Washington Gas
A WGL Company

WASHINGTON GAS MEETINGS WITH NTSB MEMBERS

NTSB ACCIDENT ID
DCA16FP003

SUMMARY

- Introductions & Washington Gas Safety Culture
- NTSB Investigation and Supported Conclusion
- Extensive Damage, Complex Investigation
- Exact Timeline Difficult to Determine
- Review of Evidence—Many Potential Sources and Possible Causes
- Washington Gas Safety Enhancements & Recommendations

INTRODUCTIONS & SAFETY CULTURE

- Tragic accident
  - 7 deaths
  - 42 injuries
- Appreciate opportunity to assist NTSB
- WGL commitment to safety

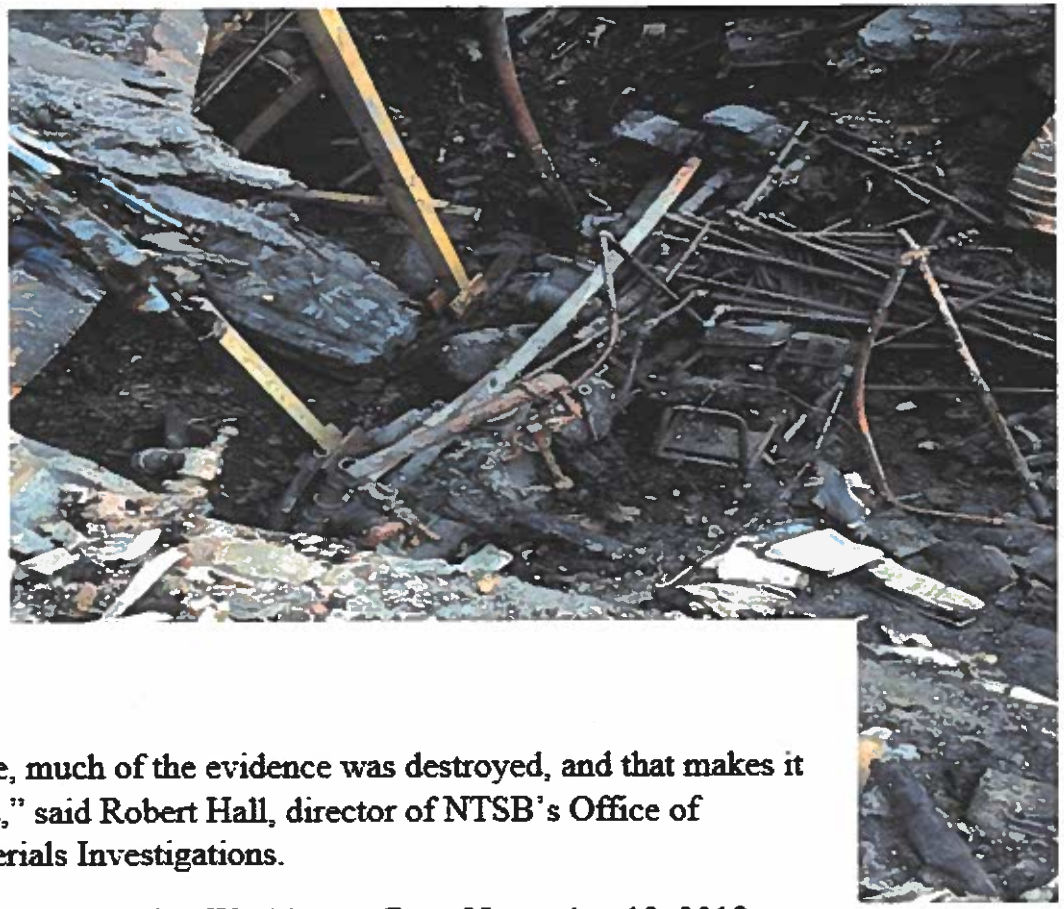
CAUSE CANNOT BE DETERMINED

Extensive investigation was completed

- ATF identified many potential sources of gas
- NTSB investigation did NOT rule out any of ATF potential sources
- Limited opportunity for gas accumulation—as few as 20-40 minutes prior to the explosion
- Utility regulators represent the least likely source

EXTENSIVE DESTRUCTION OF METER ROOM

"Given the damage to the natural gas regulators, natural gas meter bank and water heater, investigators were not able to immediately determine the failure that led to the release of fugitive natural gas in the 8701 Meter Room. " -- ATF Report



The Washington Post

"In the explosion and post-accident fire, much of the evidence was destroyed, and that makes it one of our most difficult investigations," said Robert Hall, director of NTSB's Office of Railroad, Pipeline and Hazardous Materials Investigations.

