction in the United States. The OPS enforces pipeline safety regulations for interstate gas and hazardous liquid pipeline operators in Maryland, based on the inspections performed by the state. [15]

Specific regulation to address prospective Survival Factors issues (emergency preparedness / emergency response) is addressed under the following sections of the Part 192 Regulation:

49 CFR 192.605	Procedural manual for operations, maintenance, and emergencies [16]
49 CFR 192.615	Emergency plans [17]
49 CFR 192.616	Public awareness [18]
49 CFR 192 Subpart P	Gas Distribution Pipeline Integrity Management [19]

1.5.2 State [20]

The PHMSA / OPS enforces pipeline safety regulations for interstate gas and hazardous liquid pipeline operators in Maryland, based on the inspections performed by the state. By signed agreement with OPS, the state inspects interstate gas and hazardous liquid pipeline operators in Maryland. Through certification by OPS, the state inspects and enforces the pipeline safety regulations for intrastate gas and hazardous liquid pipeline operators in Maryland. The State of Maryland has developed its own pipeline standard(s), in which State pipeline standards may be more stringent, but cannot be less stringent, than Federal regulations.

The Maryland Public Service Commission (MD-PSC) is the designated agency of the State of Maryland to perform inspections of natural gas pipeline operators in Maryland, and to enforce the pipeline safety regulations for intrastate gas and hazardous liquid pipeline operators in Maryland. [21]

1.6 Industry Standards

[15] Ref, and for further information, see [Internet] https://primis.phmsa.dot.gov/comm/FactSheets/States/MD_State_PL_Safety_Regulatory_Fact_Sheet.htm.
[16] Ref [Internet] http://www.ecfr.gov/cgi-bin/text-idx?SID=bfcd0369491cb31ec126db7971c3b0c3&node=se49.3.192_1605&rgn=div8.
[17] Ref [Internet] http://www.ecfr.gov/cgi-bin/text- idx?SID=bfcd0369491cb31ec126db7971c3b0c3&node=se49.3.192_1615&rgn=div8.
[18] Ref [Internet] http://www.ecfr.gov/cgi-bin/text- idx?SID=bfcd0369491cb31ec126db7971c3b0c3&node=se49.3.192_1616&rgn=div8.
[19] Ref [Internet] http://www.ecfr.gov/cgi-bin/retrieveECFR?gp=&SID=bfcd0369491cb31ec126db7971c3b0c3&n=sp49.3.192.o&r=SUBPART&ty=HTML.
[20] Ref, and for further information, see [Internet] http://www.psc.state.md.us/gas/natural-gas-pipeline-safety-program/, and as otherwise indicated.
[21] Ref, and for further information, see [Internet] http://www.psc.state.md.us/.

A Recommended Practice (RP) document was developed, and is promulgated by the American Petroleum Institute (API) [22], to "provide guidance to be used by natural gas pipeline operators, to develop and actively manage their Public Awareness programs", as required under 49 CFR 192.616 (ref § 1.5.1, above), as follows.

API - RP 1162 Public Awareness Programs for Pipeline Operators [23]

The most recent revision of this document is the second edition, dated December 2010. However, the first edition, dated December 2003, is applicable to the circumstances of this investigation.[24]

Although the term "recommended practice" potentially suggests 'voluntary compliance', conformity to this recommended practice is effectively a regulatory requirement, pursuant to Final Rule [25] action, issued in May 2005 by the PHMSA-OPS, in which (mandatory) compliance with RP 1162 was "incorporated by reference".

1.7 Investigative Technical Support [26]

The Bureau of Alcohol, Tobacco, Firearms and Explosives (ATF) is a law enforcement agency in the United States' Department of Justice, which provides "… support to law enforcement, public safety, and industry partners", which in this event included the gathering and evaluation of certain forensic evidence of the accident site, supportive to the Montgomery County Police Department, and the NTSB.

1.8 Meteorological Factors [27]

The recorded weather at the time of the accident was darkness, 81 degrees F., wind at 9 mph, under clear skies.

