Investigation Update

September 2025

This document provides an update on the CSB's investigation of the August 11, 2025, incident at the United States Steel Corporation (U.S. Steel) Clairton Coke Works facility in Clairton, Pennsylvania.

Incident Summary

- On August 11, 2025, an explosion occurred at the U.S. Steel Clairton Coke Works facility in Clairton, Pennsylvania.
- The explosion fatally injured two U.S. Steel employees. Four U.S. Steel employees and one Veolia Water North America Operating Services, LLC (Veolia) employee were seriously injured. Six other workers sustained injuries that did not require inpatient hospitalization. Of these six, five were U.S. Steel employees and one was an MPW Industrial Services, Inc. (MPW) employee.

Background Information

- U.S. Steel, a wholly owned subsidiary of Nippon Steel North America, Inc. [1], is headquartered in Pittsburgh, Pennsylvania, with locations across the United States and one location in Central Europe [2]. The Clairton Coke Works facility is located in the City of Clairton in Allegheny County, Pennsylvania, and is the largest coke manufacturing facility in the Western Hemisphere [2, 3, p. 6]. The facility began operations in 1916 [4] and employs approximately 1,300 people. This total includes employees represented by the United Steelworkers union, as well as non-represented employees [5].
- Veolia, a provider of environmental solutions [6], was escorting Allegheny County Health Department employees performing air quality inspections under the direction of U.S. Steel on the day of the incident.
- MPW provides industrial cleaning services, including cleaning with pressurized water [7], at the Clairton Coke Works facility.
- The Clairton Coke Works facility converts raw coal into coke, a carbon-rich substance used as fuel in blast furnaces for iron and steel production [8, p. 1]. The coking process occurs in equipment called coke ovens. A coke battery is a series of coke ovens connected by common walls and operated as one unit [9]. Clairton Coke Works achieved its maximum production capacity in 1948 and operated 22 coke batteries at the time. The facility currently operates six coke batteries.
- The unit involved in the incident is referred to by U.S. Steel as the "13/15 Battery" and is comprised of three adjacently located batteries numbered 13, 14, and 15, constructed in the 1920s. All three batteries underwent a rebuild of the coke ovens in 1952 followed by a second rebuild of Battery 15 in 1979 and a second rebuild of Batteries 13 and 14 in 1989 [10]. U.S. Steel permanently shut down Battery 15 on May 1, 2024 [11, p. 6]. At the time of the incident, Batteries 13 and 14 were operating.

- The batteries are each separated by areas referred to as the "transfer areas." The Battery 13/14 transfer area contains control rooms known as "reversing rooms," along with break rooms, personnel shacks, and entrances to the region below the batteries and transfer areas, called the "basement." The transfer area also has staircases leading to the top of the battery.

- In a coke oven, coal is heated in batches for a minimum of 18 hours at approximately 2,000 degrees Fahrenheit (°F) [3, p. 14]. The ovens are kept oxygen-free in order to prevent the coal from burning [12]. This heating process converts coal into coke by removing tar, light oils, and other volatile compounds from the coal, known collectively as "coke oven gas" [13, pp. 2-3].

- At Clairton Coke Works, coke oven gas is collected and processed in a downstream unit. Some of the processed coke oven gas is returned to the batteries to be used as fuel to heat the coke ovens [3, pp. 20-21].

- The processed coke oven gas is a mixture of hydrogen (40 to 60 weight percent), methane (20 to 30 weight percent), nitrogen (3 to 15 weight percent), and carbon monoxide (3 to 6 weight percent), along with smaller amounts of other compounds. U.S. Steel employees told the CSB that coke oven gas also contains residue that can accumulate in the bottom of piping and in valve seats. On its website, U.S. Steel has a Safety Data Sheet for coke oven gas pipeline residue [14].

- Coke oven gas is highly flammable, toxic, colorless, and has a sulfurous odor. It has a lower explosive limit of about 4.4 percent and is less dense than air. U.S. Steel identified coke oven gas as an extremely hazardous substance. Exposure to high concentrations can cause asphyxiation due to the displacement of oxygen. The autoignition temperature of hydrogen, the most prominent component of coke oven gas, is 1,065 °F [15].

- The coke oven gas processing unit supplies processed coke oven gas to Batteries 13 and 14 through an underground piping system. The coke oven gas flow splits at a tee to direct it to either battery. After the tee, each battery is equipped with a manually operated isolation valve. After the isolation valve, the coke oven gas further splits into two parallel streams, each of which flows down one side of the battery (**Figure 1**).

