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: September 29, 2020

A. Accident

Location (accident reference):	Danville, Kentucky
NTSB Accident Number:	PLD19FR002
Physical Location:	Lincoln County, KY
Date:	August 1, 2019
Time (approximate):	1:23 a.m. EDT[2]
Accident site:	In an open field, about 1,680 feet northwest of the intersection of U.S. Route 127 and Camp Road, in Lincoln County, KY, which was also about 7 miles [direct distance] to the approximate south of the central business district of the City of Danville, KY

B. Synopsis of the Accident[3]

An underground, 30-inch diameter transmission pipeline, transporting pressurized natural gas at 925 psi, in a southbound flow, experienced an in-service breach and product release, which resulted in an explosion and an intensive fire that occurred in a rural area of Lincoln County, about seven miles [direct distance] to the approximate south of the central business district of the City of Danville, Kentucky. The explosion resulted in a crater at the natural gas release site,

[1] The Survival Factors investigation exclusively addresses [1] the emergency preparedness and emergency response elements of the accident, and [2] the injury causation elements of the accident.

[2] Eastern Daylight Time; all times cited herein are local time, unless otherwise noted.

[3] Compiled in conjunction with data supplied by, and with the concurrence of, the Investigator in Charge (IIC).

from which soil, rock and a segment of pipe was ejected in the explosion. The segment of ejected pipe, measuring about 33 feet in length by just under 8 feet in width, became airborne and traveled in a southerly direction, which came to rest about 481 feet to the approximate south of the crater location. The flare of the fire was reported, to the jurisdictional 911 agency, as being visible at a location that was at least 38 miles to the northwest of the accident site. The investigation observed that the heat of the fire (flare) melted the plastic siding material of a residential dwelling that was located about 1,100 feet from the fire (crater center). The natural gas product release occurred proximate to an unincorporated, mobile home park community that is locally referred to as the Indian Camp Subdivision. Self-evacuations by residents near the fire initiated spontaneously, with further evacuations completed by the jurisdictional emergency responders. One resident of that community sustained fatal injury in the accident, and five other residents were transported to a local medical facility for evaluation and/or treatment, all of which were treated and released. One emergency responder (a deputy sheriff) sustained minor injury that occurred during a successful rescue response to the accident, who was treated and released from the medical facility. Five residential dwellings of the mobile home park community were destroyed in the ensuing fire, and 14 residential dwellings in that community sustained fire damage, in which about 30-acres of land sustained fire damage. An estimated 75 to 100 individuals were displaced as a result of damages to the Indian Camp Subdivision properties.

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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

API	American Petroleum Institute
CAD	Computer Aided Dispatch [emergency services data-logging system]
CAO	Corrective Action Order
CFR	Code of Federal Regulations
Chair	Chairperson
cu. ft.	cubic feet [volume measurement]
EDT	Eastern Daylight Time
EMS	emergency medical services
ERG	Emergency Response Guidebook
°F	degrees Fahrenheit [temperature scale]
GPS	Global Positioning System (see [Internet] https://www.gps.gov/)
HCA	High Consequence Areas
IMP	Integrity Management Program
KY	Kentucky
LCEMA	Lincoln County Emergency Management Agency
LCEMS	Lincoln County Emergency Medical Services, Inc.
LCFPD	Lincoln County Fire Protection District
LCSO	Lincoln County Sheriff's Office
MP	Milepost
Mscf	million standard cubic feet [gas volume measurement]
NFPA	National Fire Protection Association
NPMS	National Pipeline Mapping System
OPS	Office of Pipeline Safety [within the PHMSA]
PAP	Public Awareness Program
PHMSA	U.S. Department of Transportation, Pipeline and Hazardous Materials Safety Administration (see [Internet] http://www.phmsa.dot.gov/)
PIR	Potential Impact Radius
PSAP	Public Safety Answering Point
psig	pounds per square inch, gauge
ref	reference, or, in reference to
ROW	right-of-way
RP	Recommended Practice
SDS	Safety Data Sheet
SF	Survival Factors [investigation]
SMS	Safety Management Systems
TETLP	Texas Eastern Transmission, LP
UAS	Unmanned Aircraft Systems
USGS	United States Geological Survey
USPS	United States Postal Service

C. Survival Factors – Technical Working Group Participants[4]

Mr. Richard M. Downs, Jr., P.E.
NTSB / Survival Factors - Emergency Response / Group Chairperson

Mr. Don M. Gilliam
Director, Lincoln County Emergency Management (LCEMA)

Chief Danny Glass
Lincoln County Fire Protection District (LCFPD)

Mr. Thanh V. Phan
Enbridge, Inc. (Enbridge)

Mr. James A. Kelly
Pipeline and Hazardous Materials Safety Administration (PHMSA)[5]

D. Details of the Investigation

1.0 Relevant Background Factors / Information

The accident involved the unintended release of pressurized natural gas from a breach that occurred in an underground natural gas transmission pipeline, which ignited.

1.1 Locality of the Accident - Civil Jurisdiction

The natural gas product release, explosion and fire occurred immediately proximate to a residential community that is locally referred to as the Indian Camp Subdivision[6], which is an unincorporated community of Lincoln County, Kentucky (KY), which is also within the USPS

[4] The Certification of Party Representative [document] prescribes the roles, responsibilities and requirements of the Party to the Investigation participants, to which it also stipulates that, "Each NTSB Group Chairman will … prepare a Group Chairman Factual Report … [in which a] copy of the Group Chairman's draft factual report will be provided to participating group members for comment [in which] … [i]t should be understood … that the final factual report is the NTSB Group Chairman's responsibility and concurrence by the entire group is not required. Any dissent regarding the factual accuracy or completeness of the factual report should be communicated to the NTSB Group Chairman, and, if necessary, will be discussed formally during a technical review meeting later in the investigative process.".

[5] The Survival Factors Group Chairman observed that a documented 'Factual Report narrative content - concurrence acknowledgement' [referred to as a 'Party Sign-off Sheet'] was received from all of the Survival Factors Group members, except from the PHMSA member (who was indicated [by this Party] to be unavailable [due to military reserve duty obligations], in which a designated substitute PHMSA member was identified [by this Party], in which (upon multiple response opportunities that were afforded to this Party) a 'Factual Report narrative content - concurrence acknowledgement' was not forthcoming from the designated substitute PHMSA member.

[6] i.e., as identified in documentation of the Lincoln County Property Valuation Administrator's office; see further [Internet] http://www.qpublic.net/ky/lincoln/.

postal delivery zone[7] of Stanford, KY. The accident site was about seven miles [direct distance] approximately south of the central business district[8] of Danville, KY, about three miles [direct distance] approximately south of the central business district (City Hall building) of Junction City, KY, and about eight miles [direct distance] approximately west of the central business district of Stanford, KY, which is the county seat[9] of Lincoln County. The general area of the accident site is also locally referred to as Moreland, which also refers to a community enclave by that same name, which is located about 1½ miles to the south of the Indian Camp Subdivision. The accident site is within the emergency services jurisdiction (fire protection district) of the Lincoln County Fire Protection District (see § 3.1 of this report), and is within the law enforcement jurisdiction of the Lincoln County Sheriff's Office (see § 3.5).

1.2 Site Characterization – Pre-Event

The accident (pipeline breach, and unintended release of product) occurred in a segment of an interstate transmission pipeline that transported natural gas product under pressure[10], which was owned and operated by Texas Eastern Transmission, LP (which is sometimes referred to by its initials TETLP), which is an indirectly owned subsidiary of Enbridge, Inc. (Enbridge) (see further § 1.3). The pipeline was located within a common pipeline right-of-way (ROW)[11] of TETLP that traverses Lincoln County, KY, as further described.

1.2.1 Overall Physical Configuration of the Accident Site[12]

Generally described, the geographical area proximate to the accident site is a sparsely populated, rural area, consisting generally of open agricultural fields (farmlands) and some natural-growth wooded areas (which were principally along the edges of the agricultural fields), with residential dwellings and farmsteads sporadically located throughout the area. The accident (product release site) occurred in an open field (vacant land), on private property that was owned by the pipeline owner / operator (TETLP)[13]. The property parcel to the immediate south, a property parcel to the east, and seven property parcels to the north and northeast of the release site were

[7] United States Postal Service (USPS); referring to the ZIP Code® of the Indian Camp Subdivision community.

[8] For purposes of this report, the "central business district" is identified as the area proximate to the Danville City Hall building, located at 445 West Main Street, which is about 7.2 miles approximately north of the accident site.

[9] A 'county seat' refers to the municipal location of the county administrative offices.

[10] For generalized information on this topic, see [Internet] https://www.phmsa.dot.gov/pipeline/liquified-natural-gas/liquefied-natural-gas-overview.

[11] For generalized information on this topic, see [Internet] https://primis.phmsa.dot.gov/comm/ROWBrief.htm ?nocache=7935.

[12] Description based upon recorded aerial images of the accident site, post-recovery site inspection conducted by NTSB (August 1-9, 2018, inclusive), debriefing of witnesses who were at the site for various reasons, and images (recorded prior to the event) as shown in [Internet] https://www.google.com/maps/, and as further described.

[13] According to the Lincoln County property valuation map, as administered by the Property Valuation Administrator (PVA) (source, and for further information, see [Internet] http://www.lincolnky.com/departments/ pva.php, as redirected to http://qpublic.net/ky/lincoln/search.html), the land parcel in which the release occurred is at an unspecified address on Indian Camp Road, [PVA] Map parcel number 08-04 00 063.20, Lot number 20, consisting of a lot 0.925 acres in size, in which the current owner is cited as Texas Eastern Transmission LP, 5400 Westheimer Ct, Houston, Tx 77056-5310.

vacant (open fields), and were showing in the Lincoln County property valuation records as individually owned by the pipeline owner / operator.

The common pipeline ROW, in the area proximate to the accident site, contains three underground transmission pipelines, which were configured in a parallel alignment (of a common ROW), which in the vicinity of the accident extends generally in a northeast / southwest orientation. The pipeline involved in the accident, which the pipeline owner / operator designated as Line 15, transported natural gas product under pressure, which was the middle of the three pipelines configured in the common pipeline ROW at this location. The other two pipelines in the common pipeline ROW proximate to the accident site, were designated as Line 10 and Line 25, respectively, and situated to the north, and south, respectively, of the Line 15 pipeline, were not involved in the accident.

A document, referred to as an alignment sheet[14], as compiled by Texas Eastern Transmission Corporation (dated April 1963), describes the construction details and easement rights of the common pipeline ROW in this area. The alignment sheet indicated data of a Line 30 pipeline, which was described as being located to the immediate north of, and parallel to, the Line 10 pipeline. An inquiry placed to Enbridge[15] indicated that "… [a]t the time that the alignment sheet was created, the Company acquired pipeline right-of-way easement rights for a potential fourth pipeline, LN30. While a portion of LN30 was ultimately constructed much further south in Mississippi, the constructed portion of LN30 terminates [at] the Company's Egypt, MS compressor station, and does not extend northwards into Kentucky. Accordingly, LN30 does not exist at the area covered by the alignment sheet.".

The common pipeline ROW intersects with the trackage ROW of the Norfolk Southern Railroad, about 80 feet to the approximate west of the release site[16, 17], in which the railroad ROW extends generally in a north / south orientation in this area (see further § 1.3.4). On the west side of the railroad, the common pipeline ROW extends further to the southwest, through an agricultural field (open farmland). From the release site, the common pipeline ROW extends in a northeast direction, through an open field (vacant land).

See § 1.3.5, and the Operations Group Factual Report, for additional information detail.

The nearest roadway to the release site is identified in local maps as Mitchell Lane (an unpaved road), which was located about 180 feet to the east of the pipeline release site. The residential dwellings of the Indian Camp Subdivision community consisted of mobile homes and permanent single-family dwellings, which were located on Mitchell Lane, Indian Camp Road, and Camp

[14] Generally described, in pipeline operations, an alignment sheet or drawing graphically illustrates the exact route and location of a given pipeline and associated facilities, and describes all relevant information for that pipeline, for a pipeline segment between two identified geographical locations (as cited in the document), as compiled at the time when the pipeline was designed, and/or constructed, or when the document is correspondingly updated.

[15] Ref email to the Enbridge Party - SF Group participant, from the SF Group Chair, with a corresponding Enbridge response, dated 3/11, 13/2020, respectively.

[16] Henceforth in this report, "release site" refers to the approximate center of the crater that resulted in the accident.

[17] i.e., a direct distance measurement from the center of the crater (that resulted at the site), to the described location.

Road of that community, which were to the immediate east, southeast, and approximate south, respectively, of the release site, as further described (see § 1.2.2).

1.2.2 Occupied Properties Located Proximate to the Release Site

Occupied properties (i.e., residential dwellings[18]) that were directly impacted by the accident (i.e., the explosion and fire) were located on Mitchell Lane, Indian Camp Road, and Camp Road, which were situated to the immediate east, southeast, and approximate south, respectively, of the pipeline product release site. The investigation identified the approximate distances, from the pipeline release site to the closest occupied structures surrounding the release site, as situated both in the Indian Camp Subdivision community and on adjacent roadways, as follows.

Approximate compass direction (relative to release site)	Approximate Distance[19]
north	1,840 feet
north-northeast	1,130
east-northeast	1,100
east	365
east-southeast	615
southeast	480
south	310
southwest	2,060
west	2,535
northwest	2,370

A map of the immediate area proximate to the accident site was compiled by the investigation, which is available in the Aerial Imagery Report documentation (in the NTSB docket).

1.2.3 Population Density of the Accident Site - Geographic Locale

Review of Census Bureau data[20], for the geographic locale of the accident site (Lincoln County KY), for data of 2010 (i.e., the most recent Census-year data available), identified that the area of the natural gas release comprised a population density of less than 1,000 persons per square mile (i.e., the Census data indicated "population per square mile, 2010, [for Lincoln County, to be] 74.1"). See § 1.9 for additional information detail on this topic.

1.2.4 Pre-event Map of the Accident Site Area[21]

[18] The investigation noted there were a number of barns, garages, and out-buildings (e.g., agricultural-use, and otherwise) that were located within the depicted land area addressed in this report section, in which only residential dwellings were included in the dimensional tabulation of this report section, due to the unlikely human occupancy of the observed barns, garages, and out-building structures at the time of the accident (i.e., at 1:23 a.m.).

[19] Dimensional data sourced from the NTSB Aerial Imagery Factual Report of the investigation, which utilized Google Earth™ Pro software, and from https://www.google.com/maps, utilizing GPS data.

[20] Source, and for further information, see [Internet] https://www.census.gov/quickfacts/lincolncountykentucky.

[21] Source: and for further information, see [Internet] https://viewer.nationalmap.gov/basic/?basemap=b1&category=histtopo,ustopo&title=Map%20View#productSearch, and as further described.

A copy of an annotated segment of a USGS topographic (survey) map[22], describing the general area proximate to the accident site, is provided in Exhibit 1.

1.2.5 Other Natural Gas Transmission Pipeline Operations in Lincoln County

Research of the SF investigation[23] identified two other natural gas transmission pipelines that traverse Lincoln County, which are oriented in an approximate parallel alignment with the Texas Eastern ROW (at the accident site), which are about four, and about eight miles, respectively, to the east of the Texas Eastern ROW, which are owned / operated by Tennessee Gas, and Columbia Gulf, respectively.

1.3 Pipeline Owner / Operator – Texas Eastern Transmission, LP[24]

As described by Enbridge[25], "Texas Eastern Transmission, LP [which is also informally referred to, and is identified henceforth in this report, as "Texas Eastern"] is the owner and operator of the natural gas transmission pipeline that was involved in this accident. Texas Eastern is indirectly owned by Enbridge, Inc., in which Enbridge, Inc., has its main business (corporate headquarters) office located in Calgary, Alberta, Canada. Texas Eastern maintains a Control Center in the United States in Houston, Texas, which controls the flow of natural gas product through its transmission pipelines in the United States.".[26]

Relative to the "indirect ownership" aspect of Texas Eastern by Enbridge, Inc., as described by Enbridge[27], "Texas Eastern Transmission, LP, a Delaware limited partnership, is an indirect, 100%-owned subsidiary of Spectra Energy Partners, LP (SEP), which is owned 100% by Enbridge Inc. (Enbridge).".

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[22] Excerpt from United States Geological Survey (USGS) topographic survey map, [map ref] Junction City, KY, Quadrangle, [dated] 2019; ref, and for further information, see [Internet] https://www.usgs.gov/.

[23] Source: [1] the PHMSA National Pipeline Mapping System; ref, and for further information, see [Internet] https://www.npms.phmsa.dot.gov/GovOfficial.aspx, and [2] Lincoln County Emergency Operations (EOP), Appendix Q-6 Pipeline Emergency Response, § 1. Situation and Assumptions, subsection D. Pipeline Locations.

[24] Source: and for further information, see [Internet] https://www.enbridgepartners.com/, and as further described.

[25] Ref email from the Enbridge Party - SF Group participant, to the SF Group Chair, dated 07/21/2020.

[26] As described by Enbridge (ref [select excerpt of] email from the Enbridge Party - SF Group participant, to the SF Group Chair, dated 07/21/2020), this clarification was offered with "… particular respect to its ownership of property interests and relationship with PHSMA … [in which] Texas Eastern Transmission, LP is the identified operator, [in which that entity] holds the OPID, and is the relevant entity in PHMSA reporting and orders.", to which the OPID (PHMSA Operator Identification Number) is as prescribed under the criteria of 49 CFR 191.22 National Registry of Operators.

[27] Source: a document, to which Enbridge has cited as having been filed with the U.S. Securities and Exchange Commission (SEC), [titled] "Texas Eastern Transmission, LP, First Quarter Report [which is also known as a SEC "10-Q" report], Consolidated Financial Statements (Unaudited), March 31, 2020", in which the described statement was observed within the "Notes to Interim Consolidated Financial Statements (Unaudited), under [item] "1. General", under the descriptive "Nature of Operations" (i.e., on page 6 of the document); available at [Internet] https://www.enbridge.com/~/media/Enb/Documents/Investor%20Relations/Texas%20Eastern%20Transmission/TETLP%20Q1%202020%20Financials.pdf?la=en.

The company also maintains Compressor Stations[28], which collectively support product flow in the Line 10, Line 15, and Line 25 [parallel operating] pipelines that occupy the common pipeline ROW at the accident site, in which the compressor stations that were located closest to, and provided product flow at, the accident site, consisted of:

- a compressor station about 3.9 miles northeast of the accident site, which is also situated about one mile south of the southern municipal boundary of the City of Danville, KY, and
- a compressor station about 71.3 miles southwest of the accident site, which is situated near the City of Tompkinsville, KY.

The Line 15 pipeline and related infrastructure involved in the accident was owned and operated by Texas Eastern Transmission, LP, the nomenclature of which (i.e., Texas Eastern Transmission company name) was cited in documentation as made available to the investigation by Enbridge, and was cited in signage (of the company), as observed in the investigation. Line 15, having a length of about 775 miles, transports product between Uniontown, Pennsylvania (at the north end) and Kosciusko, Mississippi (at the south end).[29]

The Line 15 pipeline operation involved in the accident was previously owned and operated by Spectra Energy Transmission, LLC[30], the nomenclature of which (i.e., the Spectra Energy company name) was cited in documentation as made available to the investigation by Enbridge, and was cited in signage (of the company), as observed in the investigation.[31]

1.3.1 Brief Summarized Description of the Company

A description of the company, as compiled from documentation of the company[32], is as follows.

> "Item 1. Business
>
> Enbridge is one of North America's largest energy infrastructure companies with strategic business platforms that include an extensive network of crude oil, liquids and natural gas pipelines, regulated natural gas distribution utilities and renewable power generation. We safely deliver in excess of three million barrels of crude oil each day in North America through our Mainline and Express pipeline, and account for approximately 62% of United States-bound Canadian crude oil exports. We also move approximately 18% of all natural gas

[28] For generalized information on this topic, see [Internet] https://primis.phmsa.dot.gov/comm/FactSheets/FSPumpStations.htm, and https://www.enbridge.com/about-us/natural-gas-transmission-and-midstream/natural-gas-101/transporting-natural-gas/compressor-stations.

[29] For generalized information on this topic, see [Internet] https://www.enbridge.com/about-us/natural-gas-transmission-and-midstream, and https://www.enbridge.com/map#map:infrastructure,search=%22Texas%20Eastern%22.

[30] For the current ownership relationship of Spectra Energy, see the second paragraph of this report section.

[31] Ref: and for further information, see [Internet] https://www.enbridge.com/media-center/news/details?id=2126823&lang=en&year=2017.

[32] Source: select narrative extracted from the Annual Report (10-K) of the company, for the year ending Dec. 31, 2018, as filed with the SEC, in which the full report is available at [Internet] https://www.sec.gov/Archives/edgar/data/895728/000089572819000033/0000895728-19-000033-index.htm.

consumed in the United States, serving key supply basins and demand markets. Our regulated utilities serve approximately 3.7 million retail customers in Ontario, Quebec and New Brunswick. We also have interests in more than 1,700 megawatts (MW) of net renewable power generation capacity in North America and Europe. Our common shares trade on the Toronto Stock Exchange (TSX) and the New York Stock Exchange (NYSE) under the symbol ENB. We were incorporated on April 13, 1970 under the Companies Ordinance of the Northwest Territories and were continued under the Canada Business Corporations Act on December 15, 1987.

