



STATE OF WASHINGTON

UTILITIES AND TRANSPORTATION COMMISSION

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CERTIFIED MAIL

December 31, 2015

Eric Martuscelli
Vice President-Operations
Cascade Natural Gas Corporation
8113 W. Grandridge Blvd.
Kennewick, WA 99336

Dear Mr. Martuscelli:

**RE: Natural Gas Incident Investigation: 3400 11th Street, Bremerton, Washington
– August 18, 2015 (Insp. No. 6542)**

Staff from the Washington Utilities and Transportation Commission (staff) conducted an investigation into the natural gas incident which occurred at the Motel 6 in Bremerton, WA, on August 18, 2015, at the above address. The east end of the motel exploded resulting in four injuries, one critical. There were no fatalities. Quick action by first responders and motel staff resulted in the motel being evacuated prior to the explosion. Our investigation concluded that there were no violations of federal or state pipeline safety rules which led to or exacerbated the explosion at the motel.

Our investigation revealed that the above ground leak of natural gas was caused by an outside force which would not have been anticipated. Additionally, the operator qualification of the Cascade Natural Gas Corporation (CNGC) first responder showed he was experienced and qualified to respond to and resolve this type of leak. Unfortunately, and most likely unknown to the CNGC employee, it would appear the extent of the leak allowed escaping gas to enter an adjacent vent to the first floor laundry room which contained ignition sources. The gas accumulated until it reached ignition levels and detonated. The attached investigation report summarizes our findings.

CNGC noted during this investigation that there may be changes or revisions to your procedures for responding to natural gas incidents. Additionally, CNGC noted that a policy/procedure is being drafted for what happens when meter assemblies or regulator vents are found on existing

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services which are in close proximity to building openings. Please highlight these changes during the annual revisions and submit to the commission as required by WAC 480-93-180.

If you have any questions or if we may be of any assistance, please contact Dennis Ritter at (360) 664-1159. Please refer to the inspection number above in any future correspondence pertaining to this inspection.

Sincerely,



Alan E. Rathbun
Pipeline Safety Director

Enclosure

cc: Steve Kessie, Director Operation Services, CNG
Jeremy Ogden, Director Engineering Services, CNG
Mike Eutsey, Manager, Standards and Compliance, CNG
Patti Chartrey, Pipeline Safety Specialist, CNG

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Notification ID:	2906	Investigation ID:	6542
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Inspector Name:	Dennis Ritter, Lead Scott Rukke
Date Report Submitted to Chief Engineer:	December 22, 2015
Date Report Reviewed & Approved by Chief Engineer:	Joe Subsits December 29, 2015

Operator:	Cascade Natural Gas Corporation
District/Unit:	Bremerton
Location:	3400 11 th Street
Incident Date:	August 18, 2015

Description:
<p><u>Summary:</u> At 20:25 on August 18, 2015, the east end of the Bremerton Motel 6 exploded in a natural gas incident (see Location Map, photos 1-4). Cascade Natural Gas Corp (CNG) is the natural gas provider in this area. The CNG meter was located on the east end of the Motel 6 (photos 5-7). The meter fed a laundry room with two gas water heaters, and two gas dryers (Figure 1-Building Riser Diagram and Figure 3-Motel 6 Laundry Room Schematic). A three quarter-inch (3/4") "XTruCoat" (polyvinyl coated steel) service line fed the meter from the two-inch steel main on the south side of 11th St. (Figure 2 Gas Service Record Card). The 66-foot long service had field bends and no joints. The service tee was a Mueller "Autoperf" tapping tee installed in 1978. The 3/4" steel riser broke just below the shut off valve at the threads (Photos 10-12) due to an outside force.</p> <p>Escaping natural gas found its way into the laundry room on the first floor of the complex and reached ignition levels approximately 34 minutes after inception. Based on the location of the riser in relation to the vent or vents leading to the laundry room (photo 8, 8A), it is highly probable escaping gas at 56 pounds per square inch (psi) was blown down the vent chase into the laundry room (the fuel line shown in the picture entering the vent also followed the ducting to the laundry room as there are no exit holes in the vent). Another possibility is that a mechanical device drew gas into the laundry room. The owner of the motel said there was a fan in the laundry room. He was unsure as to the function of the fan—whether it blew air out or drew air in. He also was unsure of how the fan actually operated or when. Fan components were not found in the debris or if they were, were not recognizable as such. However, it is a probable means of entry to the first floor laundry room from the riser which is above the elevation of the laundry room.</p>

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The blast blew out the lower supporting walls and the upper floors collapsed downward. Bremerton Fire and Police were already on scene as noted below as was a CNG service mechanic responding to the leak. The service mechanic was injured and flown to Harbor View Hospital in Seattle, WA in critical condition. Two FD and a police officers were also hurt, transported to local hospitals, treated and released.

CNG performed a leak investigation (note, due to the fire and fire suppression activities, this investigation did not happen in typical timeframes as noted in subsequent narrative below). The service line was air tested post-incident to check for any underground, contributory leaks. No leaks were found.

Incident Description:

At approximately 19:30, there was a domestic disturbance at the motel. A mother was looking for her runaway daughter who had been checked into the motel by her step-father. The mother knew this and apparently was causing a scene in the parking lot trying to locate her daughter. Police were called. To avoid the mother, the daughter and another male climbed out of a third story window on the back side of the motel, directly above the meter (**photo 6**). Another male, the step-father, used the meter/fuel piping as a step to stand on while assisting the two climbing out of the window. At least two were on the meter at the same time. The step father admitted to police that he heard the pipe break and loud "hissing" sound while they were on the meter. They immediately left the scene. Another car pulled up to the manager's office at the west end of the motel and told the manager there was a gas leak. The manager noted the hissing sound and called 911. The Bremerton Fire Department (FD) arrived a few minutes later and talked to manager. The fire alarm was subsequently pulled and the building evacuated.

FD first responder Lt. Rex Hinkle (LT), immediately found the leak as he said it was very loud. He noted the leak was above ground, on the riser pipe just below the shut off valve (**photo 8, 8A show the shut off valve and riser pipe**). The LT placed his boot up against the leak to determine which way gas was blowing. He determined it was blowing away from the building (southeast) and the crack was approximately half way around the pipe as you could see the dark area in the threads. The gap was approximately 1/16 of an inch wide. The riser was not straight up and down-was "out a bit from the building" (bent slightly away from the building) according to the LT (**photo 14**). About this time, approximately 20:19, CNG service mechanic Larry Jennings arrived.

According to the LT's statement, the LT talked to him for a moment then the CNG service mechanic went over to evaluate the leak. A short time later the LT looked back to see the mechanic coming back from his truck with a crescent wrench in one hand and something else in the other. The LT stated could have been a leak clamp, but he was not sure. A leak clamp was found loose on the riser and a crescent wrench nearby (**photos 15, 16**). The LT remembered thinking, "Good he'll stop the leak." Very shortly thereafter, while the service

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mechanic was trying to stop the flow of gas, the building exploded <http://www.statter911.com/2015/08/21/must-see-multiple-views-of-motel-6-explosion-in-bremerton-washington-that-injured-firefighters-gas-worker/>. The CNG service mechanic was blown back to the east approximately 10 feet landing on the upsloping hill adjacent to the motel. The LT believed he was buried in the rubble (**photo 9, 17**). However, Bremerton FD Ladder 1 crews found him on the hill, alive and unconscious. He was transported to Harborview Hospital in Seattle in critical condition. He lived and is currently recovering from his injuries. Two firemen and a police officer were also injured. They were transported to local emergency facilities, treated and released.

The most probable route for gas to have entered the motel is through the wall vent (**photos 8, 8A, 18**). The vent duct was found in the debris on the hill east of the building (**photo 17**). Based on the orientation of the paint (which matches the outside wall paint) on the vent, it appears to be a through wall vent from the outside to the inside with the inside duct facing down to attach to internal duct work. There was a rectangular duct oriented in the vertical position on the laundry room wall which the vent would have attached (**photo 19, 22**). Gas was blowing for 34 minutes at 56 psi. The initial break in the service line according to Case Forensics almost severed the line. Case also believes the break to have initiated in the 10 o'clock position (if standing behind the meter looking due south, the 10 o'clock position on the pipe would be in the southeast direction). Aligning the "notch" in the riser pipe with the actual location in situ, with Case's break initiation point, the severed arc would allow gas to blow directly into the vent. The resisting force on the gas would be the atmospheric pressure at sea level or 14.7 psi. It would therefore be plausible for gas blowing at 56 psi to overcome this "back pressure" and force its way down the duct to the laundry room (**photo 13**).

Additionally, the owner of the Motel 6, Ramesh Rabadia, stated there was a fan in the laundry room. He was unsure of the operation of the fan (did it push air out or pull it in) or where it was located. It is somewhat irrelevant as to how the fan worked (or if it worked at all) as natural gas did find its way down into the first floor laundry. There are likely and plausible pathways: the fan, the gas leak itself via the vent and duct, or both.

The ignition point has preliminarily been identified by the AFT to have occurred above the washing machine/dryers, below the second story floor, near the east exterior wall of the motel (**Figure 3**). The explosion blew out the lower supporting walls at the foundation wall and the upper floors fell in.

After the explosion, additional CNG personnel responded. These crews were not able immediately to shut off the gas. Emergency locates were necessary to dig up service tee at the main on the south side of 11th St. Once locates were in place the crew then needed to coordinate with FD to use backhoe and dig up service. The explosion occurred at 20:25. CNG crews were able to stop the flow of gas at approximately 22:30.

Facts/Chronology of Events:

8/18/15

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19:30-Domestic disturbance in Motel 6 parking lot involving the mother of one of the guests
19:51-surveillance video shows individuals climbing out the window of the motel and another individual standing on the meter to assist in climb down (note, this video has not been reviewed, this information is from Detective Gray of the Bremerton Police Department).
19:51-Riser is cracked and gas starts to escape. Operating pressure is 56 psi. The three individuals drive away in an SUV like vehicle
19:52-Another car stops and tells manager she has a gas leak in back of motel. Manager hears and smells the gas leak, calls 911
19:53-911 call reporting a gas leak at the Motel 6
19:58-BFD (E2) arrives on site
20:02-E2 reports back to dispatch main supply line is broken below valve
20:02-CNGC notified of gas leak
20:02-fire alarm is pulled
20:19-CNGC service tech, Larry Jennings, arrives on site and confers with FD
20:23-CNG tech attempts to stop leak
20:25-explosion occurs
22:30-blowing gas shut off at service tee on east side of 11th St.
23:15-Motel 6 service cut and capped

8/19/15

2:30-WUTC inspector Scott Rukke arrived on site.
9:30-WUTC inspector Dennis Ritter arrived on site
10:30-Meeting at the Bremerton Fire Station with FD, PD, ATF, L&I, UTC, CNG, meeting focused on what information each investigation needed. Received several documents from PD. Watched video from security cameras, but PD did not release video

8/20/15

11:28-begin air test on service line at 58.2 psi. Test failed due to friction plug in end of pipe leaking. CNG welded a threaded fitting to end of service line
11:40-Begin re-test at 55.9 psi
12:11-End test. No leaks in service line
15:00-left site

Note: Bolded times are approximate

Causes/Contributing Factors:

Outside Force

The cause of the above ground leak on the steel riser was an outside force. The Motel 6 had a 1000 CFH meter, supported by the ¾-inch Grade B steel riser pipe and the two-inch fuel piping into the building (**photos 6, 8**). As can be noted in **photo 8**, the fuel pipe and meter sat adjacent (north) of the riser pipe where it came up out of the ground. The Bremerton police confirmed that several people used the meter as a step stool in leaving the third story window above the meter. The weight of several people standing on the meter/fuel piping resulted in a force (torque) being applied to the riser pipe.