- The Washington Post, November 18, 2018

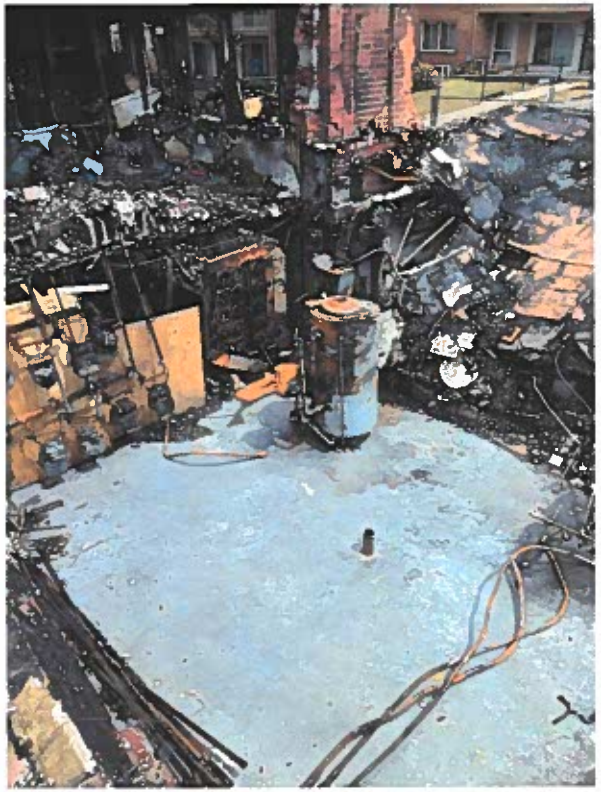
ATF UNABLE TO ESTABLISH TIMELINE

"…[I]nvestigators were unable to establish a satisfactory timeline based on the available data."

"Future testing of the involved natural gas regulators, meter bank, water heater, and associated piping may provide useful information capable of overcoming this data shortfall."

ATF Report

ATF IDENTIFIED MANY POTENTIAL SOURCES OF FUGITIVE GAS



- Regulator failure
- Failure of the meter bank
- Water heater
- Associated piping

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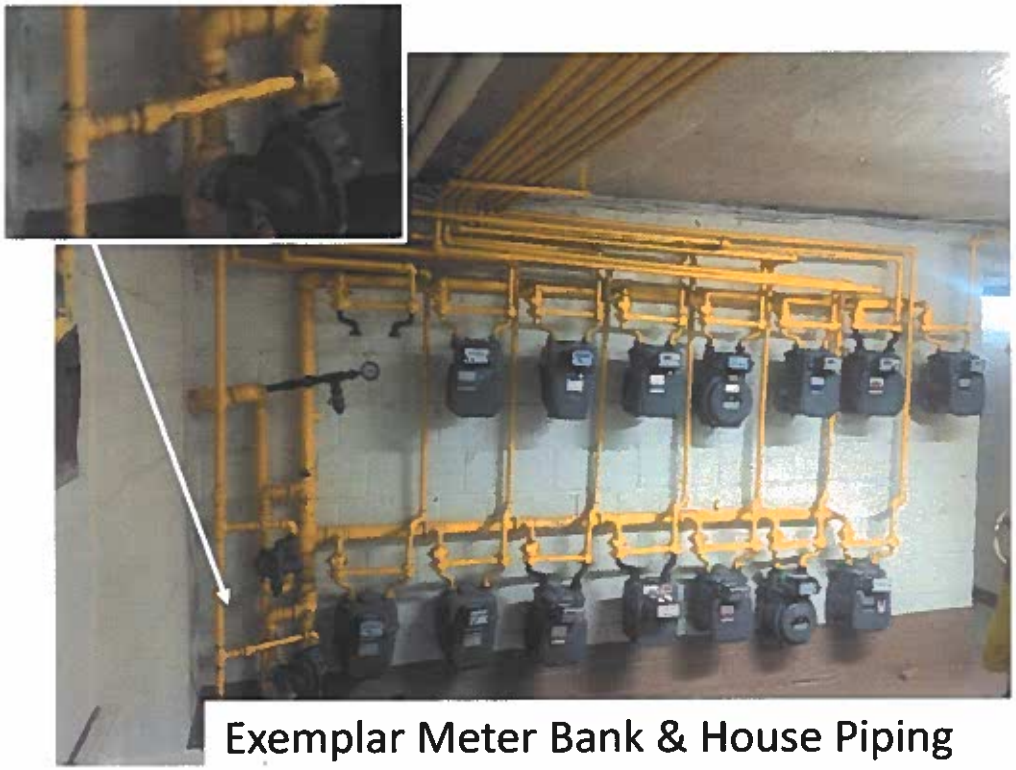
MANY POTENTIAL SOURCES AND CAUSES



Exemplar Meter Bank & House Piping
(8709 Arliss St)

Exemplar Water Heater

"Sources of natural gas in the 8701 Meter Room involve the main natural gas feed, natural gas meter bank, an 81-gallon water heater and the associated piping."
ATF Report

20 OF 21 METER ROOMS ARE WELL-PROTECTED

20 of 21 Meter Rooms in complex:

- Have protective cages around water heater and piping
- No delivery or storage of heavy equipment or maintenance activities

8701 METER ROOM WAS UNIQUELY EXPOSED

- Only 1 of 21 meter rooms without protective cage around water heater
- Regular delivery and storage of heavy equipment and maintenance supplies