BUSINESS SEGMENTS
Our activities are carried out through five business segments: Liquids Pipelines; Gas Transmission and Midstream; Gas Distribution; Green Power and Transmission; and Energy Services, as discussed below.

GAS TRANSMISSION & MIDSTREAM
Gas Transmission and Midstream consists of our investments in natural gas pipelines and gathering and processing facilities in Canada and the United States, including US Gas Transmission, Canadian Gas Transmission and Midstream, Alliance Pipeline, US Midstream and other assets.

US GAS TRANSMISSION
US Gas Transmission includes ownership interests in Texas Eastern, Algonquin, M&N U.S., East Tennessee, Gulfstream, Sabal Trail, NEXUS, Valley Crossing, Southeast Supply Header (SESH), Vector Pipeline L.P. (Vector) and certain other gas pipeline and storage assets. The US Gas Transmission business primarily provides transmission and storage of natural gas through interstate pipeline systems for customers in various regions of the northeastern, southern and midwestern United States.

The Texas Eastern natural gas transmission system extends approximately 2,735-kilometers (1,700-miles) from producing fields in the Gulf Coast region of Texas and Louisiana to Ohio, Pennsylvania, New Jersey and New York. Texas Eastern's onshore system consists of approximately 14,597-kilometers (9,070-miles) of pipeline and associated compressor stations. Texas Eastern is also connected to four affiliated storage facilities that are partially or wholly-owned by other entities within the US Gas Transmission business."

1.3.2 Brief Summary of Enbridge Natural Gas Transport Operations

A description of the company's natural gas transport operations, as compiled from documentation of the company[33], is as follows.

"US GAS TRANSMISSION
US Gas Transmission includes ownership interests in Texas Eastern, Algonquin, M&N U.S., East Tennessee, Gulfstream, Sabal Trail, NEXUS, Valley Crossing, Southeast Supply Header (SESH), Vector Pipeline L.P. (Vector) and certain other gas pipeline and storage assets. The

[33] Source: select narrative extracted from the Annual Report (10-K) of the company, for the year ending Dec. 31, 2018, as filed with the SEC, in which the full report is available at [Internet] https://www.sec.gov/Archives/edgar /data/895728/000089572819000033/0000895728-19-000033-index.htm.

US Gas Transmission business primarily provides transmission and storage of natural gas through interstate pipeline systems for customers in various regions of the northeastern, southern and midwestern United States.

The Texas Eastern natural gas transmission system extends approximately 2,735-kilometers (1,700-miles) from producing fields in the Gulf Coast region of Texas and Louisiana to Ohio, Pennsylvania, New Jersey and New York. Texas Eastern's onshore system consists of approximately 14,597-kilometers (9,070-miles) of pipeline and associated compressor stations. Texas Eastern is also connected to four affiliated storage facilities that are partially or wholly-owned by other entities within the US Gas Transmission business."

1.3.3 Enbridge Line 15 Natural Gas Transmission Pipeline System Map[34]

A copy of map documentation, describing the Enbridge / TETLP, Line 15, natural gas transmission pipeline system, is provided in Exhibit 2.

1.3.4 Accident Site Mapping - Enbridge[35]

A copy of map documentation, describing the accident site, and other aspects of the Line 15 pipeline prior to the accident, is provided in Exhibit 3.

1.3.5 Natural Gas Product Transportation Operations at the Accident Site[36]

a. Common Pipeline ROW and Line 15 Natural Gas Pipeline

The accident occurred in an open field on private property that was owned by the pipeline operator (Texas Eastern), in which Enbridge also refers to the Line 15 natural gas pipeline as the Texas Eastern Transmission line. The Line 15 pipeline at the accident site had an outside nominal diameter of 30 inches, and was buried (in the area of the accident) to a reported[37] depth of earth coverage of about 43 inches.

The common pipeline ROW in the area proximate to the accident site contained three operational underground transmission pipelines, which were configured in a parallel alignment, which in the vicinity of the accident extends generally in a northeast / southwest orientation. The Line 15 pipeline involved in the accident transported natural gas product under pressure, which was the middle of the three pipelines configured in the common pipeline ROW at this location. The

[34] Ref email from the Enbridge Party - SF Group participant, to the SF Group Chair, dated 04/01/2020.

[35] Ibid

[36] Data sources: field-examination of the accident site by NTSB investigative staff (as documented in the SF Group Chair - Field Notes Logbook), Texas Eastern Transmission Corporation (Enbridge) Alignment Sheet TF-8-C15999.15 of the area proximate to accident site [as originally] dated April 1963 (as made available to the investigation), PHMSA form F 7100.2 Incident Report - Gas Transmission and Gathering Pipeline Systems, Report number 20190103 - 32637, dated 08/30/2019, as made available by the PHMSA / Accident Investigation Division, and as further described.

[37] Data source: PHMSA form F 7100.2 Incident Report …, Report number 20190103 - 32637, dated 08/30/2019.

release occurred approximately at Milepost[38] (MP) 423.40 of the Texas Eastern Line 15 transmission pipeline, which was installed at the site in 1958. The Line 15 pipeline is operationally bi-directional[39], in which the product flow of this transmission pipeline, at the time of the accident, was in a southward direction, which is the current principal product flow direction of Line 15.

The common pipeline ROW, in the area proximate to the accident site, measured 100 feet in width. The other two pipelines in the common pipeline ROW, proximate to the accident site, were also owned and operated by Texas Eastern and designated by the company as Line 10 and Line 25, respectively, and were situated to the north, and south, respectively, of the Line 15 pipeline, and were not involved in the accident. The Line 10 and Line 25 pipelines had a separation space of 25 feet, and 25 feet, respectively, from the Line 15 pipeline, in which, at the time of the accident, the Line 10 and Line 25 pipelines each were transporting natural gas product under pressure.

The pipeline ROW intersects with the trackage ROW of the Norfolk Southern (NS) Railroad, at a location about 80 feet to the approximate west of the release site[40]. The NS Railroad ROW in this area measured about 93 feet in width[41], extends generally in a north / south orientation in this area, and was comprised of a single railroad track of conventional construction[42]. The three Texas Eastern pipelines of the common pipeline ROW crossed (passed beneath) the railroad track utilizing a pipe casing arrangement[43, 44].

On the west side of the railroad, the common pipeline ROW extended further to the southwest, through an open agricultural field (farmland). From the release site, the common pipeline ROW extended in a northeast direction, through an open field (vacant land). The nearest roadway to the release site, identified as Mitchell Lane (an unpaved road), was located about 180 feet to the east of the pipeline release site, as further described (see also § 1.2.2).

b. Other Appurtenances of the Pipeline and the Common Pipeline ROW

[38] A Milepost refers to point along the pipeline that identifies a dimensional distance, in miles, relative to the designated origin reference point.

[39] i.e., the product flow can be propelled in either a southward, or a northward direction.

[40] i.e., a direct distance measurement from the center of the crater (that resulted at the site), to the described location.

[41] Source: Lincoln County property valuation map documentation and associated records, as administered by the PVA; see [Internet] http://www.lincolnky .com/departments/pva.php, as redirected to http://qpublic.net/ky/lincoln /search.html).

[42] As a generalized description, in the context of the investigation, 'conventional construction' denotes railroad trackage that consisted of steel rails that were affixed by track spikes to wooden crossties, which were secured in place (in the railroad ROW) by crushed stone ballast.

[43] The Line 15 pipeline was encased within a larger diameter "casing" pipe, which affords a degree of protection from external damage, as compared to a pipe that is not encased within a casing pipe.

[44] Ref, and as further described in 49 CFR 192.323 Casing; see further [Internet] https://www.ecfr.gov/cgi-bin/text-idx?SID=36dcaa4e8ac24a5d266344c88d230b48&mc=true&node=se49.3.192_1323&rgn=div8.

Three lengths of pipe were observed[45] protruding vertically from the ground, in an approximately linear alignment, along the edge of a fence line, which was situated at the eastern side of the NS Railroad ROW. The three lengths of pipe were at three corresponding locations that appeared to coincide with the locations of three pipe casings (that contained the three individual transmission pipelines) that passed beneath the railroad track at that location. The three lengths of pipe functioned as vent pipes to the three underground pipe casings at that location, and also function as corrosion protection test stations.[46]

Two 'valve stations'[47] were provided in the Line 15 pipeline, to control the product flow through the segment of pipeline that included the accident site[48]. The valve stations were each fitted with a flow control device that was installed in the pipeline, which are referred to as a block valve[49, 50], which were available, and were used to stop the flow of discharging natural gas product during the accident, the operational type (i.e., manual, or remote operation[51]), and the locations of which, were as follows:

- a manually operated valve station was located at MP 427.50, in which Enbridge labels this (in maps of the company) as block valve "15-393", which was located about 4.10 miles to the northeast of the release site, on the property of the Texas Eastern Danville Compressor Station, and
- a manually operated valve station was located at MP 408.5, in which Enbridge labels this (in maps of the company) as block valve "15-382", which was located in the pipeline ROW about 14.92 miles to the southwest of the release site.

The SF investigation observed that neither block valve, at the respective valve station locations cited, were capable of remote operation.

c. Signage

[45] Source: Enbridge photograph [identification] DSC1920, et seq., as made available to the investigation.

[46] Ref, and as further described in 49 CFR 192.469 External corrosion control: Test stations; see further [Internet] https://www.ecfr.gov/cgi-bin/retrieveECFR?gp=1&ty=HTML&h=L&mc=true&=PART&n=pt49.1.192#se 49.3.192_1469.

[47] For generalized information on this topic, see [Internet] https://primis.phmsa.dot.gov/comm/glossary/index.htm ?nocache=4677#Valve.

[48] The investigation identified that there were several additional valve stations, to the south and to the north of the valve stations that were used to isolate the release site, in which the valve equipment at those additional stations was available to isolate the Line 15 pipeline flow, if the valve equipment, that was used to isolate the Line 15 pipeline flow at the release site, was not available for closure.

[49] This type of valve is also referred to as a "gate valve", in which the "manually-operated" aspect also refers to operation (the opening and closure) of the valve, which is accomplished by turning the control wheel by hand.

[50] For generalized information on this topic, see [Internet] https://primis.phmsa.dot.gov/comm/glossary/index.htm ?nocache=4677#BlockValve.

[51] A block valve that is capable of remote operation or control is referred to as a remotely operated valve (ROV), or alternately, a remote controlled valve, which can be operated by the pipeline owner / operator (to control product flow through the pipeline), from a location other than at the valve [station] site, and as further described; see [Internet] https://primis.phmsa.dot.gov/comm/glossary/index.htm?nocache=5217#RemoteControlValve.

Signage, referred to as pipeline ROW markers[52], identifying the approximate location of the common pipeline ROW, were provided along the common pipeline ROW at various locations, to identify, as a 'public awareness' feature, the approximate location of the pipeline within the ROW. The ROW markers included the [signage] phrase, "Warning Gas Pipeline," and the Texas Eastern Transmission (Enbridge) emergency contact telephone number. A pre-recovery field examination by the SF investigation, of the areas proximate to the release site, identified individual pipeline ROW markers were present, the locations of which were as follows:

- The three lengths of pipe, which function as corrosion protection test stations, which were observed protruding vertically from the ground along the edge of the eastern side of the NS Railroad ROW (as described in § 1.3.5.b), may have contained ROW marker signage (i.e., fire damage sustained by the three lengths of pipe may have destroyed any evidence of marker post signage, as might have been affixed to the individual lengths of pipe (see further § 2.3.4),
- three individual marker posts were situated[53] at a location about 500 feet to the northeast of the release site, which was along an existing fence line at that location,
- three individual marker posts, were observed at a location about 2,400 feet to the northeast of the release site, which is on the southern edge of Bowens Loop Road, to the immediate west of the intersection with U.S. Route 127,
- a MP 'marker board', containing the number 424, was located immediately adjacent to the middle of the three pipeline ROW markers at the (above noted) Bowens Loop Road location,
- three additional pipeline ROW markers were observed at the U.S. Route 127 roadside edge, to the northeast of the Bowens Loop Road / U.S. Route 127 intersection, and
- additional pipeline ROW markers were observed in the field to the northeast of that U.S. Route 127 roadside location (i.e., along the path of the common pipeline ROW).

1.3.6 Pre-event Product Flow Conditions at the Accident Site

The natural gas product flowing through the Line 15 pipeline, proximate to the time of the release, was flowing in a southbound direction, at a reported pressure[54] of 925 pounds per square inch (psi), which was comprised[55] of about 91.6% methane, and 6.9% ethane, plus very small quantities of additional substances that occur naturally[56] in natural gas.

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[52] For generalized information on this topic, see [Internet] https://primis.phmsa.dot.gov/comm/MarkersBrief.htm ?nocache=3228, or https://primis.phmsa.dot.gov/comm/MarkersBrief.htm?nocache=1889.

[53] Attribution of these particular artifacts is sourced to post-event photographs (Image ref DSC01935 and DSC01941) supplied to the investigation by Enbridge, in which elements of the fire-damaged remnants of the 3 marker posts were visibly apparent in the photographs.

[54] Source: PHMSA form F 7100.2 Incident Report - Gas Transmission and Gathering Pipeline Systems, Report number 20190103 - 32637, date 08/30/2019, as made available by the PHMSA / Accident Investigation Division.

[55] Source: Enbridge Gas Quality - Hourly GC Summary Report (Enbridge document request [DR] 72, document ref 73506 NTSB007616-c2); line-item data of 8/1/2018 [data record timestamp] 1:00:00 AM.

[56] e.g., butane, pentane, propane, nitrogen; ref, e.g., Shepherd, M., Analysis of a Standard Sample of Natural Gas by Laboratories Cooperating with the American Society for Testing Materials, Journal of Research of the National Bureau of Standards, Jan. 1947; see [Internet] https://nvlpubs.nist.gov/nistpubs/jres/38/jresv38n1p19_A1b.pdf.

1.3.7 Pre-event Product Flow Conditions at the Compressor Stations

a. Data Reported in Media Articles[57]

Media articles reported that, at the time of the accident, the Texas Eastern compressor stations, which collectively support product flow in the Line 10, Line 15, and Line 25 [parallel operating] transmission pipelines that occupy the common pipeline ROW at the accident site, were propelling natural gas product southbound at the rate of 1.7 billion cubic feet of gas per day (bcfd).

b. Data Reported to NTSB

Enbridge made volumetric flowrate data available to the investigation[58], of the individual operational compressors that were located at the Danville Compressor Station (to the northeast of the release site), and the Tompkinsville Compressor Station (to the southwest of the release site), respectively, as occurred at the time of the accident, the compressor stations of which collectively support product flow in the Line 10, Line 15, and Line 25 transmission pipelines that occupy the common pipeline ROW at the accident site, the data of which are provided in Exhibit 4.

1.4 Regulation Applicable to Emergency Preparedness / Emergency Response Aspects of the Investigation

1.4.1 Federal – Pipeline and Hazardous Materials Safety Administration[59]

The federal government establishes minimum pipeline safety standards and regulation under the U.S. Code of Federal Regulations (CFR), Title 49 "Transportation", Parts 190 - 199.

The Pipeline and Hazardous Materials Safety Administration (PHMSA), which is an agency within the U.S. Department of Transportation (DOT), as described in the U.S. Code of Federal Regulations (CFR), Title 49 "Transportation", Section (§) 1.96, et seq., has overall regulatory responsibility for pipelines and hazardous materials under its jurisdiction in the United States.[60]

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[57] Source, e.g., DiSavino, Scott, Enbridge works to return Texas Eastern natgas pipe after Kentucky blast, Gas Processing News, [undated], available at [Internet] http://gasprocessingnews.com/news/enbridge-works-to-return-texas-eastern-natgas-pipe-after-kentucky-blast.aspx), and Enbridge Texas Eastern Pipeline Remains Shut after Kentucky Blast (Reuters), Pipeline & Gas Journal, [dated] 8/2/2019, available at [Internet] https://pgjonline.com/news/2019/08-aug/enbridge-texas-eastern-pipeline-remains-shut-after-kentucky-blast.

[58] Ref email from the Enbridge Party - SF Group participant, to the SF Group Chair, dated 04/09/2020.

[59] Source, and for further information, see [Internet] http://phmsa.dot.gov/pipeline, and as further described.

[60] Ref, and for further information, see [Internet] https://www.ecfr.gov/cgi-bin/text-idx?SID=e17b3ab8db06167 8d6242db21849b99f&mc=true&node=pt49.1.1&rgn=div5#se49.1.1_196.

The Office of Pipeline Safety (OPS), which is an agency within the Pipeline and Hazardous Materials Safety Administration (PHMSA), has overall regulatory responsibility for natural gas pipelines under its jurisdiction in the United States.[61]

Regulation that prescribes requirements for pipeline facilities and the transportation of gas, among other facilities, specific to addressing topic-points and issues of the Survival Factors investigation (i.e., relative to emergency preparedness / emergency response aspects of the accident), is addressed under the following sections of the Part 192, Transportation of Natural and Other Gas by Pipeline: Minimum Federal Safety Standards.[62]

49 CFR § 192.3	Definitions.
49 CFR § 192.5	Class locations
49 CFR § 192.7	What documents are incorporated by reference partly or wholly in this part?
49 CFR § 192.179	Transmission line valves.
49 CFR § 192.605	Procedural manual for operations, maintenance, and emergencies.
49 CFR § 192.615	Emergency Plans.
49 CFR § 192.616	Public Awareness.
49 CFR § 192.617	Investigation of failures
49 CFR § 192.710	Transmission lines: Assessments outside of high consequence areas.
49 CFR § 192.903	What definitions apply to this subpart?
49 CFR § 192.905	How does an operator identify a high consequence area?
49 CFR § 192.907	What must an operator do to implement this subpart?
Appendix E to Part 192	Guidance of Determining High Consequence Areas and on Carrying Out Requirements in the Integrity Management Rule

1.5 Regulation, or Proposed Rulemaking, Initiated Subsequent to the Accident, Applicable to Emergency Preparedness / Emergency Response Aspects of the Investigation

1.5.1 PHMSA - Issuance of a Final Rule[63]

The Federal Register, for the publication date of October 1, 2019, contained an official notification of a Final Rule, [titled] "Pipeline Safety: Safety of Gas Transmission Pipelines:

[61] Ref, and for further information, see [Internet] https://www.phmsa.dot.gov/about-phmsa/offices/office-pipeline-safety.

[62] Ref (the individual sections cited), and for further information, see [Internet] https://www.ecfr.gov/cgi-bin/text-idx?SID=39adf687e6da40ef6919f68198b86c7d&mc=true&node=pt49.3.192&rgn=div5

[63] As described in, and direct quote of (a narrative element of), the Federal Register, Vol. 84, No. 190, Oct. 1, 2019, page 52180, available at [Internet] https://www.govinfo.gov/content/pkg/FR-2019-10-01/pdf/2019-20306.pdf.

MAOP Reconfirmation, Expansion of Assessment Requirements, and Other Related Amendments", which described [in the Summary of the Notice] that the "PHMSA is revising the Federal Pipeline Safety Regulations to improve the safety of onshore gas transmission pipelines. This final rule addresses congressional mandates, National Transportation Safety Board recommendations, and responds to public input. The amendments in this final rule address integrity management requirements and other requirements, and they focus on the actions an operator must take to reconfirm the maximum allowable operating pressure of previously untested natural gas transmission pipelines and pipelines lacking certain material or operational records, the periodic assessment of pipelines in populated areas not designated as ''high consequence areas," the reporting of exceedances of maximum allowable operating pressure, the consideration of seismicity as a risk factor in integrity management, safety features on in-line inspection launchers and receivers, a 6-month grace period for 7-calendar-year integrity management reassessment intervals, and related recordkeeping provisions.".

Review of the Final Rule language indicates that it includes amendments to the following select regulations as described in this report (see § 1.4.1).

49 CFR § 192.3	Definitions.
49 CFR § 192.5	Class locations
49 CFR § 192.7	What documents are incorporated by reference partly or wholly in this part?
49 CFR § 192.710	Transmission lines: Assessments outside of high consequence areas.

The effective date of the Final Rule was July 1, 2020, in which the investigation additionally identified[64] that, on April 22, 2020, the PHMSA issued a notification [titled] "PHMSA Notice of Enforcement Discretion for Certain Gas Transmission Pipeline Requirements", which indicated "PHMSA does not intend to take enforcement action relative to the July 1, 2020 compliance deadline requirements related to the Part 192 provisions in the Final Rule1 if a regulated entity fails to meet such a requirement by December 31, 2020, for reasons attributable to the National Emergency.".[65]

1.5.2 PHMSA - Issuance of a Notice of Proposed Rulemaking[66]

The Federal Register, for the publication date of February 6, 2020, contained an official notification of a Notice of Proposed Rulemaking, [titled] "Pipeline Safety: Valve Installation and

[64] Ref email from the Enbridge Party - SF Group participant, to the SF Group Chair, dated 07/06/2020, which conveyed an alert of the "… COVID extension of time for Part 192 requirements until December 31, 2020", which the investigation additionally researched, as further described.

[65] SF investigation research located [in the PHMSA website] the notification [titled] "PHMSA Notice of Enforcement Discretion …", which included a [.pdf] statement [titled] "Stay of Enforcement II Gas Transmission Rule", the full narrative of which is available at [Internet] https://www.phmsa.dot.gov/news/phmsa-notice-enforcement-discretion-certain-gas-transmission-pipeline-requirements.