The meter assembly (regulator and meter) attaches to the riser via a threaded connection. Typically, the weakest point on any threaded pipe is where the threads are cut into the pipe--

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the wall thickness is reduced to accommodate the threads. The nominal wall thickness for standard Grade B, is 0.113 inches with a minimum wall thickness of 0.0991 inches (*ASTM A53 / A53M – 12*). The standard depth of the threads for a ¾" NPT pipe ranges from 0.05071 to 0.05714 inches (*ANSI/ASME B1.20.1-1983 (R1992)*). Therefore the remaining wall thickness is reduced by approximately half (from adequacy of service perspective, this remaining wall thickness is more than adequate to handle the maximum internal pressure from the natural gas of 60 psi).

The expected failure point would be opposite the applied torque on the tension side of the pipe. First responders (and Case Forensics) confirmed the riser pipe failed just below the meter valve at the threaded connection opposite the applied force generated from people standing on the meter/fuel pipe. Unfortunately, the outside force applied was greater than could be resisted by the threaded connection and the pipe failed.

Natural gas blew from the crack at 56 psi for 34 minutes. This would result in approximately 2810 cubic feet (CF) of gas being released (*Engineering Tool Box Simple Gas Calculator*). As shown in **Figure 1 and Figure 3**, the laundry room is somewhat of an inverted L shape. Dimensions taken from the **Figure 1** give a volume of the room (conservatively assuming an 8 foot ceiling height and an empty room) of approximately 1384 CF. The flammable range for natural gas is typically between 5 and 15% gas in air. To reach the lower flammable range, approximately 69 CF of gas would have to have entered the laundry room or about 2.5% of the total gas released. It's plausible that enough gas entered the laundry room from the break via the vent and/or mechanical fan to have reached the lower explosive limit.

Photos 24, 25, show the relative locations of the two gas dryers, the hot water tanks and the washing machine during and after excavation from the rubble. One of the dryers was crushed from the top and laying on its side pushed up against the second dryer (**photos 22, 23**). The ATF believes the explosion occurred above the washer and dryer. The explosion crushed the top of the dryer down and overturned it pushing it up against the second dryer. There is very little left of the commercial washing machine which sat immediately adjacent to the dryers separated by a wooden stud wall (**photos 23, 25**).

Laboratory Analysis

Case Forensics, Seattle WA (Case) did a failure analysis on the ¾-inch steel riser pipe for the Bremerton FD and the Bureau of Alcohol, Tobacco, Firearms and Explosives (ATF). Bremerton FD called in the ATF to assist with the explosion investigation. The meter and riser pipe were taken from the Bremerton Police Department Impound Room and delivered to Case. Case then laid out the pieces on a table and aligned them (**photos 26-28**). Case then cut the meter valve nut away from the rest of the meter assembly as well as the top section of the riser pipe from the remaining piece for handling purposes (**photo 29**). The preliminary results (the final report has not been released due to a criminal investigation) of the analysis showed a ductile failure (the metal stretched until reaching its maximum tensile strength and then failed versus a brittle failure where little or no stretching occurs) (**photos 31-33**). The minimum wall thickness was measured at 0.029 inches (**photo 33**). This would be consistent

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with the on scene report of the meter riser pipe failing under the imposed load of two or more people standing on the meter/fuel pipe. The analysis could not conclude if the crack propagation stopped at a defined point. Case believes the initial break may have completely severed the pipe but it did not dislodge it entirely. This would explain why the first responders did not see a completely severed pipe. First responders noted the break as “approximately half way around the pipe”.

The ¾-inch service line nominal wall thickness as measured by Case Forensics ranged from 0.109 to 0.113 inches. The standard depth of the threads for a ¾” NPT pipe ranges from 0.05071 to 0.05714 inches (*ANSI/ASME B1.20.1-1983 (R1992)*). Case Forensics measured (in the non-deformed portion of the wall) 0.044 to 0.052 inches on the failure face of the pipe (**photos 31, 32**). It should be noted that the 0.044 inch measured thickness is on the opposite side of the actual initial fracture. The explosion dislodged the remaining pipe completing the 100% sever (**photo 32**). The failure analysis did not show any other failure mechanism such as corrosion, fatigue or brittleness nor did it show any stress concentrators associated with hardspots at the fracture location. **Photo 36** shows electron microscope image of grain structure of steel at break location. The grain structure is normal.

The pipeline material does not appear to be a deleterious contributor to the explosion.

Field Leak Test

CNG performed a leak test (**photos 38, 39**) on the existing service line to ensure a leak in the line was not a cause or contributor to the incident. Due to the Bremerton FD/ATF investigation, this test did not occur until Thursday, 8/20/15. The plan was to test the line in-situ to ensure minimal disturbance of the pipe and surroundings soils. The service line was plugged on each end and compressed air introduced into the pipe. The pressure was increased up to the CNG operating pressure prior to the incident of 56 psi. The air test was successful-55.9 psi held for 30 minutes

There were no leaks in the service line below ground which contributed gas to the explosion.

Regulatory Analysis/ Violations:

Records Review

The following records were obtained as part of the investigation. No violations of pipeline safety codes were noted from the review.

- 1/17/78 -¾” steel service line installed and pressure tested to 120 lbs by Ed Harris, Aliza, Inc. MAOP 60 psi.
- 9/22/10-WUTC request CNG inspect meter (American AL 1000) at 3400 11th St. (Dunes Motel) as it’s in contact with soil. CNG responds and rectifies. No corrosion issues noted.
- 2/10/15-8/5/15-bimonthly rectifier inspections (feeding this area) by Joel Lea, CNG. No issues noted.
- 3/25/15-last atmospheric corrosion survey at this address (Dunes Motel), no issues noted, by TWS.

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- 3/27/15-annual cathodic protection survey (PSP reads), 3122 11th St, -1750 mV, no issues noted.
- 8/18-8/19/15-CNG completed leak Investigation Form 293 A, B, C. Form A shows no below ground gas present in bar-hole testing along service line (performed by Lloyd Klineburger).
- 8/18/15-22:15 Andrew Powell, welder, cut and capped service at service tee, PSP read -1551mV.
- 8/19/15-14:10 Additional investigation by CNG, Lloyd Klineburger--barhole testing over service line was 0% except at meter riser location where it was 3% gas in soil atmosphere (note this is after service line has been cut and capped). No issues noted.
- 8/19/15-8/19/15 meter read and 12 month consumption history. No issues or noted.
- 9/2/15-WUTC received 30-d follow up report from CNG. Report states time and date of CNG notification and first responder (Larry Jennings) on site. Also notes injuries to sustained by Mr. Jennings when building exploded at 20:25.
- 11/12/15-reviewed Larry Jennings operator qualifications. According to the records, Mr. Jennings was appropriately qualified to respond, investigate and rectify leaks.
- 11/12/15-reviewed CNG Meter Set No. 6 standard drawing dated February 4, 2002. The original meter set in 1978 was replaced in Nov 17, 2008 so this newer standard would apply. Two items noted: 1) no support stand is required; 2) the riser pipe is identified as an 1-1/4" IPS reflecting the new standard for riser pipe.
- Reviewed CNG procedure 605, *Steel Gas Main & Lateral Construction*, (1982).

CNG Procedures Review

1. *CNG's Company Procedure (CP) #750 Leak Investigation*, states
 - .01 *INVESTIGATION*
 - .012 *Immediate steps are to be taken to identify possible ignition sources and to ensure that gas has not escaped into any nearby building or structure. Use warnings signs if applicable.*
 - .02 *OUTSIDE ODOR CALL*
 1. *Check for gas inside buildings near the reported location using inside investigation techniques. If no one is in the building, then the foundation must be probed for gas.*

At approximately 20:19 the CNG technician, Larry Jennings (a 30+ year employee with CNG) arrived on site. According to Bremerton FD first responder, Lt. Rex Hinkle, who witnessed him arriving, he immediately went over to the leak location on the riser. After initial assessment, he discussed with Lt Hinkle and noted he had turned off gas valve. Then went back to this truck and was returning to the leak with what appeared to be a leak clamp and crescent wrench. The leak clamp was found on the riser and the crescent wrench just east of the former meter location. It appears the CNG responder's first priority was to stop or reduce the flow of gas from the leaking riser. The CNG technician did not immediately check for gas inside the motel (investigator's note, this would be a normal response for an above ground leak, blowing away from

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the building as without an opening, like a window, immediately above the leak, it would not be expected that gas would gain access to the structure).

At 20:25 on 8/18/15, accumulated gas in the first floor laundry room (ATF believes this to be the ignition point-see **Figure 3**) and ignited resulting in an explosion and fire. (Note: the laundry room is below the elevation of the meter and gas riser on the first floor. There is a foundation wall on this end of the building due to the ground topography rising to the east) (**photos 6, 9, 21**). The explosion sheared off the already damaged gas riser pipe just below the meter shut off valve (**photos 10, 12**). CNG crews could not shut off the gas until emergency locates were completed so they could excavate the service tee. The service tee and main was then excavated and at 22:10 on 8/18/15. The gas was eventually shut off at the service tee by reinserting the auto-perf pin. The service was then cut and capped.

At 12:05 am on 12/19/15, CNG was able to complete a leak investigation over the main from the service tee east and west on 11th St. to determine if there was a leak and whether it migrated. They found 0% gas in the soils. However, due to the explosion, fire and fire suppression activities, CNG crews could not access the service line for leak investigation. A follow up leak investigation did occur at 14:10 on 12/19/15 which included the service line. This survey showed 0% gas up to the building wall where it showed 3% gas in soils immediately around the riser pipe. This was believed to be a result of the blowing gas prior to shut off.

2. *CNG's Company Procedure (CP) #685-10 Meter and Regulator Sets*, states
.03 *FABRICATION AND INSTALLATION*

.0301 All standard meter sets are to be fabricated and installed in accordance with the drawings on pages 10 through 30 of this procedure. The meter set assembly shall be fabricated such that the meter is level and all piping is square. The meter set shall be placed so that it can be easily read, maintained and inspected for leaks.