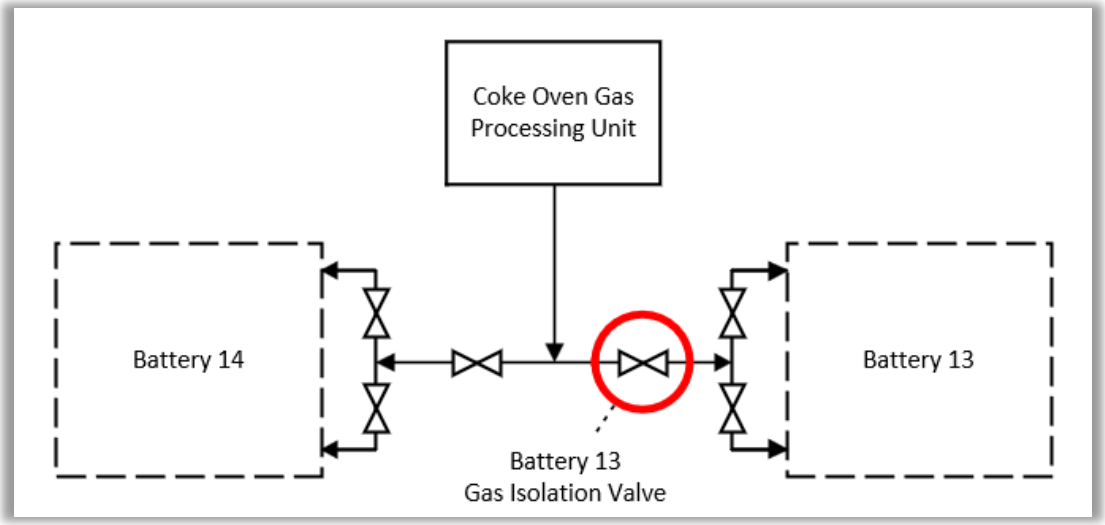

Figure 1. Simplified process flow diagram of coke oven gas flows from the processing unit to the batteries. (Credit: CSB)

- The Battery 13 gas isolation valve was located in the basement underneath the Battery 13/14 transfer area. The valve was an 18-inch cast iron double disc gate valve. Markings on the valve's body indicate that Chapman[a] fabricated it in 1953, and it was rated for 50 pounds per square inch (psig). The valve had two cleanout ports directed at the valve seat, one on either side of the valve body. Maintenance records show that U.S. Steel sent the valve to a local vendor to be refurbished in 2013.

- U.S. Steel had a procedure for "exercising" the Battery 13 gas isolation valve, along with other valves at the site. At the U.S. Steel Clairton Coke Works facility, exercising a battery gas isolation valve consisted of closing then re-opening the valve to help ensure it could successfully isolate downstream equipment and piping.

- U.S. Steel employees described that occasionally, they had difficulty fully seating a valve when exercising it due to the accumulation of residue over time in the valve seat. Employees described a practice of injecting steam or water into a valve's cleanout port to attempt to flush the valve seat during the exercising procedure.

- U.S. Steel's procedure allowed for introducing steam into the valve body to heat it prior to exercising the valve. It specified a maximum steam pressure of 10 psig. The procedure did not mention the use of water at all.

- At the time of the incident, at least 22 U.S. Steel employees and three MPW employees were working on Batteries 13 and 14. An Allegheny County Health Department Field Compliance Engineer and their Veolia escort were on top of Battery 14 inspecting the unit for compliance with air quality regulations.

[a] In 1959, the Crane Company acquired the Chapman Valve Manufacturing Company [18].

