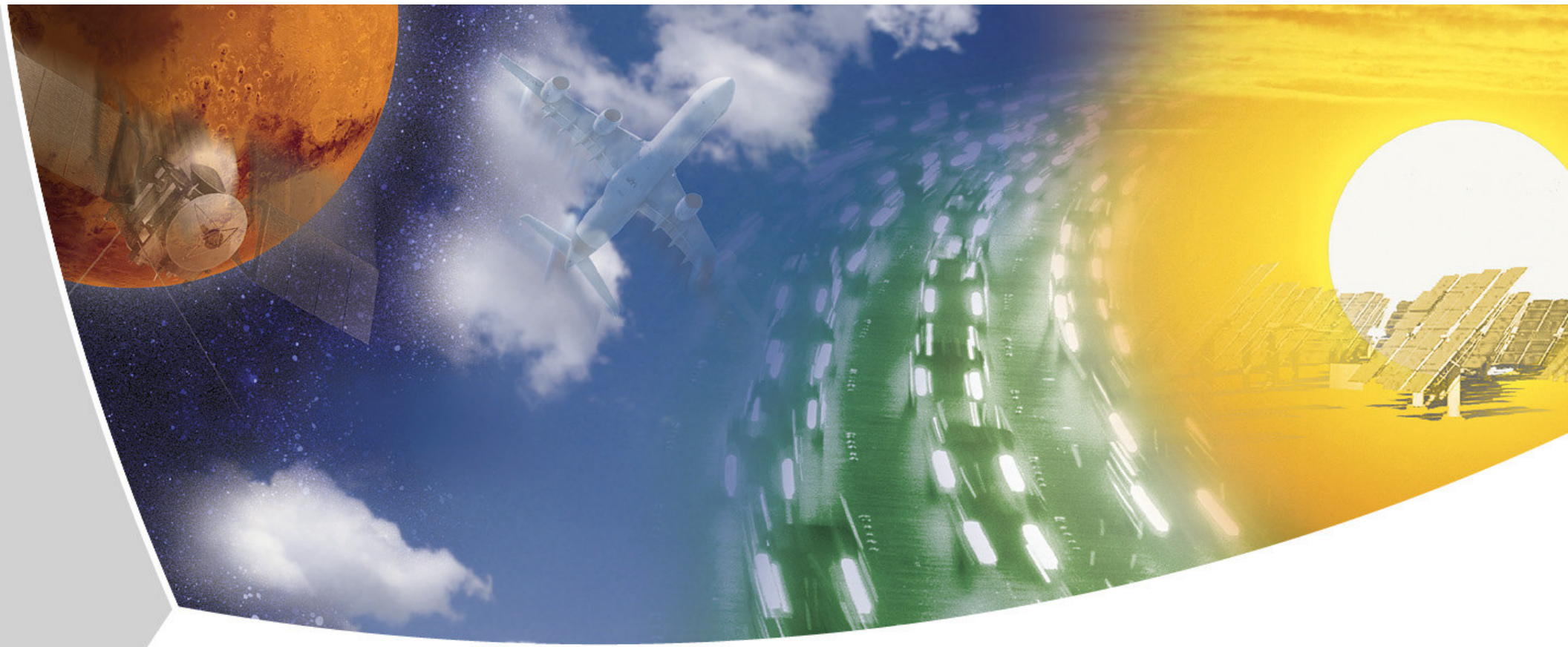

# 48th Session of the Legal Sub-Committee of the UN-COPUOS

## UN-Space Debris Mitigation Guidelines – National Implementation Mechanism

*Uwe WIRT, DLR, Federal Foreign Office, Germany*

*31 March 2009, Vienna*

DLR Deutsches Zentrum für Luft- und Raumfahrt e.V.

Auswärtiges Amt

# Scope

***In Resolution 62/217, "International cooperation in the peaceful uses of outer space", the General Assembly endorses the Space Debris Mitigation Guidelines of the Committee on the Peaceful Uses of Outer Space and agrees that the voluntary guidelines for the mitigation of space debris reflect the existing practices as developed by a number of national and international organizations, and invites Member States to implement those guidelines through relevant national mechanisms.***

**This presentation outlines the national mechanism developed at the German Space Agency DLR for the implementation of these guidelines.**

# Contents


- Overview
- From Guidelines to Implementation
- Product Assurance Requirements Tailoring
- Concluding Remarks

# Overview

## ORGANISATION OF SPACE ACTIVITIES

- Bundesministerium für Wirtschaft und Technologie (BMWi, Federal Ministry of Economics and Technology): authority for Germany's space activities
- German Space Programme:
  - German contributions to the ESA Programme
  - National Programme activities
  - DLR internal R&D Space Programme
  - space-related research at universities, etc.
- German Space Programme is implemented and managed by Germany's space agency Deutsches Zentrum für Luft und Raumfahrt (DLR, German Aerospace Centre)
- Legal framework is given by the Delegation of Space Activities Act (Raumfahrtaufgabenübertragungsgesetz).

