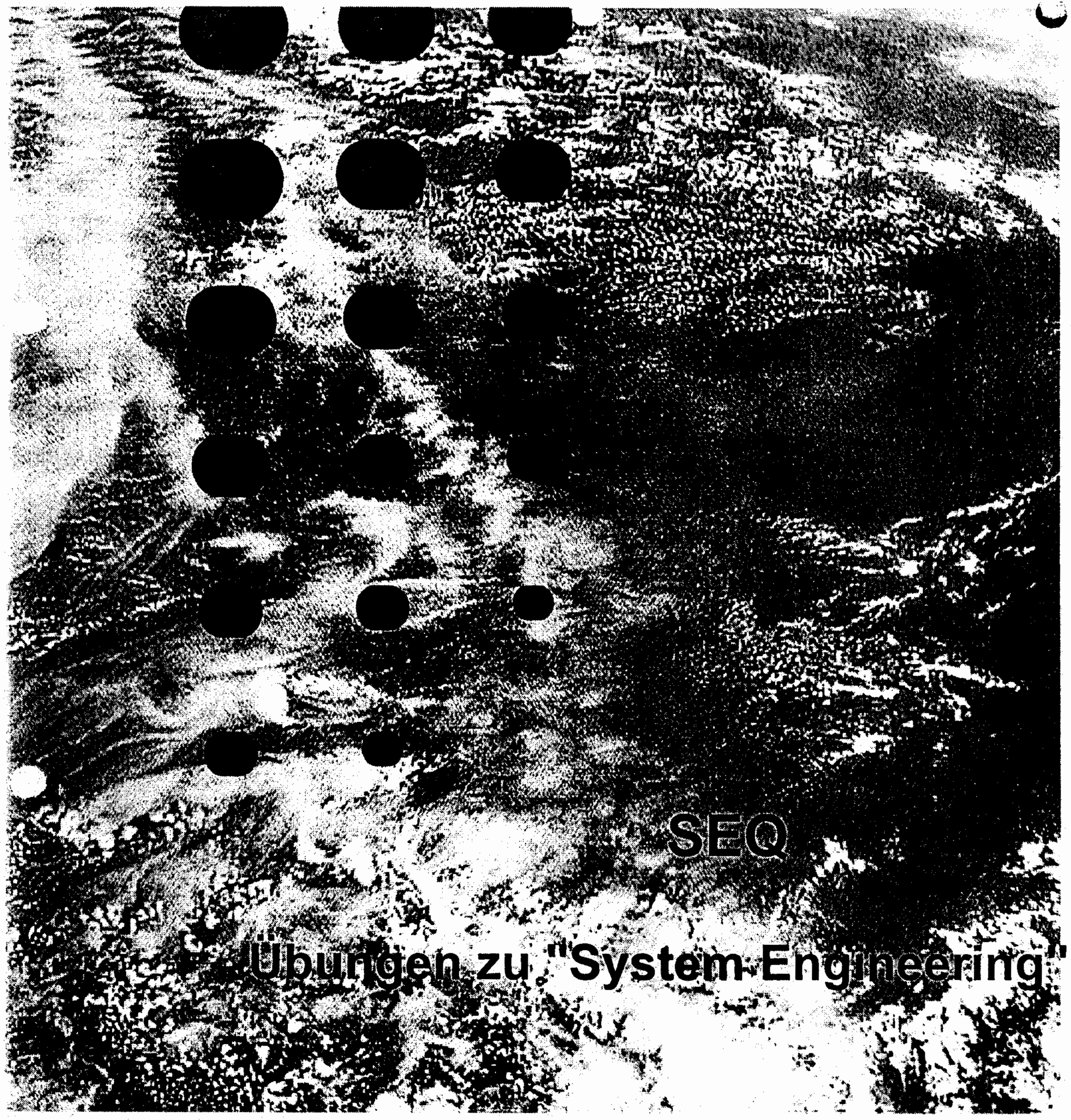

astrium

COLUMBUS

Übung 1: Anforderungformulierung

Welche der folgenden Anforderungen würden Sie nicht wie geschrieben akzeptieren?

