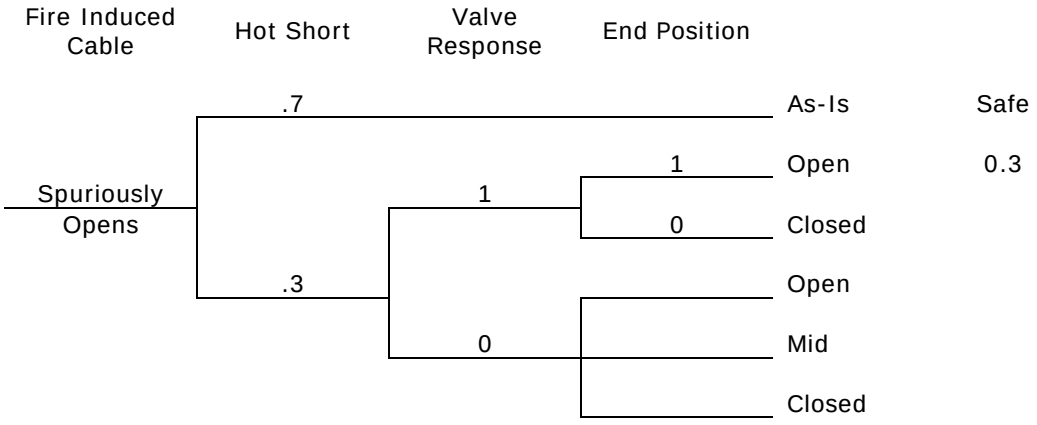
The treatment of fire induced spurious valve operation requires further clarification and discussion. The issue is related to the evolving conditional probability of hot short induced spurious operations. The issue is also related to PRA Standard Supporting Requirement SY-A12. This SR requires that no credit be taken for beneficial failures unless not doing so causes the results to be distorted. For this particular technical issue such a situation can occur.

A fire induced failure of a control cable for an MOV results in three possible failure modes for the valve.

- Functional failure – valve fails as-is
- Spurious operation – valve stokes into the full open or full closed position
- Spurious operation – valve strokes continuously and randomly fails in some intermediate position as the valve cycles from open to close to open

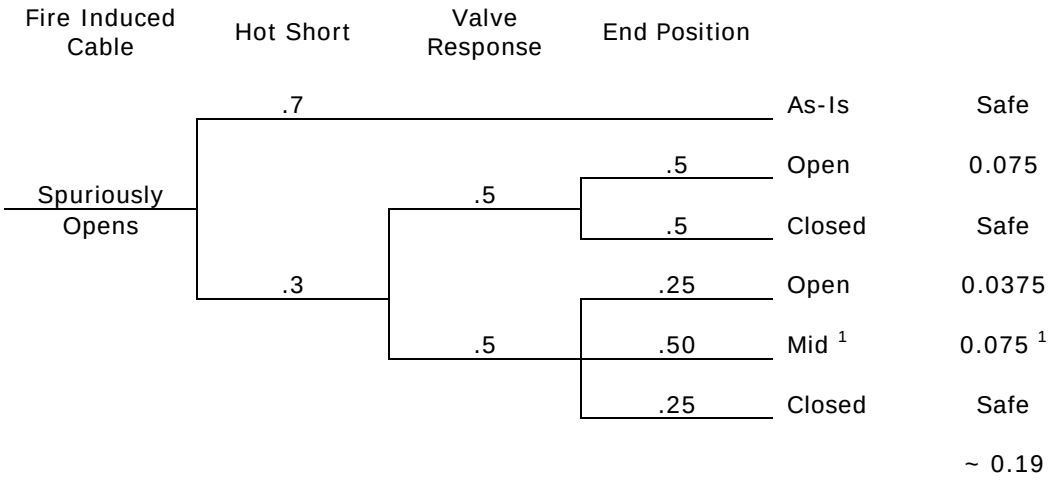
This can be represented in an event tree. The typical treatment for a valve depends on whether the valve has an active function (needs to stroke from closed to open or open to closed, or needs to remain fully functional) or is a spurious actuation concern only. As an example, for a valve that is normally closed and has a desired state of closed (spurious opening is the only concern), the event would be as follows.