[66] Ref, and for further information, see Federal Register, Vol. 85, No. 25, Feb. 26, 2020, page 7162, available at [Internet] https://www.govinfo.gov/content/pkg/FR-2020-02-06/pdf/2020-01459.pdf.

Minimum Rupture Detection Standards", which described [in the Summary of the Notice] that the "PHMSA is proposing to revise the Pipeline Safety Regulations applicable to newly constructed and entirely replaced onshore natural gas transmission and hazardous liquid pipelines to mitigate ruptures. Additionally, PHMSA is revising the regulations regarding rupture detection to shorten pipeline segment isolation times. These proposals address congressional mandates, incorporate recommendations from the National Transportation Safety Board, and are necessary to reduce the consequences of large-volume, uncontrolled releases of natural gas and hazardous liquid pipeline ruptures.".

1.6 Industry Standards Applicable to Emergency Preparedness / Emergency Response Aspects of the Investigation

1.6.1 API - RP 1162 Public Awareness Programs for Pipeline Operators

A Recommended Practice (RP) document was developed, and is promulgated by the American Petroleum Institute (API)[67], to provide "guidance … [on the topic of Public Awareness Programs] for pipeline operators [in the transportation of] Intrastate and interstate hazardous liquid pipelines", as required under 49 CFR 192.616 (see § 1.4.1), [titled] "API - RP 1162 Public Awareness Programs for Pipeline Operators".[68]

The most recent revision of this document is the second edition, dated December 2010. Based on the criteria of applicable regulation, the first edition, dated December 2003, is applicable to the circumstances of this investigation[69].

Although the term "recommended practice" potentially suggests 'voluntary compliance', conformity to this recommended practice is effectively a regulatory requirement, pursuant to Final Rule[70] action, issued in May 2005 by the PHMSA-OPS, in which (mandatory) compliance with RP 1162 was "incorporated by reference".

Review of the subject RP, indicates that Section 8.4 [titled] "Measuring Program Effectiveness", contains evaluation elements that assess the progress / success of a Public Awareness Program, which are described as follows.

§ 8.4.1 Measure 1- Outreach: Percentage of Each Intended Audience Reached with Desired Messages

[67] 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.

[68] Available, as a "non-printable copy", at [Internet] http://www.techstreet.com/api/products/1757546.

[69] Review of the subject regulation identified that the second edition of this [Recommended Practice] document (dated December 2010) has not been accepted in the Federal regulation (i.e., the regulation specifically cites the December 2003 edition applies).

[70] 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.

§ 8.4.2 Measure 2 - Understandability of the Content of the Message

§ 8.4.3 Measure 3 - Desired Behaviors by the Intended Stakeholder Audience

§ 8.4.4 Measure 4 - Achieving Bottom-Line Results

1.6.2 API - RP 1173 Pipeline Safety Management Systems

A Recommended Practice document was developed, and is promulgated by the American Petroleum Institute (API), to provide "… pipeline operators with safety management system requirements that when applied provide a framework to reveal and manage risk, promote a learning environment, and continuously improve pipeline safety and integrity [which also affords guidance on] … managing the safety of complex processes …", [titled] "API - RP 1173 Pipeline Safety Management Systems"[71], compliance of which is voluntary.

1.7 Properties of Natural Gas / Safe Product Handling and Storage

1.7.1 General Description – Product Composition / Gas Pipeline Network[72]

"Natural gas is a fossil energy source that formed deep beneath the earth's surface. Natural gas contains many different compounds. The largest component of natural gas is methane, a compound with one carbon atom and four hydrogen atoms (CH4). Natural gas also contains smaller amounts of natural gas liquids (NGL, which are also hydrocarbon gas liquids), and nonhydrocarbon gases, such as carbon dioxide and water vapor. We use natural gas as a fuel and to make materials and chemicals.".[73]

"The U.S. natural gas pipeline network is a highly integrated network that moves natural gas throughout the continental United States. The pipeline network has about 3 million miles of mainline and other pipelines that link natural gas production areas and storage facilities with consumers. In 2018, this natural gas transportation network delivered nearly 28 trillion cubic feet (Tcf) of natural gas to about 75 million customers.".[74]

1.7.2 Handling and Safety Guidance Documentation - Safety Data Sheet[75]

[71] Available, by purchase, at [Internet] http://www.api.org/~/media/files/publications/whats%20new/1173_e1%20pa.pdf.

[72] Ref, data / descriptive narrative of the U.S. Energy Information Administration; see [Internet] https://www.eia.gov/, as further described.

[73] Source (as quoted directly), and for further information, see data / descriptive narrative of the U.S. Energy Information Administration, available at [Internet] https://www.eia.gov/energyexplained/natural-gas/.

[74] Source (as quoted directly), and for further information, see data / descriptive narrative of the U.S. Energy Information Administration, available at [Internet] https://www.eia.gov/energyexplained/natural-gas/natural-gas-pipelines.php.

[75] 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; ref, and for further information, see [Internet] https://www.osha.gov/dsg/hazcom/.

The purpose and content of a Safety Data Sheet[76] (SDS), which is formally identified by the OSHA as a Hazard Communication Safety Data Sheet[77], is that it provides information on the physical data, toxicity, health effects, first aid, reactivity, storage, disposal, personal protective equipment (PPE), and [unintended / uncontrolled] release-handling procedures of the product, as might be needed by emergency responders and/or any individual who might be exposed. The manufacturer of a [natural gas] product typically compiles, and makes readily available, SDS documentation for its products[78], although SDS documentation was also observed to have been compiled, and made readily available by, local retail distribution organizations, trade associations, etc.[79]

1.7.3 SDS Documentation Utilized by Enbridge - Natural Gas Markets

a. Prior to the Accident - SDS Version Utilized in the United States Markets

A copy of an SDS document[80], as prepared by Enbridge, was made available to the investigation by Enbridge[81], which contained safety and handling information of the Enbridge natural gas product, such as that shipped in the Line 15 pipeline. The document was indicated by Enbridge to be the "current version" of this document that the company has developed, in which Enbridge also indicated that this document is intended for utilization in the Enbridge natural gas markets (transmission, storage and distribution) that are located in the United States, a copy of which is provided in Exhibit 5.

b. SDS Natural Gas Documentation Available in Enbridge [Internet] Websites

An Internet search was conducted by the investigation[82], which included a search of the Enbridge website that addresses its natural gas markets (transmission, storage and distribution) that are located in the United States, was not successful in locating a copy of the above described version of the Enbridge natural gas SDS document (i.e., the DR 104 document version that was intended for utilization in the Enbridge natural gas markets (transmission, storage and distribution) that are located in the United States).

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[76] This document was previously referred to as a Material Safety Data Sheet (MSDS).

[77] Ref, and for further information, see [Internet] https://www.osha.gov/Publications/OSHA3514.html.

[78] e.g., see [Internet] https://www.hess.com/docs/us-safety-data-sheets/natural-gas.pdf?sfvrsn=2, and http://static.conocophillips.com/files/resources/724330-natural-gas-10082015.pdf.

[79] e.g., see [Internet] https://www.virginianaturalgas.com/safety/safety-data-sheet, and https://www.socalgas.com /1443741085480/Natural-Gas-SDS.pdf.

[80] This document was labeled Documentation Request (DR) 104, in the inventory of Enbridge documentation that was made available to the investigation.

[81] Ref, email from the Enbridge Party - SF Group participant, to the SF Group Chair, dated 2/25/2020, in which a copy of the described SDS document (USA natural gas markets) was included in the transmittal.

[82] Utilizing [Internet] website for Enbridge natural gas markets located in the United States; https://www.enbridge .com/, in which access was initiated on 08/05/2019, and [periodically accessed] continuing through 03/06/2020.

Responsive to the above, the investigation identified advantages, and/or the importance of providing applicable SDS documentation of a transported product (i.e., natural gas, in this investigation) in the [Internet] website of a transportation carrier, the considerations of which were shared with Enbridge[83], on the prospect that Enbridge might proceed with making the applicable SDS documentation available in the Enbridge website that was intended to be utilized in the natural gas markets that are located in the United States.

Enbridge responded to the (above) described considerations articulated by the investigation (i.e., advantages / importance of an SDS being available through website access)[84], in which the SDS documentation for natural gas [pipeline product] is now showing as available in the Enbridge website[85] that is intended to be utilized in the natural gas markets that are located both in the United States and in Canada, in which a copy of the SDS document is provided in Exhibit 6.

1.8 Emergency Response Instructional Guidance Information - Unintended Release of Dangerous Goods / Hazardous Materials

A number of publications were identified as available for use by emergency services agencies, two publications of which are briefly summarized as follows.

1.8.1 US-DOT - Emergency Response Guidebook

The U.S. Department of Transportation (US-DOT), in conjunction with the transportation regulatory authorities of Canada[86] and Mexico[87], have produced a publication, which is available for consultation by the emergency response community, titled the "Emergency Response Guidebook" (ERG)[88], the most recent revision of which, as of the date of the accident, was dated 2016.[89]

a. Publication Content

The ERG provides basic instructional guidance recommendations for emergency responders, on how to address an unintended release of potentially dangerous / hazardous cargo substances being transported in the various transportation modes (railroad, highway, marine, aviation, and pipeline). The ERG is divided into three reference sections, which commensurately present recommended procedural handling guidance information on the various substances as addressed in the publication, to which the functionality of the three sections are summarized as follows:

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[83] Ref, email to the Enbridge Party - SF Group participant, from the SF Group Chair, dated 03/06/2020.

[84] Ref, email from the Enbridge Party - SF Group participant, to the SF Group Chair, dated 08/13/2020.

[85] Ref (source); see [Internet] https://www.enbridge.com/sds.

[86] Transport Canada; see [Internet] https://www.tc.gc.ca/en/transport-canada.html.

[87] Secretariat of Transport and Communications of Mexico; see [Internet] http://www.gob.mx/sct.

[88] Source: U.S.D.O.T. / Transport Canada / Secretariat of Transport and Communications of Mexico; 2016 Emergency Response Guidebook (see [Internet] https://www.phmsa.dot.gov/hazmat/erg/erg2016-english).

[89] This publication is updated every five years (as described by the PHMSA), in which the subsequent edition was published in February 2020, which is available at [Internet] https://www.phmsa.dot.gov/hazmat/erg/erg-2020.

- "ID Number Index" section [yellow-bordered pages] – numeric listing of substances by the 4-digit United Nations (UN) or NA identification number,
- "Name of Material Index" section [blue-bordered pages] – alphabetic listing of substances by the "proper shipping name" (i.e., the substance chemical name), and
- "Guides" section [orange-bordered pages] – provides release response handling procedural recommendations and emergency response information for a given specific substance.

As recommended response guidance / instructions for emergency responders, when addressing a release of specific hazardous materials / commodities, the "ID Number Index" section of the ERG[90], relative to this investigation, individually identified the following guidance references for the transported natural gas[91] product:

- "Methane" having an ID Number of "UN 1971", in which the reader is referred to use "Guide 115 Gasses - Flammable" (see § 1.8.1.b), and
- "Methane, compressed" having an ID Number of "UN 1971", in which the reader is referred to use "Guide 115 Gasses - Flammable" (see § 1.8.1.b), and
- "Natural gas, compressed", having an ID Number of "UN 1971", in which the reader is referred to use "Guide 115 Gasses - Flammable" (see § 1.8.1.b), and
- "LNG (cryogenic liquid)" having an ID Number of "UN 1972", in which the reader is referred to use "Guide 115 Gasses - Flammable" (see § 1.8.1.b), and
- "Methane, refrigerated liquid (cryogenic liquid)", having an ID Number of "UN 1972", in which the reader is referred to use "Guide 115 Gasses - Flammable" (see § 1.8.1.b), and
- "Natural gas, refrigerated liquid (cryogenic liquid)" having an ID Number of "UN 1972", in which the reader is referred to use "Guide 115 Gasses - Flammable" (see § 1.8.1.b).

b. ERG - Guide 115 Gasses - Flammable

A copy of the pages, specifically relevant to the investigation, of Guide 115, as included in the ERG[92], which cites the release response handling procedural recommendations, and emergency response information for the subject (natural gas) substance, is provided in Exhibit 7.

1.8.2 Safety Data Sheet

A Safety Data Sheet provides information for emergency services agencies on the physical data, toxicity, health effects, first aid, reactivity, storage, disposal, personal protective equipment, and [unintended / uncontrolled] release-handling procedures of the product, as might be needed by

[90] Source: ERG, revision date 2016.

[91] The pressurized / chilled liquid product transported in the Enbridge Line 15 pipeline was comprised of methane as the major chemical component (i.e., typically about 94%, with a range of 87-97%; ref, background research described in [Internet] https://www.uniongas.com/about-us/about-natural-gas/chemical-composition-of-natural-gas).

[92] Source: ERG, revision date 2016.

emergency responders and/or any individual who might be exposed. See § 1.7.2, for additional information on this documentation.

1.9 Class Locations / High Consequence Area(s) Classification

1.9.1 Background - Class Locations[93]

Generally described, "Class location refers to a regulatory designation for natural gas transmission pipelines that indicates the level of human population within a certain distance on either side of the line. The class location of a pipeline is a factor in determining the maximum allowable operating pressure of the pipeline.".[94]

A pipeline, used in the transportation of [natural] gas that is regulated under the Natural Gas Pipeline Safety Act, is categorized into different Class Locations. The purpose of designating class locations is to require higher standards of safety for pipelines that are situated near densely populated areas. Regulation that addresses Class Locations requires the classification of pipelines into different class locations, each providing a certain degree of safety (see further § 1.4.1). There are four class locations, in which the Class designation [number] essentially is an index that relates to a relative degree of risk associated with the specific pipeline at that location. Generally, a class location is determined by the number of buildings in a class location unit, in which other factors (as cited in the regulation) also apply. A class location unit is a designated area that extends 220 yards (i.e., 660 feet) on either side of the center line of any continuous one-mile length of pipeline. The need for class location designations arose because a "greater number of people in proximity to the pipeline substantially increases the probabilities of personal injury and property damage in the event of an accident.".[95] Further, the "external stresses, the potential for damage from third parties, and other factors which contribute to accidents will also increase with the population.".[96] In addition, class locations are considered in determining the frequency of patrolling of transmission pipelines to observe surface conditions on and adjacent to the transmission line right-of-way[97], and in conducting leakage surveys[98].

1.9.2 Background - High Consequence Areas[99]

Generally described, "A high consequence area is a location that is specially defined in pipeline safety regulations as an area where pipeline releases could have greater consequences to health and safety or the environment. For oil pipelines, HCAs include high population areas, other

[93] Ref, see [Internet] https://www.phmsa.dot.gov/regulations/title49/interp/PI-81-001, and as further described.

[94] Source: as quoted directly from, and for further information, see PHMSA / OPS; Pipeline Glossary, available at [Internet] https://primis.phmsa.dot.gov/comm/glossary/index.htm#ClassLocation.

[95] Ref, 35 Federal Register, 5012, Mar. 24, 1970.

[96] Ibid

[97] Ref, 49 CFR 192.705(b).

[98] Ibid

[99] Source, as selectively quoted from, and for further information, see [Internet] https://primis.phmsa.dot.gov/comm/FactSheets/FSHCA.htm, and as further described.

population areas, commercially navigable waterways and areas unusually sensitive to environmental damage. Regulations require a pipeline operator to take specific steps to ensure the integrity of a pipeline for which a release could affect an HCA and, thereby, the protection of the HCA.".[100]

Consequences of inadvertent releases from pipelines can vary greatly, depending on where the release occurs, and the commodity involved in the release. Releases from pipelines can adversely affect human health and safety, cause environmental degradation, and damage personal or commercial property. Pipeline safety regulations use the concept of "High Consequence Areas" (HCAs), to identify specific locales and areas where a release could have the most significant adverse consequences. Once identified, operators are required to devote additional focus, efforts, and analysis in HCAs to ensure the integrity of pipelines. HCAs for natural gas transmission pipelines focus solely on populated areas.

In researching the HCA criteria, the SF investigation located background information (explanatory narrative) of the PHMSA[101] that described the HCA development, and the criteria that a pipeline operator must employ in identifying the potential impact to the population, as might be situated proximate to a transmission pipeline, which indicated the following.

> "HCAs for natural gas transmission pipelines:
>
> - An equation has been developed based on research and experience that estimates the distance from a potential explosion at which death, injury or significant property damage could occur. This distance is known as the "potential impact radius" (or PIR), and is used to depict potential impact circles.
> - Operators must calculate the potential impact radius for all points along their pipelines and evaluate corresponding impact circles to identify what population is contained within each circle.
> - Potential impact circles that contain 20 or more structures intended for human occupancy;, buildings housing populations of limited mobility; buildings that would be hard to evacuate (e.g., nursing homes, schools); or buildings and outside areas occupied by more than 20 persons on a specified minimum number of days each year, are defined as HCA's."

The "equation" referred to, by the PHMSA in the above first 'bullet', is cited in 49 CFR 192.903.

1.9.3 Class Designation by Texas Eastern at the Accident Site

[100] Ref, see [Internet] https://primis.phmsa.dot.gov/comm/glossary/index.htm?nocache=8168#HighConsequence Area.

[101] Source, as directly quoted from [the PHMSA] "Fact Sheet: High Consequence Areas (HCA)"; see [Internet] https://primis.phmsa.dot.gov/comm/FactSheets/FSHCA.htm.

Texas Eastern documented to the PHMSA[102], that the area proximate to the pipeline release site was designated, according to the regulatory criteria in 49 CFR § 192.5 - Class locations, as a "Class 2" location. Commensurate to this, Texas Eastern additionally documented [to PHMSA] that the area proximate to the release site, according to the regulatory criteria stipulated in 49 CFR § 192.903 What definitions apply to this subpart?, was not considered a "high consequence area" (HCA).

1.9.4 HCA Status as Identified in the National Pipeline Mapping System

Review of the National Pipeline Mapping System (NPMS) map of pipelines, for the subject segment of the Texas Eastern Line 15 pipeline, indicates that the area proximate to the accident site is not situated within a High Consequence Area.[103]

1.9.5 Potential Impact Radius of the Area Proximate to the Release Site

As described by the PHMSA[104], "The potential impact radius is an approximation of the extent of immediate damage from a pipeline incident. Damage may extend slightly beyond that radius in some instances. Additionally, structures extending into the radius would very likely burn, and those fires will not be limited to the portion of the structure within the radius.".

Potential Impact Radius (PIR), according to regulation[105], is defined as "the radius of a circle within which the potential failure of a pipeline could have significant impact on people or property". A mathematical equation is provided in the regulation to calculate the PIR dimension.

Texas Eastern documented to the PHMSA[106], that the PIR of the Line 15 pipeline, in the area proximate to the release site, is 633 feet.

Calculation by the investigation[107], to further independently corroborate the identified PIR dimension, pursuant to the stipulated equation to be utilized to determine the PIR[108], indicated the calculated PIR to be 633.3 feet (see Exhibit 8 for calculation data).

2.0 Accident Site - Damage Characterization and Relevant Factual Data

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[102] Source: PHMSA form F 7100.2 Incident Report - Gas Transmission and Gathering Pipeline Systems, Report number 20190103 - 32637, date 08/30/2019, as made available by the PHMSA / Accident Investigation Division.

[103] Ref, [Internet] https://www.npms.phmsa.dot.gov/PIMMA/.

[104] Source: Gas Transmission Integrity Management FAQs (Frequently Asked Questions), as addressed in [quoted from] FAQ-162, see [Internet] https://www.phmsa.dot.gov/pipeline/gas-transmission-integrity-management/gas-transmission-integrity-management-faqs.

[105] Ref, 49 CFR 192.903(4)(c), under the definition of *Potential Impact Radius*. (see further § 1.4.1)

[106] Source: PHMSA form F 7100.2 Incident Report - Gas Transmission and Gathering Pipeline Systems, Report number 20190103 - 32637, date 08/30/2019, as made available by the PHMSA / Accident Investigation Division.

[107] i.e., the author of this report.

[108] i.e., the equation as cited in 49 CFR 192.903(4)(c), under the definition of *Potential Impact Radius*. (see further § 1.4.1)

2.1 Time of the Event Occurrence

The investigation was unable to locate documented evidence at the accident site that identified the time of the event occurrence, in which two other data sources were located that supported identifying the approximate time of the event occurrence, which are summarized as follows.

- As identified by 'timestamp' data[109, 110], of two (privately owned / operated) security camera systems that automatically recorded continuous digital video images[111], at a distance, the evidence supports[112] that the explosion and fire of discharged natural gas, as released in a breach of the Texas Eastern Line 15 transmission pipeline at the accident site, initiated at about 1:23:23 a.m. EDT, on August 1, 2019. See further § 2.4 for information details on the security camera systems that were identified / examined / utilized in the investigation.
- The local 911-Emergency Call Center [PSAP[113]] agency logged an (incoming) 911 telephone call[114], which initiated at 01:23:34, which was the initial call to report the incident, in which the caller indicated that he was a motorist, traveling southbound on a roadway south of Danville, proximate to the accident site[115], and that there was an "explosion" and a "massive fire" near the location that he was calling from.