2.0 Accident Site Damage Characterization

2.1 Damage Description

2.1.1 8701 Arliss Street Building

[22] As described in the "Mission" of the organization, the API is "to influence public policy in support of a strong, viable U.S. oil and natural gas industry" where the API "Engages in federal and state legislative and regulatory advocacy", as further described in [Internet] http://www.api.org/globalitems/globalheaderpages/about-api/industry-mission.
[23] Available, as a "non-printable copy", at [Internet] http://www.techstreet.com/api/products/1757546.
[24] Review of the subject regulation identified that the second edition of this [Recommended Practice] document has not been accepted in the Federal regulation.
[25] As described in the Federal Register, Vol. 70, No. 96, May 19, 2005, page 28833, at [Internet] http://www.gpo.gov/fdsys/pkg/FR-2005-05-19/html/05-9464.htm.
[26] Ref, and for further information, see [Internet] https://www.atf.gov/about/.
[27] Source: Quality Controlled Local Climatological Data, hourly, for Reagan Washington National Airport (WBAN station 13743/DCA), on 10 Aug. 2016, at 23:52 hours, as sourced from http://www.ncdc.noaa.gov/qclcd/QCLCD.

The explosion and subsequent fire at this property resulted in catastrophic damage to the northern approximately one-half end of the structure. The explosion resulted in a structural collapse of the first, second and third floor including the roof structure, the debris of which collapsed into the basement. The debris of the lower portion of the front exterior wall was found distributed on the ground and street in front of the building (in a manner that was characteristic of having been blown outward) with the debris field of this material reaching several hundred feet in front of the building. The debris of the upper portion of the front exterior wall fell into the front yard of the building. The fire consumed and/or heavily damaged the combustible materials in the collapsed area. The remaining southern end of the structure sustained extensive structural damage, fire and/or smoke damage, in which the individual floor levels, and roof structure, did not collapse.

2.1.2 8703 Arliss Street Building

Damage to this property consisted of a collapse of the southern (cement block) wall of this structure, the debris of which came to rest substantially in the basement level of the 8701 Arliss Street property. Floor areas immediately adjacent to the collapsed (cement block) wall displayed extensive fire damage and had also collapsed, the debris of which principally came to rest in the basement level of the 8701 Arliss Street property. The remaining areas of the structure, to the north of [the described] fire damaged floor areas and the collapsed southern (cement block) wall of this structure, sustained extensive fire and/or smoke damage, in which the individual floor levels, and roof structure, did not collapse.

2.2 Quantity of Pipeline Product Released[28]

The degree of damage sustained by the gas line piping (at the accident site) precluded performing a calculation to determine the approximate quantity of pipeline product released.[29]

2.3 Accident Site Map

Schematic floor plan illustrations, depicting the accident site infrastructure, were obtained by the investigation[30], a copy of which is anticipated to be available in the NTSB docket.

2.4 Time of the Event Occurrence[31]

[28] A calculation can be performed of the approximate quantity of pipeline product that is released, which requires identification of sequence and sources of release, duration of release, piping geometry, escape path geometry, differential pressures, inside piping diameters, and other pertinent factors to be incorporated into the equation.
[29] In this event, because the damage sustained by the piping was so extensive, definitive piping diameter (dimensions) and other pertinent factors could not be ascertained.
[30] Ref source documentation as made available to the investigation by the ATF (see § 1.7).
[31] Timestamp data of video images, recovered from security camera equipment situated in a retail store near the accident site, was identified by the ATF and made available to the investigation.

Timestamp data of images recovered from a security camera of a retail store located near the accident site [32], identified that the explosion likely occurred at approximately 23:50:57 hrs.[33]

3.0 Jurisdictional Emergency Services Agencies and Natural Gas Supplier – Background and Emergency Preparedness Measures

3.1 Jurisdictional Fire / Rescue Agency - MCFRS [34]

The accident occurred on private property within the jurisdiction [fire protection district] of the Montgomery County Fire and Rescue Service (MCFRS), which also provided resources in response to the accident event.

3.1.1 Background

The MCFRS is the principal emergency services agency responsible for responding to fire suppression, emergency rescue, and an initial response to hazardous materials incidents within the community of Silver Spring, and was the initial fire / rescue agency that responded to the scene in this incident, as further described in this report. The MCFRS, which is a "combination system" in the suburban Washington, DC area, consists of both career (paid) and volunteer response personnel, and maintains 40 fire stations and two rescue stations in Montgomery County. The MCFRS has formal "mutual aid" response agreements with fire department resources from neighboring jurisdictions, which are available to respond to emergency events in this jurisdiction. The MCFRS also provides the Emergency Medical Services (EMS) response for Montgomery County, as further described in this report (see § 3.3). All certified firefighters are also certified as Emergency Medical Technicians (EMT's) at a minimum.