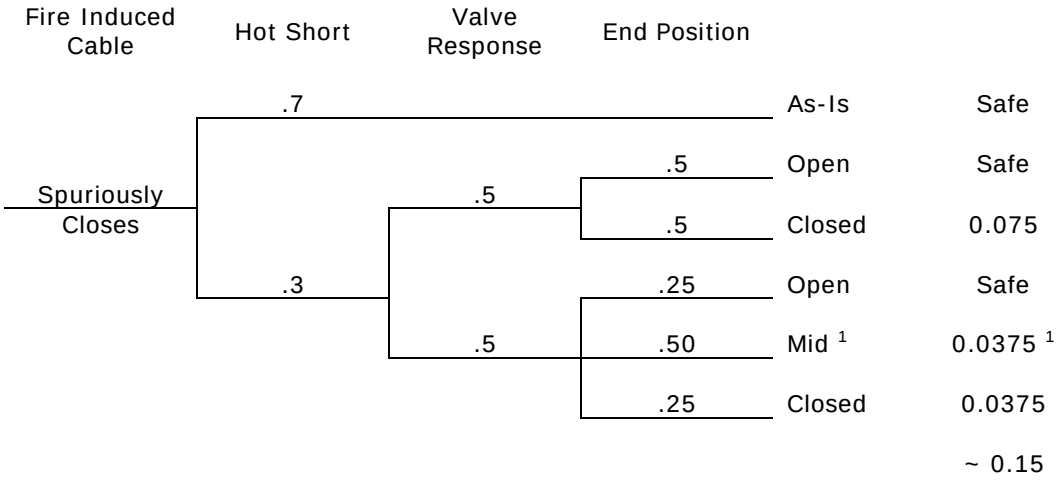
The ‘valve response’ node is intended to address whether the valve spuriously strokes once in a single direction or if the circuit failure causes the valve to stoke continuously (open-close-open-etc) until it thermally fails or the spurious single ceases to exist.

As shown, the typical treatment would conservatively bias the treatment of the possible responses of the valve to a hot short such that only the undesired position is assumed. From a practical and realistic standpoint, this is a conservative and bounding treatment as the hot short could have just as easily resulted in a spurious

stroke in the desired closed direction. As an example, the more detailed treatment could be as follows.



Note 1: For a desired position of close, it is assumed to any not-closed valve position is unacceptable. For a desired position of open, it is assumed that half of the mid position failure states are 'safe'.

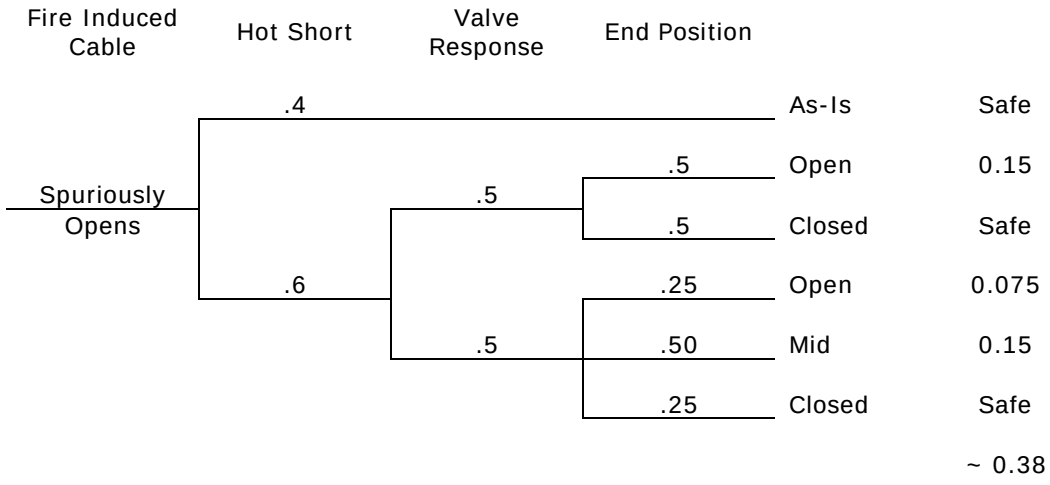


Note 1: For a desired position of close, it is assumed to any not-closed valve position is unacceptable. For a desired position of open, it is assumed that half of the mid position failure states are 'safe'.