Prescriptive meter supports start with the 3000 CFH meters (Standard Meter Set 10). The current standard for the 1000 CFH meter does not require a support (Figure 4 Standard Meter Set 6 2002).

3. *CNG CP 605 (1982) Steel Gas Main & Lateral Construction*

This procedure gives the requirements for installing new main or lateral pipe in CNG's system. CNG could not locate the 1978 requirements for pipe installation (year service was installed at 3400 11th St.), however, these requirements show very similar construction for what was found on site after the incident. No issues relating to construction were noted during the investigation.

Additionally, it was noted that the steel riser pipe and meter assembly were located adjacent to fresh air vents leading to the first floor laundry room. It is not known if the

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vents were installed after the meter assembly was installed or prior. It is known that the fuel pipe used the vent opening to access the laundry room as shown in **photo 8**. CNG was asked what their procedure was regarding existing meters/regulators located adjacent to vents or openings in a building. CNG's reply was, "**Currently we do not have a procedure/policy that defines existing meters/regulators adjacent to building openings. We are working on procedural guidance for identifying and remediating.**"

4. *C.P. #685 Meter and Regulator Sets*

0.023 (3): *All meter set assemblies should be placed, whenever possible, away from doors, windows, building overhangs, intake ducts, and other outside areas where gas can accumulate and migrate into buildings.*

This procedure pertains to new construction. The UTC was interested in how, if at all, this procedure applies to existing meters such as the meter in this particular incident. CNG was asked, If a meter/regulator vent is found by CNG which meets the a criteria outlined in *CP 685.023 (3): All meter set assemblies should be placed, whenever possible, away from doors, windows, building overhangs, intake ducts, and other outside areas where gas can accumulate and migrate into buildings*", what is the current procedure or practice to ensure gas does not enter the structure via that opening (does CNG move the meter, or regulator vent etc.)? CNG's reply was, "**CP 685.023 (3) is addressing new construction and is not intended to be referenced for existing meter sets, however we are looking into what companywide processes should be in place to address these issues when found. The guidance we are working on in item #2 will create consistency throughout the company.**"

CNG was also asked, "What distance is OK to meet the, "All meter set assemblies should be placed, whenever possible, away from doors, windows, building overhangs, intake ducts, and other outside areas where gas can accumulate and migrate into buildings" criteria? CNG's reply was, **The attached pamphlet (CNG New Construction Requirements) (Figure 5) indicates 3' is the required distance from the regulator to appliance vents, air intakes or crawl space vents, 4' distance from doors or openable windows. This pamphlet was developed in early 2000s, and was distributed by CNG personnel to builders and developers indicating the proximity requirement of the gas meter from vents, doors, window, etc. CNG Meter Locations & Clearances dated March 18, 2008 also provides specific distances from openings/vents on buildings. Again, this only deals with the procedure for the installation of new services. Cascade is looking into what companywide processes should be in place to address these issues when found on existing meter sets.**

CNG's procedures for the proximity requirements for building openings relate to new construction. CNG does not have a specific program to find existing regulator vents adjacent to building openings which would be in violation of this new construction standard. This, however, is not specific to CNG. Most of the local distribution companies (LDC's) in WA have similar procedures—that is they apply to new

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construction, not existing conditions. Some have continuing surveillance programs where personnel are instructed to look for proximity considerations for vents and building openings (PSE, phonecon with Compliance Staff). If an issue is found, personnel are instructed in next steps (forwarding the issue to Gas First Response or Engineering for final dispensation).

There does not appear to be a violation of code or procedures with respect to the location of the riser or meter assembly in proximity to the fresh air vent in the motel.

Code Compliance:

1. §49 CFR 192 Subpart H-Customer Meters, Service Regulators, and Service Lines (

192.355_b) Service regulator vents and relief vents must terminate outdoors, and the outdoor terminal must (Service regulator vents and relief vents):

(1) Be rain and insect resistant;

(2) Be located at a place where gas from the vent can escape freely into the atmosphere and away from any opening into the building (Aug 19, 1970);

The entirety of subpart H is for new construction and is not a retroactive part of the code. Additionally, the location of the regulator vent did not influence the escaping gas--it was escaping from the broken riser pipe. The location of the riser in relation to the fresh air vent was critical to gas accumulating in the first floor laundry room. However, there is not a regulation which restricts the riser from being placed where it was originally located. The restrictions placed by code are for the location of the vent from the service regulator.

There does not appear to be a violation of code with respect to the location of the regulator vent/meter assembly in proximity to the fresh air vent in the motel.

2. WAC 480-90-323 Meter set assembly location.

(3) Residential and commercial meter set assemblies should be installed outside at the building wall. All meter set assemblies should be placed, whenever possible, away from doors, windows, building overhangs, intake ducts, and other outside areas where gas can accumulate and migrate into buildings. When it becomes necessary to locate meters away from the building wall or inside buildings, the gas utility must keep a record of these meter set assemblies, including in such record the location, installation date, and leak history. Utilities must submit copies of such records to the commission upon request.

This Washington regulation specifically notes that *“all meter set assemblies should be placed, whenever possible, away from doors, windows, building overhangs, intake ducts, and other outside areas where gas can accumulate and migrate into buildings.”*

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This code would certainly apply to this incident as the meter assembly was placed adjacent to an intake duct. However, the regulation is silent on when this code restriction applies-during construction and/or after construction. If an assumption can be made based on similar code language as noted above, it can be assumed this would apply to construction only. However, this is not stated in the language of the code. Additionally, this code language was adopted on June 3, 2001, well after the construction of the service lateral and meter at the motel at 3400 11th St.

3. *§49 CFR 192.273 General.*

(a) The pipeline must be designed and installed so that each joint will sustain the longitudinal pullout or thrust forces caused by contraction or expansion of the piping or by anticipated external or internal loading.

A question was raised as to whether ¾" steel risers should have a reinforcing sleeve at the threads to prevent this type of incident. The code language is moot on this subject. The question as to whether CNG (or any distribution operator) should anticipate an outside force caused by a person or persons standing on the meter and/or associated fuel piping is not specifically addressed in the code. As the original meter assembly was installed in 1978 and was replaced in 2008. The meters performed their required function for 35 years without incident. However, the nature of incidents such as these, is that unlikely scenarios are now looked at with a new light. This may cause the operator to evaluate these areas and determine if a preventable solution is warranted. Demonstrable code violations were not noted.

Conclusion:

It appears this explosion was an unfortunate accident. CNG, like all distribution operators, has many meters supported by the riser pipe and the customer fuel piping. Prescriptively, per company procedures, some of these meters in larger sizes require an independent support. However, many, like the 1000 CFH meter at the Bremerton Motel 6, do not and effectively work without any issues. In this particular case, the investigation did not reveal any supportive documentation to indicate CNG should have known to reinforce the threaded riser/meter connection in anticipation of people standing on the meter.

A review of records for code compliance did not reveal issues which contributed to this incident. Additionally, a review of operator qualification records for the CNG employee responding to the emergency did not show any issues contributing to the incident. The employee was well qualified and experienced in dealing with natural gas leaking from above and below ground pipelines.

Follow up/ Recommendations:

CNG is reviewing and potentially revising their company policies and procedures regarding how and when employees can entering a gaseous atmosphere. Additionally, CNG is drafting a policy/procedure for what they will do as a company when meter assemblies or regulator vents are found on existing services which are in violation with current procedures regarding

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proximity to building openings such as vents and windows. UTC should review these procedures (as well as others affected by it) to ensure compliance with applicable state and federal pipeline safety codes as part of next scheduled inspection.

Pictures:

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Photo 1: Looking south, 8/19/15 early morning, from Motel 6 parking lot.



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Photo 2: Looking southeast, 8/19/15 early morning, from Motel 6 parking lot.



Photo 3: Looking northwest 8/19/15 late morning, from 11th St at east end of building. 15 rooms and the laundry room were destroyed.

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Photo 4: Looking southwest from hill at east end of building. Note collapsed roof and second floor structure has been removed by track-hoe and piled behind damaged SUV.

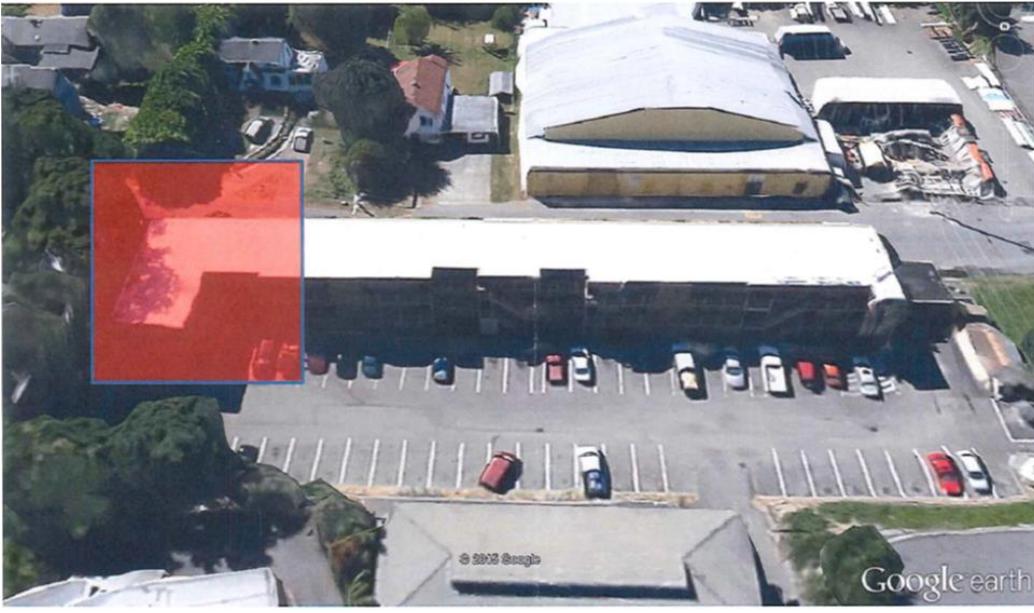


Photo 5: Google photo supplied by Bremerton Police Department looking south showing Motel 6 pre explosion. Red area was destroyed by the explosion.

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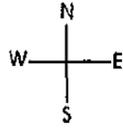


Photo 6: Google photo looking northwest from 11th St. at east end of building pre-explosion. Note gas meter location (gray object under lower window). Because of the hill, lower window is actually 2nd floor, with third floor above. Gas meter sits at approximately the ceiling level of the laundry room.