2.2 Point of Release

[109] Generally described, a "timestamp" of a digital recording device is encoded information [in the recording medium] that documents the time of the individually displayed images of a video recording, which can be used to identify when an event occurred (as shown in a given video image), in that, upon verification, accurate date and time [of day] data is documented in the encoded data, in which the identified time may be accurate to the second, where a timestamp characteristically may be provided in the format: date:00:00:00 (i.e., date:hour:minute:second), in which the 'reconciled accuracy' of the video recording equipment timestamp data would need to be verified, relative to an official, US Government-sourced, recognized time standard (e.g., [Internet] http://www.time.gov/).

[110] The 'reconciled accuracy' of the video recording equipment timestamp was verified as accurate by the investigation, relative to an official, US Government-sourced, time standard (e.g., [Internet] http://www.time.gov/).

[111] The identified security camera systems, as examined by the SF investigation, in which the equipment owners provided access consent to the video recording equipment, were located about 1.5 miles north, and about 3.0 miles south, respectively, of the accident site, and were oriented such that the cameras were facing the direction of the accident site, in which a distinctive 'flash' (of the explosion) was visibly apparent in the recorded video images.

[112] Supportive evidence consists of the observed, discernably visible, intense 'flash' of bright light in the night sky, which was successively followed by a continuous 'bright glow', which, collectively, would be distinctly characteristic of an explosion and fire, as observed in the video recording images.

[113] Public Safety Answering Point; see further § 3.2.1.

[114] Note: the SF investigation observed that, although the CAD report [of the PSAP] documented that this call had initiated at 1:23:00, review of the 'timestamp' data that is affixed to the 'file properties' of the audio recording of this specific call, documented that this call actually initiated at 1:23:34, in which the accuracy of the audio recording 'file properties' timestamp was determined to be more precise than as cited in the CAD report data.

[115] Based upon what the 911 caller depicted, as compared to local mapping data, the evidence suggests the caller was traveling on U.S. Route 127, near Bowens Loop Road or [State] Highway 2141, in which an effort was made by the investigation to conduct a follow-up [debriefing] interview with that 911 caller, which was not successful.

The approximate point of release was reported[116] by the pipeline owner / operator (Texas Eastern) to have occurred at MP 423.40 of the Line 15 natural gas transmission pipeline. The specific point of release[117] occurred in a vacant, open field that was substantially comprised of natural grassland, with some trees that were situated along the western boundary of the site (which was the railroad ROW, as previously described). The point of release was about 180 feet to the west of an unpaved roadway, which was identified (in local maps) as Mitchell Lane, and about 1,680 feet northwest of the intersection of U.S. Route 127 and Camp Road.

2.3 Damage Description / Evidentiary Artifacts of the Accident Site

2.3.1 Pipeline Infrastructure

The unintentional release of pipeline product in the accident resulted in an explosion, which resulted in the creation of a crater at the release site, from which soil, rock and a segment of the transmission pipe was ejected in the explosion. The ejected soil and rock material was observed to have been scattered throughout the area proximate to the crater. The crater that resulted from the explosion measured about 55 feet in length, by about 35 feet in width, and about 12 feet in depth[118]. Two short segments of pipe, that had been attached to each end of the ejected segment of pipe, were visible at both ends of the crater pit, protruding from the crater walls.

The segment of ejected pipe, measuring about 33 feet in length, which was discharged from the crater in the explosion, became airborne and traveled in a southerly direction. The segment of ejected pipe, which was estimated [by the investigation[119]] to weigh about 3,900 lbs., came to rest on open ground, about 481 feet to the approximate south of the crater location. The subject pipe segment was subsequently documented in-situ (at the scene), which was further recovered from the accident site, and transported (as a secure, evidentiary artifact) to the NTSB, where it was then subsequently subjected to testing / evaluation by the NTSB Materials Laboratory.

See the Operations Group Factual Report, the Materials Testing Group Factual Report, and the UAS Aerial Imagery Report, for additional information on this topic.

2.3.2 Identified Casualty[120]

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[116] Source: PHMSA form F 7100.2 Incident Report - Gas Transmission and Gathering Pipeline Systems, Report number 20190103 - 32637, date 08/30/2019, as made available by the PHMSA / Accident Investigation Division.

[117] The dimensions cited refer to direct distance measurement from the center of the crater (that resulted at the site), to the described location.

[118] Source: NTSB UAS Aerial Imagery Report, dated 11/12/2019 (a copy of which is available in the NTSB docket); see Fig. 6 of the Aerial Imagery Report.

[119] Source: data of several (commonly available) 'steel reference handbooks', which indicated, for a 30-inch outside diameter carbon steel pipe, and having a 0.375 inch wall thickness, a weight of 118.76 lbs. per [linear] foot, which calculates, for an approximate 33-foot length of pipe, to a total weight of about 3,900 lbs.

[120] Source: field-observations and field-interview notations of the SF Group Chairperson [as documented in the SF Group Chairperson Field Notes], and transcript of a [later conducted, formal / recorded] interview that was conducted with a Deputy Sheriff of the Lincoln County Sheriff's Office, who responded to the accident site (see Transcript; available in the NTSB public docket), and as further described.

The body of an adult female, which was the only fatality that occurred in the accident, was initially observed by a responding Deputy Sheriff (of the LCSO), lying on the ground, in the driveway of a residential dwelling that was located at the west end of Indian Camp Road. This distance was later measured to be about 640 feet to the south of the center of the release site crater (containing the burning natural gas flare). See further § 7.2 for additional information.

2.3.3 Real Estate and Personal Property

Five residential dwellings of the mobile home park community were destroyed in the ensuing heat of the fire (i.e., the dwellings were fully consumed in the fire, in which only non-combustible materials [metals, etc.] endured at those locations), and 14 residential dwellings in that community sustained fire damage to various degrees, but remained 'standing'. As a characterization of the degree of fire damage that was sustained by the 14 residential dwellings (that remained 'standing'), the SF investigation observed, during the pre-recovery examination of the properties proximate to the accident site, that the heat of the fire (flare) had melted the plastic ('vinyl', i.e., PVC[121, 122]) exterior siding material of a residential structure that was located about 1,100 feet to the approximate east of the fire.[123] Also, vehicles that were situated at the fire / heat damaged residential dwellings also sustained various degrees of fire / heat damage, ranging from melted plastic of the vehicle body, to fully burned-out vehicle shells.

Additional information detail on the fire damage sustained by the real estate and personal property at the accident site, is described in the NTSB UAS Aerial Imagery Report of the investigation, and in the photographs of the investigation, as available in the NTSB public docket.

2.3.4 Vegetation / Soil Conditions

Pre-recovery examination and documentation of the fire damaged ground area, identified the grassland and wooded areas (consisting of natural growth trees) immediately proximate to the pipeline rupture site received fire damage as a result of the explosive ignition of the released natural gas product, and the ensuing natural gas flare (that was emanating from the crater). In locations immediately proximate to the ensuing natural gas flare (that was emanating from the crater at the release site), the observed fire damage is characterized as a 'scorched earth' condition, in which all of the natural grass cover was consumed in the fire, where only a covering of soot and ash remained. A number of natural growth trees, situated proximate to the

[121] PVC: polyvinyl chloride, also referred to as 'vinyl', is a commonly used plastic (polymer) siding material.

[122] Research of the SF investigation identified that physical testing, conducted on various grades of PVC siding material, which resulted in 'heat deflection' (i.e., melting of the material), identified "The measured heat deflection temperatures of these products range from 142 to 192°F (61 to 89°C) with an average value of 166°F (74°C).", ref, Robert Hart, et al, Research Needs: Glass Solar Reflectance and Vinyl Siding, Lawrence Berkeley National Laboratory, Berkeley, CA, [published] 2011, available at [Internet] https://www.osti.gov/servlets/purl/1050447.

[123] Ref, as documented by Damage Assessment photographs (i.e.,, image ID 20190801_191827, and 20190801_191637) by the LCEMA, of thermal damage sustained to the western side of a residential dwelling located at 589 Mitchell Lane, the location of which was subsequently measured (utilizing GPS coordinates of the heat origin [crater center] and destination [damaged structure] locations) to be about 1,100 feet from the center of the crater that resulted at the pipeline release site.

release site crater, sustained fire damage. As identified in aerial imagery (documented by the investigation)[124], about 30-acres of land sustained fire damage.

A distinct, discolored area of ground surface, which was visibly evident in aerial imagery of the investigation[125], was observed approximately east of the eastern end of the crater that resulted at the pipeline rupture site, in which the discoloration area generally extended in an eastern direction. The discoloration area is characterized as somewhat elliptical in shape, and resembled an elongated 'teardrop' appearance, which generally measured about 30 feet in width (at the widest point), by about 180 feet in length. The longitudinal axis of the elliptically-shaped discoloration had a compass bearing of about 80 degrees (i.e., relative to a compass true-north bearing of 0 degrees). The investigation observed that the discoloration was oriented at approximately the same compass bearing as the Line 15 pipeline (in the area of the crater at the release site). Close visual examination of the ground surfaces within the confines of the elliptically-shaped discoloration area, indicated that, the area displayed characteristics that were consistent with a "high [degree of] soil burn severity.[126, 127]

Additional information detail on the fire damage sustained to the grassland and wooded areas at the accident site is described in the NTSB UAS Aerial Imagery Report of the investigation, and in the photographs of the investigation, as available in the NTSB public docket.

2.4 Real-Time - Surveillance Camera / Video Imagery

Real-time, surveillance camera / video imagery, as recorded by two, commercial-grade, security surveillance, monitoring / video recording systems, was made available to the investigation, from [1] a location about 1.5 miles approximately to the north of the accident site, and [2] a location about 3.0 miles south of the accident site. The recorded video camera imagery ('footage') at both locations displayed the initial explosion (which identified the Time of the Event Occurrence; see § 2.1), in which the video camera imagery displayed two distinct sequential flashes of extremely bright light, and subsequent continuous illumination of the flare of the burning natural gas that was released from the breached pipeline. The time interval between the two distinct sequential flashes, as displayed in the recorded video camera imagery, was observed to be about 10 seconds in duration (i.e., the initial flash occurred at about 01:23:23, with a secondary flash at about 01:23:33). Select still-photo excerpts of the described video camera imagery will be available in the NTSB public docket.

2.5 Quantity Estimation of Pipeline Product Released

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[124] Source: NTSB UAS Aerial Imagery Report, dated 11/12/2019 (a copy of which is available in the NTSB docket).

[125] Ibid

[126] Ref, and for further detail see, Parson, Annette; et al, October 2010. Field guide for mapping post-fire soil burn severity**.** General Technical Report RMRS-GTR-243. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station; available at [Internet] https://www.fs.fed.us/rm/pubs/rmrs_gtr243.pdf.

[127] Source [of observation cited]: data as depicted in the USDA Field Guide, [in report sections titled] "Soils Assessment for Low, Moderate, and High Soil Burn Severity Classes", [then, in the sub-section titled] "Severity Indicators", in which the degree of burn severity was based upon the exemplar photograph images criteria under [categories of] "Ground Cover: Amount and Condition", "Ash Color and Depth", and "Soil Structure".

2.5.1 Reporting Requirement Regulation[128]

Data of the estimated volume of product released, resulting from an uncontrolled release from a transmission pipeline, pursuant to the criteria under 49 CFR 191.15(a), is required to be reported to the PHMSA by the pipeline operator, in which the data is cited in the PHMSA form F 7100.2 Incident Report - Gas Transmission and Gathering Pipeline Systems. Also, pursuant to the criteria under 49 CFR 191.15(b), in a situation where additional related information is obtained after an operator submits a form F 7100.2 report, the operator must make a supplemental report as soon as practicable.

2.5.2 Considerations in Estimating the Quantity of Pipeline Product Released

Generally described, identifying the quantity of product released from a pressurized pipeline that sustains an unintended release, where the product likely will be vented to the atmosphere, involves one or more of the following evaluation-methodology considerations.

[1] Fundamentally, the quantity of product contained within a pipeline system is determined by:
   (a) the quantity of product that continues to be pumped through a pipeline, by an operating compressor station (that is supplying the release location) which continues to operate after a release is initiated, until the point in time that the product flow from the compressor ceases (i.e., when the compressor operation is terminated, in which no product flow is contributed by the compressor), in which also,
   (b) a flow control valve, as situated between a release location and the corresponding compressor station that is supplying the release location, is closed.

[2] Flow control valve closures (when correctly functioning) result in containment of a product within a pipeline, which may or may not be under pressure, for the length of the pipeline between corresponding flow control valve stations that are situated on either side of a release site, in which after valves closure occurs, the maximum amount of product available for potential release is limited to that as contained within the length of pipeline for the distance between the corresponding flow control valves (see further § 2.5.4).

[3] A mathematical calculation, involving complex constituent factors and data integration processes, can be performed to identify an estimation of the quantity of product that was released from the pipeline. Such a calculation utilizes integral / influential factors such as pipeline product pressure, atmospheric pressure, product temperature, pipe [internal] friction, volume of a pipeline between the containment point (i.e., the location of a flow control valve) and the release site, release site orifice geometry (size / shape of the release 'opening'), impediments to an 'open flow' release of product (e.g., hard-packed rock / soil, or other materials as might be tightly wedged against a release site orifice), among several other employed [pipeline flow dynamics] factors. Other considerations include product pumping-

[128] Ref, and for further information, see [Internet] https://www.ecfr.gov/cgi-bin/text-idx?SID=3de72d1c2a3a82ba94b5c5b58715ad2a&mc=true&node=se49.3.191_115&rgn=div8.

flowrates, upstream and/or downstream, of the release location, until the release flow is curtailed, although such a calculation can be exceptionally complex, given the variable factors that may intercede during the product flow secession process.

[4] One methodology ascertained by the investigation, to identify the quantity of a pressurized gas (i.e., natural gas) that has been released as a result of a breach to the pipeline, involves employment of a standardized algorithm that was developed by, and is recognized in the transmission pipeline profession, which is referred to as the Panhandle B Equation[129], in which the investigation also identified that there were several 'versions' available[130] of the Panhandle B Equation (see further § 2.5.3.b).

2.5.3 Texas Eastern Reported – Estimated Release Data

a. Data Initially Reported to the PHMSA

Responsive to regulation (described above; see § 2.5.1), Texas Eastern documented[131] to the PHMSA, in a PHMSA form F 7100.2 Incident Report, that the volume of gas product released in the accident was 65,689.00 MCF (million cubic feet), i.e., a volume of just under 65.7 million standard cubic feet of gas[132].

NTSB review of the released [natural gas product] volume data, as cited in the (above described) PHMSA form F 7100.2 Incident Report (as made available to the investigation by the PHMSA), identified that a review of the Texas Eastern documentation as submitted to the PHMSA was warranted (i.e., an audit of the methodology and data employed by Texas Eastern, to calculate the estimated volume of gas product released), as further described (see further § 2.5.3.b).

b. Data Reported to NTSB

To address the methodology detail and data employed by Texas Eastern in their subsequent calculation of the volume of gas product that was released in the accident (see also § 2.5.3.a), Enbridge was afforded opportunities to make data available for review by the investigation on

[129] For a brief background of the development of the Panhandle B Equation, and its utilization, and similarly employed equations, see, e.g., Rios-Mercado, Roger. Z., et al, Optimization Problems in Natural Gas Transportation Systems: A State-of-the-Art Review, available at [Internet] https://www.osti.gov/servlets/purl/1235737.

[130] The different 'versions' of the Panhandle B Equation available were observed to employ different variables and constant parameters in the algorithm (due to considerations of turbulence, transmission factors, isothermal steady-state flow, discharge coefficients, etc.), which were utilized to address the specific conditions of a given pipeline release scenario.

[131] Source: PHMSA form F 7100.2 Incident Report - Gas Transmission and Gathering Pipeline Systems, Report number 20190103 - 32637, date 08/30/2019, as made available by the PHMSA / Accident Investigation Division.

[132] A standard cubic foot is the volume of gas which, when saturated with water vapor at a temperature of 60ºF and at a pressure of 30 inches of mercury (i.e., 14.7 psia), occupies one cubic foot of volume; see further [Internet] https://www.mineralweb.com/library/oil-and-gas-terms/cubic-foot-of-gas-standard-cubic-foot-of-gas-definition/, and https://www.sciencedirect.com/topics/engineering/standard-cubic-foot.

this topic-point.[133] The activities of that review / documentation transmittal process were annotated in a document that described the methodology detail and data that was employed by Enbridge in their calculation activity, a copy of which is provided in Exhibit 9.

A tabulation summarizing the Texas Eastern calculations of the estimated volume of natural gas product released is as follows.[134]

Gas Loss Event	MLV MP 408.08 to Rupture flowing East (Downstream to Upstream), Mscf	Danville to Rupture Flowing West (Upstream to Downstream), Mscf	Total, Mscf
Transient, Determined using the pressures at a distance upstream and downstream of the rupture with compressors operating and mainline valves open.	55,384	33,318	88,702
Static, Mainline Valves Closed	10,028	2,755	12,783
Total	65,412	36,073	101,485

c. Supplemental Form F 7100.2 Report as Filed with the PHMSA

Pursuant to the criteria under 49 CFR 191.15(b), in a situation where additional related information is obtained after an operator [initially] submits a form F 7100.2 report, the operator must file a supplemental report as soon as practicable, to which Enbridge reported to the investigation[135] that a Supplemental Form F 7100.2, displaying a filing date of 07/21/2020, which contained updated estimated gas volume release data (which agreed with the Enbridge data calculation; see § 2.5.3.b), had been filed with the PHMSA.

2.5.4 Volumetric Calculations of the Pipe Between the Two Valve Stations

Calculation by the investigation of the internal volume of the subject Line 15, 30-inch diameter natural gas transmission pipeline (at the accident site), for the distance between the two valve stations that were situated on either side of the release site[136], indicated that the segment of

[133] As clarification, although Enbridge (as the designated Party to the investigation) was afforded opportunities to make data of this topic-point available for review, the calculations / data forthcoming was observed to have been sourced from resources at Texas Eastern, with delivery to the investigation via the Enbridge Party representative.

[134] Ref, email from the Enbridge Party - SF Group participant, to the SF Group Chair, dated 04/01/2020.

[135] Ref, email from the Enbridge Party - SF Group participant, to the SF Group Chair, dated 09/25/2020.

[136] i.e., the downstream valve was located at MP 408.50 (about 14.90 miles to the southwest of the release site), and the upstream valve was located at MP 427.50 (about 4.1 miles to the northeast of the release site), in which the distance between the two valves measured approximately about 19.00 miles (i.e., about 100,320 feet).

pipeline contained an approximate volume of 569,587 cu. ft. of natural gas product (see Exhibit 8 for calculation data).

2.6 Environmental Monitoring / Testing / Data Recording

In a release of a hazardous product from a breached pipeline, an integral element of an emergency response and evacuation process usually involves the monitoring of air quality [data], and testing [data] for potential soil or surface water contamination, as might be conducted for the area proximate to the accident site. The monitoring / testing information is then usually made available for contemporaneous dissemination to Incident Command (staff) and the jurisdictional air quality / soil or surface water contamination monitoring agencies, such to support time sensitive / informed decisions that need to be made, as support to the execution of the emergency response to the incident. The SF investigation typically includes, in factual report documentation of the investigation, a summarization, and sometimes data, of the collected air monitoring / soil or surface water testing activities, as conducted at the accident site.

At the onset of the investigation, Enbridge was afforded the opportunity to make documentation available, of air quality monitoring, and testing to identify possible soil or surface water contamination, as might be performed / conducted by Enbridge, and/or its contracted technical resources, as conducted in the area proximate to the accident site, the activities of which are briefly summarized as follows.

2.6.1 Air Monitoring

Environmental air monitoring and data recording at the accident site was conducted by the services of an Enbridge technical contractor at the accident scene[137], the data of which were documented to the investigation[138], in which a narrative element was cited in one of those documents[139] that provides a succinct summarization of the air monitoring / data recording activities that were initially conducted, which is provided as follows.

> "Access to the site was not granted by the NTSB on Thursday, August 1st due to the NTSB investigation. Our employees did monitor for LEL, O2, H2S, and CO via direct reading, personal 4-gas meter instruments immediately when they arrived to the perimeter of the incident site, outside of the access area, on Thursday, August 1st. All results were continuously monitored and below alarm set points, which are set as follows: LEL = 10%; O2 = 19.5% to 23.5%; H2S = 10 ppm; and CO = 35 ppm. Therefore, all 4-gas monitoring remained below these levels. Sampling was instituted upon access being granted beginning on Saturday, August 3rd and was conducted continuously to measure 24-hour averages (U.S. EPA National Ambient Air Quality Standards) for community air monitoring through Monday, August 5th. After review of the recorded air monitoring results that all showed below EPA standards and occupational exposure limits, air sampling was discontinued on

[137] As identified in 'title block' data in the supplied Enbridge documentation, the contractor was Trimedia Environmental & Engineering Services LLC; see further [Internet] https://trimediaee.com/.

[138] Source: Enbridge documentation DR105 Air Monitoring Data-c2, DR105 Air Monitoring Mapbook Figures-c2.

[139] Source: Enbridge documentation DR105 Air Monitoring Data-c2.

> Monday, August 5th. Additionally, any fugitive dust at the site was controlled with water to keep dust levels below any applicable limits. We are resuming air monitoring around the work zone today as a cautionary measure in response to recent public concerns raised."