# Overview

## QUALITY MANAGEMENT SYSTEM: PRODUCT ASSURANCE

- DLR policy requires for each contractor the implementation of a Product Assurance (PA) programme throughout all project phases
- PA programme:
  - to ensure that the space products accomplish their defined mission objectives and to demonstrate that they are safe, available, and reliable
  - to ensure verifiability and practicability of the requirements to be considered during development, production, and operation of a space system.
- European Cooperation for Space Standardization (ECSS) standards set the benchmark for the DLR Quality Management System PA activities
- Space Debris Mitigation Requirements are subject of the Safety part of the DLR Standard Product Assurance Requirements Catalogue.

# Overview

## SPACE DEBRIS MITIGATION

- Since 2004 Space Debris Mitigation requirements for the national space projects TerraSAR X, Tandem-X, TET, EnMap, and MetImage were imposed on a case-by-case basis on the basis of the European Code of Conduct
- Starting in 2007: integration of Space Debris Mitigation Guidelines into the Quality Management System´s Product Assurance requirements tailoring
- Requirements tailoring is a multiple stage process starting with a Request for Proposal and leading to the PA Controlling of the relevant project
- European Code of Conduct on Space Debris Mitigation forms the input for the safety part of the PA requirements
- Compliance with the UN Space Debris Mitigation Guidelines
- Comprising support documents and tools are available on international level and have been developed at DLR respectively, providing a substantial knowledge base with regard to the implementation of the space debris mitigation requirements and can be utilized by contractors.

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# From Guidelines to Implementation

UN-Space Debris Mitigation Guidelines

- Limit debris release during nominal operations
- Minimize break-up potential during operations
- Limit accidental in-orbit collision probability
- Avoid intentional destruction & harmful activities
- Limit the probability of post-mission break-up
- Limit the long-term presence of spacecraft and launcher orbital stages in the LEO protected region re-entry objects resulting from this recommendation must not pose an undue risk to the ground population
- Limit the long-term interference of spacecraft and launcher orbital stages with the GEO protected region.

# From Guidelines to Implementation

**UN COPUOS STSC**
**Space Debris Mitigation Guidelines**

**Fundamental principles**

**IADC*)**
**Space Debris Mitigation Guidelines**

**Technical Guidelines**

**European Code of Conduct (ECoC)**
**on Space Debris Mitigation**

**Nat. Mitigation Guidelines**

**Applicable Rules**

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**International Standards, e.g. ISO**)**

**Support documents, tools**

**How shall things be done?**

**By which means can things be done?**

*): Inter-Agency Space Debris Coordination Committee
**): International Organisation for Standardization

# From Guidelines to Implementation

## National Space Debris Mitigation Guidelines

- 5.3.4 Space Debris Mitigation
- 5.3.4.1 Objectives of Space Debris Mitigation Assessments
- 5.3.4.2 Non-compliance
- 5.3.4.3 Conducting Space Debris Mitigation Assessments
- 5.3.4.4 Space Debris Mitigation Assessment Reports (SDMAR)
- 5.3.4.4.1 SDMAR-1 "Assessment of Spacecraft Debris Released During Normal Operations"
- 5.3.4.4.2 SDMAR-2 "Assessment of Spacecraft Accidental Breakups and Potential for Explosions"
- 5.3.4.4.3 SDMAR-3 "Assessment of Spacecraft Potential for On-Orbit Collisions"
- 5.3.4.4.4 SDMAR-4 "Assessment of Spacecraft Postmission Disposal Plans and Procedures"
- 5.3.4.4.5 SDMAR-5 "Assessment of Spacecraft Re-entry Hazards"
- 5.3.4.5 Design Measures
- 5.3.4.5.1 Prevention: Mission related objects
- 5.3.4.5.2 Prevention: Solid propellants and pyrotechnics
- 5.3.4.5.3 Prevention: Materials and technologies
- 5.3.4.5.4 Prevention: Fragmentation
- 5.3.4.5.5 Prevention: Malfunction
- 5.3.4.5.6 End-of-life measures: Passivation
- 5.3.4.5.7 On-orbit collisions
- 5.3.4.5.8 End-of-life measures: De-orbiting
- 5.3.4.5.9 End-of-life measures: Re-orbiting
- 5.3.4.5.10 Re-entry Safety Measures: Safety policy
- 5.3.4.6 Operational Measures
- 5.3.4.6.1 End-of-life measures: Passivation
- 5.3.4.6.2 Disposal manoeuvres
- 5.3.4.6.3 Disposal orbit
- 5.3.4.6.4 Disposal probability
- 5.3.4.6.5 Re-entry safety measures: Safety policy
- 5.3.4.7 Project Reviews