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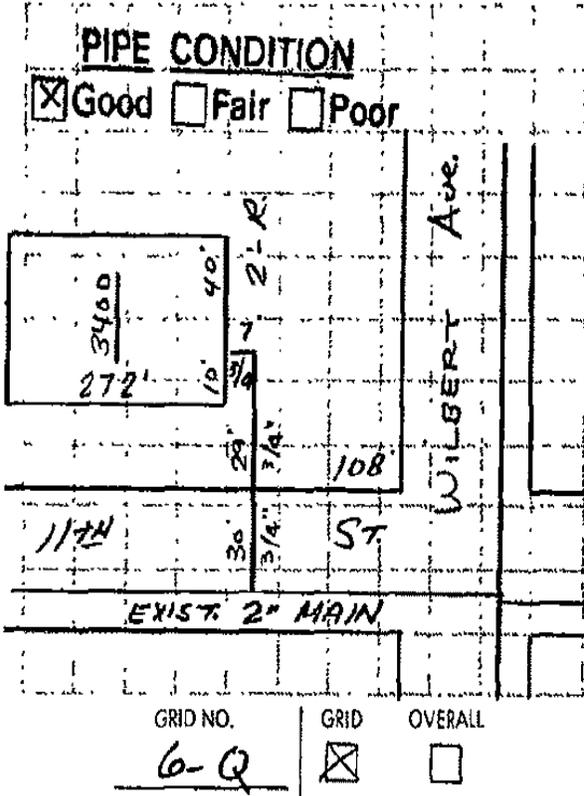
CNG 313
REV. 7/74



170-1045

SERVICE LINE NO. 4154

CASCADE NATURAL GAS CORPORATION
GAS SERVICE RECORD CARD



NAME ALIZA INC.

ADDRESS 3400 - 11th St.

CITY BREMERTON

STATE WASH.

SER. FT. 68' BY E. HARRIS

S.P.C. _____ FT. _____

PRESSURE TEST POUNDS 120 P.S.I.G.

REMARKS New

DATE COMPLETED 1-17-78

GRID NO. 6-Q | GRID | OVERALL

©s

Figure 1: Original CNG service card installation record for 3400 11th St. showing length of service and location relative to the building.

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Photo 7: Motel 6 owner's photo looking north at east end of motel. Meter and fuel pipe. Large pipe duct adjacent to meter is the exhaust for the gas dryers (from laundry room to roof). In 2014, new owners replaced cyclone fence (shown in previous Google picture) with a wood fence.

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Photo 8: Looking west at motel meter on east end of building pre-explosion. This photo was taken by the UTC on 7/21/2009 during the CNG Kitsap Standard Inspection. There is a fresh air vent behind the meter which sits on the foundation wall and then leads into the first floor laundry room. The tan fuel piping follows the vent into the building. Note the location of the vent in relation to the steel riser pipe. The assembly from the threaded riser connection to the meter was changed out at some point after this photo, however, the riser location, meter and fuel piping did not change (see photo X below).

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Photo 8A: CNG photo taken 5/22/12 of meter at east end of motel as part of CNG work order 9173110941. CNG painted part of meter pipe assembly to the left of meter. This photo shows either an additional fresh air vent behind and to the right of the meter, or an extension to the vent to the left of the meter (see photo 8).

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VACANT [redacted]
 ACCOUNTED [redacted]
 UNKNOWN

DEVICE LEGEND			
[Symbol]	SMOKE DETECTOR	[Symbol]	RECESSED LIGHT FIXTURE
[Symbol]	RECEPTACLES	[Symbol]	ADJUSTABLE CLIP ON PRY DRIVER
[Symbol]	ADJUSTABLE FULL STATION	[Symbol]	X
[Symbol]	ALARM BELL	[Symbol]	WALL SWITCH
[Symbol]	ALARM BELL RING	[Symbol]	WALL MOUNTED SWITCH
[Symbol]	ALARM BELL RING	[Symbol]	OTHER UNIDENTIFIED ITEM
[Symbol]	ALARM BELL RING	[Symbol]	

All conductors to be run per electrical code

Mark/label all initiating devices

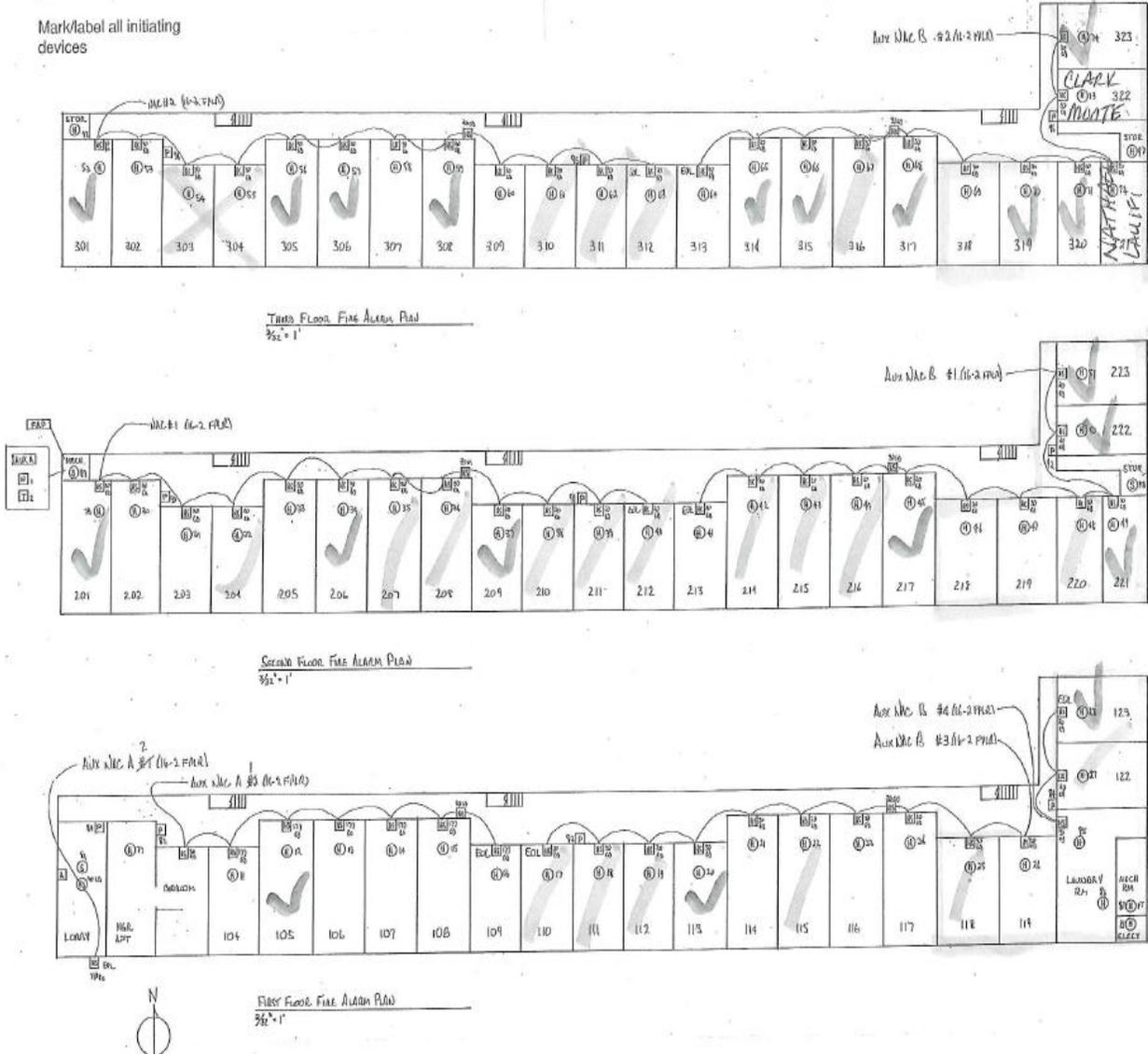


Figure 2: Motel 6 room layout used by Bremerton FD to determine if all guests were accounted for (first floor is depicted on the bottom). Note location of laundry and mechanical rooms on first floor.

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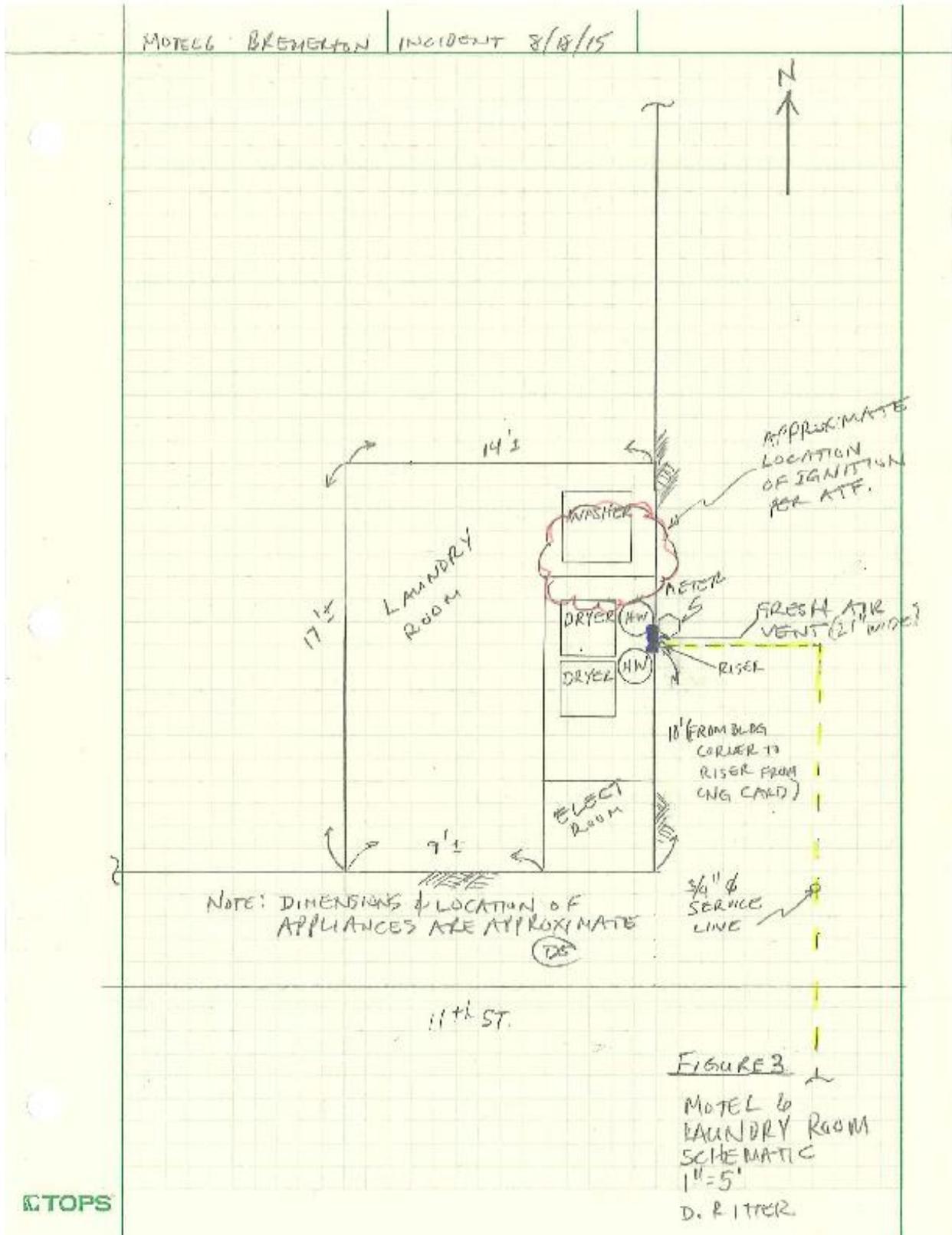


Figure 3: Schematic of laundry room with approximate location of appliances. Information

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was supplied during interview with owner Ramesh Rabadia and hand drawn by UTC inspector D. Ritter.