3.1.2 Preparedness Plans / Measures

a. Standard Operating Procedures (SOP's)

[32] I.e., a Best Way Supermarket (http://www.bestwaymarket.com/), 8549 Piney Branch Road, Silver Spring, MD, the main entrance of which was located about 350 feet to the west of the front of the 8701 Arliss Street property.
[33] The noted timestamp data was identified to the investigation by the ATF in a series of inter-agency email correspondence (NTSB / Montgomery County Police / ATF), which, in summary, indicated [1] that several security cameras at the noted retail facility were examined by ATF, in which [2] a camera having a view of the parking lot (through the main entrance), identified [3] a distinctive "flash" had occurred at 23:39:57 hrs (unadjusted timestamp indication), where small pieces of debris were then observed to be quickly passing the camera view, wherein [4] the action of which was identified to be consistent with an explosion [occurring at the 8701 Arliss Street property] and subsequent shockwave as might result from such an event, in which [5] the observed timestamp was determined by ATF to be approximately 11 minutes earlier than an official, US Government-sourced, recognized time standard (e.g., http://www.time.gov/), to which [6] this observed 11-minute time differential was corroborated by other known, and (time-standard accurate) timestamp indicators that the investigation identified (e.g., timestamp of an on-scene police officer radio-call), in which, as a resolution, the investigation determined that the 11-minute time differential adjustment factor was reasonably accurate for purposes of this investigation, to which the [explosion] event timestamp cited (in this report section) reflects the identified 11-minute time differential adjustment, and accordingly was utilized to define the 'event initiation' timestamp in the Event Timeline of the investigation.
[34] Ref, and for further information, see [Internet] https://www.montgomerycountymd.gov/mcfrs/, and as otherwise indicated.

The MCFRS maintains a series of formal and documented SOP's, which the agency refers to as Policy and Procedure [documentation], that govern most of the routine fire / rescue, and related emergency services operations, to be employed in response to a natural gas release / fire event, that include, but are not limited to the following.

Title	Ref #	Effective Date
SOP for Safe Structural Firefighting	24-07AMII	12/01/2005
Natural Gas Incident Response	25-07	04/01/1996
Explosive Incident Procedure	1112	05/20/1998

b. Training Programs Specific to Addressing the Identification and Mitigation of a Natural Gas Release / Fire Event

The MCFRS maintains a formal / documented Standardized Training Program, consisting of the instructional syllabus on the topics of "Operations at Garden Apartments" and "MCI and Triage", which govern the specific training activities (modules / evolutions) to address an FRS response as occurred in the accident event.

The MCFRS indicated that the agency does not offer any "stand-alone natural gas emergency response training", but that training in the identification and mitigation of natural gas emergencies is embedded into entry level Firefighter I and II, and Hazmat classes, and that the skillsets on this topic are augmented during Probationary Training with natural gas meter usage training and policy / procedure review.[35]

3.1.3 Training History - Activities Conducted with/by Washington Gas

The MCFRS did not identify any recent training activities, as conducted with/by Washington Gas, specific to addressing response actions to a natural gas release / fire event.

As reported by Washington Gas on this topic (see § 3.6.3), [1] a review of the "Pipeline Emergencies: Natural Gas for First Responders" PPT session attendee roster identified that the most recent presentation [preceding the accident], to which a fire department of the MCFRS had participated in, occurred in May 2016 by the Gaithersburg Fire Department, which involved a 2-hour classroom session, and [2] a review of the Washington Gas live-action training facility ("Pipe Town") attendee roster identified that the most recent simulated live-action exercise training [preceding the accident] in which MCFRS personnel had participated, occurred in July 2016, which involved a 4-hour live-action training evolution.

3.2 Emergency Services – 911 Call Processing / Fire Department and Police Dispatching

[35] Source: a MCFRS Memorandum, from the Division Chief of Human Resources, to the MCFRS Training Chief, dated Aug. 30, 2016, on the Subject of "Response to Natural Gas Emergency Training".

Telephone requests for fire or police department emergency services in Montgomery County are placed via the Montgomery County Police Department 9-1-1 Emergency Communications Center (ECC) system [36], which also serves as the Montgomery County Primary PSAP [37]. Calls to the MC-9-1-1 ECC that request a fire department or EMS response are conveyed to the MCFRS ECC for response action (dispatch of fire department or EMS resources), as follows.

Primary service radio dispatching of MCFRS resources, in response to 911 calls that request a fire department or EMS response, is performed by the MCFRS Emergency Communications Center (ECC) [38], which also serves as the Montgomery County Secondary PSAP.