Wie sollte der Text geändert werden?

Requirement	VERIFICATION METHOD ID. No	FC	ASSY	REMARKS
4. 5. 9. DRAINS, VENTS AND EXHAUST PORTS Drains, vents or exhaust ports shall be designed to prevent liquids, gases, vapours or flames from creating hazards. Draining, venting or exhausting to the external environment shall be non–propulsive.	ID.89	A	T ROD	
4. 5. 10. EXPOSED SURFACE TEMPERATURES 4. 5. 10. 1. The mean radiant temperature of habitable areas shall not exceed 35 degrees Celsius, based on an ISPR front panel mean radiant temperature of 35 degrees Celsius.	ID.2275	A		
4. 5. 11. PYROTECHNIC DEVICES AND FUNCTIONS The APM design shall not use any pyrotechnic devices.	ID.2208	ROD		
4. 5. 12. BATTERIES 4. 5. 12. 1. Batteries shall be protected against over–temperature, short circuits, reverse currents, overcharging and over discharging, etc. as required to eliminate critical or catastrophic hazard consequences. Note : (Requirement Clarification): It is assumed that the station common Emergency Illumination hardware fulfills all these requirements. (no further qualification effort foreseen).	ID.98		A	

Übung 2: Spec/Plan Relationen

Was ist im folgenden Beispiel nicht richtig?

3.18.4.3 1/A
Radiation Requirements

3.18.4.3.1 1/A
Total Dose

3.18.4.3.1.1 1/B M COL-ESA-RQ-001 4.7.8.1

EEE parts used inside the station shall withstand a total dose of more than 1.4 krad (Si) without functional and parametrical failure in accordance with the related detail specification. EEE parts used outside the primary structure of the station shall be subjected to a detailed radiation worst case analysis as per AD see paragraph : 2.1.30.

3.18.4.3.1.2 1/B M COL-ESA-RQ-001 4.7.8.1

Parts with a total dose tolerance below 1.4 krad (Si) shall be subjected to a detailed radiation worst case analysis as per AD see paragraph : 2.1.30.

3.18.4.4 1/A
Single Event Upset (SEU)

3.18.4.4.1 1/A M COL-ESA-RQ-001 4.7.8.1

Parts with an SEU threshold Linear Energy Transfer (LET) for Heavy Ions below 36 MeVcm^2 /mg shall be subjected to an SEU analysis as per AD see paragraph : 2.1.30. .

3.18.4.4.2 1/C M COL-ESA-RQ-001 4.7.8.1

Parts with an SEU threshold for Heavy Ions below 10 MeVcm^2 /mg shall be subjected in addition to Proton testing analysis as per AD see paragraph : 2.1.30.

A) All devices which do withstand a dose of 1.4 Krad (Si) without functional and parametrical failure can be used as is.

The radiation induced parameter shift at 1.4 Krad shall not affect the circuit performance. Therefore, all radiation relevant parameters (see para. 5.1.6.3) shall pass Table 2 of ESA/SCC Detail Specifications or equivalent (Electrical Parameters at Room Temperature) at 1.4 Krad (Si). Components of this category shall preferably be used. No detailed radiation worst case analysis is requested.

B) All devices which do not withstand a total dose of 1.4 Krad (Si) without functional or parametric failure shall preferably not be used.

If such a part cannot be replaced, the user has to define the actual chip level dose (sector analysis). This value shall be multiplied by 2 (safety factor) to obtain a specific total dose tolerance level required for that part.

- If the part shows no degradation (parametric and functional) at that tolerance level, it can be used as is.

- If the part is functional but shows parametric degradation at that tolerance level, a circuit analysis is required:

  a) If the electrical circuit can tolerate this parameter shift, the part can be used, but Radiation Verification Testing (RVT) is mandatory.

  b) If the circuit cannot tolerate the parameter shift, spot shielding is requested to reduce the required tolerance level. RVT may still be necessary in case of (tolerable) parameter degradation at the new level.