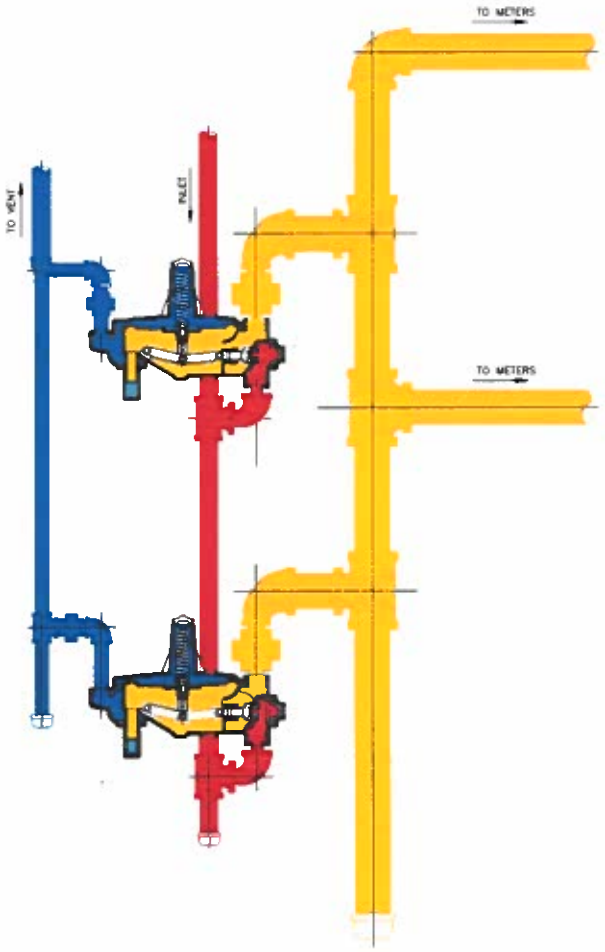
Date (2016)	Testimony on condition of Meter Room
Wed, March 23	Cited for improper storage, access & fire safety
Fri, May 6	Montgomery County Code Compliance re-inspects and clears violation
Mon, Aug 8	"Room was immaculate and spotless"…"There was no equipment" [Melillo Testimony – President, Kay Management]
Mon, Aug 8 to Wed, Aug 10	Heavy objects delivered and stacked in and around exposed, unprotected gas piping & equipment [Hidalgo Testimony – Maintenance Engineer, Kay Management]
August 10	Explosion occurs 11:51 PM

REPORTED INVENTORY IN METER ROOM ON WEDNESDAY, AUGUST 10, 2016

Aprox Quantity	Item Discription
7 to 8	Gas Furnance
3 to 4	A\C Condenser
7 to 8	A Coils for A\C
1	Roll copper a\C pipe
1	Roll B\X Wire
1	Roll Romex Wiire
20	3\4 x10' PVC Pipe
4 to 6	Condenser Pump
5 to 6	Box Fans
2	Portable A\Cs
2	Case Spray Nine
2	Case Windex
10	Bath Room Mirror
2	Case Paper Towels
1	Case Toilet Paper
20	File Boxes
5	Salt Spreader
2	Boxes Air Freshener
8	Cases Brown Caulk
3	Ceiling Fans
5 each	Top&bottom Ref. Gaskets

4	Range Tops
3 to 4	A\C Pans
4	Thermo Couplings(Oven)
7	Yelloow Boots
7	Rain Coats
1	Box Shoe Booties
2	Box Pipe Insulation
1	Box Floor Tile
1	Dehumidifier
2	Case Return Grill A\C
1	File Cabinet
1	Trash Can Full Snow Shovels
1	New Chain Saw in Box
1	Back Pack Blower almost Empty
1	Pressure Washer Almost Empty
1	1Gal Gas Can Empty

NATURAL GAS DISTRIBUTION SYSTEM



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SERVICE REGULATORS

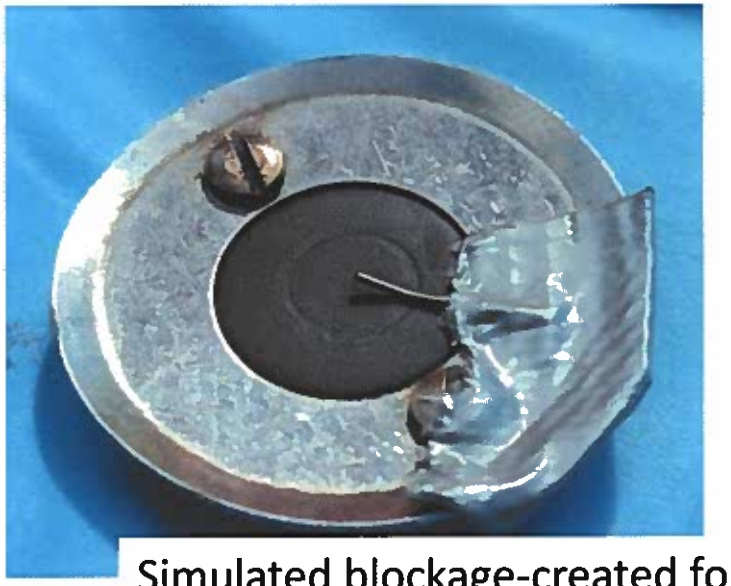
REGULATOR FAILURE IS IMPROBABLE AS A CAUSE

- ATF suggested regulators were a source of high flow gas – Not true
- No evidence of regulator failure
- ATF relies on the open fitting found after explosion
- Fitting condition likely a result of the explosion/collapse