Subsequent to the on-scene phase of the investigation, the Enbridge environmental air monitoring and data recording contractor completed a Summary Report that addressed the entire air monitoring and testing activities of the accident, and also presented the monitoring / test results. The Executive Summary of that report[140] was made available to the investigation[141], a copy of which will be available in the NTSB public docket.

2.6.2 Monitoring / Testing Conducted to Identify Possible Soil or Surface Water Contamination

Environmental monitoring and data recording at the accident site, to address possible soil or surface water contamination, was also conducted by the services of an Enbridge technical contractor[142], the data of which were documented to the investigation.[143]

Subsequent to the on-scene phase of the investigation, the Enbridge environmental sampling and testing contractor, which addressed possible soil or surface water contamination, completed a Summary Report that addressed the soil and surface water contamination sampling and testing activities of the accident, and also presented the sampling / test results. A copy of that Summary Report was made available to the investigation[144], in which a copy of that report will be available in the NTSB public docket.

2.7 Accident Site - Evidentiary Artifact Documentation

2.7.1 Accident Site Map - NTSB

The UAS Aerial Imagery [technical working] Group of the investigation compiled a report that documented the pre-recovery accident scene, utilizing an Unmanned Aircraft Systems (UAS) vehicle, which are also commonly referred to as aerial "drones", in which a copy of that report, which contains an accident site map, is available in the NTSB public docket.

2.7.2 Accident Site - Properties Acquired by Enbridge

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[140] As the entire Summary Report was quite lengthy (as it was comprised of the entire supporting datasets acquired during the on-scene activities), the Executive Summary segment of that Report was deemed sufficient for purposes of this investigation, which was correspondingly made available to the investigation, in which it was indicated that the entire Report (including all documented datasets) would be made available to the investigation upon request.

[141] Ref email from the Enbridge Party - SF Group participant, to the SF Group Chair, dated 03/25/2020.

[142] As identified in the Summary Report of this organization (as further described), the contractor was WSP USA, Inc.; see further [Internet] https://www.wsp.com/en-US.

[143] Source: Enbridge documentation DR107 Soil Quality Summary 8-8-19-c2, and DR107 TETLP - Lincoln County KY - Soil and Water Sampling Data-c2.

[144] Ref email from the Enbridge Party - SF Group participant, to the SF Group Chair, dated 03/25/2020.

Enbridge made annotated aerial imagery available to the investigation[145], which identified real estate properties, situated proximate to the accident site, which were acquired by the company as a result of the accident, in which a number of the identified residential dwellings (cited in the document) were identified to have sustained damage in the accident. The investigation noted that, based upon the on-scene visual-canvas of properties that sustained damage at the scene, as described in the Enbridge annotated aerial imagery [document], not all of the properties purchased by Enbridge had received damage as a result of the accident. A copy of the ('updated information' revision of the) Enbridge annotated aerial imagery is provided in Exhibit 10.

2.8 Meteorological Factors

The recorded weather at the nearest National Weather Service weather station[146], for the date of the accident, was obtained by the investigation, the data documentation of which is provided in Exhibit 11.

2.9 Corrective Action Orders[147] - Issued to Texas Eastern

a. As a result of the natural gas product release and fire, and consequential damage sustained in the area proximate to the accident site, the PHMSA issued a Corrective Action Order (CAO) to Texas Eastern[148], dated August 8, 2019, a copy of which is provided in Exhibit 12.

b. To supplement, and to update the data of the originally issued CAO, the PHMSA issued an Amended CAO to Texas Eastern, dated April 28, 2020, a copy of which is provided in Exhibit 12.

c. To supplement, and to update the data of the issued Amended CAO, the PHMSA issued a Second Amended CAO to Texas Eastern, dated June 1, 2020, in which (as cited in the document) this Second Amended CAO was to address [data of] an incident involving the breach, unintended [natural gas] product release, explosion, and intensive fire, that occurred in the Texas Eastern Line 10 transmission pipeline, on May 4, 2020, in a rural area about 1¾ mile to the northeast of Hillsboro, KY, which occurred at a location about 84 miles to the northeast of, and within the same Texas Eastern ROW as, the Danville Line 15 accident (of this investigation).

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[145] Ref email from the Enbridge Vice President - Engineering and Asset Management, to the Investigator in Charge, dated 03/31/2020, in which 'updated' information on this topic-point was made available by Enbridge in email correspondence from the Enbridge Party - SF Group participant, to the SF Group Chair, dated 07/24/2020.

[146] Source: Quality Controlled Local Climatological Data, hourly, for the Stuart Powell Field Airport [near Junction City], KY; Network ID [NOAA weather station] US WBAN: 72044800144 (KDVK), located about 3.3 miles northeast of the accident site, of 01 Aug. 2019; Source, and for additional data, see [Internet] https://www.ncdc.noaa.gov/cdo-web/datasets/LCD/stations/WBAN:00144/detail.

[147] Ref, and for further information, see 49 CFR 190.233 Corrective action orders; available at [Internet] https://www.ecfr.gov/cgi-bin/text-idx?SID=a6b248b4117af5ab20594d6b06203a4c&mc=true&node=pt49.3.190&rgn=div5#se49.3.190_1233.

[148] Source: [Internet] https://primis.phmsa.dot.gov/comm/reports/enforce/documents/220191002H/220191002H_Corrective%20Action%20Order_08082019.pdf.

3.0 Background and Emergency Preparedness Measures of the Jurisdictional Emergency Services Agencies / Organizations[149]

The following data is as characterized by the identified information source, or principal (senior administrator or manager) of the subject agency, or as noted otherwise.

3.1 Jurisdictional Fire / Emergency Services - Rescue Agency – LCFPD[150]

The accident occurred on private property within the jurisdiction [fire protection district] of the Lincoln County Fire Protection District (LCFPD), which also provided resources in response to the incident.

3.1.1 Background / Overview[151]

The LCFPD is the principal emergency services agency responsible for responding to fire suppression, emergency rescue, and an initial response to hazardous materials incidents within the fire protection district (in Lincoln County) that encompassed the accident site, and was the initial fire / rescue agency that responded to the scene in this incident.

The Fire Chief is the senior Command Officer in charge of the operational management of the agency. The Chief indicated that (in his professional career / vocation) he, and his command staff, had a general familiarity with the recognized hazards of natural gas, in which the agency also had established protocols for addressing natural gas incidents (as further described).

Briefly summarized, the LCFPD:

- is an all-volunteer organization, with the exception of the Chief (who is the only paid employee of the agency), which (at the time of the accident) maintained a personnel roster of 98 firefighters,
- operates out of seven fire stations, as strategically located throughout Lincoln County,
- maintained an apparatus roster (tactical operations - vehicles list) comprised of:
  - 7 Class A Engines (pumper trucks),
  - 9 Tankers (water transport),
  - 7 Brush Trucks (off-road / brush fire response vehicle),
  - 6 Rescue / Brush Truck Combination,
  - 2 Command Vehicles,
- has formal "mutual aid" response agreements with fire department resources from neighboring jurisdictions (e.g., City of Danville, Boyle County, Casey County), and correspondingly, is available to respond to emergency incidents in those jurisdictions,

[149] Source: field-observations and field-interview notations of the SF Group Chairperson [as documented in the SF Group Chairperson Field Notes], and as further described.

[150] Ref, and for further information, see [Internet] http://lincolncountyfiredepartment.com/, and as further described.

[151] Source: documentation of the agency, and debriefing interviews of LCFPD Fire Chief (on-scene, and subsequent) by NTSB staff.

- in which emergency dispatching services of the agency are performed by Bluegrass 911 (see § 3.2).

The LCFPD fire station that provided the initial tactical response to the incident, which was also the LCFPD fire station that was closest to the accident site (approximately 2.0 miles south of the accident site) was Fire Station 3, which is also informally known locally as the 'Moreland Volunteer Fire Department'. Fire Station 3 (at the time of the accident) maintained a personnel roster of 24 firefighters, and maintained an apparatus roster comprised of one Tanker [truck], one Class A Engine, and one Rescue / Brush Truck Combination.

3.1.2 Preparedness Measures / Plans

The LCFPD utilized a preparedness response plan, titled the "Lincoln County Emergency Operations Plan", as compiled / promulgated by the Lincoln County - Office of Emergency Management (see § 3.3).

3.1.3 Natural Gas Pipeline Operations Familiarization and/or Emergency Response Training Activities / Drill Exercises Conducted Prior to the Accident

Training roster / sign-in sheet documentation[152], as reviewed by the investigation, identified that personnel of the LCFPD had attended annual Pipeline Safety Awareness Training Program 'liaison training' activities that were conducted, on behalf of Enbridge (by Paradigm Liaison Services; see further § 5.1), for emergency services personnel, excavation contractors, or other entities that might interface with pipeline operations, for the years 2015, through 2019, inclusive.

3.2 Emergency Services - 911 Call Processing / Fire Department, EMS, and Law Enforcement Dispatching – Bluegrass 911[153]

3.2.1 Background / Overview[154]

Telephone requests in Lincoln County for a police department response, a fire department emergency services request, or a request for an ambulance response, or to address other emergency situations, are placed via the Bluegrass 911 Central Communication Center (Bluegrass 911), which is locally informally referred to as Bluegrass 911. This agency is a 911-Emergency Call Center [generically referred to as a PSAP[155]] that provides emergency services

[152] Ref; review by the SF investigation, for attendance corroboration, of the "Attendee Electronic Sign In Sheet(s)", for the "Danville - Safety Awareness Training Program (Dinner)", as conducted [on an annual basis] by the training contractor (Paradigm), during the corresponding years identified, as made available to the investigation by Enbridge.

[153] Source, and for further information, see [Internet] https://bluegrass911.com/, and as further described.

[154] Source: debriefing interview with the Director of Bluegrass 911 (during the on-scene phase of the investigation), and as further described.

[155] Such a facility or operation is also referred to as a Public Safety Answering Point (PSAP), as further described in [Internet] http://www.nena.org/.

communications for both Garrard County[156] and Lincoln County, as a combined operation, the facility of which is located in Lancaster, KY. The agency provides 911 Emergency Dispatching for a total of 15 fire/rescue departments of the two counties, seven law enforcement agencies, four emergency medical services (EMS) agencies, and the emergency management agencies and coroner agencies of the two counties, as well as provides Addressing & Mapping services[157] for the constituent jurisdictions. Staff of the agency (at the time of the accident) included a Director, Assistant Director, a Training Supervisor / Telecommunicator, and 14 full-time Telecommunicators. The agency has formal "mutual aid" response agreement(s) with PSAP agencies of neighboring jurisdictions, and correspondingly, is available to support emergency incidents in those neighboring jurisdictions. The facility also maintains an Emergency Operations Center (EOC) for the two counties.

Documentation, or other activity-data archive, which is routinely compiled by this agency includes [1] what is informally referred to as 'dispatch log sheets', utilizing an automated Computer Aided Dispatch System (referred to as a "CAD System" by some emergency services agencies) to automatically document communications and dispatch services activities, and [2] automatically archived digital voice recordings of agency dispatch service radio and certain Bluegrass 911 telephone communications (i.e., incoming 911-calls, and select administrative phone lines).[158, 159]

3.2.2 Preparedness Measures / Plans

Bluegrass 911 utilized a preparedness response plan, titled the "Lincoln County Emergency Operations Plan", as compiled / promulgated by the Lincoln County - Office of Emergency Management (see § 3.3).

3.2.3 Natural Gas Pipeline Operations Familiarization and/or Emergency Response Training Activities / Drill Exercises Conducted Prior to the Accident

Training roster / sign-in sheet documentation[160], as reviewed by the investigation, identified that personnel of the emergency services agencies had attended annual Pipeline Safety Awareness Training Program 'liaison training' activities that were conducted, on behalf of Enbridge (by

[156] Garrard County is contiguous to, and to the north of Lincoln County, and to the east of Boyle County.

[157] Addressing & Mapping is an ancillary service of the agency, in which property owners can contact the agency (via a non-emergency telephone number) to locate a specific address in the two counties (as described in [Internet] https://bluegrass911.com/mapping-addressing/).

[158] The [automatic / digitally recorded] incoming 911-calls have a 'timestamp' automatically applied to the archived audio file (to document the time the call initiated).

[159] The automatically applied, audio recording equipment 'timestamp' function was verified as accurate by the investigation, relative to an official, US Government-sourced, time standard (e.g., [Internet] http://www.time.gov/).

[160] Ref; review by the SF investigation, for attendance corroboration, of the "Attendee Electronic Sign In Sheet(s)", for the "Danville - Safety Awareness Training Program (Dinner)", as conducted [on an annual basis] by the training contractor (Paradigm), during the corresponding years identified, as made available to the investigation by Enbridge.

Paradigm Liaison Services), for emergency services personnel, excavation contractors, or other entities that might interface with pipeline operations, for the years 2015, through 2019, inclusive.

3.3 Jurisdictional Emergency Management Agency – LCEMA[161]

3.3.1 Background / Overview[162]

The Lincoln County Emergency Management Agency (LCEMA), as an agency of the Lincoln County Government, is the jurisdictional emergency management agency of Lincoln County. This agency, having office facilities in the City of Stanford, KY, is comprised of the Director, and the Deputy Director of the agency. The agency has formal "mutual aid" response agreement(s) with corresponding emergency management agencies of neighboring jurisdictions, and correspondingly, is available to support emergency incidents in those neighboring jurisdictions. Dispatching services of the agency are performed by Bluegrass 911 (see § 3.2).

The role / responsibilities of the LCEMA include, but is not limited to, the following.[163]

- "establishing and managing the [Lincoln County] Emergency Operations Center (EOC),
- advising and assisting county and city officials on direction and control of emergency operations and acting as liaison with appropriate organizations, as required,
- providing advice and assistance for the preparation and dissemination of emergency information,
- collecting emergency operations information, analyze data, and prepare operational reports,
- developing and coordinating the preparation and use of emergency plans necessary to county government's accomplishing essential emergency management phases of mitigation, preparedness, response and recovery."

3.3.2 Preparedness Measures / Plans

The emergency services agencies of Lincoln County, including the LCEMA, collectively utilize an "all-hazards" preparedness response plan, titled the "Lincoln County Emergency Operations Plan" (LC-EOP, or the 'Plan'), as compiled / promulgated by the Lincoln County - Office of Emergency Management (revision[164] dated 2018).

Review of the LC-EOP content indicates that it was compiled by the LCEMA, which was "… written in accordance with the guidelines provided by the [Commonwealth of] Kentucky Division of Emergency Management[165] and is consistent with the tenets of the National Response Framework.". The LC-EOP document is described therein as a "Multi-Hazard"

[161] Source, and for further information, see [Internet] http://www.lincolnky.com/departments/emergency_management.php, and as further described.

[162] Source: debriefing discussion with the Director of the LCEMA by NTSB staff, and as further described.

[163] Source: Chapter 9.3.1 of the 2018 [revision of] Lincoln County Emergency Operations Plan (see § 3.3.2).

[164] The Record of Revisions page in the document cites that the most recent revision was dated 09 Jan 2019.

[165] Ref, and for further information, see [Internet] https://kyem.ky.gov/Pages/default.aspx.

functional plan [that provides for] "A functional approach to planning, which treats the numerous emergency management requirements that are present in any disaster situation as common functions. This reveals a broad base foundation of recurring disaster tasks that are common to most disasters. In this manner, planning which concerns an application of the recurring tasks can be used in response to any emergency.". Section 4 of the LC-EOP addresses Hazard Analysis attributes of the Plan, in which Subsection 4.3 therein addresses Hazardous Materials attributes of the Plan, which includes addressing the risks associated with underground pipelines as situated in Lincoln County, to which the "Spectra Energy - Texas Eastern Transmission, Danville Compressor Station" is identified as a "Tier 2 facility", as correspondingly addressed by the Plan.

3.3.3 Natural Gas Pipeline Operations Familiarization and/or Emergency Response Training Activities / Drill Exercises Conducted Prior to the Accident

Training roster / sign-in sheet documentation[166], as reviewed by the investigation, identified that personnel of the LCEMA had attended annual Pipeline Safety Awareness Training Program 'liaison training' activities that were conducted, on behalf of Enbridge (by Paradigm Liaison Services), for emergency services personnel, excavation contractors, or other entities that might interface with pipeline operations, for the years 2015, through 2019, inclusive.

3.4 Emergency Medical Services / Ambulance – Lincoln County EMS[167]

3.4.1 Background / Overview

The Lincoln County Emergency Medical Services, Inc. (LCEMS), which is also identified as the Lincoln County EMS[168], is a "non-volunteer (career employees) / community nonprofit" service organization - status / type, Class I, ALS / BLS[169]. Ambulance service[170], in which its administrative office was located in Stanford, KY. The organization (at the time of the accident) maintained a personnel roster of 42 paramedics and EMT's, and several auxiliary members, plus administrative staff. The organization maintained an apparatus roster of eight (active) ambulance units, one 'chase' [support] vehicle, and three administrative vehicles, which operated out of four ambulance stations, as strategically located in Lincoln County. The organization has formal "mutual aid" response agreement(s) with corresponding emergency medical services organizations of neighboring jurisdictions, and correspondingly, is available to support

[166] Ref; review by the SF investigation, for attendance corroboration, of the "Attendee Electronic Sign In Sheet(s)", for the "Danville - Safety Awareness Training Program (Dinner)", as conducted [on an annual basis] by the training contractor (Paradigm), during the corresponding years identified, as made available to the investigation by Enbridge.

[167] Source: and for further information, see [Internet] http://stanfordems.com/, and informal debriefing interviews of the organization's Executive Director (on-scene, and subsequent) by NTSB staff, and as further described.

[168] This organization was formerly known as Stanford EMS and Rescue, Inc.

[169] i.e., Advanced Life Support / Basic Life Support.

[170] Source: data of Kentucky Board of Emergency Medical Services / EMS Directory, for Service License Number 1267 (ref, and for further information, see [Internet] https://kbems.kctcs.edu/media/legal/Agencies_April2020.pdf)

emergency incidents in those neighboring jurisdictions. Dispatching services of the organization are performed by Bluegrass 911 (see § 3.2).

3.4.2 Preparedness Measures / Plans

Lincoln County EMS utilized a preparedness response plan, titled the "Lincoln County Emergency Operations Plan", as compiled / promulgated by the Lincoln County - Office of Emergency Management (see § 3.3).

3.4.3 Natural Gas Pipeline Operations Familiarization and/or Emergency Response Training Activities / Drill Exercises Conducted Prior to the Accident

While Lincoln County EMS personnel have, upon occasion, attended the Pipeline Safety Awareness Training Program 'liaison training' activities[171], Lincoln County EMS personnel generally do not regularly attend those specific training activity sessions[172], in which alternately, to maintain jurisdictional professional licensure, EMS personnel attend a different regimen of in-service (recurrent) training activities (i.e., a series of formal Continuing Education courses) that are specific to the principles and practices of the EMS profession, which for KY, is as prescribed by the Kentucky Board of Emergency Medical Services.[173]

3.5 Jurisdictional Law Enforcement (Police) – LCSO[174]

3.5.1 Background / Overview[175]

The Lincoln County Sheriff's Office (LCSO) is the jurisdictional law enforcement agency of the non-municipal regions of Lincoln County, KY. This agency, having office facilities in the City of Stanford, KY, is comprised of the Sheriff, Deputy Sheriff officers, and associated administrative personnel. The agency has formal "mutual aid" response agreement(s) with corresponding law enforcement agencies of neighboring jurisdictions, and correspondingly, is available to support law enforcement incidents in those neighboring jurisdictions. Dispatching communications services of the agency are performed by Bluegrass 911 (see § 3.2).

3.5.2 Preparedness / Response Execution Plans

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[171] e.g., the Executive Director, Lincoln County EMS, attended the Paradigm 'liaison training' sessions conducted in 2018 and 2019.

[172] Pipeline 'liaison training' is typically not attended by EMS personnel, due to a general unavailability of time to participate in this category of training session (which is more focused on firefighting response efforts, than EMS-relevant activities), and because EMS personnel are not normally subjected to the same degree of risk factors, and tactical response procedures / actions, as are firefighters, etc., when responding to a pipeline incident.

[173] Ref, and for further information, see [Internet] https://kbems.kctcs.edu/Certification_and_Licensure/.

[174] Source, and for further information, see [Internet] http://www.lincolnky.com/departments/lc_sheriff.php, and informal debriefing interviews of the Sheriff (on-scene, and subsequent) by NTSB staff, and as further described.

[175] Source: informal debriefing interview of Lincoln County Sheriff by NTSB staff (during the on-scene phase of the investigation).

The LCSO utilized a preparedness response plan, titled the "Lincoln County Emergency Operations Plan", as compiled / promulgated by the Lincoln County - Office of Emergency Management (see § 3.3).

3.5.3 Natural Gas Pipeline Operations Familiarization and/or Emergency Response Training Activities / Drill Exercises Conducted Prior to the Accident

While law enforcement / patrol officer personnel have, upon occasion, attended the Pipeline Safety Awareness Training Program 'liaison training' activities[176], those personnel generally do not regularly attend the 'liaison training' sessions[177], in which alternately, law enforcement agency personnel attend a different regimen of in-service (recurrent) training activities that are specific to the principles and practices of the law enforcement profession, which for KY is as prescribed by the Department of Criminal Justice Training, which is an agency of Commonwealth of Kentucky Government.[178]

4.0 Emergency Preparedness and Response Execution Processes - Measures / Activities of the Pipeline Owner / Operator (Texas Eastern), as Executed by Enbridge, Inc.

