DRAFT

Significance Determination of Inspection Findings that Cause Initiating Event Occurrences

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Purpose (End State)

Achieve a common understanding of the ROP and SDP historical and technical bases and identify the appropriate guidance clarifications to accurately reflect that common understanding.

- Appropriate guidance - Inspection Manual Chapter (IMC) 0609, 0308, and RASP Handbook, Volume 1.

Objectives

- Review areas of alignment reached in previous public meetings
- Discuss areas that need alignment
- Resolve areas that need alignment
- Develop plan to revise applicable guidance documents to communicate alignment

Alignment

- In accordance with ROP guidance documents, inspection findings in the Initiating Events cornerstone are characterized for safety significance using the appropriate SDP.

- The difference in the CCDP of a finding and the nominal CDP (i.e., CCDP – CDP) is extremely numerically approximate to a ΔCDF calculation.

Alignment

- From Section 8 of IMC 0308, Att 3, the CCDP description below refers to a reactive inspection type calculation (e.g., MD 8.3):

Represents the probability that a core would have gone to a damaged state given that (i.e., "conditioned on") a specific initiating event occurred AND the actual plant equipment and operator responses are accounted for. This "event" use of CCDP represents the remaining probabilistic "margin" (related to defense-in-depth) to core damage at a precise moment in time, that of the event itself.

Alignment

- For findings that are the proximate cause of an initiating event occurrence, the nominal initiating event frequency should be increased to a new, higher value.

Need Alignment - #1

- For findings that are the proximate cause of an initiating event occurrence, the nominal initiating event frequency should be increased to:

  - Option A: New, higher value, but not 1.0 (or 1.0/year)
  - Option B: New, higher value of 1.0 (or 1.0/year)

Need Alignment - #2

- The finding must ALWAYS cause the initiating event occurrence
  - Always Cause VS. Proximate Cause

Need Alignment - #3

- ROP founding documentation (e.g., SECYs) may suggest that actual initiating events should be captured by either Performance Indicators (PIs) or reactive inspections (e.g., special or augmented inspections); not the SDP.

Historical Background

- Starts with SECY 99-007 and ends with the initial issue IMC 0308 and its associated Attachments

  - SECY 99-007
  - SECY 99-007A
  - SECY 00-0049
  - IMC 0308 (and IMC 0308, Attachment 3)

SECY 99-007

- Appendix A – Initiating Events Cornerstone

  – <u>Key Safety Attributes</u>

    - Human Performance → Human Error →**PI**
    - Procedure Quality → Procedure Adequacy → **PI**
    - Equipment Performance → Barrier Integrity (SGTR, ISLOCA, S/M/LLOCA) → **RII**
    - Configuration Control → Operating Equipment Lineup → **RII**

SECY 99-007, App A

Human Performance → Human Error

"Human errors that cause initiating events during both shutdown and power operations will be captured by PIs"

Procedure Quality → Procedure Adequacy

"Procedural inadequacies that cause initiating events will be monitored by PIs"

SECY 99-007, App A

Equipment Performance → Barrier Integrity (SGTR, ISLOCA, S/M/LLOCA)

"…judged to be unsuitable for monitoring by an indicator due to their low frequency and possible high risk"

Configuration Control → Operating Equipment Lineup

"Loss of configuration control of risk-significant safety equipment (primarily support systems) can initiate a reactor transient and simultaneously compromise mitigation capability (common-cause initiators)"

SECY 99-007, App A

Scrams vs. Risk-significant Scrams

"Risk-Significant Scrams = Scrams with LOCA, SGTR, LOOP, Total Loss of Heat Sink, Total Loss of Feedwater; or Scrams with a failure of one or more trains of the SSPI systems"

→ Previous guidance in 99-007, App A mentioned that SGTR, LOCA, ISLOCA are handled under RII

SECY 99-007, App H

- Supporting Analysis for Performance Thresholds for the IE and MS Cornerstone PIs

  Unplanned Scrams

  "…it was considered more meaningful to perform sensitivity studies by increasing the frequencies of those initiating events that are expected to occur. Therefore the frequencies of those rare, but potentially risk significant initiating events such as LOCAs, SGTR, LOSP, and failure of a support system were not increased when performing the sensitivity studies. If any of these potentially risk significant scrams were to occur, it is highly likely that a reactive inspection would be initiated."