NO EVIDENCE "OF ANY ISSUES THAT AFFECTED THE PERFORMANCE OF THE REGULATOR" – NTSB, JULY 6, 2018

SERVICE REGULATORS

- Less than 0.05% removed annually for leakage and venting
- 1950s exemplar regulators from Flower Branch complex in excellent working order—best evidence of condition of regulators at incident site
- Any regulator failure scenario would be low flow (<< 165 CFH)



Simulated blockage-created for testing

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SERVICE REGULATOR VENT LINE

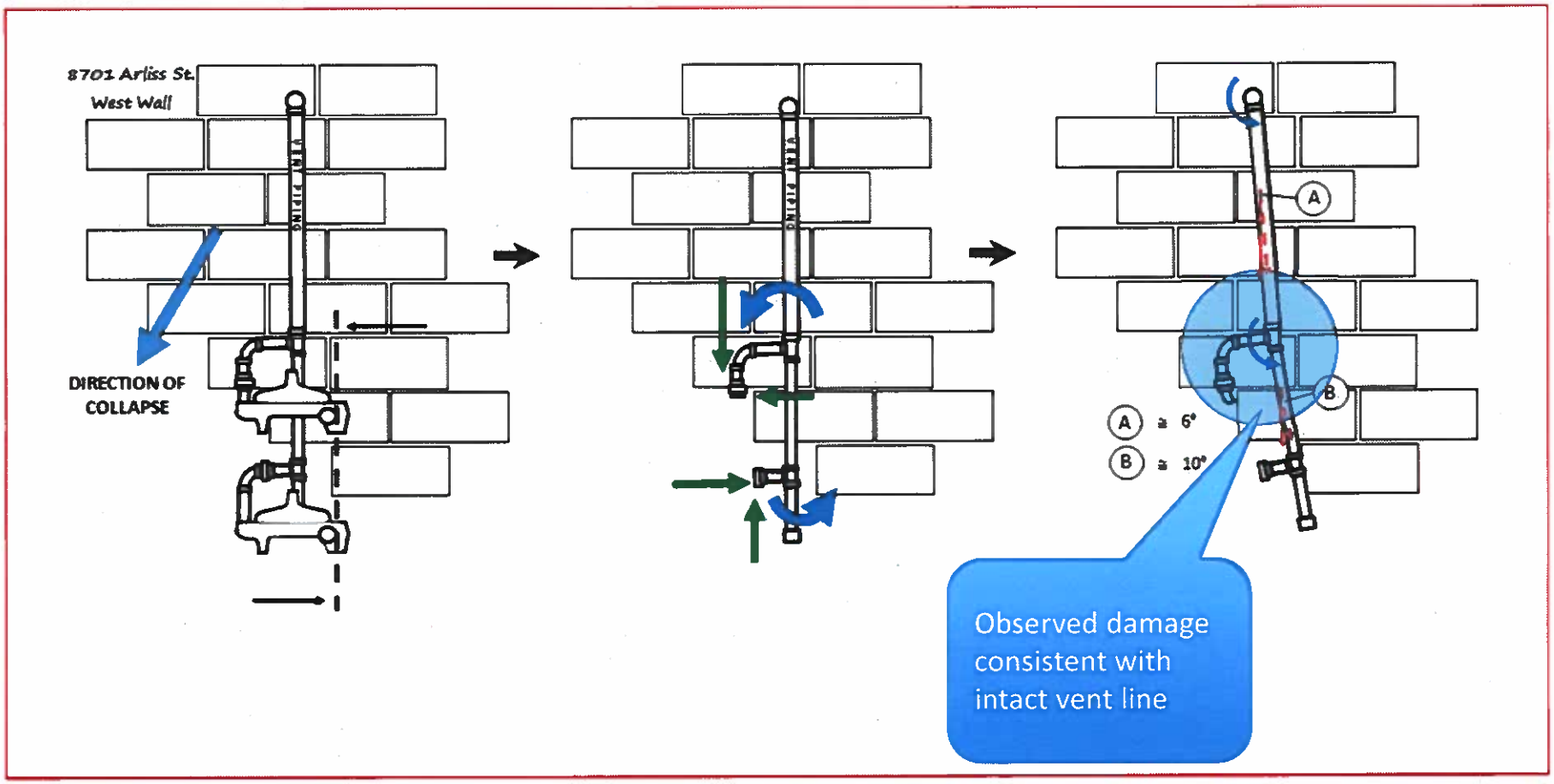
- Piping conditions consistent with union being intact
- Damage indicates forceful separation
- No observations of open/breached vent line
  - No procedure required fitting to be opened
  - No evidence it was left open by Washington Gas

Deflection of Vent Piping

Fit of Union Components

Thread Deformation

ONLY A CONNECTED VENT LINE EXPLAINS OBSERVED PIPING CONDITION



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BROKEN FUEL LINE TO WATER HEATER

- Fuel line exposed and vulnerable
- Active storage of heavy, appliances, equipment and materials near water heater and exposed gas fuel line (human factors)
- Broken ½" threaded connection observed
- Broken ½" threaded connection produces a large flow of gas: 650 CFH (<20 minutes to LEL)

cleaned in Alconox, a commercial detergent. Figures 3 and 5 show photographs of the fracture faces after cleaning. Post cleaning examination of the fracture faces revealed they contained a rough fracture texture on slant planes consistent with overstress separation.