Photo 9: Looking northwest. Note location of gas riser and meter. Meter is approximately 10 feet east of riser and upside down. This is also where CNG service mechanic was found after blast.

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Photo 10: Looking east. Meter valve is in closed position as CNG service mechanic closed it when he arrived. Note, meter and service riser are upside down in this picture.

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Photo 11: Threaded portion of riser pipe inside threaded nut portion of meter valve. Note notch in threaded riser pipe at top of photo. This notch mates to a corresponding notch on riser pipe. Note rust is surface rust from fire suppression water.

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Photo 12: Looking north at ¾-inch steel riser after explosion. Note pipe lip is notched where blast tore remaining connected material.



Photo 13: Looking south. UTC inspector's depiction of how releasing gas entered building via the fresh air vent as shown. Initial break according to Case Forensics initiated at approximately the 10 o'clock position (southeast in this picture) and extended almost 360 degrees of pipe circumference. The gap according to first responders was "approximately 1/16" and halfway around the pipe". (note: text boxes and red layout added by D. Ritter).

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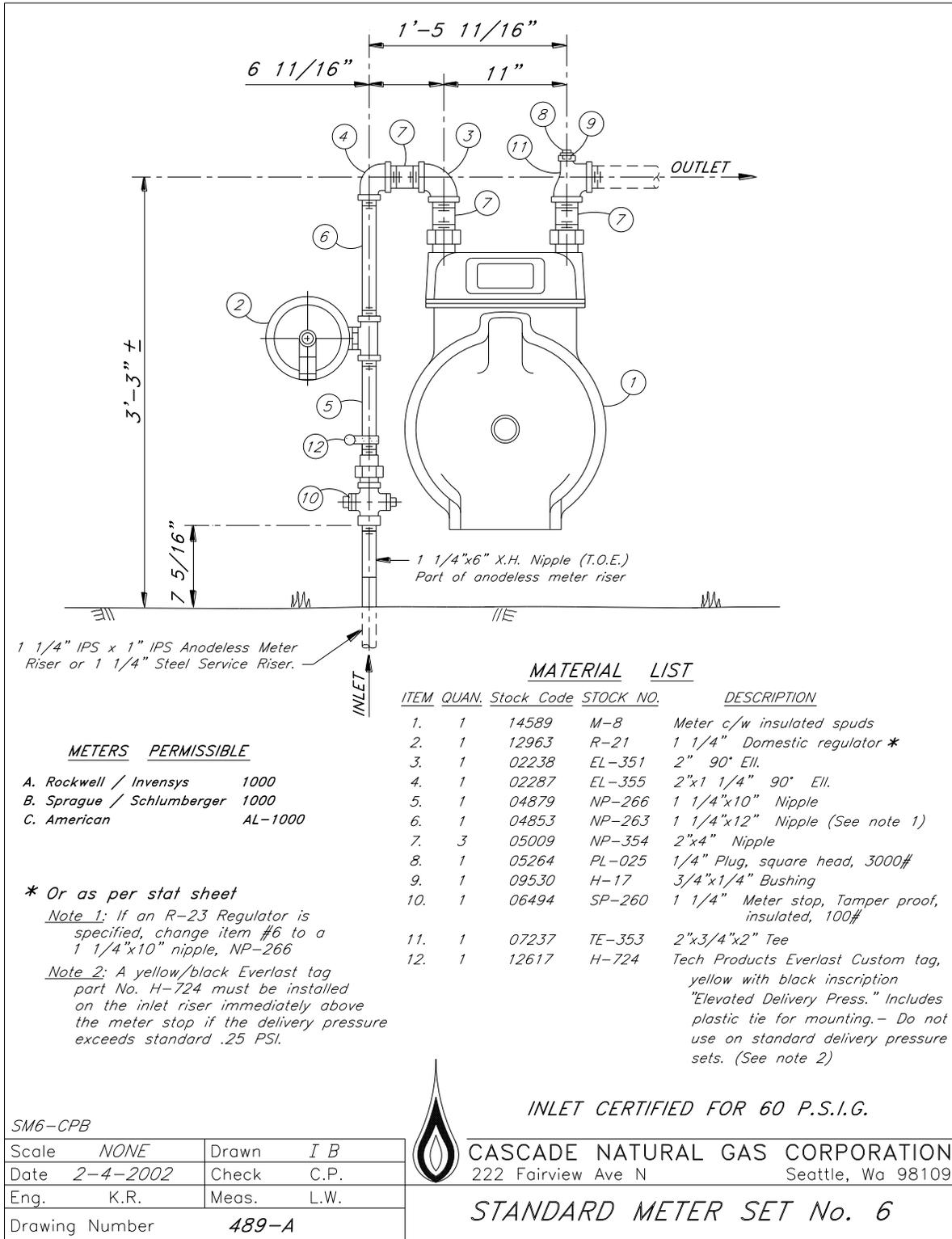


Figure 4: CNG Standard Meter Set drawing for a meter similar to Motel 6 installation (note a standard meter set drawing is not available for the time when the service was installed in 1978).

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Photo 14: Looking north. Service riser is bent away from building. Possibly bent by outside force of people standing on meter and/or from explosion. First responders noted the riser was “out from the building” prior to explosion.

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Photo 15: Looking north at CNG service riser being excavated on 8/19/15. Note leak clamp at base of riser which was being installed by CNG employee when building exploded.

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Photo 16: Looking south at gas riser pipe. Note CNG employee crescent wrench adjacent to riser. Wrench was found a few feet east of riser.

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Photo 17: Looking NW from hill east of motel at air vent which is suspected to be the gas pathway into the laundry room. The vent was found in the debris on the hill just east of the building. It is suspected to have been a fresh air vent (there is no debris or lint in the vent and it has bird screen). A picture of the east side of the building prior to the explosion shows the vent immediately behind the riser and meter. The paint on the duct indicates its orientation on the building. The downward facing portion of the duct is believed to have tied into a rectangular duct shown attached to the building wall inside the laundry room below.

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Photo 18: Through wall fresh air vent which connects to duct to laundry room on east wall of motel.

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Photo 19: Looking south at laundry room retaining wall and rectangular ductwork in background which is suspected to have been connected to rectangular fresh air vent. This ductwork would sit immediately adjacent to the hot water tanks and behind the gas dryers.

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Photo 20: Looking SE at what is left of laundry room from first floor. Note fire discoloration on walls and how it increases moving away from laundry. This is an indicator of where fire started.

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Photo 21: Looking SE at retaining wall at laundry room from first floor. Vertical two by four stud is what's left of a wall separating the washing machine room on the left and the dryer/hot water tanks on the right. Note how burn/soot marks increase away from dryer/hot water tank location.

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Photo 22: Looking SE at two industrial gas dryers from first floor. The one in foreground is laying on its side having been pushed down and over from the top (explosion is thought to have originated above this dryer).

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Photo 23: Looking South at remnants of industrial washing machine with gas dryers in background. Two by four studs are part of wall between dryers and washing machine. It is believe the explosion originated immediately above these appliances in this room.

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Photo 24: Looking South at one of two hot water tanks in foreground and two gas dryer behind after significant debris removal. Dryer has been set upright. Note how dryer top and side are pushed in.

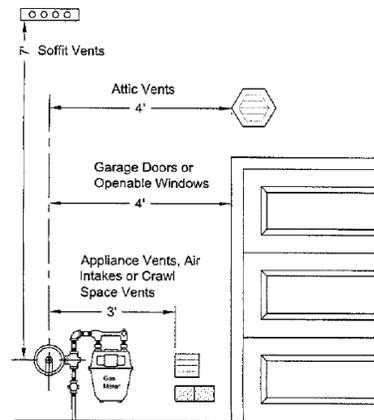
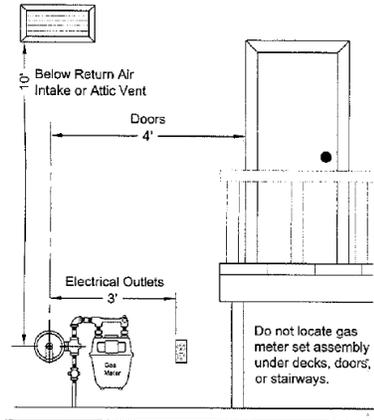
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Photo 25: Looking east from first floor at laundry room after significant debris removal. Washing machine on left, hot water tank and two dryers on the right. This is approximately the location of these appliances prior to explosion.

Gas Meter Clearances



Conduit Requirements

1. Conduit placement must meet depth and separation requirements
2. Conduits must be 2" (minimum) schedule 40 White PVC
3. Conduit ends should be left exposed stake ends with yellow stakes.
4. Conduits must end at least 5' from the end of the existing stub or main. Conduit should end minimum of 10' from the structure wall, although 5' will be allowed if circumstances require it. (must get prior approval)
5. Conduits over 40' in length will require 3/8" minimum pull rope

CNG will set a meter if:

1. City, County or State mechanical permits signed off. This includes pressure test and equipment installed to code. (Furnace must be hard piped from gas valve to outside of furnace wall.)
2. House piping must be tied into CNG's meter bar assembly. Meter bar must be plumb and level.
3. Appliance stops in place and must be plugged. (This applies to equipment that will be in use immediately. In new construction, if an appliance is not going to be used, the line can be capped.)
4. Furnace must have power (temporary power is acceptable) and a thermostat.
5. CNG needs to be able to have at least one piece of gas equipment ready and to be fired.
6. Call from dealer or builder when all is ready.

CNG will not set a meter if:

1. No permit (CNG must verify)
2. Permit not signed off, no pressure test.
3. No power
4. House piping not tied into CNG meter bar.
5. No equipment installed into home.

Cascade Natural Gas Corporation may alter these policies at any time.

New Construction Service Requirements

Questions? Please contact your local Construction Coordinator or New Construction Service Center.