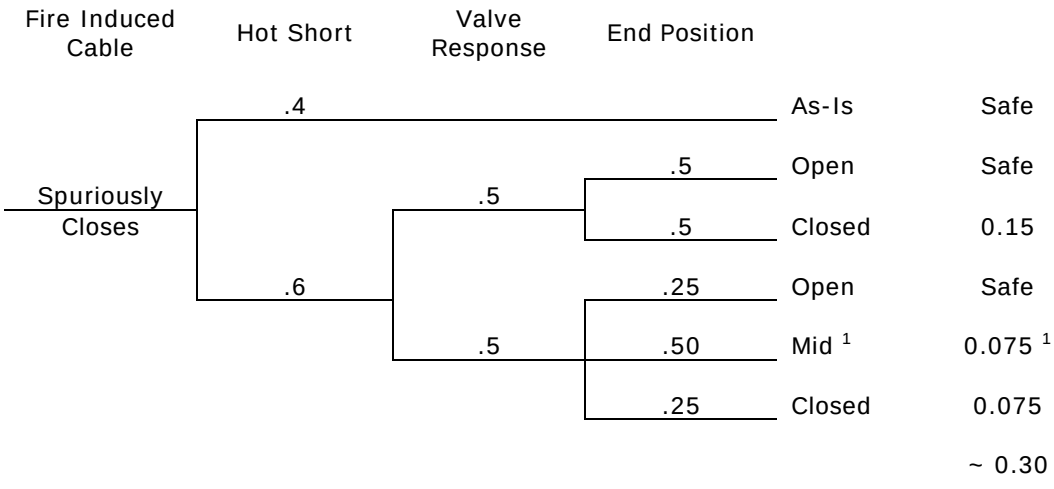
The example above suggests that a conservative bias likely already is imbedded in the current industry treatment.

The recent set of the NRC questions related to NFPA 805 indicates a change in the prior industry guidance for the application of hot short induced spurious actuations for MOV circuits. The questions suggest that the previous guidance in NUREG/CR-

6850 is no longer appropriate and that an updated value of 0.60 should be used. When this change is applied together with the more detailed treatment shown above, the resultant change in the spurious valve stroke probability for a valve with a desired position of closed (spuriously opens) becomes ~ 0.38.



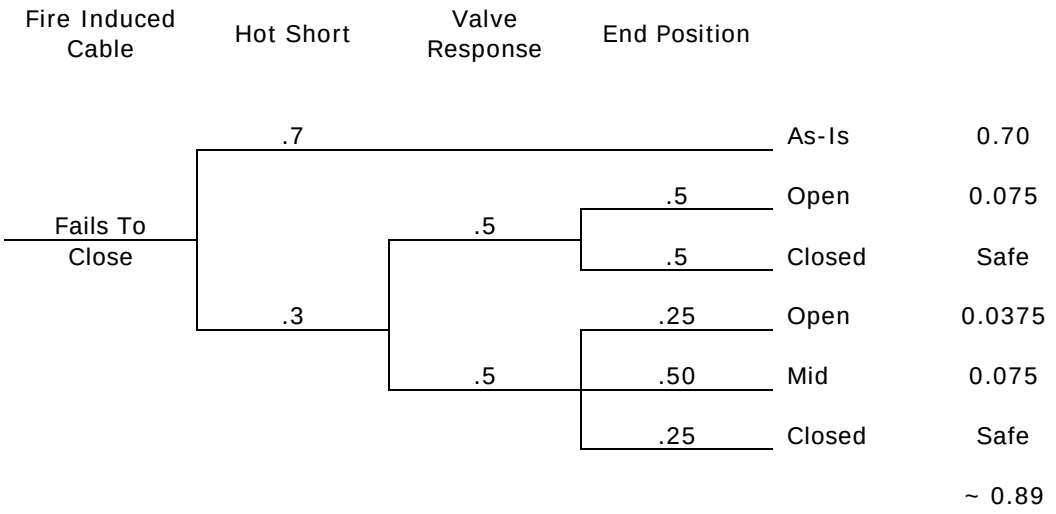
If this same treatment is applied to a valve whose desired position is open (spuriously closes), a numerical change to the 'mid' position sequence should be made. This is because for most application almost any non-closed position would allow substantial flow – but may not necessarily be sufficient flow. This is treated in the event tree by assuming that half of the mid-position failure states would still be 'safe'. This would reduce the spurious operation probability from ~ 0.38 to 0.30.