3.3 Emergency Medical Services (EMS) / Ambulance [39] - MCFRS EMS

3.3.1 Background

The MCFRS provides EMS response services for Montgomery County, which is referred to as the MCFRS EMS, which also provided resources in response to the accident event.

3.3.2 Preparedness Plans / Measures

The MCFRS EMS, being an operational Section within the Operations Division of the MCFRS, utilizes the same preparedness plans / measures as prescribed for the fire / rescue operations (see § 3.1.2).

3.4 Jurisdictional Law Enforcement (Police) – MCPD

3.4.1 Background

The Montgomery County Police Department (MCPD) is the primary law enforcement agency responsible for responding to criminal activity complaints, civil disorder, or other law enforcement-relevant emergency events in Montgomery County, which also provided resources in response to the accident event.

3.4.2 Preparedness Plans / Measures

As a law enforcement agency, the MCPD does not maintain specific formal preparedness plans and measures (that govern police operations), which are to be employed in response to a natural gas release / fire event, although as general guidance, the agency's "Basic SOP" document would provide a degree of governance for the response of police officer personnel to such an event. The agency also indicated that the "MCPD actions are governed by Function Codes 613/ 901/

[36] Ref, and for further information, see [Internet] https://www.montgomerycountymd.gov/POL/Chief/bureaus/management/ecc.html.
[37] Such a facility / operation is also referred to as a Public Safety Answering Point (PSAP), as further described in [Internet] http://www.nena.org/
[38] Ref, and for further information, see [Internet] https://www.montgomerycountymd.gov/mcfrs/about/ecc.html.
[39] Ref, and for further information, see [Internet] https://www.montgomerycountymd.gov/mcfrs/about/ems.html.

910 as well as standard ICS training. Officers also receive 4 hours of training with MCFR on fire response."

3.5 Jurisdictional Emergency Management Agency (OEMHS)

3.5.1 Background

The Montgomery County Office of Emergency Management and Homeland Security (OEMHS) provides emergency management support to address natural and technological hazards in Montgomery County, as also described in its Mission Statement, as follows.[40]

"The Office of Emergency Management and Homeland Security's mission is to plan, coordinate, prevent, prepare and protect against major threats that may harm, disrupt, or destroy our communities, commerce and institutions and to effectively manage and coordinate the County's unified response, mitigation, support and recovery from the consequences of such disasters or events should they occur."

3.5.2 Preparedness Plans / Measures

The OEMHS prepared and uses an "All-Hazards" preparedness response plan titled "Montgomery County Hazard Mitigation Plan 2013", as obtained by the investigation.[41]

3.6 Natural Gas Supplier – Washington Gas [42]

Washington Gas supplied natural gas to all of the structures that used natural gas in the subject community, including the structures involved in the explosion / fire.

3.6.1 Resources to Address a Gas Leak and Other Gas Safety Issues

Resources utilized by the company to address a natural gas leak, or other safety issues involving its product delivery and usage, include the following resources and functional departments of the company.

a. Emergency Telephone Contact

The company maintained and publicized, in its [Internet] web-site, two telephone numbers [43] for individuals to contact the company in the event of a gas leak, or other safety issues involving its product delivery and usage. The company also indicated, in its [Internet] website and in periodic information mailed to its customers (e.g., a pamphlet included in monthly billing statements), for individuals to call 9-1-1 in the event of a gas leak.

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[40] Source: email correspondence from the agency Director, dated 1/13/2017

[41] Ref, and for further information, see [Internet] http://www.montgomerycountymd.gov/council/Resources/Files/REPORTS/MCHazardMitigation-Jul2013.pdf

[42] Ref, and for further information, see [Internet] https://www.washingtongas.com/, and as otherwise indicated.

[43] The cited telephone numbers were 703-750-1400, or 800-752-7520, both numbers of which connect directly to the WG Operations Emergency Call Center, which operates on a 24-hour basis.

b. Customer Service Call Center

The company maintained a "Customer Service Call Center" [44], which is staffed by trained personnel (referred to as Customer Service Representatives), for gas service customers, or other individuals who are within the WG service territory, to communicate [place a telephone call, in ref to] various inquiries and requests (principally customer billing or service changes). The Call Center, which is operated by a contractor (under a commercial arrangement [45]), is also available to receive notifications of a natural gas odor from the public, the information of which is then immediately conveyed to the Gas Operations Dispatch Center (see § 3.6.1.c.).