- If the part shows functional failure at the specific tolerance level, it shall not be used. If the user asks for a waiver, decision shall be subject to an MRB. As a minimum, a detailed rationale for the planned usage, a detailed radiation analysis, including environment, shielding and circuit behaviour and risk analysis is mandatory.

C) For EEE parts which are intended to be used outside COLUMBUS, the required total dose tolerance level shall be determined using Appendix A of this plan. A.m. rules shall then be applied accordingly for the required tolerance level.

For a characterization of an SEU sensitive part, a cross-section versus LET curve needs to be produced, which allows the calculation of the device upset rate for the Space Station orbit.

5.2.2 SEU Tolerance Assurance

SEU is not a destructive effect because the failed bistable element can be rewritten. So SEU tolerance is not only a device problem, but also a system task. Several methods - both hardware and software - have been developed to minimize or even exclude the impact of SEU on system performance.

The following procedure is, therefore, recommended:

- o Selection of devices with sufficient SEU threshold LET value whenever this is possible (see 5.2.1).

- o If the circuit cannot be implemented without SEU-sensitive devices, an SEU characterization test must be performed from threshold to saturation with an accelerator. Based on the produced cross-section versus LET curve, the in-orbit soft error rate shall be estimated, using the calculation method B of para. 5.4. Note that this method gives a pessimistic approximation, which over-estimates the in-orbit soft error rate.
  In parallel the user has to perform the circuit analysis, determining the acceptable soft error rate of the device. For this determination, the application of the device, the number of parts, the duty cycle and the usage of SEU circumvention techniques (EDACs, watchdogs...) must be considered.
  Therefore the user shall summarize for every SEU-sensitive device the following information as a minimum: manufacturer and function, circuit position, criticality of the application, level of tolerable soft error rate, and countermeasures taken to prevent circuit malfunction. A format proposed for this purpose is shown in Appendices D1 and D2.
  If the estimated in-orbit error rate, derived from the cross-section versus LET curve, is below that value which is acceptable for the user, the part can be used as is in this application.

- o If the estimated in-orbit error rate is not acceptable for the user, a detailed calculation of the error rate must be performed, using method A of para. 5.4. If the detailed in-orbit error rate is below that value, which is acceptable for the user, the part can be used as is in this application. Note that for parts with low threshold LET (< 10 $MeVcm^2/mg$) for SEUs induced by heavy ions the proton-induced SEU rate must be added to the value (see para. 5.5).

- If the in-orbit error rate as calculated according to method A of para. 5.4 is not acceptable for the user, the part shall not be used.

  If the user asks for a waiver, decision shall be subjected to an MRB. As a minimum, a detailed rationale for the planned usage, a detailed radiation analysis, including environment and circuit behaviour and an investigation of the application of (further) SEU correcting measures is mandatory.

- If the SEU threshold LET value of a part is below 36 MeVcm^2/mg and shows multi-bit errors in a single byte, this device shall not be used.

It is important to note that SEU sensitivity does not depend on the specific device manufacturing lot, which is in sharp contrast to the behaviour found for total dose effects.

5.2.3 SEU Test Facilities

The required SEU tests shall be carried out at accepted test facilities.

A Californium 252 fission fragment source (if the range of the fission particles can be shown to be sufficient) may be used to achieve a first order assessment of devices sensitivity to heavy ions. Since no calculation of the SEU error rate can be performed, an accelerator test will be necessary for a characterization of a device.

Accepted test facilities for accelerator testing are (SEU, LU and burn-out):

- Brookhaven National Laboratory, Long Island, USA
- GANIL, Caen, France
- IPN, Orsay, France.

5.2.4 SEU Test Conditions

Since the only parameter of interest in SEU testing in a given project is the soft error rate expected under mission conditions, it is essential to define a minimum heavy ion fluence level and LET range for the tests. As a baseline an ion fluence of more than 10^6 particles/cm^2 shall be used.

