

NRC INSPECTION MANUAL

APHB

INSPECTION MANUAL CHAPTER 0609 APPENDIX F ATTACHMENT 6

GUIDANCE FOR THE IDENTIFICATION OF TARGETS AND
THEIR IGNITION AND DAMAGE CRITERIA

GUIDANCE FOR THE IDENTIFICATION OF TARGETS AND THEIR IGNITION AND DAMAGE CRITERIA

The identification of nearest ignition and damage targets will most often involve the identification of cables as both ignition and damage targets. Often the same cable will represent both targets. For thermoplastic (TP) and thermoset (TS) cables, the ignition and damage criteria will be assumed to be the same. Heat flux and temperature criteria for damage and/or ignition are identified below:

Table A6.1 - Screening Criteria for the Assessment of the Ignition and Damage Potential of Electrical Cables		
Cable Type	Radiant Heating Criteria	Temperature Criteria
Thermoplastic	6 kW/m ² (0.5 BTU/ft ² s)	205°C (400°F)
Thermoset	11 kW/m ² (1.0 BTU/ft ² s)	330°C (625°F)

TP damage thresholds are assumed for Kerite-FR cable. Kerite FR-II, FR-III, and HT cable are assigned TS damage thresholds. In addition, since all Kerite cable varieties are qualified, TS ignition thresholds are assigned to these types of cables.

Additional rules for application in the target identification task are:

Cables in conduit will be considered potential damage targets, but not ignition targets. Cables in conduit will not contribute to fire growth and spread. The conduit will be given no credit for delaying the onset of thermal damage.

Cables coated by a fire-retardant coating will be considered as both thermal damage and fire spread targets. For the purposes of the Phase 2 analysis, no credit will be given to the coating for delaying or preventing the onset of damage and/or ignition.

In identifying damage targets, do not include components directly within or associated with the fire ignition source itself. The fire ignition source will inherently be assumed to be damaged given any fire involving itself as the source so further evaluation of the components as damage targets is unnecessary.

Example: For an electrical panel fire, all equipment and components within the panel will be assumed to fail. Per the counting guidance, a panel will be defined as a distinct vertical section in this context.

Example: Given a self-ignited cable fire, all cables in the initiating raceway will be assumed to fail immediately on fire ignition (time zero).

Cables in Trays with Solid Bottoms

Bottom tray covers do not affect the ignition and damage thresholds of cables in the tray, but can be assumed to delay ignition and damage to TS and TP cables by 20 min and 4 min, respectively.

Mixed Cable Insulation/Jacket Type Configurations

There are cables that are formulated with a TS insulation and a TP jacket, and potentially, *vice-versa*. The parts of a cable are shown in Figure A6.1 below. Armored cables may have a bare metal armor exposed, or may have either a TS or TP covering over the metallic armor. For such cases, some special consideration is needed.

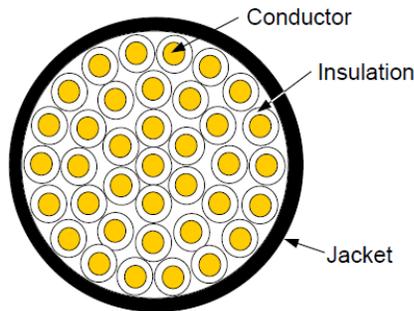


Figure A6.1: Illustration of Parts of a Cable

In the SDP process, the analysis does not distinguish between ignition and damage behaviors, except for Kerite cable as explained above. Ignition of a TS or TP cable is taken as an indication of imminent failure. In the assessment of whether to treat a cable as TS or TP, the weakest link will dominate. Therefore, if any part of the cable is TP, the entire cable is treated as TP. For example, a cable with a TS insulation and a TP jacket will be treated using the failure criteria of a TP cable to reflect the reduced resistance to ignition of the jacket material. A cable with a TP insulation and a TS jacket will also be treated as a TP due to the likelihood of melting of the insulation material.

The following table provides a decision matrix for the selection of which failure/ignition property set to apply to a given cable.

Table A6.2 - Cable Properties Selection Decision Matrix		
Cable Construction / Configuration		Ignition/Damage Parameter Set to be Used
Insulation Type	Jacket/Covering Type	
TS	TS	TS
TS	TP	TP
TP	TS	TP
TP	TP	TP
Armored – TS	TS, or No Cover	TS
Armored – TS	TP Cover	TP
Armored – TP	TS, TP, or No Cover	TP

Targets other than electrical cables may also be vulnerable to fire damage. Large, strictly mechanical components (e.g., pipes, check valves, structural supports, tanks, etc.) are not considered vulnerable to fire damage for the purposes of SDP Phase 2 analyses. Should an

issue related to potential fire-induced failures of such elements (e.g., fire-induced collapse of a structure or structural supports) be deemed relevant, the analyst should consult NRC HQ staff for guidance.

For the majority of plant components, electrical cables servicing the equipment (power, control, and/or instrument cables) will be the most vulnerable aspect of the component. Hence, failure of the cables will represent the predominant failure mode for the component. In these cases, the failure criteria for the component will be based on failure of the cables servicing the component as already described. This approach applies to any electrical or electro-mechanical component with a thermal mass that exceeds that of a short segment of cable. Such components would include motors, pumps, fans, most valves, transformers, electro-mechanical relays, switchgear, breakers, mechanical switches, hand switches on a control board, etc.

The only case where damage criteria other than those applied to cables should be considered is solid state devices and printed circuit based components (e.g., circuit cards, electronic relays, computers, electronic signal conditioning equipment, digital instrumentation and control circuits, electronic displays, etc.). Electronic devices are generally vulnerable to failure at temperatures much lower than those that may cause cable failures. If a scenario should arise involving exposed solid state control components as a potentially risk-important thermal damage target, the failure criteria to be applied in screening are 3 kW/m^2 ($0.25 \text{ BTU/ft}^2\text{s}$) and 65°C (150°F), unless information is available to indicate the components are qualified for continuous operation at a higher temperature.

Sensitive electronic components that are mounted inside a control panel (cabinet) such that the cabinet walls, top, front and back doors shield the component from the radiant energy of an exposure fire may be considered qualified up to the heat flux damage threshold for thermoset cables, provided that:

- The component is not mounted on the surface of the cabinet (front or back wall/door) where it would be directly exposed to the convective and/or radiant energy of an exposure fire.
- The presence of louvers or other typical ventilation means does not invalidate the guidance provided for here.

ATTACHMENT 1

Revision History for IMC 0609, Appendix F Attachment 6

Commitment Tracking Number	Accession Number Issue Date Change Notice	Description of Change	Description of Training Required and Completion Date	Comment Resolution and Closed Feedback Form Accession Number (Pre-Decisional, Non-Public)
	05/28/2004 CN 04-016	IMC 0609, App F, Att 6 "Guidance for the Identification of Targets and Their Ignition and Damage Criteria," is added to provide for the development of specific fire growth and damage scenarios for fire ignition sources that were not screened out to this point by the process. This helps to evaluate the independence of the designated safe shutdown path.	None	N/A
	02/28/2005 CN 05-007	IMC 0609, App F, Att 6 "Guidance for the Identification of Targets and Their Ignition and Damage Criteria," is revised to provide additional guidance for solid state components.		
	ML17089A423 DRAFT CN 17-XXX	Revised to reflect changes to the Phase 2 process. CA Note sent 7/18/17 for information only, ML17191A681.	November 2017	ML17093A185