Frank Zakar
Senior Metallurgist

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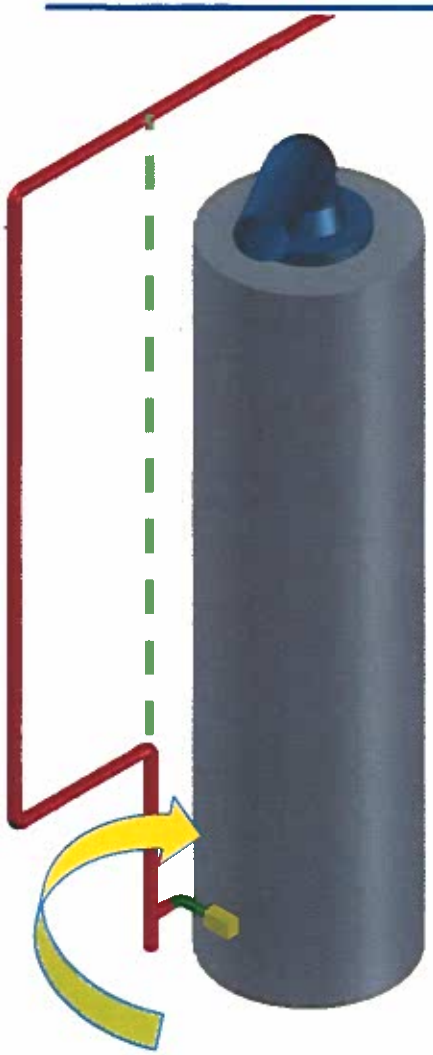
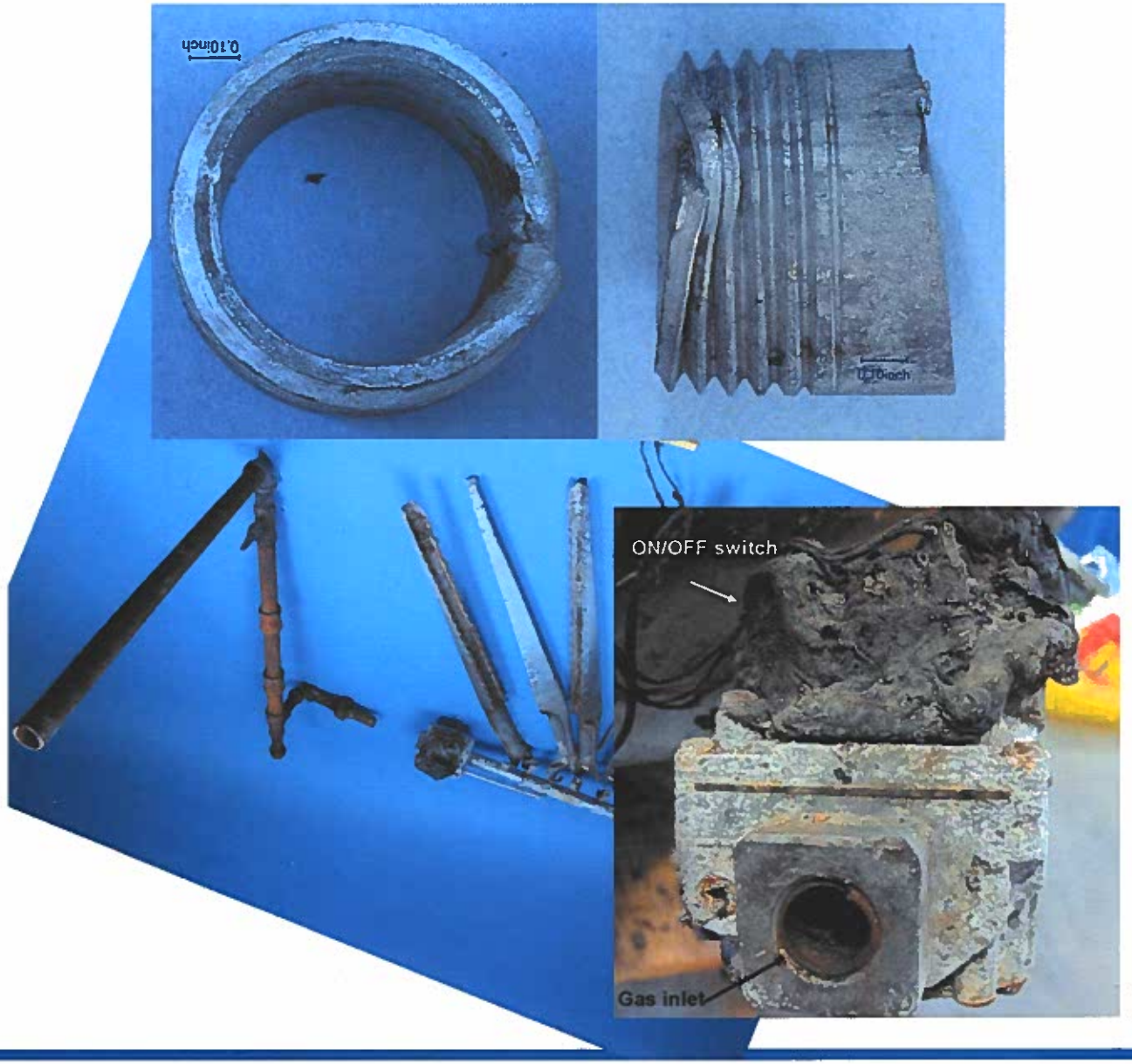
VULNERABILITY OF WATER HEATER FUEL LINE