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- **Product Assurance Requirements Tailoring**
- Concluding Remarks

# Product Assurance Requirements Tailoring Process

European Cooperation for Space Standardization

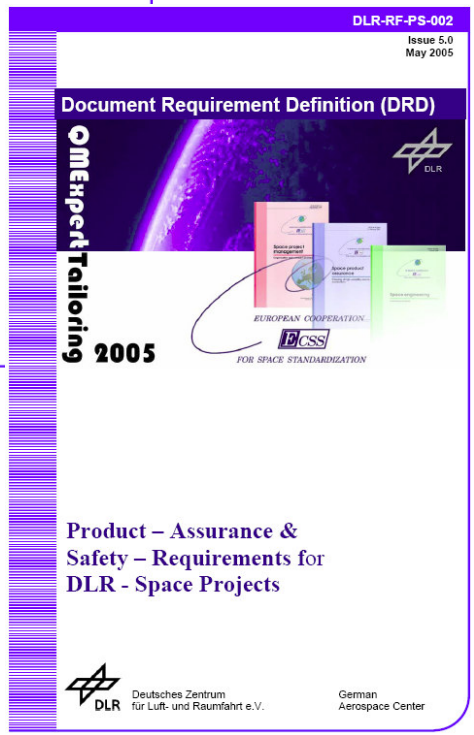
European Space Components Cooperation

Space Station & Shuttle Safety

Military Standards

European CoC Space Debris

NASA STD 8718.14