NW Region - Bellingham, Mount Vernon
Rick Jennings XXX-XXX-XXXX
Gordon Van Corback XXX-XXX-XXXX

Western Region - Bremerton, Aberdeen
Longview
Dan Harris XXX-XXX-XXXX

Central Region - Sunnyside, Wenatchee,
Yakima
Greg Wristen XXX-XXX-XXXX

Eastern Region - Kennewick, Pendleton,
Walla Walla
Arnie Garza XXX-XXX-XXXX

Southern Region - Baker, Bend, Ontario
Eric Martuscelli XXX-XXX-XXXX

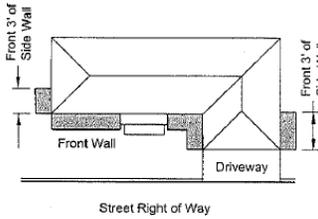
New Construction Service Center
XXX-XXX-XXXX
www.cngc.com



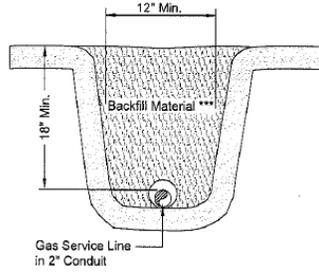
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Gas Meter Locations

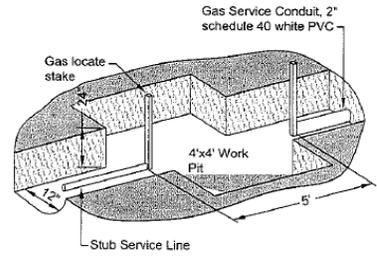
Gas meters shall be located on the front wall or within the front 1/3 of the side wall unless the gas meter clearances required below cannot be met



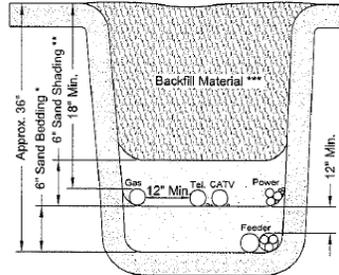
Conduit Installations



Termination of Conduit

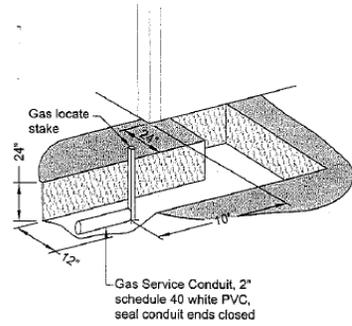


Direct Burial Installations



Note: Gas may be placed on a level above all other utilities provided 12" vertical separation is maintained.

- * Sand placed on the bottom of a trench or work pit containing direct buried or exposed facilities.
- ** Sand placed on top of direct buried or exposed facilities in the trench or work pit.
- *** Soil that is free from debris, sharp rocks and rocks larger than 10" diameter. Backfill shall not damage the conduit.



Installation Requirements

1. Conduit bends shall be long radius sweeps. 2" (minimum) Schedule 40 White PVC shall have a minimum 28" radius. No fittings allowed in conduit.
2. The sum total degrees of bends in the conduit run cannot exceed 180°.
3. White PVC conduit used for gas service lines shall not be marked "water pipe".

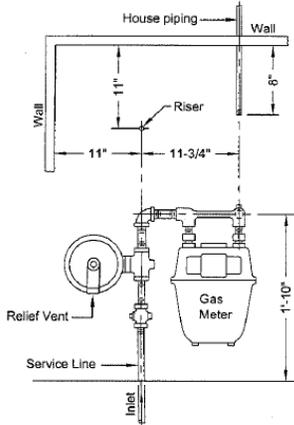


Figure 5: New Construction Service Requirements (CNG pamphlet from 2002) showing clearances from building openings to meter and regulator vent

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Photo 26: Riser pipe and valve assembly as set up at Case Forensics. Photo depicts relative alignment of assembly to the left and riser pipe to the right in the positions prior to explosion.

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Photo 27: Close up of meter valve nut to the left and riser pipe to the right. Pieces are positionally accurate as laid out at Case Forensics.



Photo 28: Case Forensics photo of meter valve assembly to the left and riser pipe to the right with an orientation line drawing between the two to allow for positional orientation in subsequent photos.

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Photo 29: Relative position of cuts to valve nut and top of riser pipe. These pieces were subsequently analyzed in more detail to determine fracture mechanics.

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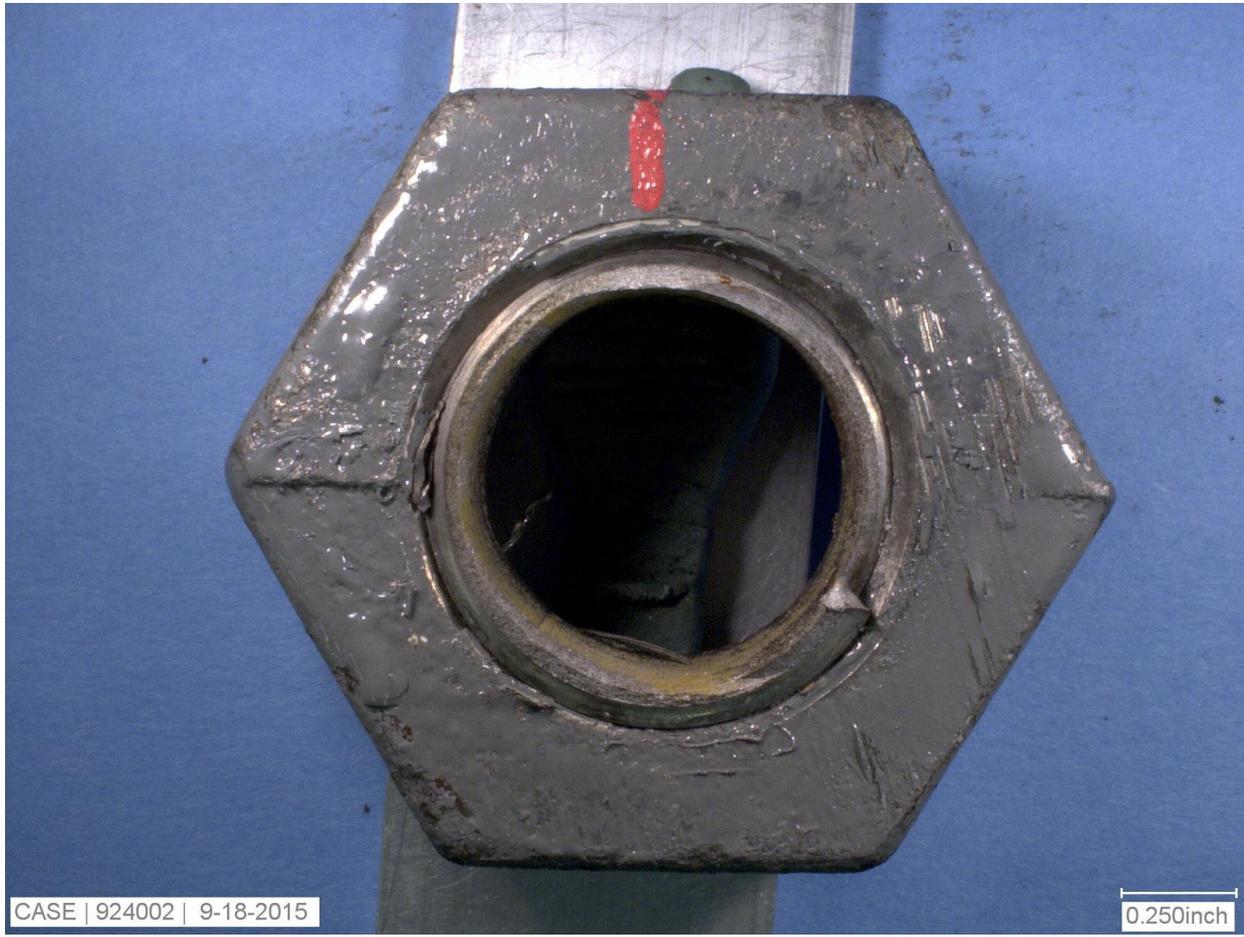


Photo 30: Case Forensics photo showing cleaned riser valve nut with sheared off riser pipe still threaded inside. Note “notch” portion of pipe to the lower right. Red orientation line references line is previous photos.

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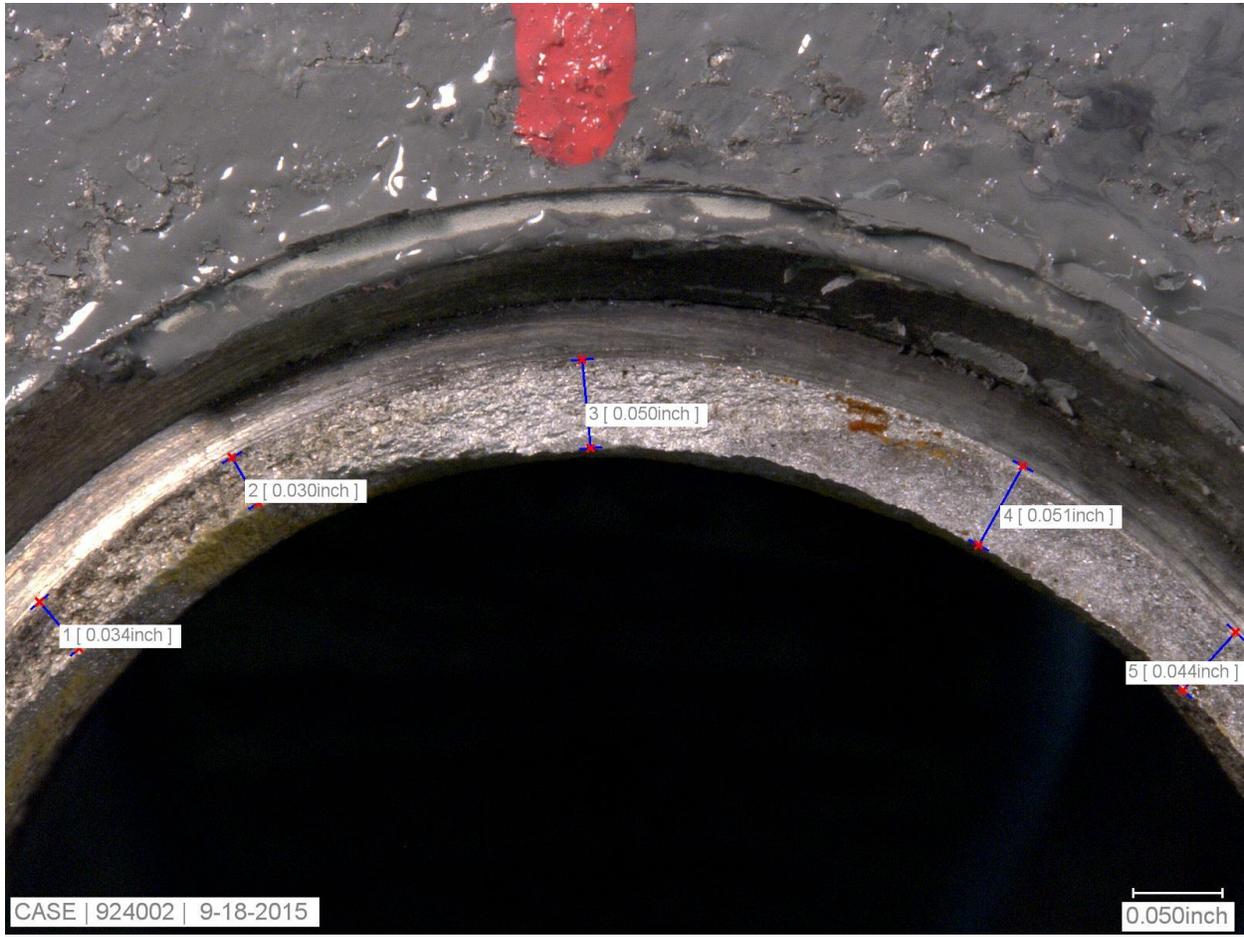


Photo 31: Case Forensics photo (cleaned) showing remaining wall thickness of threaded riser pipe. Wall thickness narrows as steel yields (stretches) to the outside force in a ductile manner (non brittle). Eventually it reached a critical point and snapped (tensile point). Case believes break initiated at 10 o'clock position. Note red orientation mark to align with layout on Photo 28.