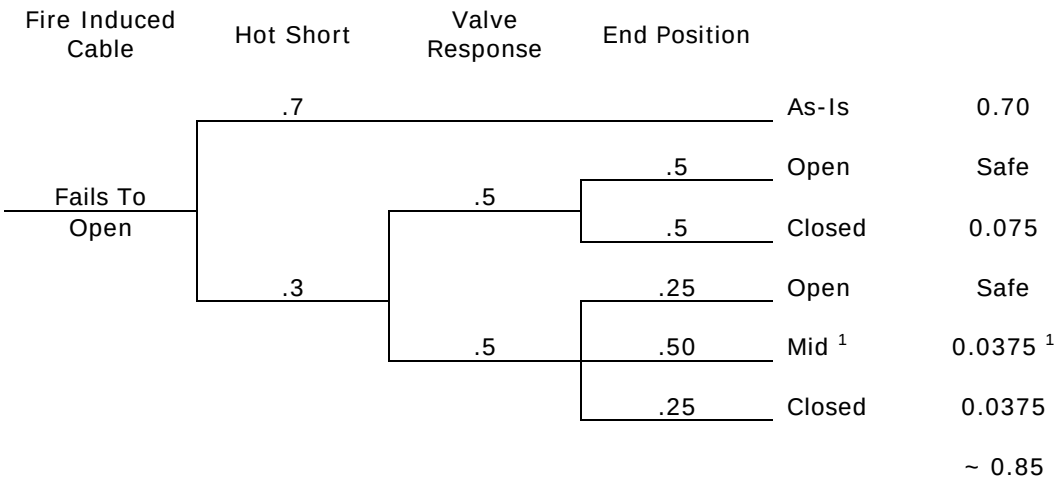


Note 1: For a desired position of close, it is assumed to any not-closed valve position is unacceptable. For a desired position of open, it is assumed

that half of the mid position failure states are ‘safe’.

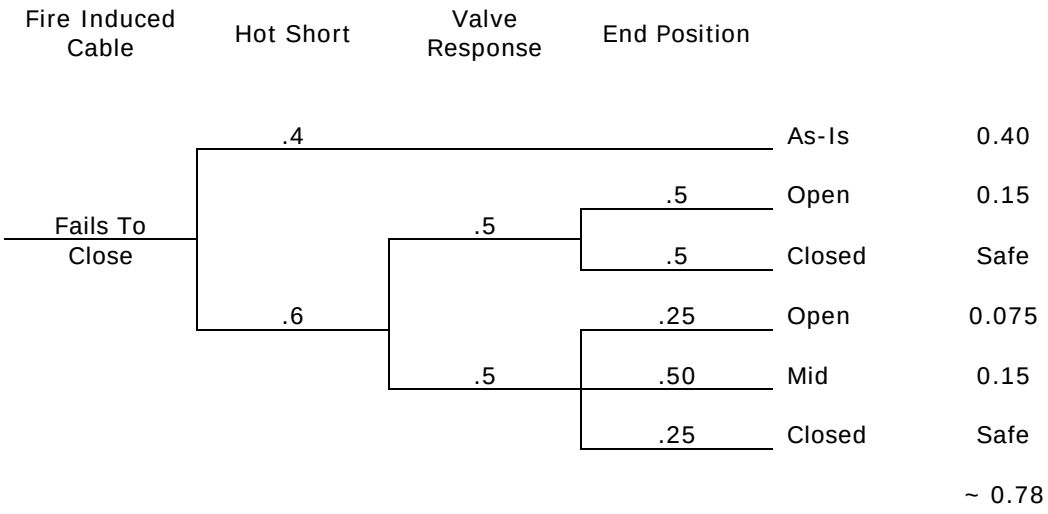
The implication of this more detailed treatment highlights an opportunity to refine the treatment for active valves. For active valves, the occurrence of a spurious signal could generate a spurious signal to drive the valve in the desired direction or it could drive the valve in the undesired position. Using the prior values for spurious events from NUREG/CR-6850, that potential beneficial failure was not credited and the failure was taken as 1.0 (logical TRUE). However, the detailed treatment highlights the conservatism.