SECY 99-007, App H

- Supporting Analysis for Performance Thresholds for the IE and MS Cornerstone PIs

  Risk-Significant Scrams

  "The sensitivity studies were preformed by increasing the frequency of a selected number of the initiating events used in the PRA models, namely those representing a loss of the power conversion system. The LOOP and loss of support systems were not included since they have a disproportionate impact on CDF and are relatively more rare, and furthermore would in any case initiate a more significant regulatory response."

SECY 99-007

- Issued prior to the development of the SDP (the initial SDP guidance was described in SECY 99-007A)

- The ROP guidance progressively changed with the addition of SECY 99-007A and the lessons learned from the ROP pilot SECY 00-0049 (e.g., ~~A~~ shutdown PI was never developed)

SECY 99-007A

Attachment 2 “Inspection Finding Risk Characterization Process”

“Entry Conditions – An actual initiating event will either be captured by a PI (e.g., reactor trip) or, if it is complicated by equipment malfunction or operator error, will be assessed by NRC risk analysts outside the process described herein.”

→ meaning…outside of the SDP (e.g., MD 8.3, ASP)

IP 93812 “Special Inspection (SI)”

Issued Date: 4/3/2000

-Section 02 – Inspection Requirements

-Section 02.02 - SI Members

-Section 02.02b – “Conduct a timely, thorough, and systematic inspection of significant operational events at facilities licensed by the NRC, under the supervision of the SI leader. In doing so, members shall:

-Section 02.02.b.4 – “Utilize IMC 0609, “Significance Determination Process”, to evaluate the risk significance of inspection findings”

SECY 99-007A

Step 2.1 – Define the Applicable Scenarios

"Identifying the scenarios begins with identifying the equipment and the assumed or actual impact of the finding, and takes into consideration the role the equipment plays in either the continued operation of the plant or the response to the initiating event. This step leads to an identification of the role of the finding in either contributing to an initiating event or affecting a mitigating system, or both".

SECY 99-007A

Step 2.2 – Estimation of the Likelihood of Scenario Initiating Events and Conditions

"If the finding relates to the increased likelihood of a specific initiating event, the likelihood of that initiating event is increased according to the significance of the degradation"

→ Example: loose parts found inside a SG. Increase the SGTR frequency to the next level.

SECY 99-007A

Attachment 3 “Feasibility Review of the Inspection Finding Risk Characterization and Reactor Oversight Process”

Results: “…The actions recommended by the new process were made on the basis of risk insights from hardware problems that were experienced (**what** occurred) and not insights from programmatic or repetitive items (**why** they occurred).“

“It is fully expected that refinement of the inspection and assessment processes will continue during the pilot”

SECY 00-0049

"Results of the Revised ROP Pilot Program"

Attachment 6 – SDP

- Addresses the reasons to use the ΔCDF metric and not the CCDP (e.g., MD 8.3) metric for the SDP.
- "…it is expected that as ongoing experience is gained, further refinements will be necessary. The SDPs currently provide an acceptable starting point to begin this process of continuing improvement".

SECY 00-0049

Attachment 7 – Feasibility Review

BWR Example – Loss of Condenser Vacuum

Using the risk-informed notebook, the IEF for a Transient with loss of PCS, the nominal 10E-1 would increase to 10E-0 for an exposure period of 3-30 days or 10E+1 for >30 days.

→ Meaning that the IEF would be increased from 0.1/year to either 1.0/year or 10/year.

IMC 0308

06.06 - Risk-Informed Scale

"The philosophy behind the establishment of the thresholds on PIs and inspection findings was essentially to *assume that an increase in PI values or conditions indicated by the finding, would*, *if their root causes were uncorrected*, be equivalent to accepting a de facto increase in the CDF and LERF metrics."

"This is clearer for the PIs than it is for the inspection findings, which *may relate to a time limited undesired condition*. For such cases, the model used is that the event is indicative of an underlying performance issue that, *if uncorrected*, **would be expected to result in similar occurrences with the same frequency**."