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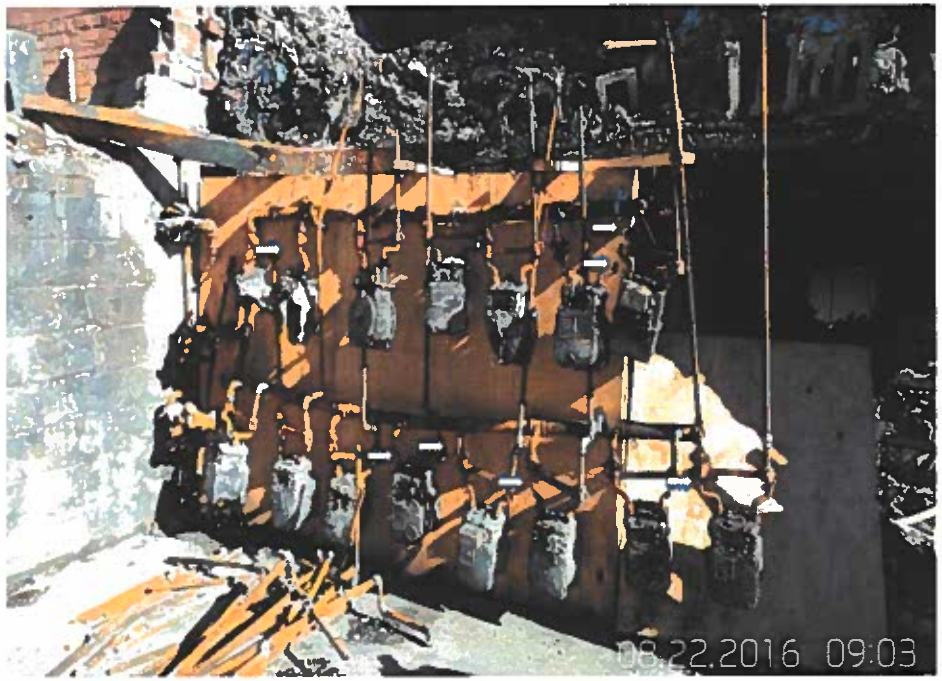
METER SWIVELS

Exemplar Meter Bank & House Piping



- Meters exposed and vulnerable to damage from heavy objects
- Numerous swivels found broken
- Evidence of heavy materials / equipment stored near meter rack
- Severed swivel would produce a gas flow of 1,613 CFH (<10 minutes to LEL)

NUMEROUS BROKEN HOUSE PIPE CONNECTIONS

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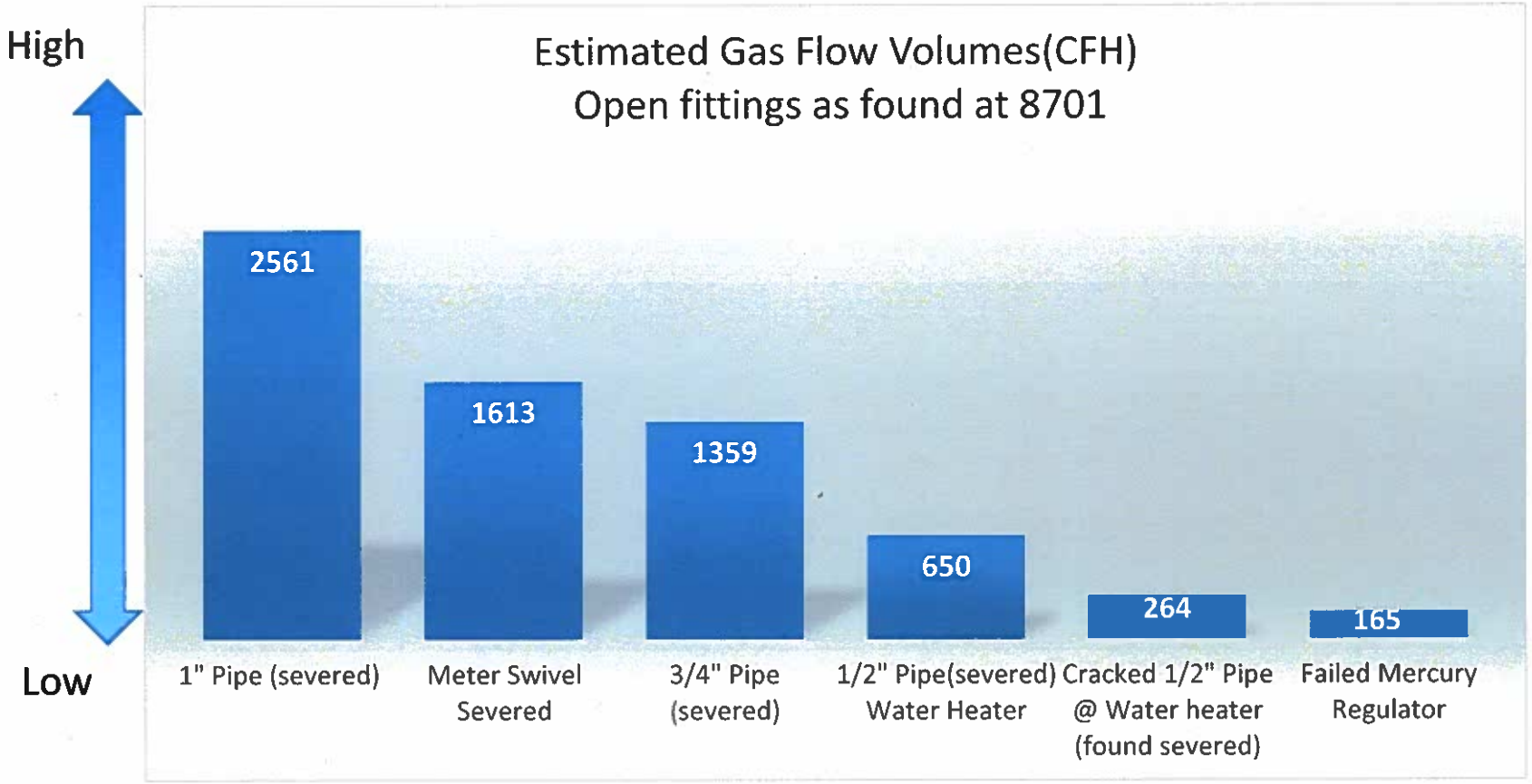
FLOW RATES AND TIMELINES