The natural gas transmission pipeline that was involved in this accident was owned by a company by the [formal] name of Texas Eastern Transmission, LP, in which, "Texas Eastern owns and operates this pipeline, [in which] Texas Eastern is indirectly owned by Enbridge Inc."[179], wherein, relative to the company's transmission pipeline operations, the various measures and activities of the company's emergency preparedness and response execution methodologies, procedures and processes are briefly summarized as follows.

4.1 System Integrity Management - Program / Plan

4.1.1 Background / Overview

Regulation under 49 CFR § 192.907 [titled] What must an operator do to implement this subpart?[180], requires, "(a) *General.* No later than December 17, 2004, an operator of a covered pipeline segment must develop and follow a written integrity management program that contains

[176] e.g., attendance by other law enforcement agencies was observed in the 'liaison training' sign-in sheets / rosters.

[177] Pipeline 'liaison training' is typically not attended because law enforcement / patrol officer personnel are not normally subjected to the same degree of risk factors, and tactical response procedures / actions, as are firefighters, etc., when responding to a pipeline incident.

[178] Ref, and for further information, see [Internet] https://www.docjt.ky.gov/inservice.

[179] Ref, email from the Enbridge Party - SF Group participant, to the SF Group Chair, dated 07/06/2020, in which, although it was indicated that "Texas Eastern owns and operates this pipeline", all of the documentation that was responsive to the investigation inquiries, as made available to the investigation, was forthcoming from Enbridge Inc.

[180] Source, and for further information, see [Internet] https://www.ecfr.gov/cgi-bin/text-idx?SID=3128e6bf6c159a15dc370d6132870ab4&mc=true&node=pt49.3.192&rgn=div5#se49.3.192_1907.

all the elements described in §192.911 and that addresses the risks on each covered transmission pipeline segment.", among other criteria.

Additionally, as promulgated in API Recommended Practice 1173 Pipeline Safety Management Systems (see further § 1.6.2), as relevant to the investigation, System Integrity is addressed as an advocated practice of API RP 1173, which, generally described, involves the pipeline operator assuring that … 'pipeline systems … are designed, manufactured, fabricated, installed, operated, maintained, inspected, and tested … to maintain safety in a manner consistent with the specified requirements, regulations, and applicable standards'.[181]

4.1.2 Enbridge - System Integrity Management – Program Content

Enbridge documented to the investigation[182], that it developed, and utilized, a formal, documented, system integrity management program, the topic-elements of which are comprised within a document [of the company] titled "Spectra Energy Integrity Management Program (IMP) Manual", revision dated January 5, 2019. Section 8.0 addresses the Enbridge Communications Plan, to which, within that section, the document further addresses the Enbridge Public Awareness Program (see further § 4.2), wherein within that subsection, the document further describes utilization of the Enbridge External Communications Plan.

Review of the IMP Manual, as made available to the investigation, indicated that it displayed nomenclature depicting that the document submitter had stipulated a 'confidentiality constraint' (information disclosure) restriction. Accordingly, the content of the IMP Manual is anticipated to be addressed in a subsequently compiled Group Chairman's Supplemental Factual Report of the Investigation, which will contain data supportive to the Pipeline - Operations / Integrity Management Group, and the Survival Factors Group investigations.

4.2 Public Awareness Program

4.2.1 Background / Overview

Pursuant to the requirements of 49 CFR 192.616 [titled] Public awareness, a transmission pipeline operator is required to compile a documented Public Awareness Program (PAP), in which, pursuant to the criteria of 49 CFR 192.616(a), "… each pipeline operator must develop and implement a written continuing public education program that follows the guidance provided in the American Petroleum Institute's (API) Recommended Practice (RP) 1162", which is "incorporated by reference" in 49 CFR 192.616.

As promulgated in API Recommended Practice 1162 for Public Awareness Programs for Pipeline Operators (see further § 1.6.1), generally described, as relevant to the investigation, a

[181] Ref, a paraphrased narrative segment of § 8.2.1 [System Integrity] General, of API Recommended Practice 1173 Pipeline Safety Management Systems, © 2018 American Petroleum Institute, Washington, DC.

[182] Source: a document, having the e-document filename "DR12 PLD19FR002 Integrity Management Plan Manual-c2", was made available to the SF investigation during the on-scene phase of the investigation, via transfer to the NTSB Accellion FTP [secure transmittal] website.

PAP involves the effort by, and activities of the pipeline owner / operator, to communicate (distribute) appropriate safety information, in the form of outreach activities, to the jurisdictional emergency services agencies, and to property owners that are situated along the length of the common pipeline ROW. As depicted in the Recommended Practice 1162, the purpose of the PAP is to help assure that the recipients of the distributed safety information become better informed about:

[1] how the pipeline functions,

[2] the responsibilities of the public to help prevent damage to a pipeline, and

[3] measures that can be employed by the recipients of the information to help avoid damage or injury should an anomaly occur in the operation of the pipeline.[183]

4.2.2 Enbridge PAP – Content

Enbridge documented to the investigation[184], that it developed, and utilized, a formal, documented, PAP, which is comprised in a document [of the company] titled "Enterprise-Wide Public Awareness Program Plan (External Communications Plan)", revision dated June 5, 2019, which is also informally referred to as the Enbridge PAP document.

Review of the Enbridge PAP document, as made available to the investigation, indicated that it displayed nomenclature depicting that the document submitter had stipulated a 'confidentiality constraint' (information disclosure) restriction. Accordingly, the content of the Enbridge PAP document is anticipated to be addressed in a subsequently compiled Group Chairman's Supplemental Factual Report of the Investigation, which will contain data supportive to the Pipeline - Operations / Integrity Management Group, and the Survival Factors Group investigations.

4.3 Safety Information Distribution to the Local Public (Civilian Addresses)[185]

4.3.1. Background / Overview

Enbridge described to the investigation that they perform outreach activities, consisting of an annual distribution of PAP materials (printed documentation), which is mailed (via the USPS) to the property owners as located adjacent to the common pipeline ROW. A contractor performed this mailing activity process for Enbridge (i.e., Paradigm; see further § 5.1). Additionally, "hand-out" PAP printed materials, similar in content to that which is mailed, are also distributed to the property owners located adjacent to the common pipeline ROW, through a 'door-to-door canvas', hand-delivery activity. A summarization of this documentation distribution activity, relative to this investigation, is as follows.

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[183] Source: select narrative elements extracted from API RP 1162 (rev [dated] 2003).

[184] Source: a document, having the e-document filename "DR22A Public Awareness Program Plan 060519_Final.pdf", was made available to the SF investigation during the on-scene phase of the investigation, via transfer to the NTSB Accellion FTP [secure transmittal] website.

[185] Source: on-scene debriefing discussion with Enbridge staff by NTSB staff, and as further described.

4.3.2. Printed Documentation Content[186]

Prior to the accident, the printed materials that were mailed to the property owners consisted of the following:

[1] a post-card sized paper describing the "811 Call before you dig" program, which also contained a peel-off / adhesive-backed label that contained the telephone contact information,

[2] a six-page compact pamphlet [titled] "Pipeline Safety" (in English), and

[3] a 'business reply post card' / postage prepaid] mailing acknowledgement response (in English and Spanish), indicating "Please tell us how we are doing", and

[4] the mailing is sent in a distinctive envelope, having the Enbridge return address, which prominently states, "Pipeline Safety Information", and the "811 Call before you dig" program logo.

4.3.3. Delivery Execution

Enbridge documented to the investigation[187], the history of the Annual Mailing of PAP outreach activity printed materials that was distributed to the public (civilian addresses) in the five-year interval prior to the accident.

Review by the investigation, of the (above described) distribution history data [tabulations] as made available to the investigation, indicated the following.

a. For the report [tabulation] documentation made available to the investigation, depicting data for the years 2016, 2017, 2018, and 2019, there is no data column, no other data and/or narrative elements, and/or no additional 'data tabs' in the document, that otherwise indicates the specific dates, of which, the individual Annual Mailings of PAP outreach activity (printed materials) had occurred.

b. Regarding the 2019 PAP mailing activity, Enbridge separately documented to the investigation[188], that a "3rd party contractor" by the name of Enertech[189] had performed this PAP mailing activity, in which a "… confirmation letter from Enertech [had been provided]. They were the contractor handling our bulk public awareness mailers in 2019.", in

[186] Source: an exemplar copy of the subject documentation was made available to the SF investigation during the on-scene phase of the investigation.

[187] Source: a series of 5 [digital] documents (Excel spreadsheets) were made available by Enbridge, which were comprised of the following filenames, DR15A 2015 Mailout Zip Code 40484 NTSB002782, DR15B 2016 Zip Code 40484 NTSB002783, DR15E 2017 Mailout Zip Code 40484 NTSB002786, DR15C 2018 Zip Code 40484 NTSB002784, and DR15D 2019 Zip Code 40484 NTSB002785, in which the individual respective tabulation documents were depicted, by Enbridge, to be comprised of the individual yearly Civilian PAP mailing data history, describing the individual civilian addresses, and associated data, to which the PAP literature was individually mailed [via USPS] for the corresponding 5 years.

[188] Source: emails between the Enbridge SF Group Party representative and the SF Group Chair, 6/01-03/2020, inclusive.

[189] Ref, and for further information see [Internet] https://enertech.com/.

which a copy of the subject correspondence, from the President of this company to an Enbridge management official (Houston, TX, facility), dated "June 2nd, 2020", was made available to the investigation, attesting that "… The 2019 Enbridge Public Awareness Program was mailed between the dates of 4/18/19 and 5/30/19. Lincoln County Emergency Management was mailed within the duration of these dates.".

c. In a close-comparison to mapping [documentation] of the local area[190], the mailing addresses, cited in the individual yearly tabulations, appeared to correspondingly encompass addresses on the streets, proximate to the accident site, as were identified in local maps.

4.4 Safety Information Distribution to the Local Emergency Services Agencies[191]

4.4.1 Background / Overview

Enbridge described to the investigation that, in compliance with regulation, they perform outreach activities, consisting of an annual documentation distribution of PAP materials (printed safety brochures), which were hand-delivered, as well as potentially mailed, to the emergency officials of the jurisdictions as located adjacent to the common pipeline ROW. Enbridge personnel directly performed this documentation delivery process, in which also, sometimes the distribution process was performed by a contractor (i.e., Paradigm; see further § 5.1). A summarization of this distribution activity, relative to this investigation, is as follows.

4.4.2 Delivery Execution of Annual PAP Printed Safety Brochures

An SF investigation typically reviews the documented distribution history of the pipeline owner / operator's PAP 'printed materials' (safety brochures, etc.), for a five-year time interval preceding an accident. Enbridge documented to the investigation[192], the history data of the annual distribution of PAP (outreach activity) printed materials that were distributed to the local emergency services agencies (i.e., LCFPD, LCEMA, LCEMS, LCSO, Bluegrass 911 [PSAP]), the data of which are summarized in Exhibit 13.

Debriefing interviews, as conducted by NTSB staff during the on-scene phase of the investigation, with operations officials of the emergency services agencies that responded to the incident (i.e., LCFPD, LCEMA, LCEMS, LCSO, Bluegrass 911 [PSAP]), indicated that all of the corresponding emergency services agency officials recalled that their agencies had received, either by hand-delivery or by mail, the [annual] 2019 printed safety brochures.

[190] e.g., see [Internet] https://www.google.com/maps/.

[191] Source: on-scene debriefing discussion with Enbridge staff by NTSB staff, and as further described.

[192] Source: a series of nine pdf and six Excel spreadsheet documents were made available to the SF investigation, via transfer to the NTSB Accellion FTP [secure transmittal] website, in which the respective documents described the delivery of the subject documentation packages to the identified emergency services agencies.

4.4.3 Content of Printed Safety Brochures Distributed to Local Emergency Officials[193]

Enbridge documented to the investigation[194], that for the four-years prior to the accident, the printed safety brochures that were distributed to the local emergency officials, consisted of four documentation [brochure] versions, the content of which are depicted in Exhibit 14.

4.5 'Liaison Training' - Made Available to the Jurisdictional Emergency Services Agencies

4.5.1 Background / Overview

Regulation under 49 CFR § 192.616 Public Awareness[195] (see § 1.4.1), requires pipeline operators to "develop and implement a written continuing public education program" that follows the guidance provided in API RP 1162, which "must specifically include provisions to educate the public", and "appropriate government organizations", on the "possible hazards associated with unintended releases from a hazardous liquid … facility" [which would include an natural gas pipeline], and in the recognition of the "physical indications that such a release may have occurred", and the "steps that should be taken for public safety in the event of a hazardous liquid release" occurs.

4.5.2 Training Program Content

Responsive to the regulation, as implementation of this education effort for government organizations (which typically consist of the jurisdictional emergency services agencies, and associated response / support organizations, and excavation contractors), Enbridge arranged to conduct, what is described as a 'Liaison Training Program', which is comprised of formal, annually conducted, training sessions (which are also referred to, in the pipeline training profession, as "stakeholder meetings"), the activities of which were conducted utilizing the resources of a specialty services contactor, which was a company by the name of Paradigm Liaison Services (as further described; see § 5.1).

4.5.3 Delivery Execution

[193] Source: see the tabulation as made available to the investigation (email transmittal, as described), in which an actual (exemplar) copy of the documentation package was made available to the SF investigation during the on-scene phase of the investigation.

[194] Ref, email from the Enbridge Party - SF Group participant, to the SF Group Chair, dated 04/29 through 5/15/2020, inclusive.

[195] Source, and for further information, see [Internet] https://www.ecfr.gov/cgi-bin/text-idx?SID=53535e562d10fef0ce3f9307e656bb8b&mc=true&node=pt49.3.192&rgn=div5.

Enbridge documented to the investigation[196], the history of the 'Liaison Training Program', for the five-year time interval prior to the accident, as conducted by Paradigm Liaison Services, for the emergency services jurisdiction proximate to the accident site, as further described (see further § 3.1.3, § 3.2.3, § 3.3.3, § 3.4.3, and § 3.5.3).

4.6 Safety Management Systems

4.6.1 Background / Overview

As promulgated in API Recommended Practice 1173 Pipeline Safety Management Systems (see further § 1.6.2), as relevant to the investigation, the successful execution of Safety Management Systems (SMS), generally described, involves the pipeline operator adhering to, and addressing the following principals of RP 1173[197], which prescribes:

a) top management commitment, leadership, and oversight, are essential to the success of a SMS,
b) effective implementation and SMS continuous improvements is enabled by a safety-oriented culture,
c) risk management in integral to safe design, construction, operation, and maintenance activities,
d) safe design, construction, operation, and maintenance activities need to be compliant with applicable regulation,
e) conformance to industry and consensus codes and standards,
f) operational controls which are defined, are a fundamental precept of safe design, construction, operation, and maintenance activities,
g) adverse impacts to life, property, and environment are minimized by prompt and effective incident response,
h) comprehensively investigating incidents, promoting non-punitive incident reporting, and lessons-learned communications helps cultivate a continuous improvement learning environment,
i) an effective SMS is substantiated by risk management effectiveness evaluations and safety performance improvement processes,
j) effective communication and collaboration should be employed by operating personnel, and
k) managing changes is essential to pipeline safety.

4.6.2 Enbridge SMS – Program Content

[196] Ref; email from the Enbridge Party - SF Group participant, to the SF Group Chair, dated 04/29/2020, transmittal of [Enbridge designated] DR 20 documentation, [titled] "Attendee Electronic Sign In Sheet(s)", for the "Danville - Safety Awareness Training Program (Dinner)", as conducted [on an annual basis] by the training contractor (Paradigm), for the corresponding years 2015, through 2019, inclusive.

[197] Ref, paraphrased narrative segments of the Introduction of API Recommended Practice 1173 Pipeline Safety Management Systems, © 2018 American Petroleum Institute, Washington, DC.

Research of the investigation identified a webpage[198] of Enbridge that provided information about the Enbridge SMS.

To further address this topic-point, Enbridge was afforded an opportunity[199] to describe the elements, methodologies, and measures of its SMS Program content to the investigation, wherein Enbridge made a document available to the investigation[200], [digital filename] titled "DR115A Asset Integrity Program Transformation-c2", which addressed the NTSB inquiry to Enbridge, [to] "Provide a summary of changes to Enbridge GTM's Asset Integrity Program and a summary of Enbridge GTM's Safety Management System", a copy of which is provided in Exhibit 15.

4.7 Emergency Preparedness and Response Procedures – Measures / Plans

4.7.1 Background / Overview

Pursuant to the requirements of 49 CFR 192.615 [titled] Emergency plans, a transmission pipeline operator is required to compile documented emergency plans, to address the hazard resulting from a gas pipeline emergency. Such plans should include, but are not limited to the elements of communication, a prompt and effective response, fire, explosion, availability of resources, response actions, emergency shutdown and pressure reduction, notification of appropriate [local] emergency services agencies, establish and maintain liaison with appropriate [local] emergency services agencies and other public officials, among other criteria.

4.7.2 Enbridge Manual(s) / Measures – Program Content

Enbridge documented to the investigation[201], that it developed, and utilized, a formal, documented, emergency preparedness and response procedures document, which is comprised in a document [of the company] titled "Emergency Manual Stanford Area", revision date February 2014.

Review of the Enbridge Emergency Manual Stanford Area document, as made available to the investigation, indicated that it displayed nomenclature depicting that the document submitter had stipulated a 'confidentiality constraint' (information disclosure) restriction. Accordingly, the content of the Enbridge Emergency Manual Stanford Area is anticipated to be addressed in a subsequently compiled Group Chairman's Supplemental Factual Report of the Investigation,

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[198] Ref, and for further information, see [Internet] https://www.enbridge.com/~/media/www/Site%20Documents /About%20Enbridge/Enbridge%20Safety%20Management%20System%20Framework.pdf .

[199] Ref, email to the Enbridge Party - SF Group participant, from the SF Group Chair, dated 5/04/2020

[200] Source: an e-document, having the filename "DR115A Asset Integrity Program Transformation-c2", containing the title [notation] "Company Response to NTSB Information Request No. 115", [dated] May 8, 2020, was made available to the Pipeline - Operations / Integrity Management Group investigation, via transfer to the NTSB Accellion FTP [secure transmittal] website.

[201] Source: a document, having the e-document filename "DR17 Emergency Response Plan", as distributed in individual Sections 1 through 10, inclusive, was made available to the SF investigation during the on-scene phase of the investigation, via transfer to the NTSB Accellion FTP [secure transmittal] website.

which will contain data supportive to the Pipeline - Operations / Integrity Management Group, and the Survival Factors Group investigations.

5.0 Pipeline Safety Training / Educational Information and Initiatives, and Standards and Recommended Practices

Responsive to regulation under 49 CFR § 192.616 Public Awareness, pipeline operators sometimes make use of resources from various organizations / commercial establishments (specialty services contractors) that provide emergency preparedness and emergency response training services. The investigation conducted a focused survey to identify some entities that provide these training services, the results of which are briefly summarized as follows.

5.1 Paradigm Liaison Services[202]

5.1.1 Background / Overview

A company by the name of Paradigm Liaison Services (Paradigm) was identified as a resource that provided pipeline familiarization and emergency response instructional training, on a commercial basis, to the emergency services community (both career / professional, and volunteer emergency services agencies), along with providing other services to the pipeline owner / operator industry, several service segments of which are briefly summarized as follows.

5.1.2 Training Resources Available from, and Conducted by, Paradigm

Paradigm conducts training sessions for its clients, which are informally described as 'liaison training activities', and are formally referred to as "Liaison Meetings" (which are also referred to, in the pipeline training profession, as "stakeholder meetings"), in which "Paradigm brings together operators and their local emergency and public officials, as well as excavators, for liaison purposes; implementing nearly 1,000 face-to-face programs annually, with more than 63,000 people in attendance.".[203] Paradigm refers to the instructional training element of the conducted Liaison Meetings as the "Coordinated Response Exercise" (CoRE) program[204], in which the instructional training session offerings are conducted utilizing both 'in-person / class-room environment' settings, and conducted in "Online Pipeline Safety Training" activities (i.e., Internet-based courses).

The natural gas transmission pipeline owner / operator involved in the accident (Enbridge) is a client of Paradigm's 'liaison training' activity services (as further described in § 4.5.2), in which Paradigm also conducted the annual 'liaison training' activity sessions, on behalf of Enbridge, as attended by the Lincoln County emergency services agencies, for the five-year time interval that preceded this accident, as further described (see § 3.1.3, § 3.2.3, § 3.3.3, § 3.4.3, and § 3.5.3).

[202] Ref, and for further information, see [Internet] https://www.pdigm.com/index.html, and as further described.

[203] Ref, as quoted from, [Internet] https://www.pdigm.com/Liaison_Meetings_Overview.html.

[204] Ref, and for further information, see [Internet] https://www.pdigm.com/CoRE.html.

5.1.3 Compliance Services - Public Awareness Program / Common Pipeline ROW Mailings[205]

As separate / parallel business activities, Paradigm also offers what are referred to as "Compliance Services" to its pipeline owner / operator clients, which, generally described, include:

- certified mailing of Public Awareness Program documentation (responsive to the criteria cited in API RP 1162 (rev [dated] 2003), as stipulated in regulation of 49 CFR § 192.616 Public Awareness, to property owners that are located adjacent to pipeline ROW's (see also § 1.4.1), and
- (advertised) support activities included Annual Reviews, Audit Support, Effectiveness Evaluations, Public Awareness Plan writing, among other services, as documented demonstration of compliance with regulation in 49 CFR § 192.616 Public Awareness.

