19th BIS2, SMPv2 Reliability Study Progress Meeting

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**SMP-LHC Setup Beam Flag**

<table>
<thead>
<tr>
<th></th>
<th>SPS PROBE_BEAM</th>
<th>SPS SETUP_BEAM</th>
<th>LHC BEAM_PRESENCE</th>
<th>LHC SETUP_BEAM</th>
<th>LHC EXT_ALLOWED</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>FALSE</td>
<td>FALSE</td>
<td>TRUE</td>
<td>FALSE</td>
<td>TRUE</td>
</tr>
<tr>
<td>2</td>
<td>FALSE</td>
<td>FALSE</td>
<td>TRUE</td>
<td>TRUE</td>
<td>FALSE</td>
</tr>
</tbody>
</table>

Damage to the machine possible if:
- SPS tries to extract a high intensity beam while it is not supposed to
  - Sequence of extractions goes wrong (i.e., SPS tries to extract high intensity beam while there is nothing LHC is not ready for it)
  - Operator mistake: setting injection of a train into the LHC with LHC-SBF set to TRUE
- Problems with LHC SBF flag:
  - Actual conditions should set LHC SBF to TRUE, as the LHC intensity is within the Setup Beam Limit.
  - LHC SBF flag provided to SPS Extraction is FALSE (erroneously): allowing a high intensity extraction,
  - LHC SBF flag provided to the LHC Ring BIS is TRUE (correct): allowing masking.
- LHC Ring BIS has some critical channels masked (1.5%)
- There is a failure in one of the masked channels (50%)

This assumes that the only reason for the LHC EXT_ALLOWED being FALSE in (2) is enabling or disabling the masking.

It also makes the SMP error more intricate that what is usually considered: erroneous information to some systems, while correct information to others.
1. Answered questions

1. How to establish the probability of an operator masking a critical input to the SPS BIS? (SBF for SPS Ring BIS)
   - 1.5%, just like for SMP-LHC

2. What is the frequency of beams entering energy and intensity above Setup Beam Limit in SPS? (SBF for SPS Ring BIS)
   - 2-3 times per day

3. How frequently is Wire Scanner in use? (Intensity for WS)
   - JR mentioned “prior to fill”, so 2-3 times per day?

4. How to calculate the probability of beam parameters causing damage to the TL equipment? (Energy_4X0)
   - Dangerous
SMP-SPS Flags Hazard Chains

1. Remaining questions
   1. Initiating event for this hazard chain for TED
   2. How to establish probability of having high bunch intensity? (MBI for BSRT)
   3. Initiating event for Max Bunch Intensity for BSRT
BIS2 CIBG
Results of the prediction mode
Individual pages as contributors to the overall failure rate

Overall failure rate for the entire CIBG from the Prediction mode: 1441.47 FITS
Total number of components

- Altium’s Bill of Materials specifies exactly 709 components
  - These components have 99 unique part numbers

- Isograph file features 710 components
  - Dual transistors calculated from 217Plus are counted twice +1
  - Dual coax connectors are counted twice +3
  - Dual LEDs are counted twice +7
  - Light Pipes not counted -2
  - Surface Mount PCB Test Points not counted -8
  - $710 - 1 - 3 - 7 + 2 + 8 = 709$

- Transistors – only one (dual) transistor is assigned category Transistor. Remaining 19 are treated as external (with failure rates provided by the manufacturer).
Component categories as contributors to the overall failure rate

Component categories as contributors to the overall failure rate

![Graph showing component categories and failure rates.](image)

- **353 capacitors**: 923.2 FITS
- **16 connectors**: 12.6 FITS
- **77 externals**: 140.1 FITS
- **14 inductors**: 15.1 FITS
- **18 optoelectronic devices**: 41.1 FITS
- **223 resistors**: 25.3 FITS
- **3 switches**: 69.1 FITS
- **2 transistors**: 29.9 FITS

**Average FITS per component**

- **Capacitor**: 2.7 FITS
- **Connector**: 0.6 FITS
- **External**: 1.7 FITS
- **Inductor**: 0.1 FITS
- **Optoelectronic Device**: 1.4 FITS
- **Resistor**: 0.1 FITS
- **Switch**: 1.2 FITS
- **Transistor**: 23.0 FITS

**Component Category**

**Total FITS**