FLOW RATES OF POTENTIAL SOURCES



ATF made incorrect assumption about relative gas flow rates.

ATF Report – page 11

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INCIDENT TIMELINE – HIGH FLOW EVENT

Time	Basis	Window for Accumulation by 11:51 PM explosion	Potential sources to reach LEL, based on NTSB flow rates.
6:04 pm	Kay Maintenance leaves meter room **(no odor present)**	Approx. 5 hrs. 47 min.	1. Regulator (low flow) 2. Water heater (high flow) 3. Meter bank swivels (high flow) 4. House pipe (high flow)
8:42 pm	Kay Security checks area outside meter room **(no odor present)**	Approx. 3 hrs. 9 min.	1. Regulator (low flow) 2. Water heater (high flow) 3. Meter bank swivels (high flow) 4. House pipe (high flow)
11:15 – 11:30 pm	Witness Boye enters building **(no odor present)**	Approx. 20 min. – 40 min.	~~1. Regulator (low flow)~~ 2. Water heater (high flow) 3. Meter bank swivels (high flow) 4. House pipe (high flow)
11:47 pm	Witness Boye **(inside odor present)**	<10 min. (Boye cell phone record)	N/A
11:51 pm	Explosion occurs		N/A

INDETERMINATE CAUSE

- Double Failure scenario (open vent and failed regulator) —improbable
  - No evidence of a regulator failure (NTSB finding)
  - No evidence Washington Gas left any fitting open
  - Any suggestion to the contrary is pure speculation
- Other sources identified by ATF produce significantly higher gas flow rates
- Gas odor reports indicate a short timeline
- Alternate fuel sources not eliminated by evidence or testing
- Water heater has characteristics that cannot be ignored
- Human error more likely than mechanical error (industry accident statistics)

WGL CONTINUING SAFETY IMPROVEMENTS

- Support Residential Methane Detection R&D
- Industry Leader in Implementation of Thermal Safety Valves
- Improved Multi-Family, Multi-Lingual Safety Messaging and Outreach
- Enhanced Emergency Response Coordination with Fire Departments
- Early adoption of API 1173 Pipeline Safety Management System (July 2015)

MULTI-FAMILY BUILDING RECOMMENDATIONS

- Enhance code enforcement regarding storage activities in meter rooms
- Require flexible connections at rigidly mounted gas appliances
- Require methane detector installations in the gas meter rooms
- Enhance tenant information re gas safety and reporting of gas odors

THANK YOU

APPENDIX

INDETERMINATE-CAUSE NTSB REPORTS

2017.09.18 Bus Collision, Flushing, New York

The National Transportation Safety Board determines that the probable cause of the Flushing, New York, crash was the driver's unintended acceleration of the motorcoach and inability to brake for reasons that could not be conclusively determined from the information available. (Page 10)

2016.05.12 Flooding and Sinking of Small Passenger Vessel, Turtle Bay, Mexico

The National Transportation Safety Board determines that the probable cause of the flooding and sinking of small passenger vessel *Maximus* was a hull breach near the waterline from an unknown cause. Contributing to the accident was the ineffectiveness of the installed high-level bilge alarm system to alert the crew to water accumulating in the hull. (Page 7)

2016.02.20 Railway Employee Fatality, New Orleans, Louisiana

The National Transportation Safety Board determines that the probable cause of the accident was the trainmaster not detecting the presence of an oncoming train and removing himself from main track 2 for unknown reasons. (Page 2)

2016.02.03 Highway-Railroad Grade Crossing Collision, Valhalla, New York

The National Transportation Safety Board determines that the probable cause of the accident was the driver of the sport-utility vehicle, for undetermined reasons, moving the vehicle onto the tracks while the Commerce Street highway-railroad grade crossing warning system was activated, into the path of Metro-North Railroad train 659. Contributing to the accident was the driver of the sport-utility vehicle: (1) stopping beyond the stop line, within the boundary of the highway-railroad grade crossing, despite warning signs indicating the approach to the grade crossing; and (2) reducing the available time to clear the grade crossing by exiting the vehicle after the grade crossing warning system activated because the driver's attention was diverted by the grade crossing warning system crossing gate arm striking her vehicle. Contributing to the severity of the accident was the third rail penetrating the passenger compartment of the lead passenger railcar and the post-accident fire. (Page 66)

