



Critical Systems Labs

Strategic Insight for Safety

Key Performance Indicators (KPI) Building a “Live” Assurance Case

May 3, 2023

Key Performance Indicator

- KPI: a critical (key) quantifiable measure used to evaluate the success of an organization, employee, etc. in meeting objectives”.
- Safety Performance Indicators (SPIs) are a subset of KPIs that focus on safety.
- KPIs can also support the safety case and ensure that it remains “fit for purpose” and “live”.

Leading VS Lagging Indicators

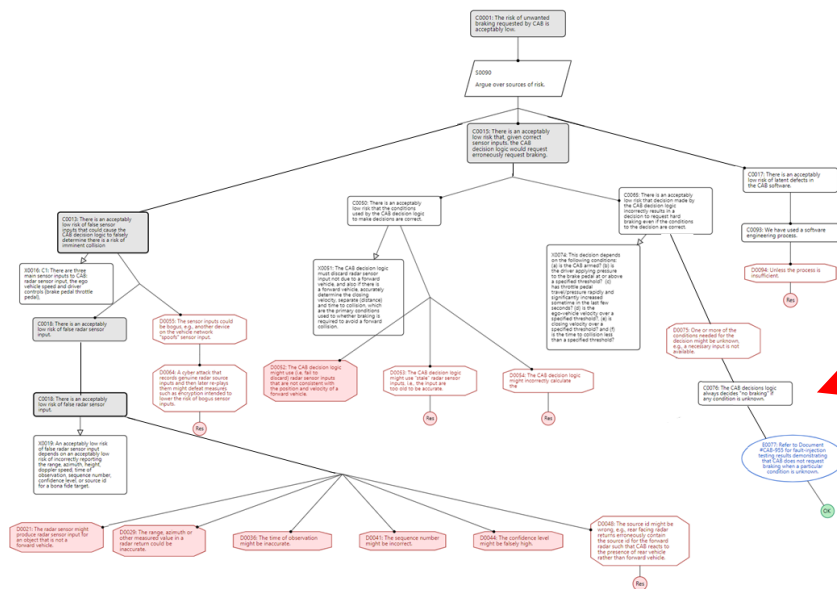
- Leading indicators measure the occurrence of events that, while not themselves harmful (e.g., beam dump), are expected to precede or indicate the potential for more harmful events.
- A lagging indicator is a direct measure of performance as it tracks the occurrence rate of hazards and/or loss events, such as crashes, injuries and fatalities.

“Live” Assurance Case

- Design
 - Identification of necessary monitoring capabilities
 - Identification of reasons for decisions taken based on data
- Implementation: change management
 - Measure of improvement or regression
 - Used to validate the change in the system
 - Used to ensure that the assurance case is “fit for purpose”
- Maintenance: on-line monitoring
 - Measure of success/performance of a system
 - Used to predict from data trend that the system is starting to act abnormally or to fail
- Overall
 - Providing evidence of ongoing safety performance for regulatory agencies, stakeholders, etc.