One approach is to use Californium testing as a preliminary screen for the first assessment of the part and the verification of the test set-up. As already mentioned it is mandatory to know, whether the

SEQ
Übungen zu "System Engineering"

Übung 3: ICD Inhalt

Was würden Sie an folgenden ICD-Seiten anders machen?

3.2.2 Output Power N/A

3.2.3 Grounding and Isolation

The grounding and isolation of the PICA equipment will follow the requirements defined in applicable document /2.1.2/, para 4.1.1.1.

Specific details influencing the counterpart of the interface will be outlined in the corresponding EMC assessments of the involved equipment.

3.2.4 Equipment Internal Bonding

The bonding of the PICA equipment will follow the requirements defined in applicable document /2.1.2/, para. 4.1.1.2.

3.4 Command Interfaces

The command interface types used by PICA equipment and the number of command interfaces of PICA to the Data Management System (DMS) are listed in Annex 5.

3.4.1 15-Volt Pulse Command Interfaces(PCFV)

The 15-V pulse command interfaces are in accordance with para. 3.5.4 of applicable document /2.1.3/.

3.4.2 15-Volt Level Command Interfaces (LCFV)

The 15-V level command interfaces are in accordance with para. 5.14.1.2.3 of applicable document /2.1.1/.

3.4.3 Analog Command Interfaces (ACLV)

The analog command interfaces are in accordance with para. 3.5.5 of applicable document /2.1.3/.

2 Related Documents

All listed documents apply according to their latest contractural version.

2.1 Applicable Documents

/2.1.1/ Pre-Integrated COF APM (PICA) Specification, COL-RIBRE-SPE-0094

/2.1.2/ EMC and Power Quality Specification, COL-RIBRE-SPE-0020

/2.1.3/ Electrical Design Specification, COL-RIBRE-SPE-0025

2.2 Reference Documents

/2.2.1/ ICD Identification List, COL-RIBRE-TN-0006

/2.2.2/ Interface Management Plan, COL-RIBRE-ICD-0026

2 Related Documents

All listed documents apply according to their latest contractual version.

2.1 Applicable Documents

/2.1.2/ EMC and Power Quality Specification, COL-RIBRE-SPE-0020

/2.1.3/ Electrical Design Specification, COL-RIBRE-SPE-0025

0018B

2.2 Reference Documents

/2.2.1/ ICD Identification List, COL-RIBRE-TN-0006

/2.2.2/ Interface Management Plan, COL-RIBRE-ICD-0026

Übung 4: Verifikationsmethoden

Kommentieren Sie die Verifikationsmethode R für Para 3.1.1.1: Lifetime

	VERIFICATION APPROACH			REMARKS
	FC	SS	ASSY/EQ/PR	

3 FUNCTIONAL AND PERFORMANCE REQUIREMENTS

3.1 Lifetime and Applications

3.1.1 Lifetime

3.1.1.1 Lifetime [M: RQ001: 10.1.6]

	FC	SS	ASSY/EQ/PR	REMARKS
3.1.1.1		R		

The EGSE shall be designed for an operational lifetime of 8 years commencing with initial installation at the APM AIT location.

3.1.2 Applications

This section defines how the operational EGSE will be used and the global functions which the user requires from it. It serves as a background to the detailed functional requirements which follow.

In general it is the task of the user to create procedures and displays to implement these global functions using the facilities supplied by the integrated EGSE.

.1.2.1 AIT Scenario

3.1.2.1.1 Flight Configuration Level Activities [M: RQ001: 10.1.2]

	FC	SS	ASSY/EQ/PR	REMARKS
3.1.2.1.1	NTBT			

The EGSE shall support the integration and qualification test activities on the APM Electrical Test Model (ETM) and verification test activities on the Protoflight Model (PFM) at Flight Configuration level.

3.1.2.1.2 Flight Software SIVQ [M: SPE1235071: 3.1.1.2.1]

	FC	SS	ASSY/EQ/PR	REMARKS
3.1.2.1.2	NTBT			

The EGSE shall support flight software integration, qualification and acceptance test activities on the APM Electrical Test Model (ETM).

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