Fire Damage Assessment

When a fire occurs on your worksite, the recovery process can be challenging and complex. Stress Engineering Services has supported dozens of Upstream, Midstream, and Downstream operators in the U.S. and throughout North America with fire damage assessments.

"We have meticulously evaluated thousands of pieces of pressure equipment and piping circuits in dozens of plants."

Approach

Our approach to fire damage assessment is based on the API 579-1/ASME FFS-1 Standard, Fitness-for-Service, and our extensive engineering experience in metallurgy, stress analysis, piping analysis, hardness testing, inspection, heat zone mapping and project management. Our team of professionals establishes heat zones and develops specific inspection plans for each piece of equipment. Ultimately, Level 1, 2, or 3 assessments will determine if the equipment must be repaired, replaced, or can be used as-is. A comprehensive final report documents the findings.

Stages of Fire Damage Assessment

Typically, fire damage assessments proceed through the following stages:

- Establish safe access to the site
- Define Heat Exposure Zones
- Perform visual inspection and API 579 Level 1 assessments
- Establish equ ipment-specific inspection plans
- Perform and/or direct inspections
- Perform API 579 Level 2 and Level 3 assessments, as needed
- Issue comprehensive final report

Heat Exposure Zones – The Keystone of Fire Damage Assessment

Heat exposure zones are a concept presented in API 579, Part 11, characterized by isobars of maximum sustained ambient temperature during the incident. A visual inspection establishes the highest temperature to which different zones were exposed. Maximum exposure temperatures are assigned based on clues such as discoloration, softening, and known melting temperatures of typical construction materials. The heat exposure zones range from the highest temperature at the center of the fire, to regions that sustained no fire impact.

Zone 1 — No effects.

Zone 2 — Temperatures up to 150°F, smoke and water exposure.

Zone 3 — Temperatures between 150°F and 400°F, light heat exposure.

Zone 4 — Temperatures between 400°F and 800°F, moderate heat exposure.

Zone 5 — Temperatures between 800°F and 1,350°F, direct flame exposure, heavy heat exposure, no impingement.

Zone 6 — Temperatures higher than 1,350°F, direct flames, severe heat exposure, impingement.

API 579-1 Part 11 Heat Exposure Zones

Inspection

Level 1 assessments typically require only visual inspection, but for equipment requiring Level 2 or Level 3 assessment, inspection becomes more involved.

Hardness testing is the most frequently used type of non-destructive examination (NDE) in fire damage assessments. Heat exposure during a fire can either "harden" or "soften" the steel. "Softening" indicates a lower strength, while "hardening" indicates higher strength, less ductility, and increased brittleness in the steel.
Other types of inspections employed may include:

Typically, fire damage assessments proceed through the following stages:

- **Visual testing (VT)** – including inspection for bowing, sagging, bending, corrosion, cracks, and distortion. VT may include use of our drone services.
- **Laser scanning** – using our fixed position terrestrial scanner and high-resolution metrology-grade scanner to establish plumb, out of round, distortion, and metal loss.
- **Magnetic particle testing (MT)** – for surface cracking.
- **Eddy current testing (ET)** – for surface and near-surface cracking of magnetic materials.
- **Ultrasonic testing (UT)** – for wall thickness (straight beam) and crack detection (shear wave).
- **Acoustic emission testing (AET)** – for efficient global inspection focused on cracking.
- **Field Metallographic Replication (FMR)** – to inspect the material's surface microstructure without cutting out a sample of metal.
- **Videography, High Resolution Photography, and Drone Inspection**

Our experts develop specific inspection plans for each piece of equipment, enabling the client to complete the process as quickly as possible.

Scanning, Videography, and Drone Inspections

Fixed Position Laser Scanning – 3D laser scanning of vessels and towers for deformation and plumb is performed with our FARO laser scanner. This high-accuracy scanner allows accurate characterization of shape and distortions in large vessels and towers. Because it is offered an in-house service, integration with our finite element analysis is seamless.

Handheld Metrology Grade Laser Scanners – The Creaform high-resolution laser scanner is our instrument-of-choice for high accuracy scanning of smaller features and is used to characterize local deformations and even severe pitting. Once again, because it is offered an in-house service, there is a smooth integration with subsequent analysis.

Drone Photography / Videography and Scanning – Scene documentation and visual inspection is enhanced, and safety increased, with our high-resolution drone inspection capabilities and FAA licensed pilot.

Level 1, 2, and 3 Assessments

Whereas Level 1 fire damage assessment is relatively simple, Level 2 and Level 3 assessments require our expertise and an understanding of materials, mechanics, and plant conditions to ensure the problem is neither over-simplified nor over-analyzed.

Broad Industry Experience

We have performed fire damage assessments in a broad range of oil and gas, petrochemical, gas processing, and chemical plant facilities including numerous petroleum refineries, olefins plants, ethylene plants and other chemical plants, pipeline facilities, above and below-ground storage tanks, onshore and offshore.

Vast Range of Equipment Types

Fire damage assessments can involve a wide variety of facility processing equipment, structural components, and materials. Our experts have assessed everything from tall towers to condensate drums, including aluminum plate heat exchanges, fin-fan coolers, pumps, compressors, blowers and fans, plant piping, shell and tube heat exchangers, and more.

Structural Steel & Concrete – In general, API 579 addresses only pressure equipment, but industrial fires often involve other components including structural steel and concrete. These very basic components are featured in nearly every fire damage assessment performed by our team of civil/structural engineers who are highly experienced in assessment of these key components.

Full Spectrum of Services

Fire damage assessment is only one of the services we can offer to support your needs after a fire occurs. Our full spectrum of services includes:

- Origin & Cause Investigation – with Certified Fire Investigators
- Fire Damage Assessment – Fitness-for-Service assessment of fire damaged equipment
- Forensic/Litigation Support – Expert witness support and forensic investigations

Contact us today to learn more about how our fire damage assessment capabilities can help you.

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