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Photo 32: Case Forensics photo (cleaned) showing the area where original break propagation may have cracked pipe but did not separate. The jagged notch is where the blast simply tore off the remaining steel of the riser pipe.

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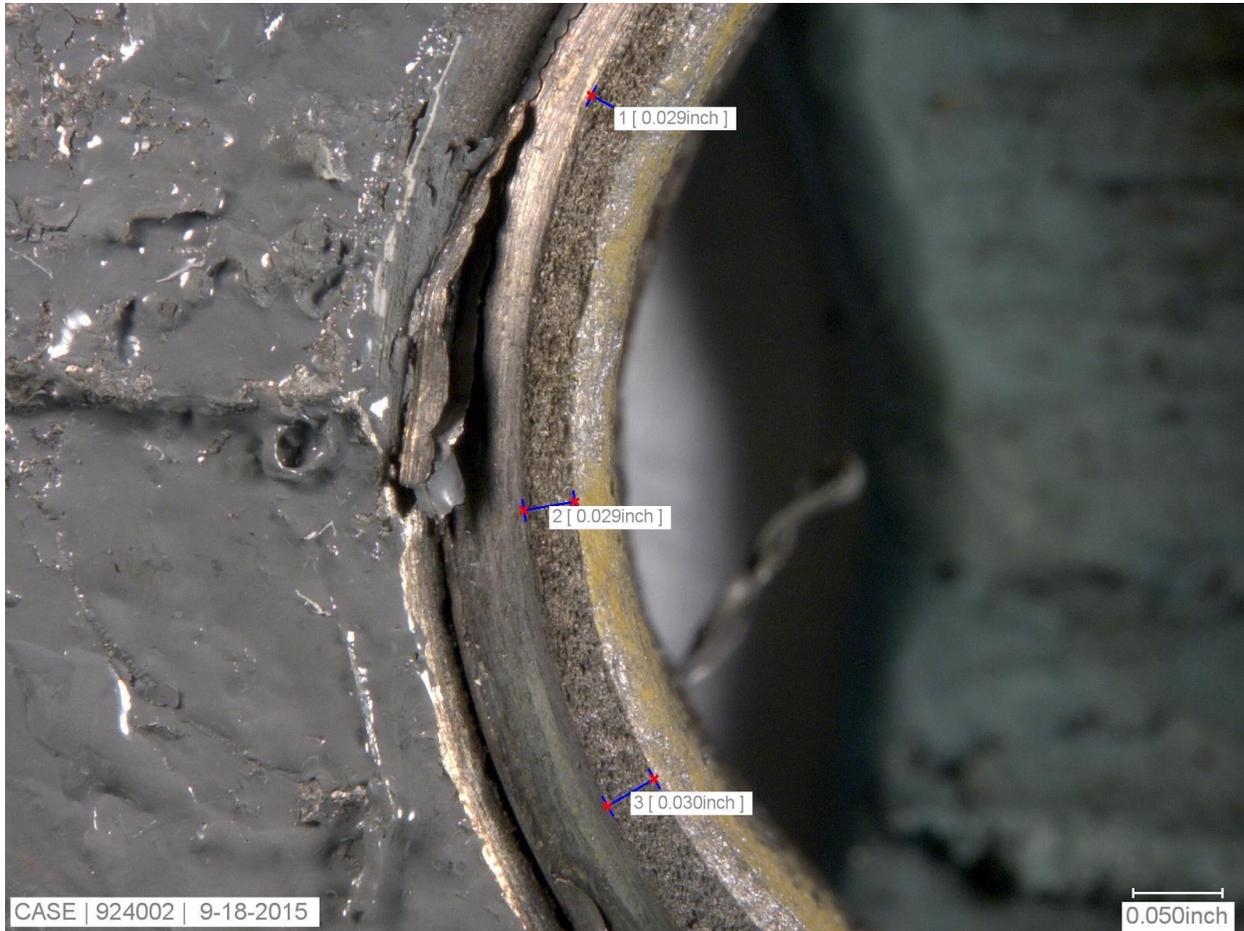


Photo 33: Case Forensics photo (cleaned) showing remaining wall thickness of threaded riser pipe. Wall thickness narrows as steel yields (stretches) to the outside force in a ductile manner (non brittle). Eventually it reached a critical point and snapped (tensile point). Case believes break initiated at 10 o'clock position-0.029" is narrowest measured thickness at approximately 10 o'clock position.

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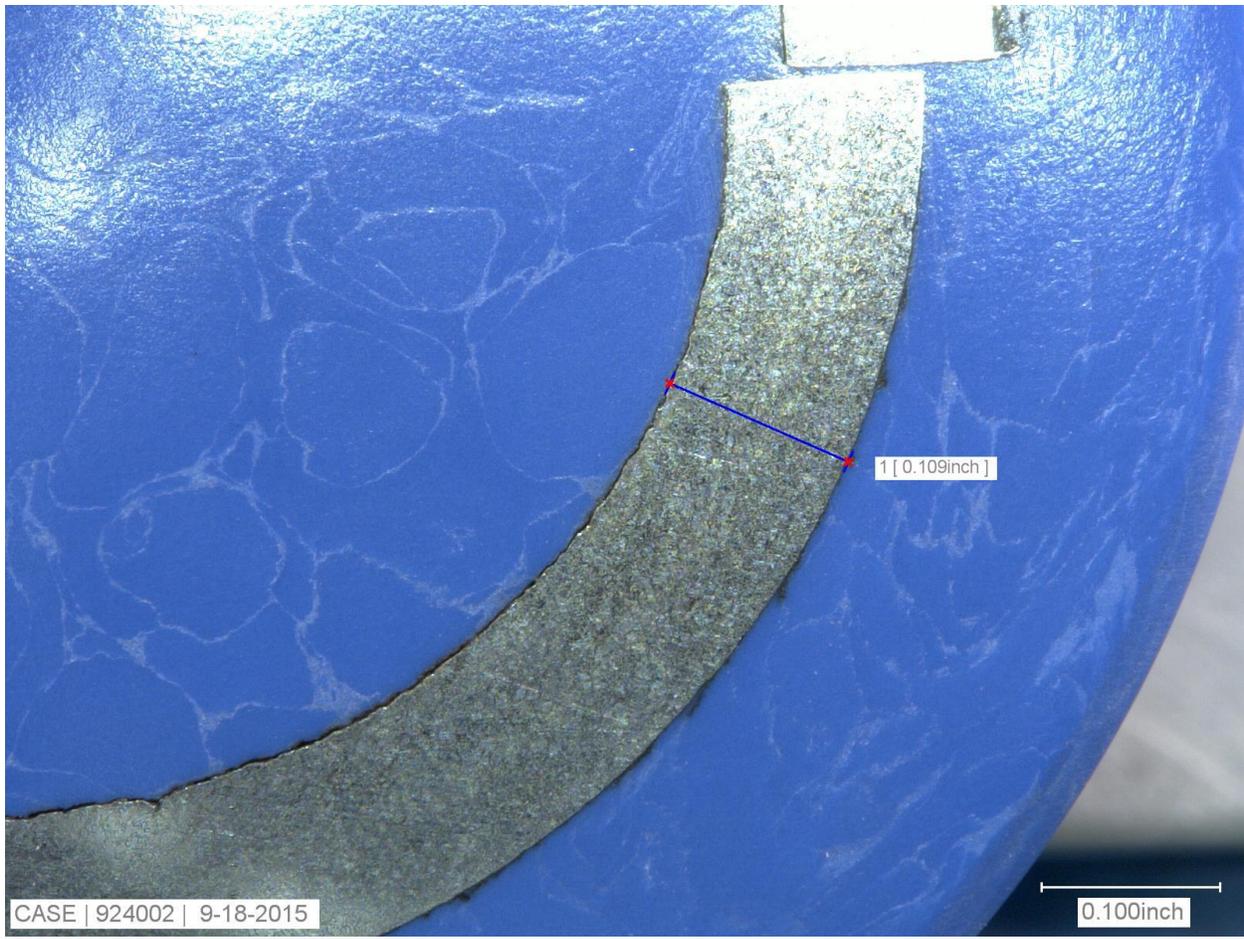


Photo 34: Case Forensics photo showing wall thickness of riser pipe. Nominal wall thickness for standard Class B pipe is 0.113 inches with a minimum of 0.0991 inches.