The natural gas transmission pipeline owner / operator involved in the accident (Enbridge) is a client of Paradigm's Public Awareness Program – Compliance Mailing Services (see § 4.3, and § 4.4).

5.2 National Association of State Fire Marshals[206]

The National Association of State Fire Marshals offers pipeline preparedness training for emergency responders. Review of the 'catalog' of this organization identified specific course offerings on this topic, which were indicated as joint initiatives with the API and the Association of Oil Pipe Lines (AOPL), that are also offered at no cost to the attendees, which include [pipeline topic-dedicated] sessions titled "Awareness", "Operations", and "Technician".[207] The instructional training session offerings are conducted utilizing both 'in-person / class-room environment' settings, and by "Online Training" activities (i.e., Internet-based courses).

5.3 Pipeline Association for Public Awareness

As described by the organization[208], it was organized "1. To provide an organization that the general public, governmental entities, and other organizations may contact to obtain educational information concerning pipeline safety and emergency preparedness., [and] 2. To provide its Pipeline Members who are persons, organizations, and other entities who own or operate pipeline facilities with an organization through which they can communicate relevant pipeline safety information to protect life, enhance public safety, improve emergency preparedness, increase protection of the environment, and prevent damage to property and facilities. [and] 3. To provide its Sustaining Members who are persons, organizations, and other entities who make charitable contributions to the corporation with an organization through which they can support

[205] Ref, and for further information, see [Internet] https://www.pdigm.com/Compliance_Services_Overview.html.

[206] Ref, and for further information, see [Internet] http://www.firemarshals.org/, and as further described.

[207] Ref, and for further information, see [Internet] https://nasfm-training.org/pipeline/, and https://www.pipelineemergencies.com/.

[208] Ref, see [Internet] https://www.pipelineawareness.org/about/.

educational programs relating to pipeline safety which are intended for the benefit of the general public or certain communities within the general public.".[209] The organization established an "Emergency Responder Program", that was established to "provide pipeline safety information to Emergency Responders", in which this organization makes various publications [instructional documentation on pipeline safety] and training videos available to its membership.[210] One of the publications of this organization is titled "Pipeline Emergency Response Guidelines", which provides comprehensive preparedness and response guidance information in addressing pipeline emergencies, which is available from this organization at no cost.[211] The organization also published a document titled "Recommended Minimum Evacuation Distances for Natural Gas Pipeline Leaks and Ruptures", as available from that organization.[212]

5.4 Pipeline Safety Trust

As described by the organization, "The Pipeline Safety Trust is a nonprofit public charity promoting pipeline safety through education and advocacy by increasing access to information, and by building partnerships with residents, safety advocates, government, and industry, that result in safer communities and a healthier environment.".[213] Publications of this organization that address various aspects of pipeline safety, relative to emergency response agencies of local governments, include a document [titled] "Local Government Guide to Pipelines", as available from this organization.[214]

5.5 National Emergency Number Association (NENA)

As described by the organization, "NENA serves the public safety community as the only professional organization solely focused on 9-1-1 policy, technology, operations, and education issues. … [in which this organization] … promotes the implementation and awareness of 9-1-1 and international three-digit emergency communications systems … [and] … works with public policy leaders; emergency services and telecommunications industry partners; like-minded public safety associations; and other stakeholder groups to develop and carry out critical programs and initiatives; to facilitate the creation of an IP-based Next Generation 9-1-1 system; and to establish industry leading standards, training, and certifications.".[215] Publications of this organization that address the topic of pipeline emergency operations as related to PSAP (911) agency operation, include a document, as developed by this organization, [titled] "NENA

[209] Ref, see [Internet] https://www.pipelineawareness.org/about/.

[210] Ref, see [Internet] https://www.pipelineawareness.org/about/program-information/.

[211] See [Internet] https://pipelineawareness.org/media/1537/2019-pipeline-emergency-response-guidelines.pdf.

[212] Source, and for further information, see [Internet] https://pipelineawareness.org/media/1117/evacuation-distances-for-natural-gas.pdf.

[213] Ref, and for further information, see [Internet] http://pstrust.org/about/.

[214] Ref, and for further information, see [Internet] http://pstrust.org/trust-initiatives-programs/publications/.

[215] Source, and for further information, see [Internet] http://www.nena.org/?page=AboutNENA.

Pipeline Emergency Operations Standard/Model Recommendation", as available from this organization.[216]

5.6 Pipelines and Informed Planning Alliance[217]

The Pipelines and Informed Planning Alliance (PIPA) is "… a stakeholder initiative led and supported by the US Department of Transportation's Pipeline and Hazardous Materials Safety Administration[218], and also is described as "… a collaborative effort of pipeline safety stakeholders who have developed recommended practices for protecting communities and transmission pipelines, and communication among stakeholders. The PIPA recommended practices are intended to help communities make risk informed decisions for land use planning and development adjacent to transmission pipelines".[219] In January 2015, the PHMSA and the Federal Emergency Management Agency (FEMA) released a hazard mitigation guidance and planning document, which was prepared by [a PIPA working group, referred to as] the PIPA Communication Team, [titled] "Hazard Mitigation Planning: Practices for Land Use Planning and Development near Pipelines", which "… outlines best practices for communities to reduce risks from pipeline incidents, including those caused by natural hazards".[220]

5.7 National Fire Protection Association (NFPA)[221]

The National Fire Protection Association is an international nonprofit organization, which produces and advocates scientifically-based consensus codes and standards, many of which have been adopted as a required safety standard by various municipal and jurisdictional authorities. Publications as developed by this organization, that address the topic of handling releases of flammable and combustible liquids and gases, include a document, [titled] "NFPA 329 Recommended Practice for Handling Releases of Flammable and Combustible Liquids and Gases", as available from this organization.[222]

6.0 The Emergency Response

6.1 Event Chronology ("Timeline")

[216] Source, and for further information, see [Internet] https://cdn.ymaws.com/www.nena.org/resource/resmgr/Standards/NENA_56-007.1_Pipeline_Emerg.pdf.

[217] Ref, and for further information, see [Internet] https://primis.phmsa.dot.gov/comm/pipa/pipa_hazard_mitigation.htm, and as further described.

[218] Ref [direct quote of], and for further information, see [Internet] https://primis.phmsa.dot.gov/comm/publications/PIPA/NACo-PIPA-SummaryReportForElectedOfficials-June2011.pdf.

[219] Ref [direct quote of], and for further information, see [Internet] https://primis.phmsa.dot.gov/comm/publications/PIPA/PIPA-Brochure-AllStakeholders-20111129.pdf.

[220] Source, and for further information, see [Internet] https://www.fema.gov/media-library/assets/documents/101688.

[221] Ref, and for further information, see [Internet] http://www.nfpa.org/, and as further described.

[222] Source, and for further information, see [Internet] https://www.nfpa.org/codes-and-standards/all-codes-and-standards/list-of-codes-and-standards/detail?code=329.

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 principal responding emergency services agencies (i.e., the local fire department, PSAP, emergency management), and Enbridge, were afforded the opportunity to provide incident response data and communications information as relevant to this event. NTSB staff also conducted individual interviews of principals of the local responding fire departments and the pipeline owner / operator, and initiated investigation dialog with key management personnel of other responding emergency services agencies, to identify the facts as cited in the Timeline narrative. Additionally, NTSB staff canvassed the area proximate to the accident, and contacted a number of 911 callers, for first-hand witness [informal interview] accounts of activities that transpired in the accident.

A Summary Event Chronology Timeline, utilizing the identified incident response and communications data, and (the above described) interview information, was compiled in the investigation, a copy of which is provided in Exhibit 16.

6.2 Execution of the Emergency Response

6.2.1 Bluegrass 911 (PSAP/emergency services dispatch)

This agency provides Lincoln County 911 [PSAP] emergency services call-processing and emergency services dispatch services, in which, generally described, this agency[223]:

[1] Received / processed the initial notification of the incident, which was a 911 call received from a motorist who indicated he was traveling southbound on a roadway south of Danville, proximate to the accident site[224], who reported that there was an "explosion" and a "massive fire" near the location that he was calling from.

[2] Responsive to the incident report, resources of the jurisdictional [local] fire department (LCFPD) were dispatched to the scene, along with mutual aid fire departments, the jurisdictional law enforcement agency (LCSO), and various other response support agencies / organizations that responded to the incident.

The agency received a total of 71 [inbound] 911 calls to report the incident (in which 59 other calls were abandoned [by the callers] before they could be answered by the PSAP operations staff).

The collective activities of this agency are further described in the Summary Timeline (Exhibit 16) documentation, as compiled in the investigation (see § 6.1).

[223] Source: digital recording of [incoming] 911 call, as received by the PSAP agency; see also 3.2).

[224] Based upon what the 911 caller depicted, as compared to local mapping data, the data supports that the caller was traveling on U.S. Route 127, near Bowens Loop Road or [State] Highway 2141, in which an effort was made by the investigation to conduct a follow-up [debriefing] interview with that 911 caller, which was not successful.

6.2.2 Fire Department and Response Support Organizations[225]

Generally described, the jurisdictional fire department (LCFPD), the emergency management agency of Lincoln County (LCEMA), the emergency medical services agency (LCEMS), and emergency services agencies of adjacent jurisdictions (e.g., Boyle County Fire Department, Danville Fire Department), and various response support organizations (e.g., Red Cross), dispatched personnel and equipment resources to the scene, and provided support services, the collective response activities of which are as described in the Summary Timeline (Exhibit 16) documentation, as compiled in the investigation (see § 6.1).

6.2.3 LCSO (jurisdictional law enforcement agency)[226]

A part-time Deputy Sheriff of the LCSO, who was also employed as a full-time, professional firefighter with the Lexington, KY, Fire Department, regularly monitored the late-night radio transmissions of his [assigned] fire department / police radio receiver equipment. Upon hearing a broadcast of the Bluegrass 911, describing the pipeline release and fire incident, the officer immediately self-dispatched from his residence, in which he hastily drove his LCSO [assigned] vehicle (a police cruiser) to the accident site. In driving west on Indian Camp Road, upon approaching the burning natural gas release site, the officer observed an "older, elderly" gentleman[227], with a cane, who was lying on the front porch [entrance] of a burning residential dwelling (which was later determined to be about 480 feet from the burning natural gas flare crater at the release site). The officer swiftly exited his patrol car, in the intense heat, and was able to place that individual in his police cruiser, at which time the officer was alerted by that gentleman to a second individual (an older woman, who was the spouse of the older gentleman) who was still in the dwelling. The officer then, in the intense heat, returned to the entrance of that dwelling, where he immediately located that second individual, to which he picked her up, and swiftly returned to, and placed this woman in his patrol car.

The deputy sheriff, having rescued the two individuals (evacuees) from the burning residential dwelling, and was the process of egressing that location in his vehicle, when he observed an individual lying on the ground near the travel path of his vehicle. The officer stopped and exited his vehicle, in the intense heat, in an attempt to render assistance to that individual. As the officer approached that individual on foot, he instantly determined that nothing could be done for that individual at that time (i.e., as it was visibly apparent that the individual was deceased), in which also, due to the intense heat at that location at that time, he was unable to pause (to effect a recovery effort of this particular individual), and returned to his vehicle. The intense heat further necessitated that the officer, transporting the two evacuees, immediately vacate that area. Upon egress from the area of intense heat, he returned in the direction of the emergency services

[225] Ref, debriefing interview conducted with the Lincoln County emergency services agencies / organizations, on 8/04/2019 by NTSB staff (during the on-scene phase of the investigation), and subsequent follow-up debriefing discussions with various agencies / organizations, as documented in the SF investigation notations Logbook.

[226] Ref, documented debriefing interview of the described Lincoln County Deputy Sheriff, by NTSB staff, during the on-scene phase of the investigation; see also Transcript, as available in the NTSB public docket.

[227] The ages of the rescued individuals are as characterized in the interview Transcript, to best factually describe the 'degree of frailty' of the rescued individuals, in which no disrespect to the rescued individuals is intended.

staging area, which was proximate to the initial Incident Command post. Upon arrival at the staging area, the officer immediately alerted personnel of the Boyle County Sheriff's Office, to the location of the individual that he had observed lying on the ground. Upon doing this, the officer was able to proceed with completing the rescue activity, in which he turned the two evacuees over to ambulance personnel that were situated near the scene, in which that ambulance and crew provided transport of the two evacuees to a local medical facility.

Subsequent to transferring the two evacuees to the ambulance, the deputy sheriff determined that he apparently sustained a minor burn injury, for which he self-transported to the local medical facility for treatment. The officer also indicated that later examination of his LCSO police cruiser, identified that, in it being exposed to the intense heat of the accident site, it had sustained apparent heat damage during the rescue activity.

The details of this activity were documented in a transcript of an interview that was conducted, by the SF investigation, with the deputy sheriff, in which the transcript is available in the NTSB public docket.

Additionally, generally described, the LCSO dispatched personnel and equipment resources to the scene, wherein the agency officers provided site perimeter security (i.e., road blocks placed at strategic roadway intersection locations circumscribing the accident site), and provided direct logistical support to Incident Command (during and subsequent to the evacuation process). The collective response activities of this agency are as described in the Summary Timeline documentation (Exhibit 16), as compiled in the investigation (see § 6.1).

6.2.4 Pipeline Owner / Operator (Texas Eastern)[228]

Generally described, company personnel of the pipeline owner / operator (Texas Eastern) addressed the incident at the Danville Compressor Station and other company property locations, as well as company personnel and equipment resources were dispatched to the scene and other locations (involved in the incident), in which Timeline response activity data of this organization, as made available to the investigation, is included in Exhibit 17.

6.3 Mutual Aid Response Support in the Incident

The LCFPD has "mutual aid" response agreements with emergency services resources from neighboring jurisdictions, in which a number of those mutual aid organizations provided a personnel and equipment response to the incident, a list of which is provided in Exhibit 18.

6.4 Evacuation / Emergency Shelter Facility - Activities

Activities and processes of the evacuation, and the establishment of the emergency shelter facilities, are summarized as follows.

[228] Source: Enbridge documentation "DR19A REVISED Summary of Emergency Response Action as of 8.13.19", as made available to the investigation.

- Prior to the on-scene arrival of the LCFPD responding resources, due to the obvious extreme peril (of remaining in their residences), essentially all[229] of the individuals [residents] that were located proximate to the natural gas release site (i.e., all of the residential properties in the Indian Camp Subdivision) had self-evacuated to locations outside of the area proximate to the natural gas release site, in which these individuals later transported / relocated to the evacuation shelter (as described below).[230]

- Upon arrival of the LCFPD responding resources at the Incident Command staging location (near the intersection of US Route 127 and Camp Road), an evacuation zone, having a perimeter boundary [radius] of about one-half mile (relative to the pipeline release site), which encompassed the entire Indian Camp Subdivision, was established by the LCFPD, in which the LCFPD, as supported by law enforcement (i.e., the LCSO), upon the diminishment of the gas fire flare, then initiated a door-to-door canvas search of the properties within the evacuation zone, in which no individuals were located.[231]

- Shortly after identifying that an evacuation shelter would be needed for those displaced individuals whose dwellings were located within the evacuation zone, an evacuation shelter was established at the New Hope Baptist Church.[232] The shelter facility was also available to individuals who resided on other roads that were adjacent to the Indian Camp Subdivision. This evacuation shelter was located on KY Highway 1194, near the intersection of US Route 127, which was about 2.1 miles south of the Incident Command staging area at the accident site (i.e., at the intersection of US Route 127 and Camp Road). This evacuation shelter, which was the only shelter utilized in the incident response, initiated operations at about 2:30 a.m. on August 1, in which indoor accommodations and support services were provided to all arriving individuals (e.g., rest areas, sustenance, counseling). Enbridge, and the local chapter of the Red Cross, established a 'needs assessment' station [a series of worktables, with staff] at that location, allowing the displaced [Indian Camp Subdivision] residents to confer with those organizations regarding short-term lodging and provisions arrangements. LCEMA also established a 'victim accounting' station at this location, in which a tabulation of displaced individuals was compiled. An unknown number of firefighters were also provided 'rehab accommodations' (rest and recuperation). Donations of food and personal items were received from church parishioners and local retail establishments (e.g., Walmart, Kroeger, local restaurants, etc.). The evacuation shelter concluded formal operations in the late afternoon of August 1.

- Establishment of this specific evacuation shelter was pursuant to the criteria identified in the LC-EOP, in which this facility (the Church) had been previously prescribed, for about five to six years prior to the incident, as a designated evacuation shelter for an incident requiring a 'sizable' head-count evacuation in this area. The church pastor (managing the facility during

[229] The noted exceptions to the self-evacuations, were the two individuals that were rescued by the LCSO Deputy Sheriff (see § 6.2.3), and the one fatality at the scene (see § 7.2).

[230] Source: NTSB staff interviews [notations] conducted with several evacuees (located at the evacuation site).

[231] Source: debriefing interview of LCFPD Fire Chief (on-scene, and subsequent) by NTSB staff.

[232] Source: debriefing interview of the church pastor by NTSB staff.

the evacuation / emergency sheltering activities) commented that, if called upon, the facility could easily accommodate 200, or more, individuals.

A total of between 75 and 100 individuals, as sourced from about 25 property locations (proximate to the accident site), were documented to have been evacuated in the accident.[233]

6.5 Medical Facilities Utilized in the Response to the Accident[234]

One medical facility, by the name of Ephraim McDowell Regional Medical Center[235], which was located in Danville, KY, received / processed all of the civilian individuals, and the one Sheriff's Deputy that were transported from the accident site.

6.6 Witness Observations of the Incident[236]

[1] A 911 call was received by the local PSAP (Bluegrass 911), which was the initial call to report the incident, from a motorist who indicated he was traveling southbound on a roadway south of Danville, proximate to the accident site[237], who reported that there was an "explosion" and a "massive fire" near the location that he was calling from.[238]

[2] A 911 call was received by the local PSAP, from a resident of a dwelling near the intersection of U.S. Route 127 and Highway 2141 (about ½ mile east of the release site), in which, in an interview[239], this witness stated the following (briefly summarized).

- While watching television, an explosion was heard that "shook the house", and caused [wall-hung] artwork to dislodge from the walls, in which it was initially thought that an airplane had crashed.
- In stepping outside his residence, the witness could feel the "intense heat", and observed a "huge flame" and heard a "very loud roar" emanating from the accident site, at which time he called 911 to report the incident.
- This individual, who was also a local volunteer firefighter (LCFPD, Station 3), drove the short distance toward the site, stopping near the intersection of U.S. Route 127 and Camp Road, to visually assess the situation. An even greater level of heat was felt, at which time he observed an ambulance unit at that location, in which he also realized that it wasn't an airplane crash, as the flare of the fire was intense and continuous (where he

[233] Source: debriefing interview of the church pastor by NTSB staff, as supported by data of the LCEMA.

[234] Source: debriefing interview (during the on-scene phase of the investigation), by NTSB staff, of the medical center's Emergency Department Director, and as further described.

[235] Ref, and for further information, see [Internet] https://www.emhealth.org/.

[236] For the timestamp of the described [911-call] witness activities, see the Event Chronology Timeline (Exhibit 16).

[237] Based upon what the 911 caller depicted, as compared to local mapping data, it appears that the caller was traveling on U.S. Route 127, near Bowens Loop Road or [State] Highway 2141, in which an effort was made by the investigation to conduct a follow-up [debriefing] interview with that 911 caller, which was not successful.

[238] Source: digital recording of [incoming] 911 call, as received by the PSAP agency; see also 6.2.1).

[239] Source: informal telephone [debriefing] interview of the witness, by the SF Group Chair, dated 5/13/2020.

surmised that an airplane crash fire would have somewhat subsided by that time), in which he then recognized that the fire source probably was the natural gas pipeline that was in that area.

- This individual then departed that location, in which he then dispatched with his fire department, and responded with other firefighters to the scene.

[3] A call placed by Bluegrass 911 / Dispatch to an employee with the NS Railroad, indicated that the railroad "had a train in that area earlier [in which the train crew] thought they saw a plane crash".[240] An attempt, by NTSB staff, to conduct a follow-up debriefing [telephone] interview with that railroad employee was unsuccessful.

[4] In a 911 call that was received by the local PSAP, the flare of the fire was reported as being visible at a location in/near Nazareth, KY, which was subsequently determined to be at least 38 miles to the northwest of the accident site.

[5] A door-to-door canvas, by NTSB staff, of the residential properties proximate to the accident site[241], located a family of three adults and one child, who resided in a dwelling located near the west end of Indian Camp Road, in which informal interview discussion identified the following (briefly summarized) observations.[242]

- The family was asleep when an explosion was heard that shook the house and awakened them, in which they initially thought it was an airplane crash, or a tornado, and later commented that they thought it was a train accident.
- Upon opening the window curtains on the west side of the dwelling, they observed an extremely bright light (of the fire at the crater), in which they quickly realized that it was a pipeline explosion to the approximate northwest of their location, in which they also heard a very loud sound, similar to that of a "jet engine" (as they described it).
- They quickly gathered-up some belongings, exited the dwelling, and then, upon feeling the intense heat and in seeing the plastic siding on the house was melting, they quickly entered their two automobiles (located in the driveway), and drove in the direction of U.S. Route 127.
- In their driving away from their property, they observed many local residents to be running in the direction of U.S. Route 127, in which this family was able to flee the immediate area.
- They did not sustain any injury in their rapid evacuation from the area, and later that day the family was able to acquire temporary shelter with relatives who were located in the general area, in which their dwelling structure sustained heat damage but did not ignite.