INDETERMINATE-CAUSE NTSB REPORTS

22014.04.14 Fed Ex Collision with Bus, California

The National Transportation Safety Board determines that the probable cause of the Orland, California, crash was the inability of the FedEx Freight truck driver to maintain control of the vehicle due to his unresponsiveness for reasons that could not be established from available information. Contributing to the severity of some motorcoach occupant injuries were high impact forces; the release of combustible fluids, leading to a fast-spreading post-crash fire; difficulties in motorcoach egress; and lack of restraint use. (Page 65)

2012.05.28 Marine Vessel Fire, Mediterranean Sea, NE Malta

The National Transportation Safety Board determines that the probable cause of the fire on the M/V Alliance Norfolk was ignition of flammable material by an undetermined ignition source on deck 5 due to shifting cargo while the vessel was rolling in heavy seas after losing power. Contributing to the severity of the damage was the re-flash of the smoldering fire when the vessel was in port. (Page 4)

2008.05.28 School Bus Rollover, Milton, Florida

The National Transportation Safety Board determines that the probable cause of the Milton, Florida, accident was the school bus driver's failure, for undetermined reasons, to maintain her traffic lane, which resulted in the bus being struck from behind when it drifted into the left lane and into the path of an oncoming faster-moving vehicle. Injury severity was mitigated by the use of lap belts. (Page 7)

2006.07.29 Crash of Skydive Quantum Leap, Sullivan, Missouri

The National Transportation Safety Board determines that the probable cause of this accident was the pilot's failure to maintain airspeed following a loss of power in the right engine due to the fracturing of compressor turbine blades for undetermined reasons. Contributing to some parachutists' injuries was the lack of a more effective restraint system on the airplane. (Page 20)

INDETERMINATE-CAUSE NTSB REPORTS

2006.02.07 In-flight Cargo Fire, Philadelphia, Pennsylvania

The National Transportation Safety Board determines that the probable cause of this accident was an in-flight cargo fire that initiated from an unknown source, which was most likely located within cargo container 12, 13, or 14. Contributing to the loss of the aircraft were the inadequate certification test requirements for smoke and fire detection systems and the lack of an on-board fire suppression system. (Page 66)

2004.01.13 Tanker Truck Overturn and Fire, Elkridge, Maryland

The National Transportation Safety Board determines that the probable cause of the January 13, 2004, accident in Elkridge, Maryland, was the failure of the tanker driver to maintain control of his vehicle for undetermined reasons. Contributing to the accident was the narrowed shoulder at the beginning of the overpass and the outdated design of this section of the roadway, including the flared concrete parapet and guardrail transition, which led the tanker to mount the parapet and vault the concrete safety shape barrier bridge rail so that the vehicle fell from the overpass onto the roadway below. (Page 10)

2003.12.23 Aircraft Accident, Helendale, California

The National Transportation Safety Board determines that the probable cause of this accident was a loss of airplane control for undetermined reasons. (Page 10)

1996.07.17 In-Flight Breakup, Over Atlantic Ocean

The National Transportation Safety Board determines that the probable cause of the TWA flight 800 accident was an explosion of the center wing fuel tank (CWT), resulting from ignition of the flammable fuel/air mixture in the tank. The source of ignition energy for the explosion could not be determined with certainty, but, of the sources evaluated by the investigation, the most likely was a short circuit outside of the CWT that allowed excessive voltage to enter it through electrical wiring associated with the fuel quantity indication system. (Page 308)

INDETERMINATE-CAUSE NTSB REPORTS

1996.02.01 Derailment of Freight Train, California

The National Transportation Safety Board determines that the probable cause of the derailment of freight train H-BALT1-31 was an undetermined restriction or blockage that prevented the train crew from achieving and maintaining adequate train braking force and also the lack of adequate Federal Railroad Administration and industry, specifically the Atchison Topeka and Santa Fe Railway Company, regulations, policies, procedures, and standards to consistently utilize two-way end of train devices as a redundant braking system to protect trains from catastrophic brake system failure. (Page 64)

1986.01.31 Aircraft Accident, Covington, Kentucky

The National Transportation Safety Board determines that the probable causes of the accident were a fire of undetermined origin, an underestimate of fire severity, and misleading fire progress information provided to the captain. (Page 1)

1979.10.30 NTSB Safety Recommendations re Aircraft Crash, Sanford, North Carolina

The Safety Board determined that the probable cause of this accident was one or more low-order explosions in the aircraft's aft fuselage which resulted in a fire and loss of control capability. The Safety Board could not determine conclusively the fuel and ignition sources of the initial explosion; however, gases from the aircraft's batteries or fuel leakage from fuel system components, or both, could have been present in the area of the initial explosion. The Safety Board believes that the evidence uncovered by its investigation relating to the ventilation of aircraft batteries and tailcone areas of this and possibly other corporate type jets merits dissemination throughout the industry. (Page 1)