Need Alignment - #2

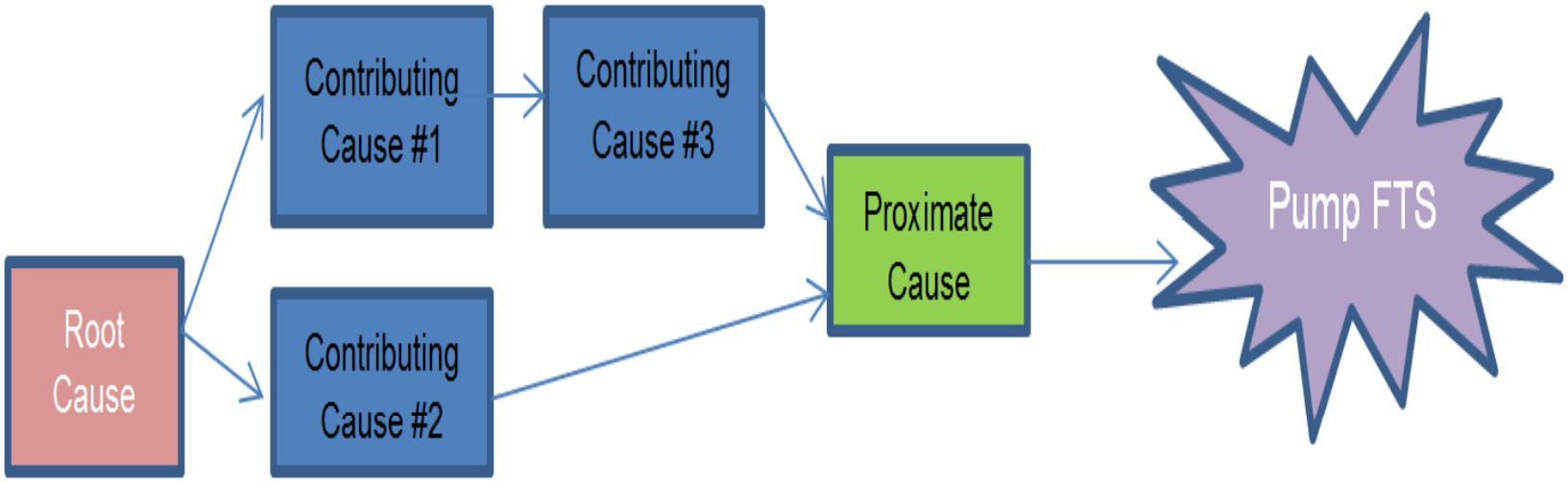
- The finding must ALWAYS cause the initiating event occurrence
  - Always Cause VS. Proximate Cause