Incident Description

- On July 8, 2025, a U.S. Steel employee identified a coke oven gas leak from a valve downstream of the Battery 13 isolation valve. The company found that the downstream valve was cracked near one of its flanges. U.S. Steel applied a temporary repair to the cracked valve, which prevented flammable coke oven gas from leaking into the Battery 13/14 basement.
- To replace the damaged valve, U.S. Steel planned to isolate Battery 13 from the coke oven gas supply. In addition, U.S. Steel planned to opportunistically replace at least three other valves in the Battery 13 coke oven gas supply system while the gas to the battery was isolated and purged from the piping.
- On July 28, 2025, U.S. Steel held a meeting to define the scope of work and review the hazards for the upcoming maintenance outage for the Battery 13 coke oven gas system planned for August 19, 2025. MPW was not a participant in the meeting.
- On August 11, 2025, the day of the incident, U.S. Steel decided to exercise the Battery 13 gas isolation valve. A U.S. Steel supervisor called an MPW employee and asked MPW to provide a pump to flush the valve seat.
- At approximately 10:30 a.m. three U.S. Steel employees proceeded to the Battery 13 gas isolation valve, located in the basement below the Battery 13/14 transfer area, to begin exercising it. Three MPW employees were preparing their equipment to inject water toward the valve seat through a cleanout port from a hose connected to a positive displacement pump.
- Each of the workers had personal carbon monoxide monitors, and one of the MPW employees carried a four-gas monitor to detect oxygen, carbon monoxide, hydrogen sulfide, and flammable gas.
- A U.S. Steel supervisor, one of the three U.S. Steel employees working on the valve, instructed MPW to begin pumping water into the valve body through one of the cleanout ports. Once water was introduced into the valve, the U.S. Steel employees began to exercise the valve.
- Data recovered from the workers' carbon monoxide monitors and the four-gas monitor indicate that the monitors alarmed around this time. One of the MPW workers told the CSB that they observed water leaking from the valve's bonnet flange. Additionally, the workers heard a "pop" sound, and one U.S. Steel employee said they smelled gas.
- The U.S. Steel supervisor directed the workers to evacuate the basement. The U.S. Steel employees then called for the evacuation of Batteries 13 and 14, both verbally and by radio. The explosion occurred at approximately 10:47 a.m., less than one minute after the workers made the radio evacuation call.
- At the time of the explosion, at least four people were on top of Battery 14 and the Battery 13/14 transfer area (**Figure 2**).

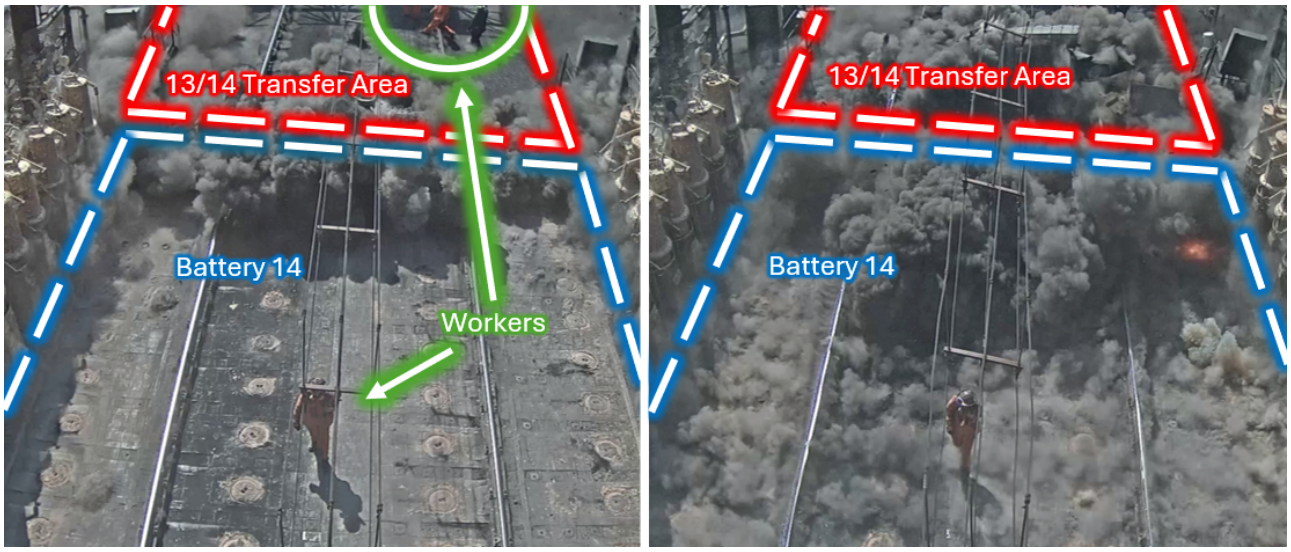

Figure 2. Surveillance images of the initial moments of the explosion, overlooking the top of Battery 14 and the Battery 13/14 transfer area. (Credit: U.S. Steel, annotated by CSB)

- Two U.S. Steel employees were fatally injured by the explosion. One of these employees was located shortly after the explosion occurred, but the other was not located until approximately 7:30 p.m., roughly 9 hours after the explosion. This employee was found buried under explosion debris [16].
- According to U.S. Steel, four other of its employees suffered injuries that required inpatient hospitalization. One of these four employees was trapped under debris from the explosion and was found alive around 2:45 p.m., roughly four hours after the explosion [17].
- The explosion heavily damaged the structures within the Battery 13/14 transfer area, including both the Battery 13 and Battery 14 reversing rooms (**Figure 3**).