# Product Assurance Requirements Tailoring Process

DLR

EADS ASTRIUM

EADS SPACE TRANSPORTATION

TESAT SPACECOM

OHB SYSTEM FUCHS GRUPPE

KAYSER-THREDE

Astro- und Feinwerktechnik Adlershof GmbH

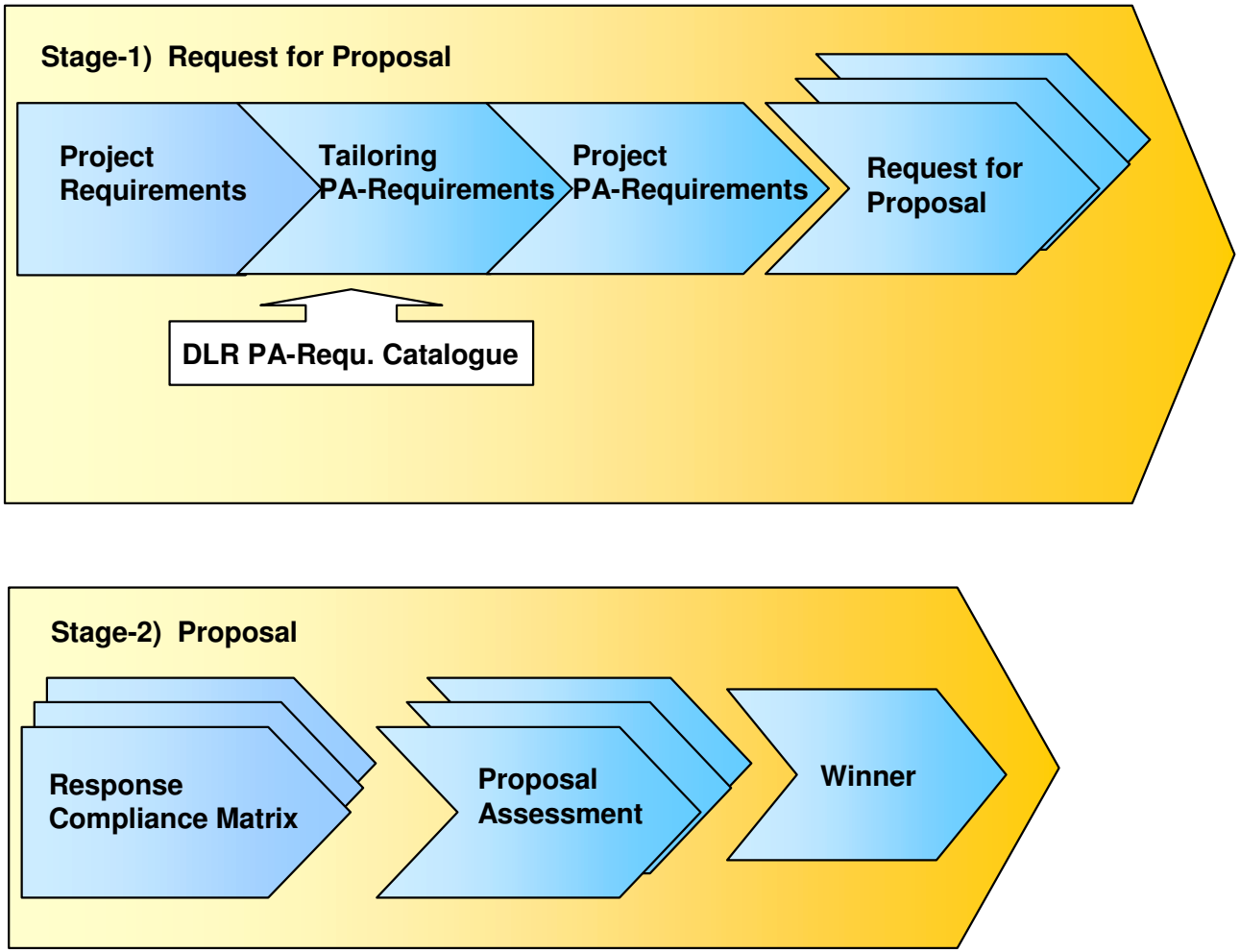


# Product Assurance Requirements Tailoring Process

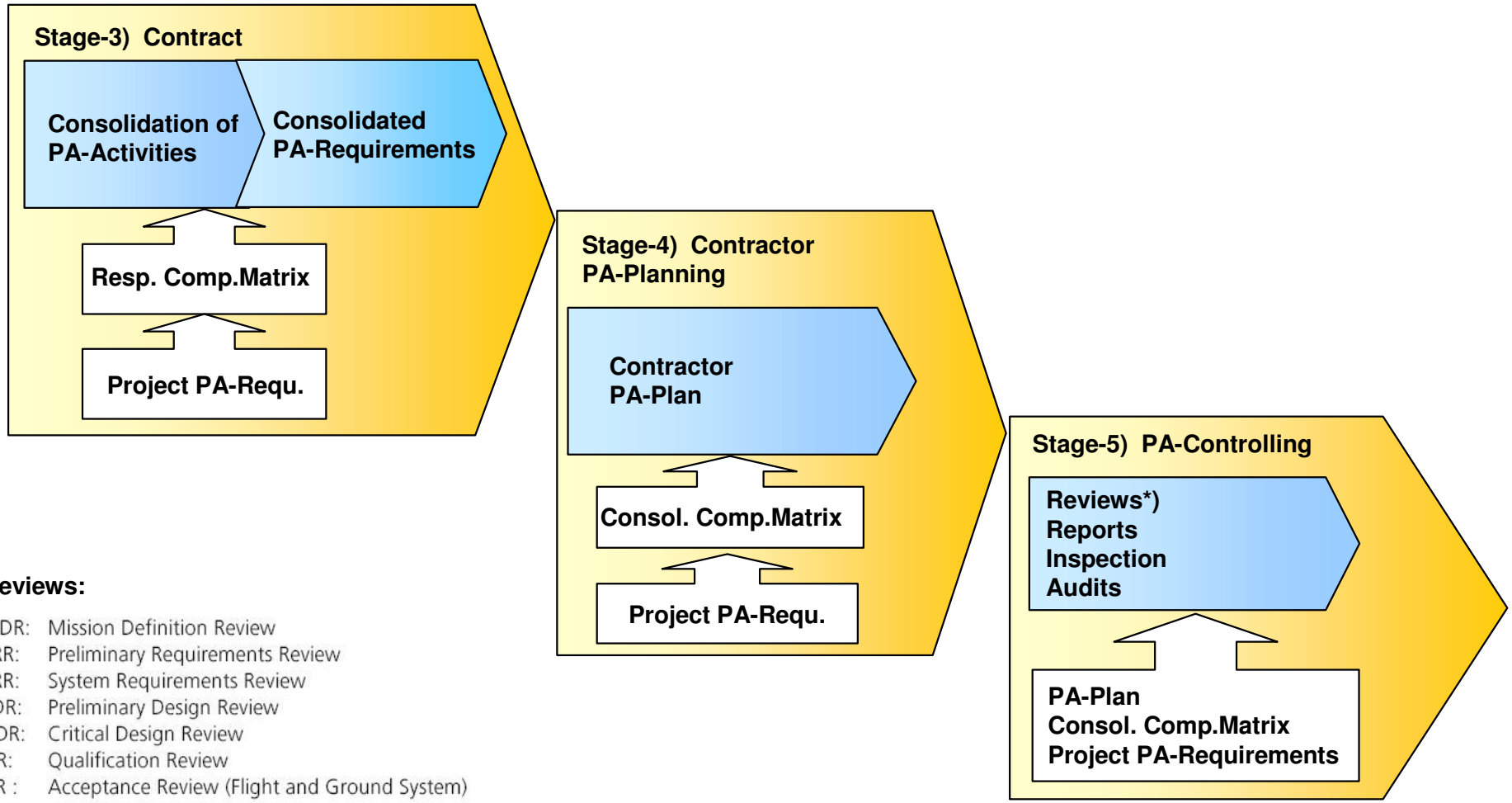
## DLR Standard Product Assurance Requirements Catalogue