Proximate Cause

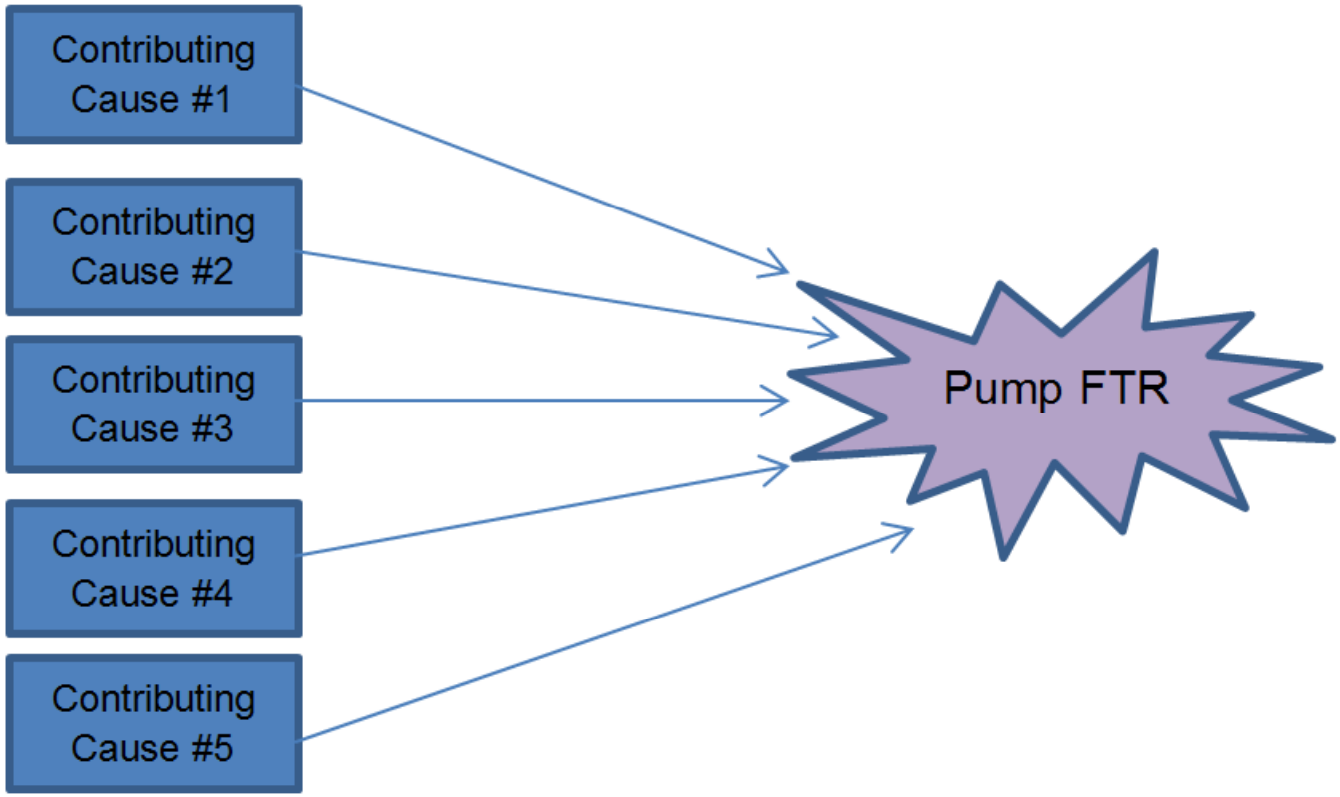
From IMC 0308, Attachment 3, Section 5

"…discernable risk increases come from degraded plant conditions, both material and procedure/process in nature and the performance deficiency should most often be identified as the proximate cause of this degradation. In other words, the performance deficiency is not the degraded condition itself, it is the proximate cause of the degraded condition. This determination of cause does not need to be based on a rigorous root-cause evaluation (which might require a licensee months to complete), but rather on a reasonable assessment and judgment of the staff."

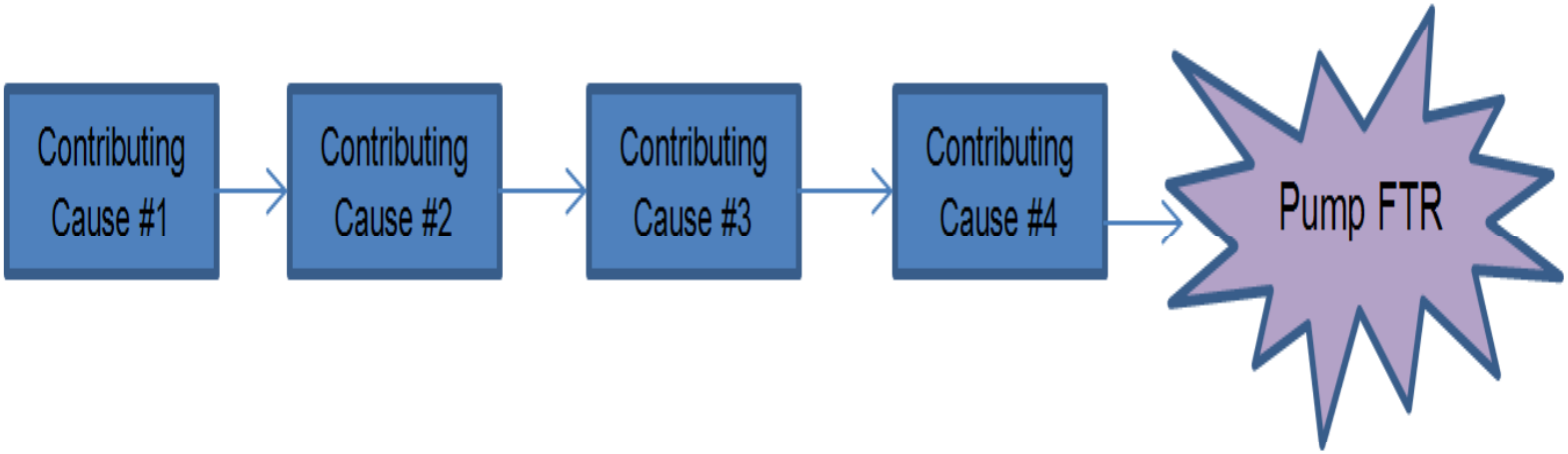
Proximate Cause



Proximate Cause



Proximate Cause



Proximate Cause

Conclusions:

The FINDING does not *always have to cause* the degraded condition or initiating event (e.g., 100% of the cause)

The FINDING needs to be *the proximate cause* of the degraded condition or initiating event (e.g., >51% of the cause)

Need Alignment - #1

- For findings that are the proximate cause of an initiating event occurrence, the nominal initiating event frequency should be increased to:

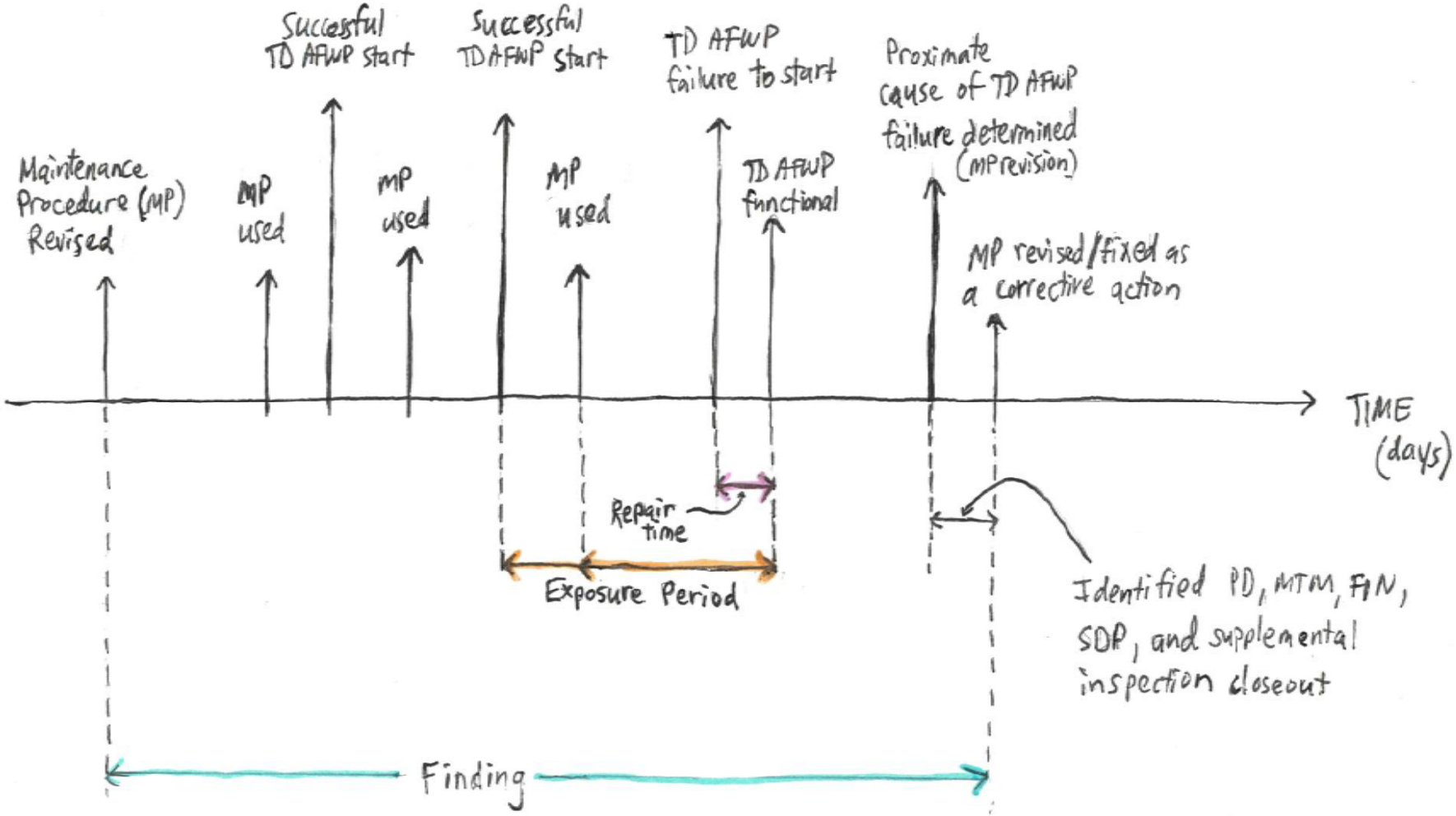
  - Option A: New, higher value, but not 1.0 (or 1.0/year)
  - Option B: New, higher value of 1.0 (or 1.0/year)

