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Adverse Impacts of Wildfires on Power Industry Steel Structures

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Foreword

AMPP technical reports are intended to convey technical information or state-of-the-art knowledge regarding corrosion. In many cases, they discuss specific applications of corrosion mitigation technology, whether considered successful or not. Statements used to convey this information are factual and are provided to the reader as input and guidance for consideration when applying this technology in the future. However, these statements are not intended to be recommendations for general application of this technology and must not be construed as such.

Scope

The purpose of this report is to communicate the effects of wildfires heat and combustion products on corrosion resistance, material properties, and mechanical integrity of power transmission infrastructure and to identify next steps to research, develop, and implement future asset integrity management actions for the power industry. The report addresses the following general topics.

- Wildfire vulnerabilities and impacts
- Materials effects for steel, coatings, and concrete
- Power infrastructure risks and impacts
- Asset integrity risk assessment guidance
- Recommended industry actions
- AMPP activities proposed

A wildfire, bushfire, wildland fire or field fire is an unplanned, unwanted, and usually uncontrolled event in an area of combustible vegetation. Due to climate change, many locations in the United States and worldwide, such as Australia and even India, are subject to wildfires due to dry conditions during parts of the year. The frequency and severity of wildfires are increasing. According to the National Interagency Fire Center,[1] more than 10.3 million acres were burned in the U.S. in 2020, as compared with 4.7 million acres in 2019.[1] Further details are provided in the Introduction section.

Rationale

The extreme temperatures of wildfires can alter properties of structural materials and result in a reduction in mechanical/structural strength. In the case of transmission and distribution (T&D) line structures, this can lead to accelerated corrosion, or even the collapse the structures at some later time. Furthermore, wildfires can severely damage wires for grounding and cathodic protection systems.

Corrosion occurs at both above- and sub-grade portions of structures; however, in most cases the rate of underground corrosion is much higher than above-grade (atmospheric) corrosion. Steel structures exposed to these wildfires may suffer damage from the heat and smoke that could affect their reliability and longevity. It is important to point out that a structure may have preexisting corrosion or other structural damage prior to wildfire exposure, and the additional effects of high-temperature wildfire exposure may lead to catastrophic damage and structural failure. Accordingly, there is a broader need for asset integrity management both before and after fire exposure.

Galvanized coatings are zinc-based metallic coatings applied to structural steel using a variety of processes. The performance of these zinc-based coatings when subjected to fires depends on the characteristics of the galvanized coating. Loss of galvanizing without loss of strength may occur at lower temperatures and not be obvious, since such a structure would still be standing. It would, however, be subject to accelerated corrosion and weakening over time. Although temperatures in fires can easily exceed 538 °C (1,000 °F), they do not often last for durations which might compromise the integrity of a hot-dip galvanized steel structure. Therefore, the potential for coating damage exists, however prior experience has typically found minimal fire damage on galvanized structural steel parts exposed to fires with short durations and/or non-critical temperatures.

Organic coatings and paints which may be burnt or charred due to wildfire exposure will require replacement. A possible technique to mitigate extensive damage to a coated steel structure exposed to a wildfire would be to replace

(1) National Interagency Fire Center, 3833 Development Ave., Boise, ID 83705-5354, www.nifc.gov.

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