[240] Ref, email [as quoted] from the PSAP agency Director to the SF Group Chair, dated 5/13/2020.

[241] An attempt was made by the SF investigation to canvas-visit all residential properties in that area (19 dwellings), in which, because property owners had largely vacated their properties, only one property owner was located.

[242] Ref, notations of an area canvas / field interview, as documented in the SF Group Chair - Field Notes Logbook.

6.7 Post-Event Critique / Debriefing - After-Action Review Activities / Reports[243]

The Parties to the SF Investigation (i.e., the jurisdictional fire department, the Lincoln County emergency management agency, the PSAP, Enbridge, and the PHMSA), were afforded an opportunity[244] to document to the investigation any post-event critique / debriefing - review activities (which is sometimes referred to, in the emergency response community, as an After-Action meeting / report), as might have been conducted, and/or compiled to address the response to the incident, the results of which are as follows.

6.7.1 LCFPD[245]

An After-Action Review, conducted by the Chief of the LCFPD with all seven LCFPD fire stations, resulted in identifying a concern that could present in a large-scale incident response (e.g., the pipeline accident of this investigation), in which it was recognized that the LCFPD previously did not have the capability to execute an efficient / effective *personnel accountability system* [246, 247]. Responsive to this, the Chief has since remedied the concern, by placing an accountability system in each of the individual LCFPD [Fire] Engines, which, in an incident response involving more than a single Engine, can be combined together with the accountability systems as have been placed in the other LCFPD Engines. This has resulted in the LCFPD now having a *Large-Scale Accountability System*, the components of which are also carried within the two [individual] LCFPD Command Vehicles (as operated by the Chief, and Deputy Chief, respectively), and thus can be utilized by the Command Officers in a large-scale incident.

6.7.2 LCEMA[248]

The LCEMA conducted an After-Action Review, in which the responding emergency services agencies in this incident participated, the report documentation of which was made available to the investigation, a copy of which is included in Exhibit 19.

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[243] Ref, and for further information, "Special Report: The After-Action Critique: Training Through Lessons Learned", dated April 2006, compiled by United States Fire Administration; see [Internet] https://www.usfa.fema.gov/downloads/pdf/publications/tr_159.pdf.

[244] Ref, as verbally represented by the SF Group Chair to the emergency services agencies during the on-scene phase of the investigation, and as a documented inquiry to the SF Group - Party participants, in an email from the SF Group Chairperson, dated 5/7/2020, and subsequent similar message to other emergency services entities.

[245] Ref, email from the Party representative (Chief of the LCFPD), to the SF Group Chair, dated 5/13/2020.

[246] The prior personnel accountability process, which is utilized by many firefighting agencies, involved utilization of what's informally referred to as a 'note-pad method', which is recognized in the firefighting profession as a 'workable', but a not particularly efficient and/or effective means of personnel accountability at an active fire scene.

[247] In the context of the firefighting profession, a *personnel accountability system* is "[a] system that readily identifies both the location and function of all members operating at an incident scene", as defined in NFPA 1561 Standard on Emergency Services Incident Management System and Command Safety, ©2014, NFPA, Quincy, MA, available at [Internet] https://catalog.nfpa.org/NFPA-1561-Standard-on-Emergency-Services-Incident-Management-System-and-Command-Safety-P1433.aspx.

[248] Ref, email correspondence, between the agency Party representative (Director of the LCEMA), and the SF Group Chair, dated 05/07 through 6/09/2020, inclusive.

6.7.3 Enbridge[249]

Enbridge participated in an After-Action Review as conducted with the LCEMA, and also conducted its own internal After-Action Review activity, in which report documentation for both activities was made available to the investigation, a copy of which is included in Exhibit 20.

6.7.4 PHMSA[250]

This agency does not normally conduct, or participate in After-Action Review activities, in which the agency surveyed internal agency staff that participated in the agency dispatch / response to, and evaluation of, the circumstances / facts of the accident, to which the agency made the internal observations and notations of that survey available to the investigation (see further § 8.3).

7.0 Medical and/or Pathology Data

7.1 Civilian Injuries[251]

A total of five civilian injuries were reported to the investigation, which are briefly summarized as follows.[252, 253]

- an older male*, sustained smoke inhalation (no burn injury), with an unspecified cardiac issue; examined / treated, then admitted for observation, then discharged on day 2.
- an older female*, sustained smoke inhalation (no burn injury); examined / treated, then discharged.
- a mid-50's female*, minor burn injury to back and arms; examined / treated, then discharged.
- a mid-30's male**, sustained smoke inhalation (no burn injury); examined / treated, then discharged.
- a preteen child** [of the above, mid-30's male, parent], sustained smoke inhalation (no burn injury); examined / treated, then discharged.

Transport modes: *ambulance transport to medical facility, **self-transport to medical facility.

7.2 Civilian Fatality

[249] Ref, email correspondence, between the Enbridge Party - SF Group participant and the SF Group Chair, dated 05/07 through 6/04/2020, inclusive.

[250] Ref, email from [the support staff of] the Party representative, to the SF Group Chair, dated 5/14/2020.

[251] Source: debriefing interview of the described medical center's Emergency Department Director by NTSB staff.

[252] Note - only a brief / generic summarization is provided in this report section, due to HIPAA privacy constraint / regulation considerations; ref, and for further detail, see [Internet] https://www.hhs.gov/hipaa/index.html.

[253] The ages of the treated individuals described, which are also the individuals that were rescued by the Deputy Sheriff (see § 6.2.3), are as characterized to the investigation in the debriefing interview, to best factually describe the 'degree of frailty' of those individuals, in which no disrespect to the those individuals is intended.

A Deputy Sheriff, driving his LCSO assigned vehicle (police cruiser), had rescued two individuals (evacuees) from a burning residential dwelling, and was the process of egressing that location (as described; see § 6.2.3), when he observed an individual lying on the ground near the travel path of his exiting vehicle. The officer stopped and exited his vehicle, in the intense heat, in an attempt to render assistance to that individual. As the officer approached that individual, he instantly determined that nothing could be done for that individual at that time (i.e., it was visibly apparent that the individual was deceased), and due to the intense heat at that location at that time, he was unable to pause (to effect a recovery effort of this particular individual), and returned to his vehicle. The intense heat further necessitated that the deputy sheriff, transporting the two evacuees, immediately vacate that area. Upon egress from the area of intense heat, and upon arrival at the staging area proximate to the initial Incident Command post, the officer immediately alerted personnel of the Boyle County Sheriff's Office, to the location of the individual that he had observed lying on the ground.

Upon learning of the individual lying on the ground at that residential location, an attempt was then made by the Boyle County Sheriff's Office deputies, in their BCSO vehicle, to approach that location. Extreme heat in that area, which was issuing from the burning natural gas flare (about 640 feet to the approximate north), precluded the deputies from further approaching that location, which forced the deputies to retreat from that area. Recovery of the decedent was correspondingly deferred a short time (estimated[254] to be about 15 minutes) until protective measures could be implemented by those Boyle County Sheriff's Office personnel (i.e., their use of borrowed [heat resistant] firefighter bunker gear, and gloves), wherein a recovery of that individual was then executed (i.e., the decedent was transported in the Boyle County Sheriff's Office vehicle to the staging area proximate to the initial Incident Command site).

Personnel of the Lincoln County Coroner's Office responded to the scene, who conducted a field-examination of the decedent at the staging area, in which the individual was pronounced deceased by Coroner's Office personnel at 3:30 a.m., on August 1, 2020. The decedent was transported to a local mortuary for temporary holding, and then transported to the Kentucky State Medical Examiner's Office (in Frankfort, KY), for further examination.

Documentation[255] of the Kentucky State Medical Examiner's Office indicated that the decedent, a 58-year-old female, sustained:

[254] Time estimate is based upon a radio transmission of the Deputy Sheriff [who rescued the two individuals] to the PASP / Dispatch that occurred at 02:19:30, and a subsequent radio transmission, about 13 minutes later, of the PASP / Dispatch requesting "Contact Coroner's Office respond to staging area", that occurred at 02:32:22, as supported by testimony in the Deputy Sheriff's interview Transcript, that described the intervening sequence of events by the on-scene responders, which included the two Boyle County Sheriff's Office deputies that recovered the decedent.

[255] Source: official correspondence [data request response] from the Lincoln County Coroner's Office, dated 02/06/2020, containing the Coroner's Report and associated documentation, the Certificate of Death, and forensic pathology documentation of the Kentucky State Medical Examiner's Office.

I. Pulmonary barotrauma[256] and thermal burns [as] sustained in a gas line explosion [which included],
   a. Pulmonary and hemorrhage [injury, and]
   b. Second and third-degree thermal burns involving approximately 50% of total body.

II. Postmortem femoral blood carboxyhemoglobin saturation: less than 10%.

Coroner's Report documentation[257] indicated:

- the Cause of Death was "Pulmonary Barotrauma and Thermal Injuries", [in which,]
- the Manner of Death was "Accidental".[258]

The investigation identified that the decedent was the resident of a mobile home dwelling, in which the front door was situated about 315 feet to the approximate north of where the decedent was observed by the responding Deputy Sheriff (who had rescued the noted two individuals). The north end of the decedent's residential dwelling was located about 310 feet approximately south of the natural gas flare (fire) that was issuing from the crater at the release site.

7.3 Emergency Responder Injuries

7.3.1 Firefighters

There were none reported to the investigation.

7.3.2 Law Enforcement

The Deputy Sheriff, who successfully accomplished a rescue of two individuals at the accident scene (see § 6.2.3), sustained minor burn injury, in which the officer self-transported to the local medical facility, for examination / treatment, and was subsequently discharged, in which a recovery was achieved.[259]

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[256] Definition (in the context of pulmonary injury): "Barotrauma is physical tissue damage caused by an unrelieved pressure differential between a surrounding gas or fluid and an unvented body cavity (e.g., sinuses, lungs), or across a tissue plane. The damage is due to compressive/ expansive forces and shear, leading to overstretching of tissues. Barotrauma … may also cause … pulmonary hemorrhage …. Tears in pulmonary tissue can allow gas to enter the circulation. This causes embolic blockage of the circulation at distant sites or interferes with normal organ function."; [excerpt for a paper by] Battisti AS, Haftel A, Murphy-Lavoie HM. [titled] Barotrauma, [published by] National Center for Biotechnology Information, a division of the National Library of Medicine, at the National Institutes of Health (ref, and for further detail, see [Internet] https://www.ncbi.nlm.nih.gov/books/NBK482348/),

[257] Source: official correspondence [data request response] from the Lincoln County Coroner's Office, dated 02/06/2020, containing the Coroner's Report and associated documentation, the Certificate of Death, and forensic pathology documentation of the Kentucky State Medical Examiner's Office.

[258] Ref, "Accidental deaths are defined as those in which unintentional injury or poisoning contributed to or caused the death.", Erin G. Brooks, MD and Kurt D. Reed, MD, Principles and Pitfalls: a Guide to Death Certification, National Library of Medicine [Journal of] Clinical Medicine & Research, Volume 13, Number 2: 74-82, © 2015, available at [Internet] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4504663/pdf/0130074.pdf

[259] Source: interview Transcript of the Deputy Sheriff (available in the NTSB public docket of the investigation).

7.4 Pipeline Owner / Operator Injuries

There were none reported to the investigation.

8.0 Actions Implemented Subsequent to the Accident by Party to the Investigation Participants, or Other Emergency Services Entities

The SF Group participants of the investigation, and other emergency services entities that were involved in the execution of the emergency response, were offered an opportunity for data feedback to the investigation[260], to describe specific / documented safety initiative measures that have been initiated or employed subsequent to the incident, such to potentially take advantage of 'lessons-learned' in the accident, the response(s) of which are described below.[261]

8.1 LCFPD[262]

To address a concern identified as a result of their After-Action review (see further § 6.7.1), the LCFPD Chief acquired a number of *personnel accountability systems*, which were placed in the individual LCFPD [Fire] Engines, and the two Command Vehicles of the agency, which can be combined together, resulting in now having a *Large-Scale Accountability System* for the agency.

8.2 LCEMA[263]

The LCEMA conducted an After-Action Review, in which the responding emergency services agencies in this incident participated, which resulted in actions that were implemented by this agency, in which the report documentation was made available to the investigation, a copy of which is included in Exhibit 19.

8.3 PHMSA[264]

This agency surveyed internal agency staff that participated in the agency dispatch / response to, and evaluation of, the circumstances / facts of the accident, to which the agency made the internal observations and notations of that survey available to the investigation, as follows.

Internal Observations and Notes:

- Response served as a test & validation of communication between on-site AID, Regions, other personnel (i.e. Community Liaisons and O&E).

[260] Ref, email from the NTSB SF Group Chairperson, dated 4/27/2020, to the Party participants of the SF Group, and subsequent similar message to other emergency services entities.

[261] Information element in this report section was quoted verbatim as received (to the extent possible, allowing for typo-graphical error corrections, summarizing detailed / lengthy submissions, etc.).

[262] Ref, email from the Party representative (Chief of the LCFPD), to the SF Group Chair, dated 5/14/2020.

[263] Ref, email correspondence, between the agency Party representative (Director of the LCEMA), and the SF Group Chair, dated 05/07 through 6/09/2020, inclusive.

[264] Ref, email from [the support staff of] the PHMSA Party representative, to the SF Group Chair, dated 5/14/2020; data elements quoted [essentially] verbatim.

- Also confirmed the importance of having the right people on site vs too many extraneous participants.

- Importance of articulating and reinforcing the defined roles of all on-site personnel.
- General confirmation of effectiveness of our internal communication.

External-facing Observations:

- Identified operator/local emergency responder and law enforcement interaction as an area of interest for future pipeline inspections.
- Reinforced importance of coordination with other involved government entities (i.e. NTSB), and confirmation of their awareness of forthcoming PHMSA actions.

8.4 Enbridge[265]

Enbridge participated in an After-Action Review as conducted by the LCEMA, and Enbridge also conducted its own internal After-Action Review activity, both activities of which resulted in actions that were implemented by this organization, in which report documentation for both activities was made available to the investigation, a copy of which is included in Exhibit 20.

8.5 Bluegrass 911 (PSAP/emergency services dispatch)[266]

This agency reported that the following safety initiative measures were implemented:

- A 'back-door' telephone line [call-in number] has been established (which is not published to the public), which has been provided to pipeline companies and other infrastructure partners of the jurisdiction, so they will have communications access to this PSAP agency, in the event of an incident in which the normal incoming 911 telephone lines become congested / overloaded, thus encumbering incoming emergency communication capabilities.
- This PSAP agency has established a 'group callback set-up', which will, when activated by this agency, immediately contact all employees by text and telephone, if they need to report to work, due to a large-scale incident occurring in the jurisdiction.

9.0 Prior Natural Gas Transmission Pipeline Release Accidents That Occurred in the Corresponding 'Texas Eastern' Pipeline ROW

9.1 Texas Eastern Transmission Corporation – Pipeline Rupture and Fire, November 2003, near Morehead, KY

An unintended discharge [release] of natural gas occurred in a natural gas transmission pipeline, designated as Line 15, which occurred at a location about 78.3 miles northeast of the accident site, which was owned and operated (at that time) by a company from which Texas Eastern later

[265] Ref: email correspondence, between the Enbridge Party - SF Group participant and the SF Group Chair, dated 05/07 through 6/04/2020, inclusive.

[266] Ref, email from the Director of the agency, to the NTSB SF Group Chairperson, dated 5/07/2020.

purchased the pipeline and ROW, which was the same pipeline as that of the [Danville, KY] accident site.[267]

As a result of the natural gas product release and fire, and consequential damage sustained in the area proximate to that accident site, the PHMSA issued Corrective Action Order [PHMSA Case ref] CPF 2-2003-1018H, dated November 6, 2003[268], to Texas Eastern, a copy which is available in the NTSB public docket of this investigation.

9.2 Texas Eastern Gas Pipeline Company – Pipeline Rupture and Fire, February 1986, near Lancaster, KY

An unintended discharge [release] of natural gas occurred in a natural gas transmission pipeline, designated as Line 15, which occurred at a location about 10.8 miles northeast of the accident site, which was owned and operated (at that time) by a company from which Texas Eastern later purchased the pipeline and ROW, which was the same pipeline as that of the [Danville, KY] accident site. The accident was described in a report issued by the NTSB, [titled] "Texas Eastern Gas Pipeline Company Ruptures and Fires (4/27/1985 - Beaumont, KY and 2/21/1986 - Lancaster, KY)"[269], in which a brief abstract narrative was provided that described the accident, as follows.

> "At 2:05 a.m. E.S.T., on February 21, 1986, natural gas under 987 psig ruptured the No. 15, SO-inch-diameter pipeline of the Texas Eastern Gas Pipeline Company 50 feet south of State highway 52 near Lancaster, Kentucky. The force of the escaping gas ripped 480 feet of pipe out of the ground, exposed 40 feet of an adjacent parallel pipeline, ignited and destroyed two houses, one house trailer, six automobiles, and damaged other buildings. Three persons were injured, 2 of them seriously, and 77 other persons were evacuated from the area."

9.3 Texas Eastern Gas Pipeline Company – Pipeline Rupture and Fire, April 1985, near Beaumont, KY

An unintended discharge [release] of natural gas occurred in a natural gas transmission pipeline, designated as Line 10, which occurred at a location about 66.0 miles southwest of the [Danville, KY] accident site. The pipeline was owned and operated (at that time) by a company from which Texas Eastern later purchased the pipeline and ROW, in which the accident site was located in the [now Texas Eastern] ROW that also contained the [Danville, KY] accident pipeline (Line 15). The accident was described in a report issued by the NTSB, [titled] "Texas Eastern Gas Pipeline Company Ruptures and Fires (4/27/1985 - Beaumont, KY and 2/21/1986 -

[267] The NTSB did not investigate this described accident.

[268] Ref, and for further information, see [Internet] https://primis.phmsa.dot.gov/comm/reports/enforce/documents/220031018H/220031018H_CAO_11062003.pdf.

[269] Source (narrative element quoted verbatim from report documentation of the accident), and for further information, see [Internet] https://www.ntsb.gov/investigations/AccidentReports/Pages/PAR8701.aspx

Lancaster, KY)"[270], in which a brief abstract narrative was provided that described the accident, as follows.

> "About 9:10 p.m. c.s.t. on April 27, 1985 natural gas under 990 psig ruptured the No. 10, SO-inch-diameter pipeline of the Texas Eastern Gas Pipeline Company. The pipeline was located 2 miles east of Beaumont, Kentucky, under Kentucky State highway 90. The force of the escaping high-pressure gas ripped open 30 feet of pipe, blasted an opening across Kentucky State highway 90, and dug out a crater 90 feet long, 38 feet wide, and 12 feet deep. The escaping gas ignited and incinerated an area about 700 feet long and about 500 feet wide. Five persons in a house 318 feet north of the rupture were killed and three persons 320 feet south of the rupture were burned as they ran from their house trailer. Two houses, three house trailers, a sawmill, two barns, numerous parked cars and abandoned vehicles, and nine pieces of road construction equipment were destroyed."

E. **Authorship**

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List of Exhibits

1. Annotated Segment of USGS Topographic (Survey) Map, Proximate to Accident Site
2. Enbridge Line 15 Natural Gas Transmission Pipeline System Map
3. Enbridge Map Documentation, Describing the Accident Site, and Other Aspects of the Line 15 Transmission Pipeline Prior to the Accident
4. Pre-event Product Flow Conditions at the Enbridge Compressor Stations
5. Enbridge SDS Document Utilized in United States Markets at the Time of the Accident
6. Enbridge SDS Document Currently Utilized in United States Markets
7. ERG Guide 115

[270] Source (narrative element quoted verbatim from report documentation of the accident), and for further information, see [Internet] https://www.ntsb.gov/investigations/AccidentReports/Pages/PAR8701.aspx

8. Calculations of the Investigation

9. Enbridge Documentation of Estimated Product Release Data and Calculations

10. Accident Site Properties Acquired by Enbridge

11. Meteorological Factors Data Documentation

12. Corrective Action Orders Issued by the PHMSA to Texas Eastern

13. Enbridge - History of PAP Printed Materials Distribution to Emergency Officials

14. Content of Enbridge Printed 'Safety Pamphlets' as Distributed to Emergency Services Agencies

15. Enbridge GTM's Asset Integrity Program and Summary of Enbridge GTM's Safety Management System

16. Summary Emergency Services Activity Chronology (Timeline) Documentation

17. Texas Eastern Response Activity Chronology (Timeline)

18. Mutual Aid Support and Other Response Organizations in the Incident

19. LCEMA – After-Action Review Activity Documentation, and Advocacy Measures and/or Initiatives Implemented

20. Enbridge – After-Action Review Activity Documentation, and Advocacy Measures and/or Initiatives Implemented

– End of Exhibits List –