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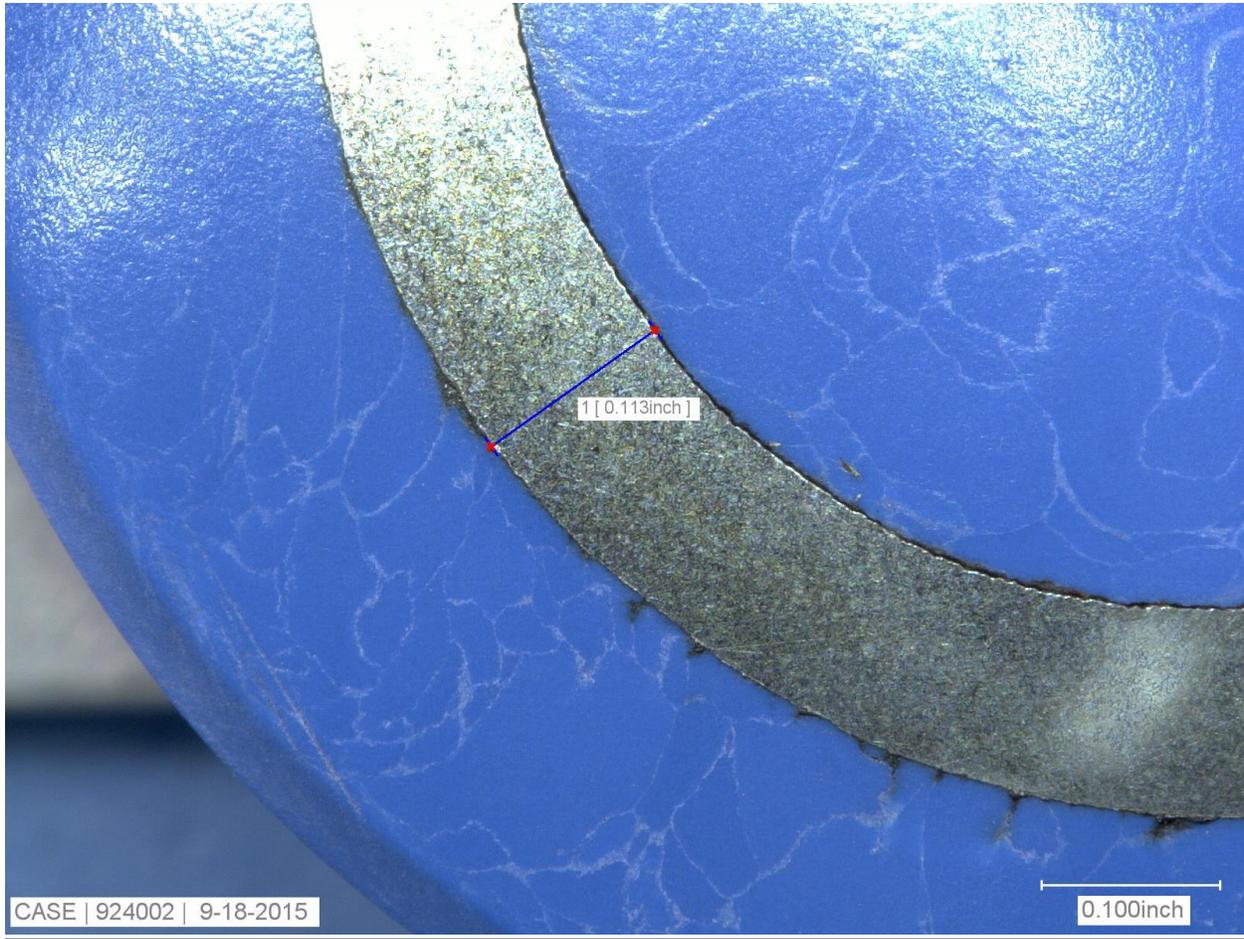


Photo 35: Case Forensics photo showing wall thickness of riser pipe. Nominal wall thickness for standard Class B pipe is 0.113 inches.

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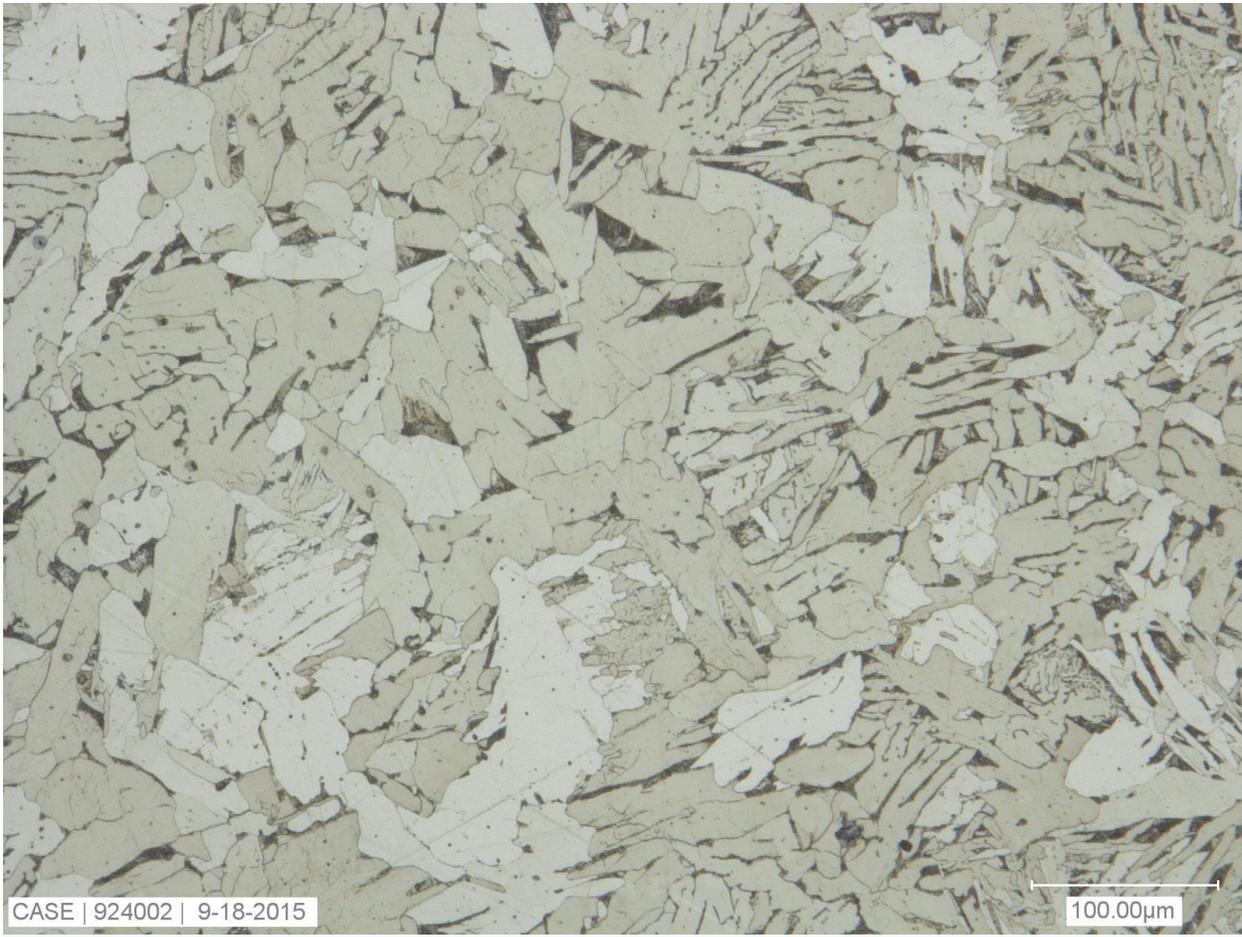


Photo 36: Case Forensics scanning electron microscope image showing grain structure of steel in riser pipe near break location. Image shows normal crystalline structure for steel. No indications of abnormal conditions.

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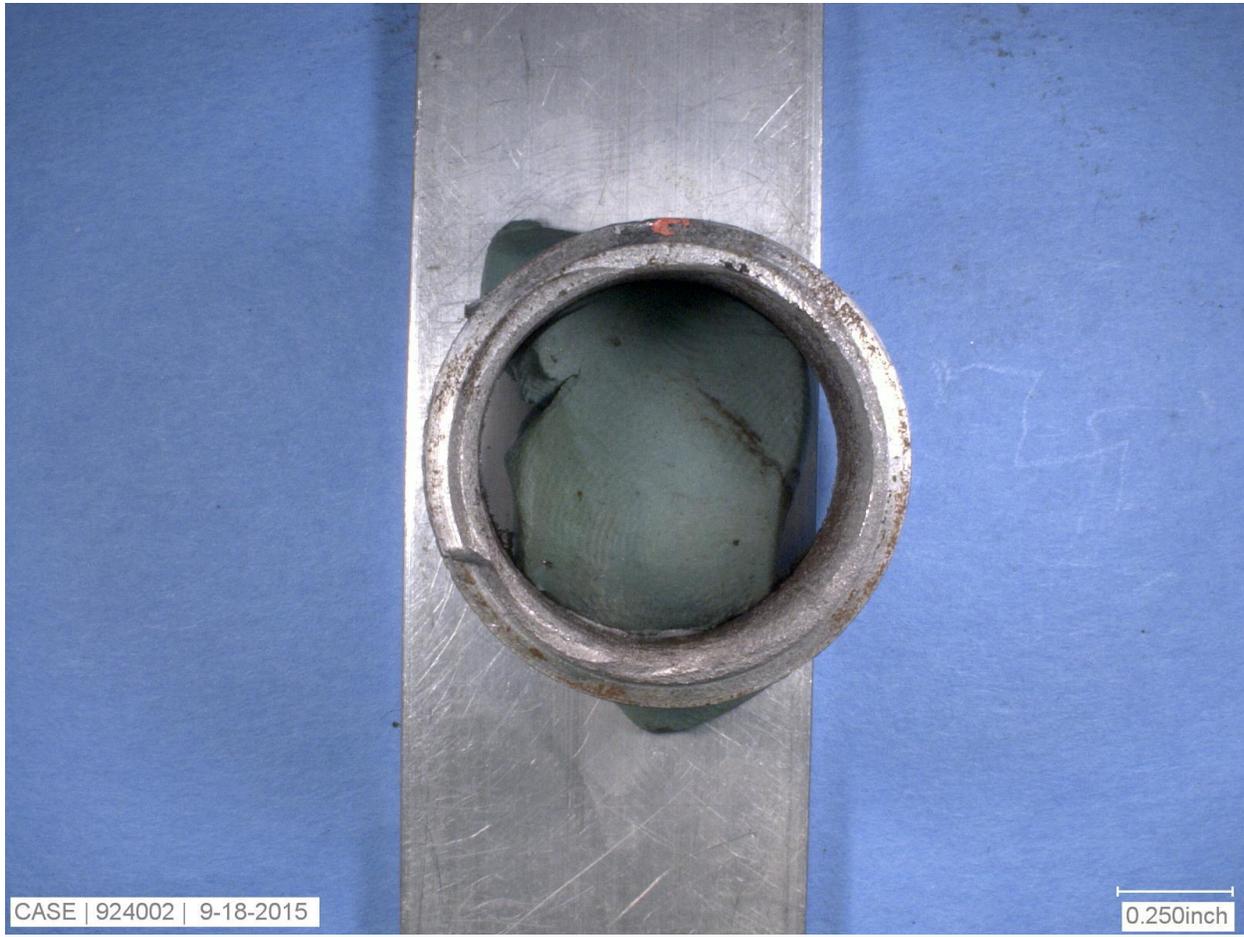


Photo 37: Case Forensics photo (cleaned) of riser pipe section remaining in ground after meter assembly was torn off by explosion. Note red orientation line. Notched section on lower left aligns with notched section on remaining riser in valve nut shown on photo 30.

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Photo 38: Pressure testing of service line. Looking east at end of service line at the 2" main on 11th St. Pressure test was held at operating pressure of 56 psi for 30 minutes with compressed air.

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Photo 39: Pressure testing of service line. Looking east at end of service line on 11th St. Pressure test was held at operating pressure of 56 psi (55.9) for 30 minutes with compressed air.