BIS2: CIBFi FMECA

Provisional Results for the Analysis of the Second Version of the BIS in the LHC
Outline

1) Updated reliability predictions
2) Results of CIBFi FMECA
   1) Types of components vs failure rate
   2) Contributors to the overall failure rate
   3) Contributors to the overall failure rate per end effect
   4) Individual components contributions to different end effects
3) Next steps
4) Questions
Updated reliability predictions

<table>
<thead>
<tr>
<th>Scenario B</th>
<th>Probability of a false dump [%]</th>
<th>Number of false dumps</th>
<th>Probability of a blind failure [%]</th>
<th>Number of blind failures</th>
</tr>
</thead>
<tbody>
<tr>
<td>CIBU (channel)</td>
<td>99.994835</td>
<td>0.0035</td>
<td>99.967861</td>
<td>0.0219</td>
</tr>
<tr>
<td>CIBM (channel)</td>
<td>99.948366</td>
<td>0.0351</td>
<td>99.898368</td>
<td>0.0691</td>
</tr>
<tr>
<td>CIBFi</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 1. Requirement allocation to each subsystem (reliability target) per one year

<table>
<thead>
<tr>
<th></th>
<th>Probability of a false dump [%]</th>
<th>Number of false dumps</th>
<th>Probability of a blind failure [%]</th>
<th>Number of blind failures</th>
</tr>
</thead>
<tbody>
<tr>
<td>CIBU (channel)</td>
<td>99.9374</td>
<td>0.8517</td>
<td>99.9997</td>
<td>0.0042</td>
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<td>CIBM (channel)</td>
<td>99.7156</td>
<td>0.1936</td>
<td>99.9904</td>
<td>0.0065</td>
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<tr>
<td>CIBFi</td>
<td>99.5323</td>
<td></td>
<td>99.9938</td>
<td></td>
</tr>
</tbody>
</table>

Table 2. Failure rate predictions for each subsystem per one year

Assumptions needed for calculating number of events per year are included in the next slide
Assumptions

Model: 250 operation days per year

CIBM

\[ 2 \times 17 \times 2 = 68 \]
CIBMs per beam (A/B) BICs Beams

CIBU (pessimistic)

\[ 2 \times 20 \times 17 \times 2 = 1360 \]
CIBU channels (A/B) (up to) CIBUs per CIBM BICs Beams

CIBU (precise)

\[ 2 \times 12 \times 17 + 2 \times (2 \times 8 \times 17) = 952 \]
CIBU channels (A/B) CIBUs per CIBM BICs Beams CIBU channels (A/B) CIBUs per CIBM BICs
CIBFi: Types of components vs Failure Rate [FITS]

- Capacitor (362 components)
- Transistor (36 components)
- Resistor (291 components)
- External (78 components)
- Switch (3 components)
- Diode (30 components)
- Connector (13 components)
- Optoelectronic Device (42 components)
- Inductor (14 components)

Rate [FITS]

Normalized by the number of components
Overall
Failure contributors
Components vs Failure Rate, I

**Blind Failure**

- Bar chart: Blind Failure Contributors - Description
  - Rate [FIT斯, linear]
  - Components: IC13, IC14, IC39, C40, C41, C47, C48, C49

- Scatter plot: Blind Failure
  - X-axis: Rate [FIT斯, log]
  - Y-axis: Rate [FIT斯, linear]
  - Data points: External

**False Dump**

- Bar chart: False Dump Contributors - Description
  - Rate [FIT斯, linear]
  - Components: Capacitor, External, Resistor, Transistor, Diode, Connector, Switch, Inductor

- Line graph: False Dump
  - X-axis: Rate [FIT斯, log]
  - Y-axis: Rate [FIT斯, linear]
  - Data points: False Dump

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BIS2: Reliability Analysis for the LHC
Components vs Failure Rate, II

No Effect

Maintenance

No Effect Contributors - Description

Maintenance Contributors - Description

Maintenance Contributors - Part Name

Rate [FITs]:

Transistor | Capacitor | Resistor | Switch | Diode | External | Optoelectronic Device | Connector | Inductor

No Effect: Reliability Analysis for the LHC

2/17/2022
Next steps

1. Fault tree of the CIBFi
2. CIBDS link mode
3. CIBG – when ready
Questions?