Initiating Events Vs Mitigating Systems

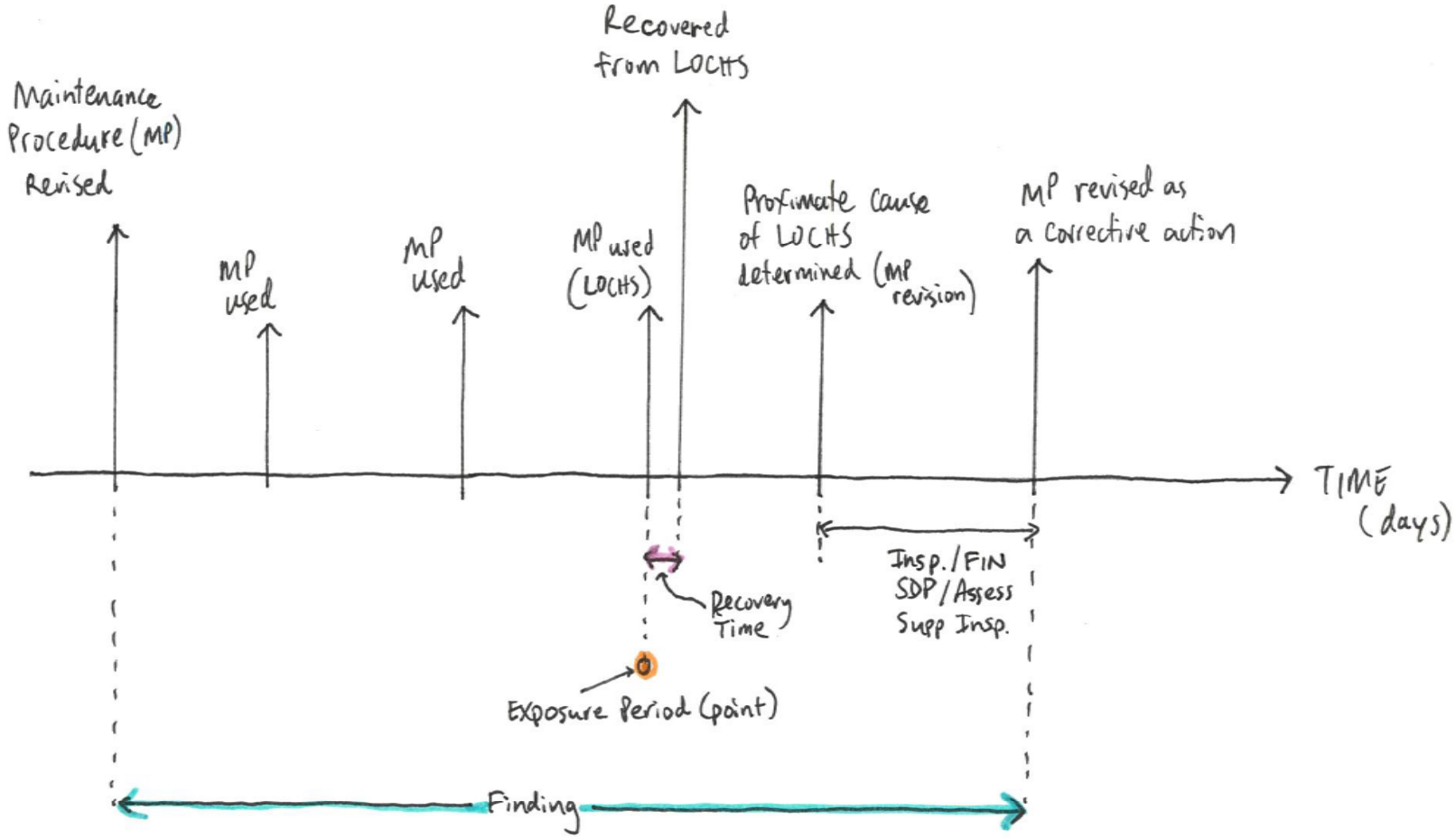
Initiating Events – Given that an initiating event occurred, what is the probability that the necessary mitigating systems will function successfully during the mission time to prevent core damage