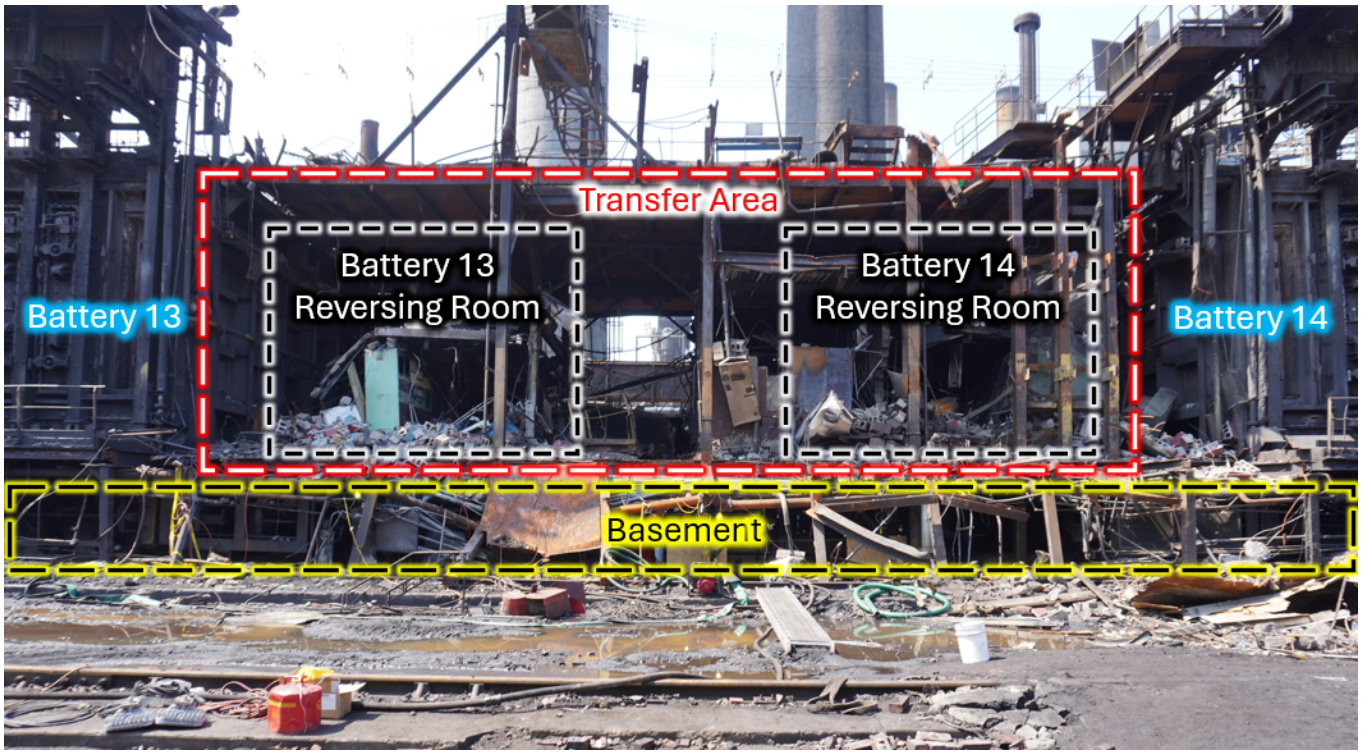

Figure 3. Post-incident photo, taken four days after the explosion, showing the damage to the Battery 13/14 transfer area. Locations of the reversing rooms are approximate. (Credit: CSB)

Additional Information

- After the incident, the Battery 13 coke oven gas isolation valve was found to have failed catastrophically, with its body split open by a fully circumferential crack (**Figure 4**).

Figure 4. Battery 13 gas isolation valve as found post-incident (Credit: Allegheny County Fire Marshall, annotated by CSB)

- After the incident, U.S. Steel recovered at least nine valves, varying in size from 16 to 18 inches in diameter, integral to the Battery 13 and Battery 14 coke oven gas systems from the Battery 13/14 transfer area. The CSB noted that four of these nine recovered valves were damaged (**Figure 5**). The CSB has not yet determined whether the observed valve failures occurred prior to or as a result of the explosion.