c. Gas Operations Dispatch Center

The company maintained a "Gas Operations Dispatch Center", which was staffed by trained personnel (referred to as Gas Operations Dispatchers), that, generally described, receive information from the Customer Service Call Center regarding a routine gas service request, or information regarding a gas-related emergency event (i.e., a reported gas odor [46]), wherein, and responsive thereto, the Dispatchers will dispatch Gas Operations - Service Technician(s) (see § 3.6.1.d.) to perform:

[1] various routine gas operations service-call duties throughout the WG system (e.g., service connections, disconnections, meter servicing, etc.), or

[2] emergency gas operations duties, such as if a gas odor is reported, consisting, for example, of an immediate shut-off of the gas flow valve(s) at a gas leak site, and/or coordinating with the local emergency services personnel (fire department, police, etc.) to perform other emergency support as needed (as further described).

In the event a gas odor is reported to WG's Dispatch Center, as a generalized procedural description, pursuant to the Dispatch Center's documented operational procedures [i.e., the "WG Engineering and Operating Standards - Operations and Maintenance Manual"], the received gas odor data (referred to as a 'service ticket') is processed in a prescribed response, as follows:

[44] WG maintains two Customer Service Call Centers (published telephone number is 703-750-1000, and hours of operation are: Monday - Friday: 8 a.m. - 9 p.m., and Saturday: 8 a.m. - 4:30 p.m., except major holidays), which are operated by a contractor (as further described), which are fully redundant operations and function as a primary and a secondary facility, respectively, with the latter serving as a 'back-up operation', available to process incoming calls that the primary facility is unable to immediately process. [WG further indicates in this] "If a customer, seeking to report an emergency, unwittingly calls the Customer Service Call Center outside of its normal operations hours, the customer will get a message directing the customer to press "1" to report the emergency. Upon pressing "1" the customer will be transferred directly to the WG Operations Emergency Call Center, which operates on a 24-hour basis."

[45] A company by the name Faneuil, Inc., operates Customer Service Call Centers for WG, which is located in Hampton, VA, with a secondary facility in Martinsville, VA (ref, and for further information, see [Internet] http://faneuil.com/, and (a news announcement in Ref to support of WG 'call center' activities), http://faneuil.com/news/faneuil-add-35-jobs-call-center/), and [a similar news announcement by WG:] http://newsroom.washingtongas.com/press-release/wgl-establish-washington-gas-customer-service-centers-virginia.

[46] As a point of technical clarification, WG internally considers a received report / complaint of a "gas leak" to be a "gas odor" until verified by a WG representative to be, in fact, a "gas leak".

[1] the gas odor data is logged into the Gas Operations Computer Aided Dispatch (CAD) System by the Dispatcher,

[2] a Gas Operations Service Technician, who is closest to the reported odor site, is identified,

[3] the received gas odor data ['service ticket'] is transmitted to that closest identified Service Technician (i.e., relayed as a digital message, via the CAD System, to a computer display in the Service Technician's vehicle), as preparation for dispatch of the Service Technician to the report site,

[4] a telephone call is placed by the Dispatcher to the Service Technician, to affirm that the 'service ticket' has been received and that the Service Technician is responding,

[5] in the event that the reported gas odor is potentially of a significant consequence, a field supervisor and/or other resources may be notified, and may subsequently be dispatched to the reported gas odor site.

Additionally, arrangements have been implemented by WG, whereby the local emergency services agencies can connect immediately with / directly to the Gas Operations Dispatch Center to report an emergency event (in a process analogous to a 'speed-dial system'), rather than having to relay reported gas odor data to the Dispatch Center via contacting the Customer Service Call Center. Further, the above [five] procedural response steps would also apply in the event that a reported gas odor is received directly from a local emergency services agency (e.g., Montgomery County 9-1-1 ECC).

d. Gas Operations - Service Technicians

Supportive to the Gas Operations Dispatch Center, the company maintained a number of trained personnel, referred to as Service Technicians, who were strategically situated, on a daily basis, throughout the WG operational system. The Service Technicians are assigned to respond to various routine service-calls throughout the WG system, to [1] perform routine gas operations duties (e.g., gas service connections and disconnections, meter servicing, infrastructure [piping] inspections, etc.), or [2] perform emergency operations duties, consisting of, for example, an expedited closure of gas flow valve(s) at a gas leak site, and/or coordinating with the local emergency personnel (fire department, police, etc.) to perform other emergency support as needed.