| Subject | Source |
|---|---|
| Product Assurance Management | ECSS-Q-00, ECSS-Q-20, ECSS-Q-20-09, ECSS-M-00, ECSS-M-20, ECSS-M-30, ECSS-M-30-01, ECSS-M-40, ECSS-M-50 |
| Quality Assurance & Verfification | ECSS-Q-20, ECSS-Q-20-04, ECSS-M-40, ECSS-E-10, ECSS-E-10-02, ECSS-E-20 |
| Dependability | ECSS-Q-30, ECSS-Q-30-02, ECSS-Q-30-01, ECSS-Q-40-12, ECSS-Q-60-11, ECSS-E-10-05, NASA NSTS/ISS, MIL |
| Safety / Space Debris Mitigation | ECSS-Q-40, ECSS-Q-40-02, ECSS-Q-70-29, ECSS-M-20, ECSS-Q-40-12, ECSS-Q-70-36, ECSS-E-30-01, ECoC-SD, NASA STD-8719, NASA NSTS/ISS |
| EEE-Parts Procurement | ECSS-Q-60, ECSS-Q-60-01, ECSS-Q-60-05, ESCC, NASA NSTS/ISS, MIL |
| Mechanical Parts, Materials & Processes | ECSS-Q-70, ECSS-Q-70-04, ECSS-Q-70-10, ECSS-Q-70-21, ECSS-Q-70-28, ECSS-Q-70-36, ECSS-Q-70-01, ECSS-Q-70-06, ECSS-Q-70-11, ECSS-Q-70-22, ECSS-Q-70-29, ECSS-Q-70-37, ECSS-Q-70-02, ECSS-Q-70-07, ECSS-Q-70-18, ECSS-Q-70-26, ECSS-Q-70-30, ECSS-E-30-01, ECSS-Q-70-71, ECSS-Q-70-08, NASA NSTS/ISS |
| Software Product Assurance | ECSS-Q-00, ECSS-Q-80, ECSS-E-40 |
| Mission Operation | ECSS-Q-20, ECSS-E-70 |

# Product Assurance Requirements Tailoring Process



# Product Assurance Requirements Tailoring Process




***) Reviews:**

| | |
|---|---|
| MDR: | Mission Definition Review |
| PRR: | Preliminary Requirements Review |
| SRR: | System Requirements Review |
| PDR: | Preliminary Design Review |
| CDR: | Critical Design Review |
| QR: | Qualification Review |
| AR : | Acceptance Review (Flight and Ground System) |
| ORR: | Operational Readiness Review |
| FRR: | Flight Readiness Review |
| LRR: | Launch Readiness Review |
| FQR: | Flight Qualification Review |
| EOLR: | End-Of-Life Review |

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# Concluding Remarks

## National UN-Space Debris Mitigation Guidelines Implementation Mechanism: Product Assurance (PA)

- DLR policy requires for each contractor the implementation of a PA programme throughout all project phases
- Applicable standards are tailored according to the project – to ensure verifiability and practicability of the requirements to be considered during development, production, and operation - and assignment of contractual PA requirements and their control ensures, that space products accomplish their defined mission objectives, demonstrate safety, availability, reliability
- Space Debris Mitigation requirements for national space projects are integrated into the “Safety” part of the Quality Management System´s PA requirements tailoring process
- Space Debris Mitigation requirements for national space projects are in compliance with the UN Space Debris Mitigation Guidelines.