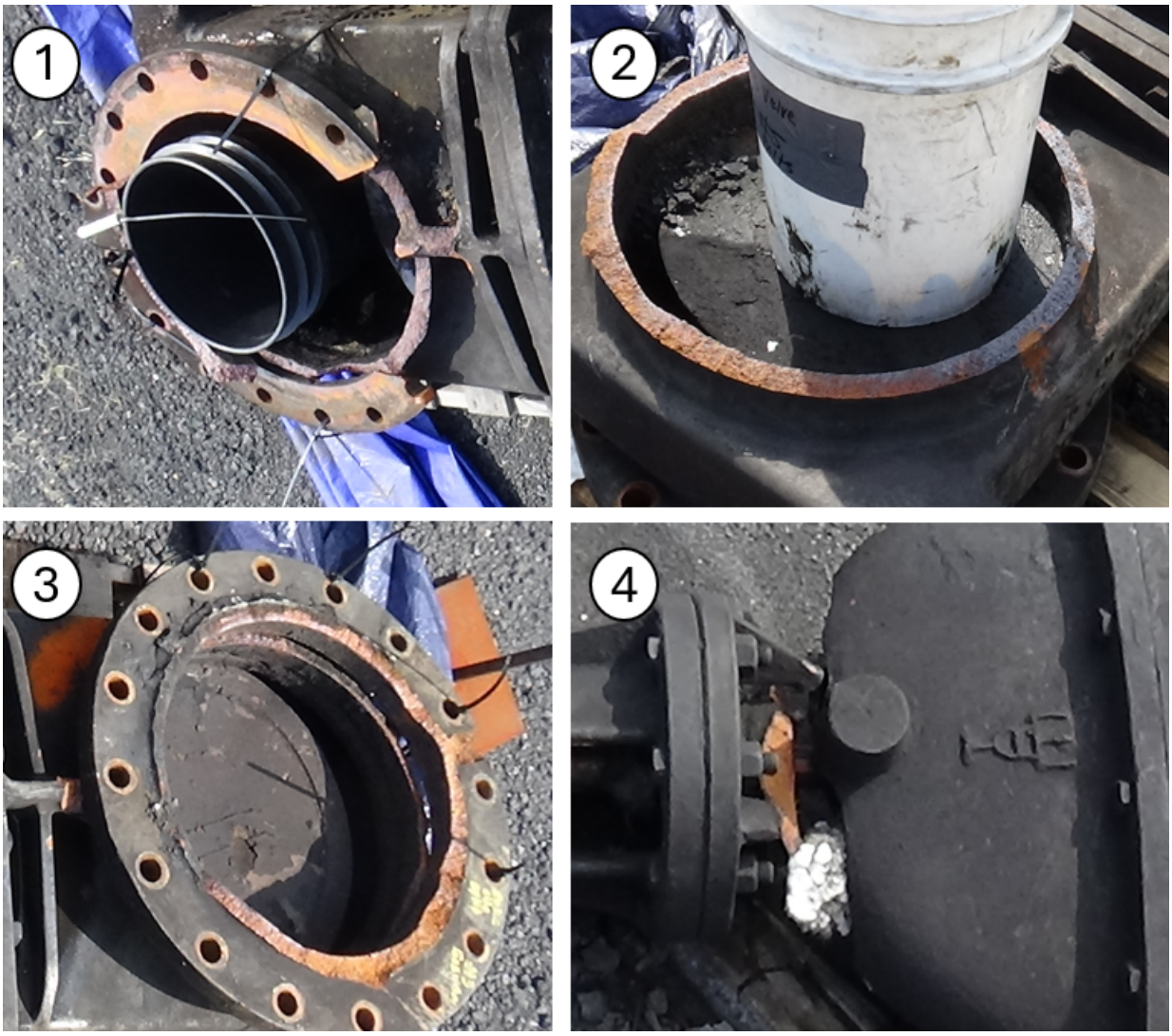

Figure 5. Damaged valves recovered after the incident: (1) portion of flange broken; (2) complete flange separation from valve body; (3) complete flange separation from the valve body; (4) fracture at the top of the bonnet. (Credit: CSB)

Path Forward

- The CSB is continuing to gather facts and analyze several key areas, including:
    - Determining the cause and source of the gas release that led to the explosion;
    - Metallurgical analysis of the cast iron coke oven gas valves;
    - U.S. Steel's use of cast iron in coke oven gas piping; and,
    - U.S. Steel's policies, procedures, and safety management systems.
- The investigation is ongoing. Complete findings, analyses, and recommendations, if appropriate, will be detailed in the CSB's final investigation report.

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