Service Technicians are issued a vehicle (a specially equipped service van) to perform their service-calls (whether routine, or as an emergency dispatch). Communication of the Service Technicians with the Gas Operations Dispatch Center personnel are by cellular telephone (company issued), company service radio, or by the WG CAD System located in the Service Technician's vehicle (digital data transmittal). Movement of the Service Technician's vehicle was reported to the Dispatch Center via a vehicle tracking (telemetry) system supplied by TomTom Telematics.[47] Service Technicians are required to insert report data in the [service van] CAD System describing their field activities during a response to an emergency event.

[47] Ref, and for further information, see [Internet] https://telematics.tomtom.com/en_us/webfleet/fleet-management/vehicle-tracking/.

3.6.2 Emergency Preparedness and Response - Plans / Measures

Supportive to the Gas Operations Dispatch Center, and Service Technicians operations, WG has developed and maintains preparedness plan and technical specification documentation as follows (copies of which were obtained by the investigation).

Plan / Specification - Identification Title	Rev. Date
Engineering and Operating Standards - Operations and Maintenance Manual	May 2016
Engineering and Operating Standards - Emergency Manual	Jan. 2014

3.6.3 Natural Gas Supplier - Gas Operations – Instructional Support Documentation and Training

WG offers two tiers of professional instructional support training in the principles and practices of emergency response to address natural gas emergencies, which are available to personnel of the local emergency services agencies within the WG gas-service operational territories (principally fire departments). This training involves both [a] the distribution of instructional guidance documentation as well as instructional technical lectures on same at either the WG training facility or at constituent fire department facilities (fire stations), and [b] attendance at the WG live-action field exercise training facility, all of which are offered at no cost to the recipients, which are summarized as follows.

a. Instructional Guidance Documentation and Lectures

WG had produced guidance documentation, in the form of a PowerPoint® (PPT) presentation, titled "Pipeline Emergencies: Natural Gas for First Responders", which addressed detailed technical aspects of emergency procedures to be implemented in the event of a gas leak or a fire. The PPT is presented by WG training staff to any fire department agency that's located within its operational territories (in VA, MD, and DC), which is usually conducted in a classroom session, and held at either the fire department agency's facility (fire station), or at the WG training facility (see § 3.6.3.b.).

A review of PPT session attendee roster documentation identified that the most recent presentation [preceding the accident], to which a fire department of the MCFRS had participated in, occurred in May 2016 by the Gaithersburg Fire Department, which involved a 2-hour classroom session.

b. Live-Action - Professional Training Facility

WG maintains and operates a formal, dedicated, professionally equipped, training facility for emergency services personnel (principally fire departments), and WG service technician personnel (principally newly hired personnel, with recurrent training for existing personnel), which is referred to by the company as "Pipe Town", which is located at the company's Springfield, VA, business office property. The facility consisted of classrooms, and a 'live-action training exercise yard', which is fitted with underground natural gas piping that are

connected to a number of individual training evolution sites in the facility that simulate various real-world 'fire ground environment' training scenarios (e.g., broken pipelines, leaking meters, etc.). Fire departments are invited to visit the training facility, where attendees can participate in both [1] classroom-based training sessions, as well as [2] a 4-hour training evolution routine that involves various 'live-action' field exercise training activities, utilizing actual natural gas-fed fires, in which the attendees can practice fire suppression techniques, and engage in other gas-related emergency response training evolutions (e.g., leak detection, valve closure procedures, etc.).

Participation in the facility's training activities is by invitation, in which WG mails (certified), on an annual basis, formal training opportunity invitation letters to all 379 fire department agencies within its operational territories (in VA, MD, and DC). WG documented to the investigation that the most recent mailing [preceding the accident] occurred with the issuance of letters dated Apr. 21, 2016. It is the responsibility of the recipient fire department agencies to respond to the received invitation, and commensurately schedule a training activity session with WG, to which CEU's are also awarded to attendee personnel for their participation. If a given [invitation-letter] recipient fire department agency doesn't respond to the initial invitation letter, a second (follow-up) invitation letter is then mailed to that agency. If no response is received to this second letter, WG follows-up with a personal visit by WG training staff to the subject fire department agency, in which another invitation letter is then hand-delivered to the recipient fire department.

A review of the [Pipe Town] attendee roster documentation identified that the most recent simulated live-action exercise training [preceding the accident] in which MCFRS personnel had participated, had occurred in July 2016, which involved a 4-hour live-action training evolution. WG further identified that, in 2015, of the 379 fire department agencies within its operational territories that were issued training activity invitations, approximately 30 fire department agencies participated in simulated live-action exercise training at the Pipe Town facility.

