FAQ Number	**18-0014**	**FAQ Revision**	**0 (Draft V7)**
FAQ Title	**The time of Detection is Zero for the start of the Manual Non-Suppression Probability (NSP) Calculations**		

Plant:	Various	Date:	~~September 25, 2018~~ March 13, 2019
Contact:	Robert Cavedo	Phone:	(301) 938-0397
	Ashley Lindeman		(704) 595-2538
	Patricia Pringle		(410) 495-4496
		Email:	Robert.cavedo@exeloncorp.com
			alindeman@epri.com
			patricia.pringle@exeloncorp.com

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Purpose of FAQ:

This FAQ provides an interpretation of when to begin crediting the empirically based manual Non-Suppression Probability (NSP) curves for the case where the fire damaged equipment is indicated directly in the MCR in order to align with the data used to develop the curves.

Relevant NRC document(s):

NUREG/CR-6850
NUREG/CR-6850 Supplement 1 (FAQ 08-0050)
NUREG 2169

Details:

NRC document needing interpretation (include document number and title, section, paragraph, and line numbers as applicable):

See list of relevant NRC documents

Circumstances requiring interpretation or new guidance:

The guidance in NUREG/CR-6850 Appendix P implicitly and through example directs that the detection time be subtracted from the overall time until target damage when developing the manual non-suppression probability. Although NUREG/CR-6850 Supplement 1 (FAQ 08-0050) and NUREG 2169 remove the brigade response time from the NUREG/CR-6850 approach for crediting manual suppression, the subtraction term for the detection time remains. As a result, the risk associated with the manual non-suppression probability is artificially high in a limited case.

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Detail contentious points if licensee and NRC have not reached consensus on the facts and circumstances:

None.

Potentially relevant existing FAQ numbers:

FAQ 08-0050, "Manual Non-Suppression Probability"

Response Section:

Proposed resolution of FAQ and the basis for the proposal:

The manual non-suppression probability (NSP) curves by nature of the data collection process already include the detection time in addition to the brigade response time in a limited case. Once a fire event is logged in a Nuclear power plant, it is detected ~~(i.e. the NSP curve begins).~~

NUREG-2169 used the Updated Fire Events Database (EPRI 1025284) in the development of the NSP curves. ~~Whether the fire is detected by a detector, plant equipment failure, or personnel, the T=0 from which the fire is detected is inherently included in the manual response time curves~~ .

Incipient detectors are excluded from the approach in this FAQ since~~,~~ these detectors are not~~the vast majority of the fires are not detected using~~ traditional fire detectors and the vast majority of fires are not detected using incipient detectors. ~~(e.g. heat sensors)~~.

Detection (T=0), in the context of this FAQ, is considered the point at which operations logs that something has happened. This does not mean that it is initially known that a fire has occurred. But, it corresponds to the start of the time used to determine event duration. This is the point at which the NSP curve begins. The fire will be controlled or extinguished within x amount of time from detection at the confidence calculated using the NSP curves.

The case in which the time to detection equals 0 with respect to applying the NSP curves from NUREG-2169 is the following:

When the fire is detected by a plant equipment failure that is indicated directly in the control room, the time to detection (T_{det}) is inherently included in the manual response time curves since the time from fire initiation to detection is generally assumed negligible and thus the HRR t-squared growth profile does not begin in the PRA model until detection

Commented [HJ1]: This FAQ is insufficient since it does not specify the interaction of this approach with the plant response timeline.

Commented [HJ2]: This is a small part of the RES/EPRI research project. This condition is integrated into the RES program with respect to interruptible fires and growth fires.

Commented [MB3]: How is the confirmation of the fire taken into account in the fire response timeline and consequently NSP credit? If a fire is not confirmed, then no response occurs. Also, could some procedures stipulate that a fire should be confirmed, and others not?

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This timeline illustrates the sequence of events:

- Time = -y Fire Starts
- Time = 0 Fire is Detected (i.e. operations logged the event)
  Fire Growth Curve Begins (for the specific case above)
- Time = x Fire is controlled or extinguished

In Fire PRA, the NSP curves are used to prevent damage beyond the initial zone-of-influence (ZOI) of the fire source. For high-energy-arcing faults (HEAF) events, the initial ZOI for target damage is applied at T=0.

For example, if the fire source is an electrical cabinet, the fire might be in the incipient stage for an extended period. Detection can~~will most likely~~ occur due to equipment damage manifesting through main control board indication changes~~ or a passer by detecting the fire~~. In this~~any~~ case, the timeclock for controlling the fire from expanding beyond the initial ZOI begins when initially logged by operations (i.e. detected).

~~It is not realistic to require heat detector actuation prior to crediting the NSP curves. Using current Fire PRA methods and approaches, fire scenarios often postulate cable tray damage before heat detection, which is not in line with reality or experience.~~

~~The T=0 point for the NSP curves and conservatively growth should be the point of operations logging the event which is inherently part of the data collection process. Although in many cases fires are detected incipient stages well before the growth phase, fire growth is conservatively assumed.~~

Thus, t~~T~~his approach will only be applied to fire scenarios where equipment affected by first target/ignition source affected by the fire would cause direct indication in the control room, aside from ~~beyond~~ any fire detector actuation. Using T=0 for detection time is only applicable for the current t-squared growth curve (characterized as fast growth in future research). If growth curves other than the t-squared growth at T=0 are considered, then using T=0 as the detection time is not appropriate.

Commented [MB4]: The growth profile recommended in NUREG/CR-6850 is considered to be slow relative to other fire protection literature.

Direct indication is valve position lights, annunciators, gauges, etc. For example, a transient fire damages a tray that contains a component cooling pump heat exchanger control cable. The fire causes the throttling valve to change state. This causes a reactor coolant pump seal high temperature alarm in the control room. T=0 can be used as valve changing state has control room indication.

If appropriate, provide proposed rewording of guidance for inclusion in the next Revision:

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The following are proposed revisions to NUREG 2169:

The start ~~i~~of the t-squared growth curves and manual NSP curves is T=0 if the first piece of equipment damaged by the fire would be indicated in the control room. This is equivalent to using the equation with the time to detection, $T_{det,}$ set to zero (T_{det}=0).

Thus, i~~I~~f control room indication for the first piece of equipment damaged by the fire is not available, then the T_{det}, must be calculated using the fire detection models. The time to ~~of~~ detection, T_{det}, for ~~other~~ automatic suppression systems must ~~still~~ be calculated regardless of whether or not control room indication is available for the first piece of equipment damaged by the fire. Setting T_{det}=0 is only applicable to the empirically based manual NSP curves for this particular case~~which already include the detection time in the data~~.

As this approach is essentially a data change, use of this FAQ would be considered an update (not an upgrade).

Commented [MB5]: This is similar to the existing prompt detection credit in NUREG/CR-6850 for in-cabinet detection.

Commented [HJ6]: This project needs to be rolled into the RES/EPRI research project to more fully describe the model, including conditions, caveats, relationship to the plant response model, distinction between interruptible and growth fires and their application, etc.