Mitigating Systems – Given that a particular mitigating system in non-functional for a specific period of time, what is the probability an initiating event will occur during the specific time period that challenges the non-functional mitigating system

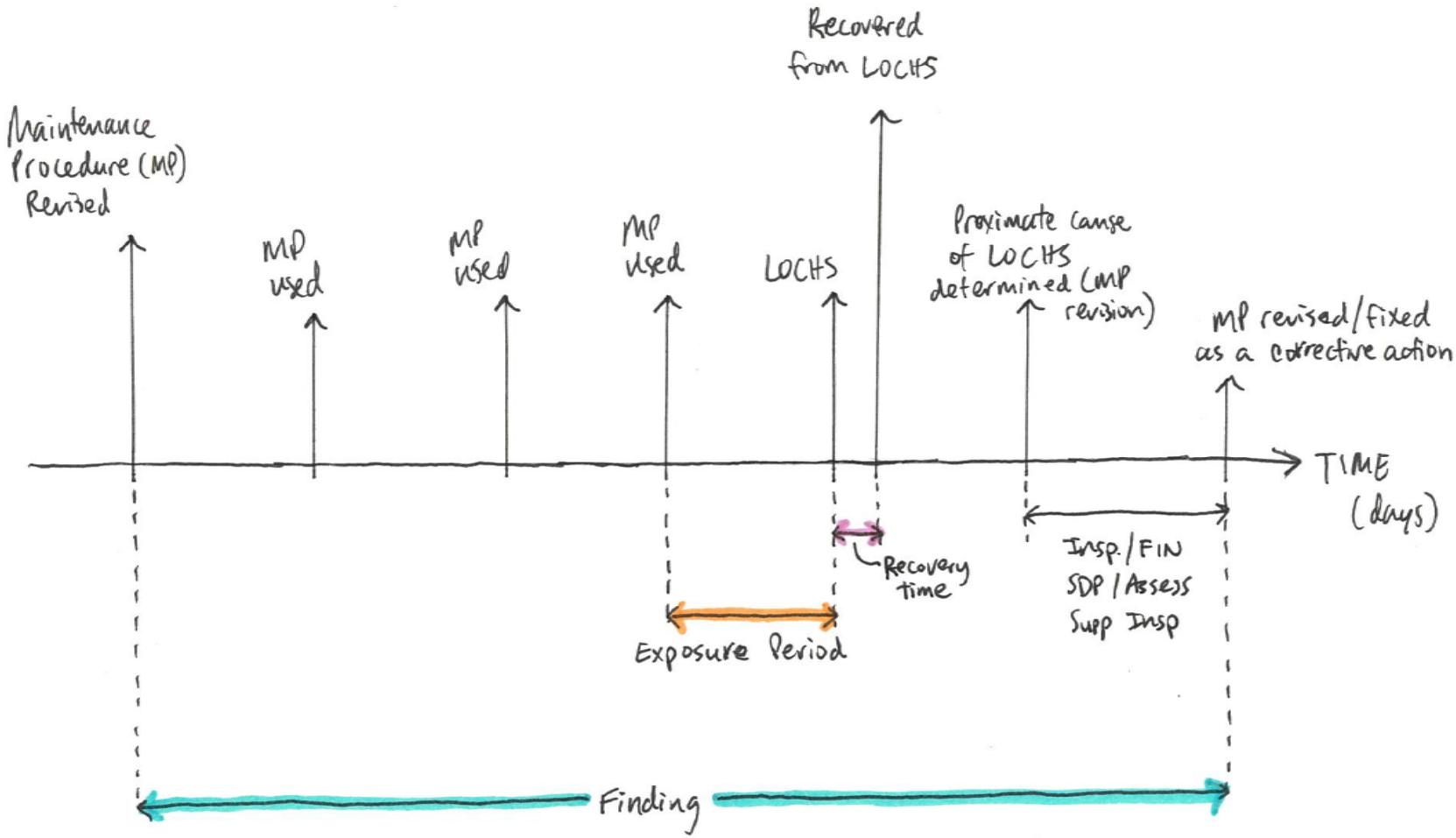
Mitigating Systems Example



Initiating Events Example #1



Initiating Events Example #2



Initiating Events Vs. Mitigating Systems

Conclusions:

- The “exposure time” concept is applied to the duration of the degraded condition, not the duration of the “finding”
- As such, the “exposure time” concept works for mitigating systems but not for initiating events; therefore the IE occurrence should be treated like a MS failure (i.e., 1.0 or 1.0/year)

Back-up Slides…

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SPAR Model Calculations

- Used at least 1 unit from every operating plant
- Ran LOCHS and LOMFW initiating events
- Ran RCIC and AFW failure to run conditions
  - RCIC (6 months) and AFW (2 months)
- Ran various TRANS initiating events
- Ran PC LOOP initiating event
- Ran EDG failure to run condition (1 year)
- Grouped units by BWR, PWR, and Total
- Compared results to unit baseline CDF, 1E-06 threshold, and similar IEs and MS (e.g., PC LOOP versus EDG failure)

SPAR Model Calculations

ΔCCDP Calculation

- For initiating events (IEs) only
- Subtracts the nominal IEF from 1.0/year
- All other IEs are assumed not to occur

ICCDP Calculation

- For IEs and MS
- IEs use 1.0/year and MS use “True”
- All other IEs and MS are nominal

LOCHS and LOMFW (mean)

	ΔCCDP **LOMFW** (Mean)	ΔCCDP **LOCHS** (Mean)
BWR	4.27E-06	5.54E-06
PWR	2.74E-06	3.43E-06
Total	3.31E-06	4.21E-06

LOCHS and LOMFW
% Greater than Baseline CDF

	ΔCCDP LOMFW	ΔCCDP LOCHS
BWR	39.13%	47.83%
PWR	10.26%	12.82%
Total	20.97%	25.81%

LOCHS and LOMFW
% Greater than 1E-06 CDF

	ΔCCDP LOMFW	ΔCCDP LOCHS
BWR	82.61%	73.91%
PWR	51.28%	61.54%
Total	62.90%	66.13%

TRANSIENT (mean)

	ΔCCDP Transient	CCDP Transient	ICCDP (3/year)	ΔCCDP x3	CCDP x3
BWR	2.02E-07	8.59E-07	1.94E-06	6.06E-07	2.58E-06
PWR	3.40E-07	1.11E-06	2.60E-06	1.02E-06	3.34E-06
Total	2.89E-07	1.02E-06	2.36E-06	8.66E-07	3.06E-06

TRANSIENT
% Greater than Baseline CDF

	ΔCCDP Transient	CCDP Transient	ICCDP (3/year)	ΔCCDP x3	CCDP x3
BWR	0.00%	4.35%	8.70%	4.35%	8.70%
PWR	0.00%	0.00%	2.56%	0.00%	15.38%
Total	0.00%	1.61%	4.84%	1.61%	12.90%

TRANSIENT
% Greater than 1E-06 CDF

	ΔCCDP Transient	CCDP Transient	ICCDP (3/year)	ΔCCDP x3	CCDP x3
BWR	4.35%	17.39%	26.09%	13.04%	30.43%
PWR	5.13%	41.03%	64.10%	41.03%	76.92%
Total	4.84%	32.26%	50.00%	30.65%	59.68%

PC LOOP and EDG FTR (mean)

	ΔCCDP PC LOOP	ICCDP EDG FTR
BWR	2.71E-05	2.08E-05
PWR	6.68E-05	6.66E-05
Total	5.21E-05	4.96E-05

PC LOOP and EDG FTR
% Greater than Baseline CDF

	ΔCCDP PC LOOP	ICCDP EDG FTR
BWR	100.00%	65.22%
PWR	84.62%	84.62%
Total	90.32%	77.42%

PC LOOP and EDG FTR
% Greater than 1E-06 CDF

	ΔCCDP PC LOOP	ICCDP EDG FTR
BWR	100.00%	82.61%
PWR	100.00%	97.44%
Total	100.00%	91.94%