3.6.4 Specialized Gas Operations - Emergency Response Protocol Documentation Distributed to Local Emergency Services Agencies

None were identified to the investigation.

3.6.5 Public Awareness Program

WG compiled a document titled "Washington Gas Pipeline Safety Public Awareness Plan", which was dated December 14, 2015, which describes the Public Awareness Program as implemented by the company, a copy of which was made available to the investigation.[48]

4.0 The Emergency Response

4.1 Event Chronology ("Timeline")

[48] Pursuant to the criteria of API 1162, and PHMSA regulation (49 CFR 192.161 Public Awareness), the subject document is required to be compiled by the utility operator.

An event chronology ("Timeline") was constructed to identify the sequencing facts of the emergency response to the event, and to examine the execution of the emergency response effort (e.g., fire suppression / search and rescue). In support of this, the natural gas utility company involved (Washington Gas), and the principal responding emergency services agencies (MCFRS, MC- 9-1-1 ECC [PSAP] and [emergency services] Dispatch, and MCPD) were offered the opportunity to provide incident response data and communications information as relevant to this event. NTSB staff also conducted individual interviews of gas utility company personnel, and initiated investigation dialog with key management personnel of the emergency services agencies and the natural gas utility involved, to identify the facts as cited in the Timeline narrative.

The Emergency Response - Event Chronology ("Timeline") narrative compiled during the investigation is presented in Exhibit 1.

4.2 Execution of the Emergency Response

See the Timeline of the Event (Exhibit 1, as described in § 4.1).

Supporting mutual-aid fire department organizations included Prince Georges County and the District of Columbia.

4.3 Medical Facilities Utilized in the Response to the Accident

Medical facilities that received patients transported from the accident site are listed below.[49]

Facility	Location
Children's National Medical Center	Washington, DC
Holy Cross Germantown	Germantown, MD
Montgomery Medical Center	Olney, MD
Shady Grove Adventist Hospital	Rockville, MD
Sibley Memorial Hospital	Washington, D.C.
Suburban Hospital	Bethesda, MD
Walter Reed National Military Medical Center	Bethesda, MD
Washington Adventist Hospital	Takoma Park, MD
Washington Hospital Center	Washington, DC

4.4 Emergency Management (OEMHS) Response to the Accident [50]

The OEMHS issued a Memorandum summarizing its role in the response to the event, a copy of which is provided in Exhibit 2.

[49] Ref data received from NTSB Transportation Disaster Assistance (TDA) staff, as sourced from the local emergency response agencies.
[50] Source: email correspondence from the agency Director, dated 1/13/2017

4.5 Post-Event Critique / Debriefing - Review Activities / Reports

The principal emergency services agencies of Montgomery County that were involved in the tactical response to the event (i.e., MCFRS / MCPD), the jurisdictional emergency management agency (OEMHS), and the pipeline owner / operator (WG), were afforded an opportunity to document to the investigation any post-event critique / debriefing - review activities, or report documentation as might have been conducted / compiled in the event, the responses of which are summarized as follows.

- The MCPD indicated [51] that an internal critique / debriefing review (informally referred to in the emergency response community as a "Hot Wash") was conducted by "MCFR/MCP/ MCOEMS" on September 9, 2016, and that a report on same was produced (as further described in the following bullet).
- In conjunction with the above, the MCPD provided a copy of an undated "preliminary … draft" document titled "Montgomery County, Office of the County Executive, Office of Internal Audit, Silver Spring Apartment Fire: County Response / Recovery Effort, MCIA-17-4", in which a review of same indicated [1] it does not make any reference to the "Hot Wash" activity (as occurred on 9/9/2016) as the source data of the document, [2] it does not address the tactical response activities of the MCFRS / MCPD in the event, and [3] it was compiled to (as cited in the document) "… identify lessons learned from the County's response and recovery effort in addressing the human and social service needs following the fire." [52]
- A document titled "After-Action Report / Improvement Plan", dated November 16, 2017, as compiled by the OEMHS, was made available to the investigation by that agency [53], in which a review of same indicated [1] it does not make any reference to the "Hot Wash" activity (as occurred on 9/9/2016) as the source data of the document, [2] it does address the specific tactical response activities of the MCFRS / MCPD, among many other response agencies in the County that supported the response to the event, and [3] although it doesn't cite, per se, that this document had a 'countywide' After-Action Report (AAR) applicability, the transmittal [email] of this did indicate "… as the lead for the collective countywide Emergency Management Group (a collection of the emergency response stakeholders - public, private and non-profit), OEMHS organized the effort to conduct a countywide AAR targeting the strengths and areas of improvement for collective response".[54]
- The pipeline owner / operator (WG) indicated that a post-event critique / debriefing has not yet been completed in this event. [55, 56]

