

Data Collection in Support of Integrating Operating Experience into NUREG-2180

Purpose

At the October 3-5, 2017 NRC/Industry workshop on improving realism in Fire PRAs, an event tree (Attachment 1) for quantifying the risk benefit of in-cabinet Aspirating Smoke Detection (ASD) Very Early Warning Fire Detection Systems (VEWFDS), incipient detection, was proposed as an alternative to the event tree in Figure 6-4 and Figure 6-6 in NUREG-2180. The proposed event tree was based on two key parameters (i.e., the incipient event frequency and the incipient stage duration) for which adequate knowledge does not currently exist. Also at this workshop, an industry initiative was proposed to collect the data necessary to establish adequate knowledge for using these two key parameters. This whitepaper provides additional details about:

- 1) What data will be collected and why that collection is necessary,
- 2) How the data will be collected and what length of time is this collection effort expected to take, and
- 3) How will the data be used in the proposed event tree?

Incipient Event Frequency

In the proposed event tree, the incipient event frequency was used for the initiating event. The collection of data for the incipient event frequency is necessary because fires in the associated electrical enclosures are not well-represented by the generic BIN 15 ignition frequencies, due to physical and administrative differences in the as-built and as-operated plant. Physically, incipient detection is installed selectively, rather than uniformly or randomly, in electrical enclosures (usually low-voltage) based, in part, on expectations for effectiveness. Administratively, the response to incipient ALERTs and incipient ALARMS represents an operational difference in the treatment of the electrical enclosures for which incipient detection has been credited with the intent of preventing an actual fire. Consequently, electrical enclosures with in-cabinet ASD VEWFDs are considered unique ignition sources.

Section 6.5.1 of NUREG/CR-6850 provides guidance for establishing a fire frequency for unique ignition sources that may not be reflected in the generic frequency model ignition source list. In particular, the following information should be collected:

- 1) Characterization of the ignition source (e.g., power, voltage),
- 2) Percentage of time the ignition source is functioning when it has the potential of starting a fire,
- 3) Any history of fire events in the plant associated with the specific ignition source, and
- 4) History of fire events at nuclear and non-nuclear locations.

The frequency of incipient events leading to a potentially challenging fire will be determined from the results of a review of operating experience. Either a fire in an electrical enclosure credited with incipient detection or an incipient ALERT/ALARM terminated prior to actual fire by intervention in the electrical enclosure where incipient detection was credited would be considered an incipient event. An incipient ALERT/ALARM that clears without intervention and does not progress to an actual fire would not be considered an incipient event. Data will be considered only for monitored ignition sources. Fire or intervention in an electrical enclosure where incipient detection was not credited would not be considered an incipient event. An actual fire in an electrical enclosure credited with incipient detection would be judged with regard to whether it was challenging or potentially challenging. Because every

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incipient ALERT/ALARM would not be expected to progress to an actual fire, some additional judgment with regard to challenging or potentially challenging would be necessary for incipient events that are terminated by intervention. The judgment could result in a fractional count when there is doubt in whether an incipient event could have progressed to a challenging or potentially challenging fire.

Incipient Stage Duration

In the proposed event tree, the incipient stage duration was used to establish the time available in the associated Human Reliability Analysis (HRA). As advocated in NUREG-2180, the incipient stage duration will be based on information obtained from formal expert elicitation, employing experts knowledgeable of the design and failure characteristics of the equipment being protected and similar components. Section 8.2 of NUREG-2180 discusses additional considerations for characterizing an ignition source with respect to the incipient stage duration. In addition to power or voltage, those considerations include the type of components and applicable failure mode or mechanism. For an electrical enclosure, the incipient stage duration would represent a composite of components contained within the electrical enclosure. The experts would be asked about the expected incipient stage duration and associated uncertainty for the components typically contained within electrical enclosures.

Review of Components Identified in Reportable Fire Events

As described in Section 2.2 of NUREG-2180, not all situations involving an incipient stage actually result in a fire. Therefore, before attempting to establish an incipient event frequency or an incipient stage duration, some additional screening is required to identify those components contained within an electrical enclosure and having some failure mode or mechanism that could result in a fire. In particular, the Reportable Fire Events documented in the INPO ICES database were reviewed to identify (Attachment 3) the type of component, voltage level, and failure mode/mechanism attributed to cause the event. Whether the event involved an actual fire is also noted.

Time-table

This effort is envisioned in two Phases. In Phase I, the pilot plant will collect the operating experience, determine an incipient event frequency, and evaluate the risk. In parallel, EPRI will conduct the expert elicitation for incipient stage duration, support the creation of the incipient event reporting database, and report the results. In Phase II, other plants will contribute operating experience to the database and evaluate risk. At the end of Phase II, EPRI will publish an updated report.

INPO ICES database review	January 2018
Incipient Event Frequency Pilot	First Quarter 2018
Incipient Stage Duration Expert Elicitation	Second Quarter 2018
Phase I Report	Third Quarter 2018
Phase II	Fourth Quarter 2018
Phase II Report	First Quarter 2019