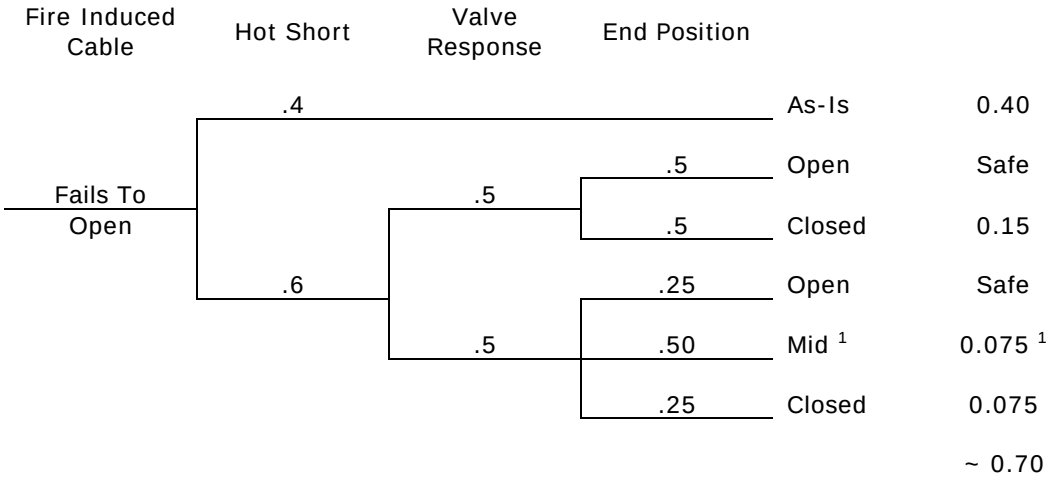




Note 1: Half of the mid position failure states are assumed to be ‘safe’ for a valve with a desired position of open.

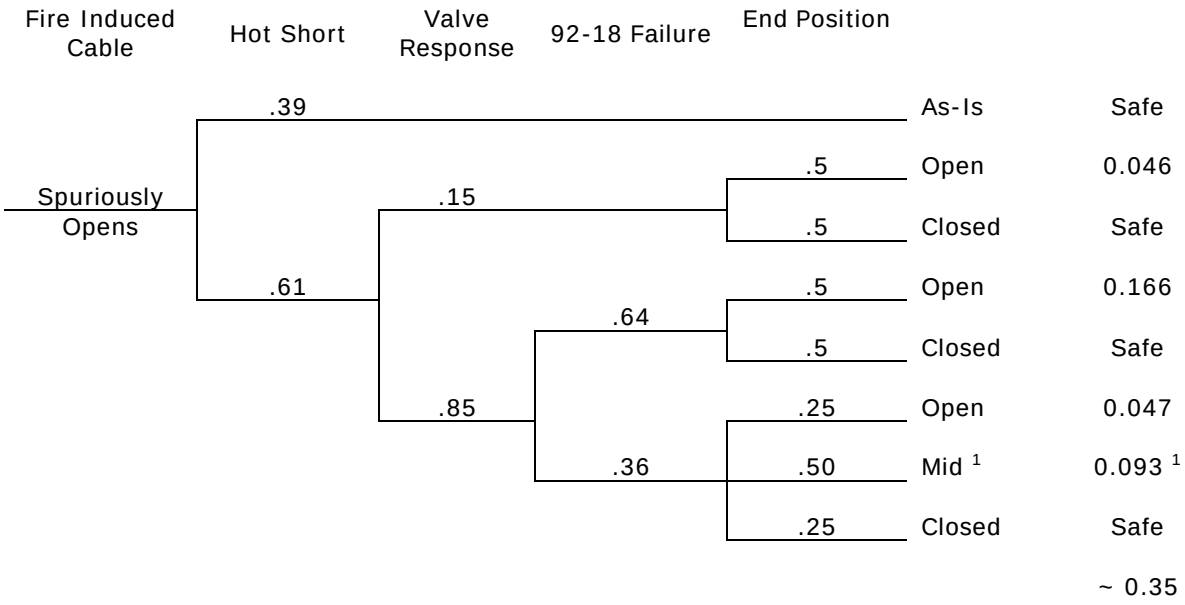
However, if the spurious event probability were changed from 0.30 to 0.60 as indicated in the NRC question:



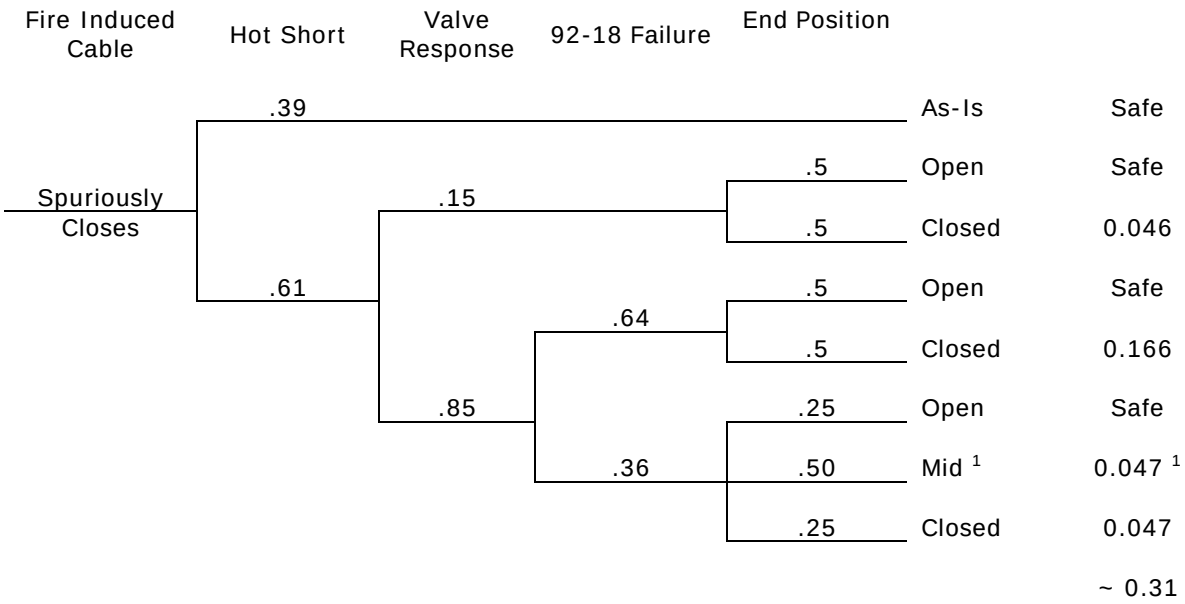


Note 1: Half of the mid position failure states are assumed to be 'safe' for a valve with a desired position of open.

The framework represented in the event trees above form the underlying basis for the evaluation of the circuit failures test data when applied to a control circuit for an MOV.