“Live” Assurance Cases

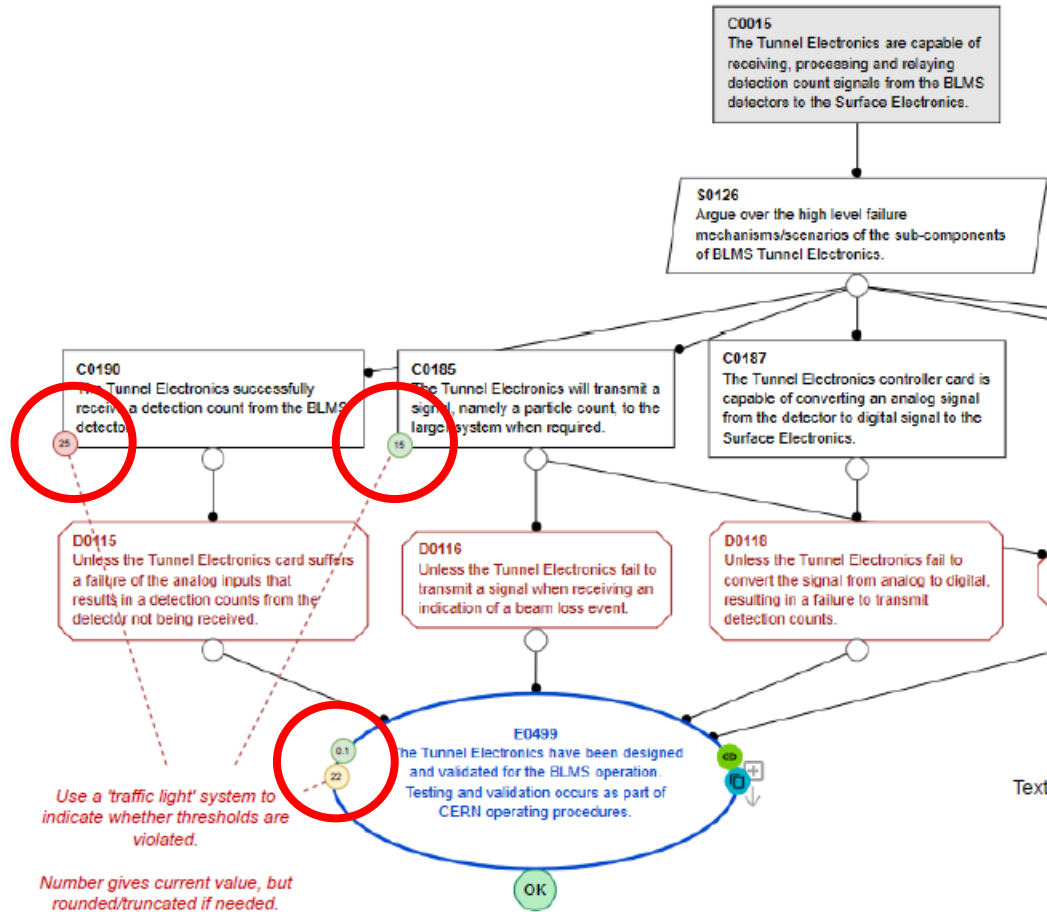
- Link assurance case argument with performance measures obtained from operational environment
- See directly in the argument how observable trends could affect overall confidence



0.5932
0.5989
0.6121
0.6123
0.7788
0.9001

.....

LHC MPS - Original EA / C0001 / C0009 / C0015



C0001	The LHC Machine Protection System (MPS) protects a...
C0009	The Beam Loss Monitoring System (BLMS) provides ti...
C0010	The Beam Interlock System (BIS) actively collects ...
C0011	Whenever the Beam Dumping System (BDS) detects the...
C0014	The BLMS detectors are designed, located, operated...
C0015	The Tunnel Electronics are capable of receiving, p...
C0016	The BLMS Surface Electronics are operational, capa...
C0021	Whenever a beam dump request is received by the BD...
C0023	The Beam Interlock Controllers (BIC) collects USER...
C0024	The BICs generate FALSE BEAM_PERMIT statuses and t...
C0025	The BIS will withdraw the beam permit when any cri...
C0029	The BIS will withdraw the beam permit when intoler...

Indicators

Description	Discussion	Artifacts	Problems
22.345	My Favourite Indicator...		
0.1234	My second favorite indicator...		

Description of my second favourite indicator. The quick brown fox jumped over the lazy dogs...

Thresholds:

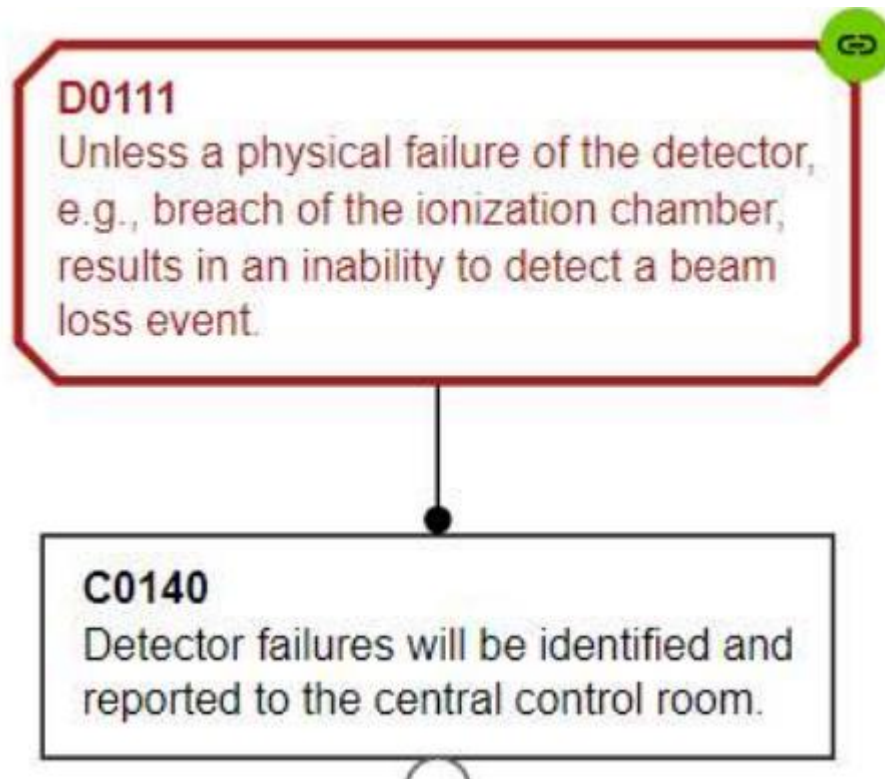
TODO

Search to link an indicator...

> Collapse

How to Identify KPIs?

- Identification of systems/functions/events whose performance can be monitored to ensure the successful operation of the system.



- Lagging: occurrence of undetected detector failure
- Leading: time of detection of detector failure

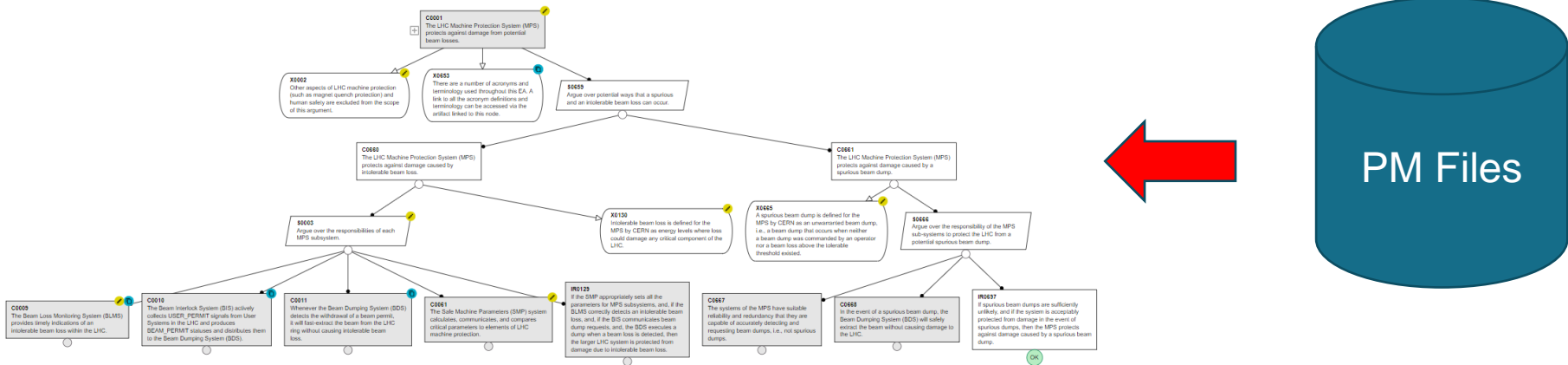
Leading KPIs – Some possibilities

- The frequency at which there is a significant difference between the continuous outputs of individual BLM ionization chambers connected to the same BLM data acquisition cards (BLECF)
- The frequency at which there is some inconsistency (or “glitch” ?) in the user permit signals received by each Beam Interlock Controller (BIC)
- The frequency at which there is a significant difference between the trigger pulse trains continuously produced by the two redundant Trigger Synchronization Units (TSU)

How to identify good KPIs?

- Complete set of KPIs
 - Short, medium, and long-term goals;
 - Safety and performance goals;
 - Cover all the measurable claims and doubts
- Sound set of KPIs
 - Realistic, specific and attainable
 - Clearly described and justified

First Step: Linking MPS argument to PM Data



“... a periodic (re)view showing trends could be very interesting and also easier to start with”

Possible Obstacle for using PM data?

- PM data does not include values relevant to MPS operation, i.e., data does not exist
- PM data is too big or complex to automatically parsed out KPI values
- Security or confidentially issues
- Other?