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[51] Source: email correspondence from the MCPD Party representative, dated 1/13/2017.
[52] As the document did not address the tactical response activities of the MCFRS / MCPD in the event, it was not considered relevant to the SF investigation.
[53] Source: email correspondence from the agency Director, dated 1/13/2017
[54] A copy of the document will be available in the NTSB public docket
[55] Compilation of "Post-Incident Critiques" is addressed in Section 1102 of the WG Engineering and Operating Standards - Emergency Manual (Ref § 3.6.2 of this report).
[56] Relative to the completion status of post-event critique [report] documentation, WG also noted to the investigation [email from the WG Party representative, dated 1/30/2017], "Per our Emergency Manual, our post incident critique is not completed, but is clearly underway through the examination of our Emergency Response as a party to the

- The OEMHS documented its role / response to the event, as further described (see § 4.4).

5.0 Medical and/or Pathology Data

5.1 Civilian Injuries / Fatalities [57]

Data obtained by the investigation indicated:

- 65 civilian individuals (i.e., persons located within, or near, the subject explosion / fire damaged structures) were identified as transported to local medical facilities, for medical evaluation and/or treatment, and
- seven civilian individuals sustained fatal injuries.

5.2 Emergency Responder Injuries

Three firefighters reportedly sustained minor injuries, all of which were treated and released by local medical facilities.

5.3 Pipeline Owner / Operator Injuries

There were none reported to the investigation.

6.0 Proactively Employed Initiative Measures / Actions - Implemented Subsequent to the Accident

SF Group participants of the investigation were offered an opportunity for data feedback to the investigation, to describe specific / documented initiative measures that have been initiated or employed by these organizations subsequent to the event, such to take advantage of 'lessons-learned' in the accident, the response(s) of which are summarized below.[58]

6.1 Washington Gas[59]

- WG participates in industry research and development collaborative organizations such as the Gas Technology Institute[60] [in which WG's Maryland customers contribute to the

NTSB investigation. [and] … Through the course of this NTSB investigation we have examined most, if not all, of the elements covered by section 1102 from the WG Emergency Manual. The results of that examination will be compiled in a formal post incident critique upon completion of the NTSB investigation."

[57] The investigation utilizes data of civilians involved in the accident, as directly obtained by the NTSB Transportation Disaster Assistance (TDA) staff during the course of the investigation, and data as identified in obtained death certificate / pathology report documentation.

[58] Information in this report section was quoted verbatim as received (to the extent possible, allowing for typo-graphical error corrections, summarizing detailed / lengthy submissions, etc.), where also, for SF Group - Party participants that are not listed in this report section, there was no responsive data received from those organizations.

[59] Source: email received from SF Group / WG Party representative, dated 1/13/2017 (received content quoted verbatim).

[60] Ref, and for further information, see [Internet] http://www.gastechnology.org/.

initiative programs] and NYSEARCH[61].

- These organizations seek to develop technologies and products that enhance system safety. Examples of products currently being researched include the "Triple Plus Shut Off Valve", and the "Residential Methane Detectors".
- WG also researched and procured a fitting which is designed to shut off gas flow when excessive temperatures such as those experienced in a structure fire exist.
- WG is also a member of the American Gas Association, Southern Gas Association, Northeast Gas Association, and the Virginia Gas Operators Association, where operating personnel participate to develop or uncover industry best practices for use within the WG operating territories.
- Additionally, as a result of the NTSB's collaborative review of WG's emergency response procedures and protocols, WG has improved the data quality of documentation with respect to receipt of fireboard calls by establishing process validations and conducting training on the documentation of such calls. WG also improved communication and awareness of its toll-free emergency leak line on its web site.

E. AUTHORSHIP

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-- End of this report section --

List of Exhibits

1. Emergency Response - Event Chronology ("Timeline")
2. OEMHS Memorandum - summarizing its role in the response to the fire / explosion at 8701 Arliss Street, on August 10, 2016

[61] Ref, and for further information, see [Internet] http://www.nysearch.org/