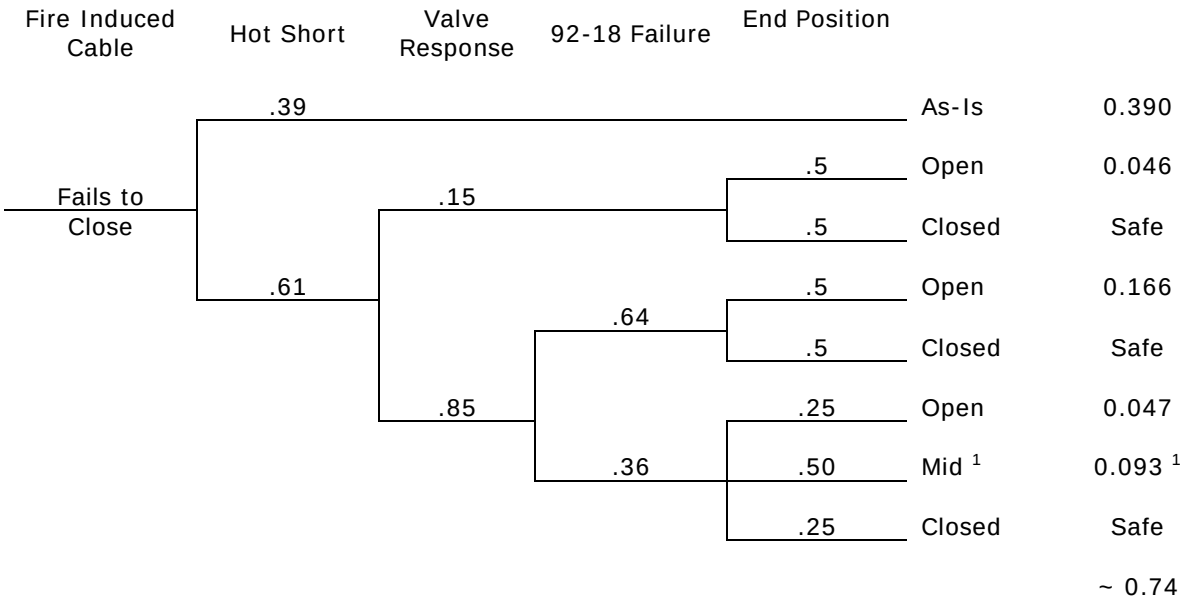


Note 1: For a desired position of close, it is assumed to any not-closed valve position is unacceptable. For a desired position of open, it is assumed that half of the mid position failure states are 'safe'.

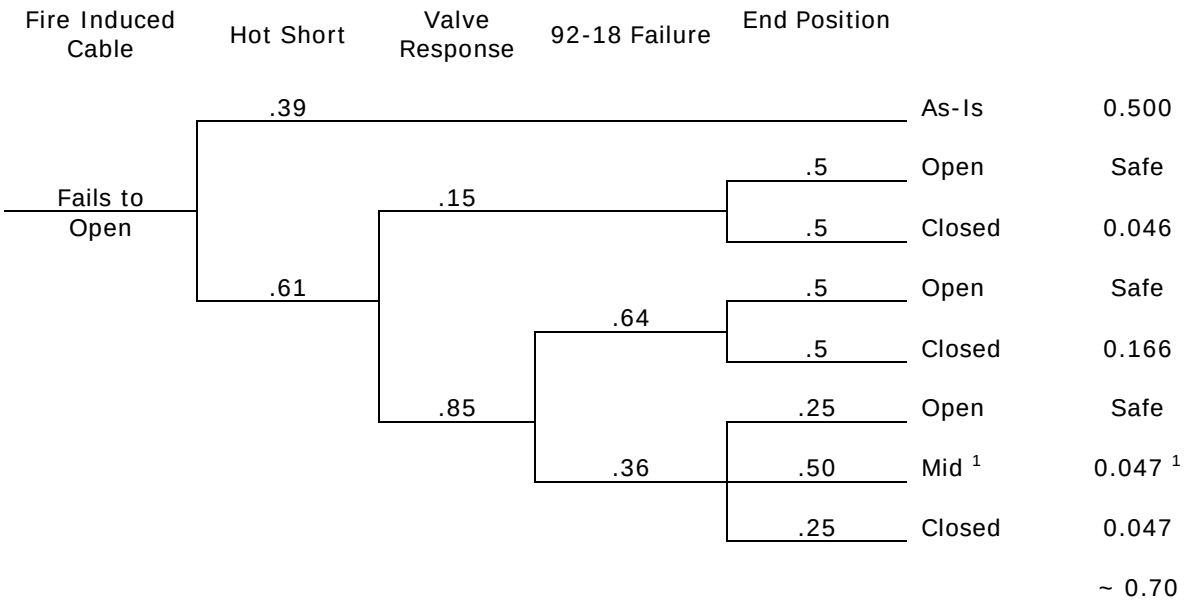


Note 1: For a desired position of close, it is assumed to any not-closed valve position is unacceptable. For a desired position of open, it is assumed that half of the mid position failure states are 'safe'.

The treatment above is repeated for the active valve function below.



Note 1: For a desired position of close, it is assumed to any not-closed valve position is unacceptable. For a desired position of open, it is assumed that half of the mid position failure states are 'safe'.



Note 1: For a desired position of close, it is assumed to any not-closed valve position is unacceptable. For a desired position of open, it is assumed that half of the mid position failure states are 'safe'.