Verification

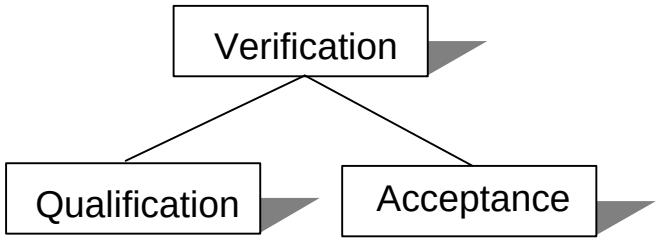
- **Definitions and Rules**
- **Relations to Specifications and ICD‘s**
- **Requirements Tracing**
- **Verification Methods**
- **Qualification Models and Testing**
- **Verification Documentation Formalities**

Introduction

- **Verification during Phase C/D mostly underestimated during proposal Preparation / contract negotiations: schedule delays, technical problems / late design changes**
- **Engineers like more creativity but not so much detailed formal proof that all requirements and Interface commitments are fulfilled; often forgotten in the begining**
  - **Fault management**
  - **Maintenance task**
  - **GSE**
- **Depending on customer strength compromises can be "sold" later but one should never rely on that**
- **Multiple examples in several programs where insufficient / wrong verification caused failures on-orbit or even complete mission loss**
- **Failures during specification generation (begin of program) cause verification problems at the end of the program**

Verification Definition / Rules

- **Definition: Verification is summary term for**
  - **Qualification activities**
  - **Acceptance activities**



- **Qualification**
  - **Proof that design fulfills all applicable requirements (incl.manufacturing tolerances, lifetime effects) in all combinations**
  - **Independent of serial number of Qualification Model; related to part number**
- **Acceptance (Related to serial number)**
  - **Proof that item (unit or system) is in accordance with qualified design and free of workmanship failures**
- **Principle agreement with ECSS-E-10-02**

Resources Management

- **In addition to specific requirements (orbit, up-/down-link data rates etc. generic critical requirements applicable to any space system: so called "Resources"**
  - **Mass**
  - **Electrical power**
  - **Computer memory occupancy etc.**

- **Because of compliance importance (up to overall system/mission feasibility) generic resources control principles have been developed (continuous verification = Resources Management).**

Specification Relations

- **Systems engineering for a spacecraft: a very complex process involving several parties with different responsibilities:**
  - **Customer**
  - **Subsystem / Assembly subcontractors**
  - **Equipment / Software end item subcontractors**
- **Success of a design / development program**
  - **Fulfillment of customer requirements**
  - **Staying within costs / schedule**

strongly depending on proper splitting of the "System" into lower level entities and continuous control of fulfillment of allocated requirements and Interface commitments (in ICD's).

Spacecraft System Definition

- **Clear Responsibility Splitting:**

- System level contractual barriers

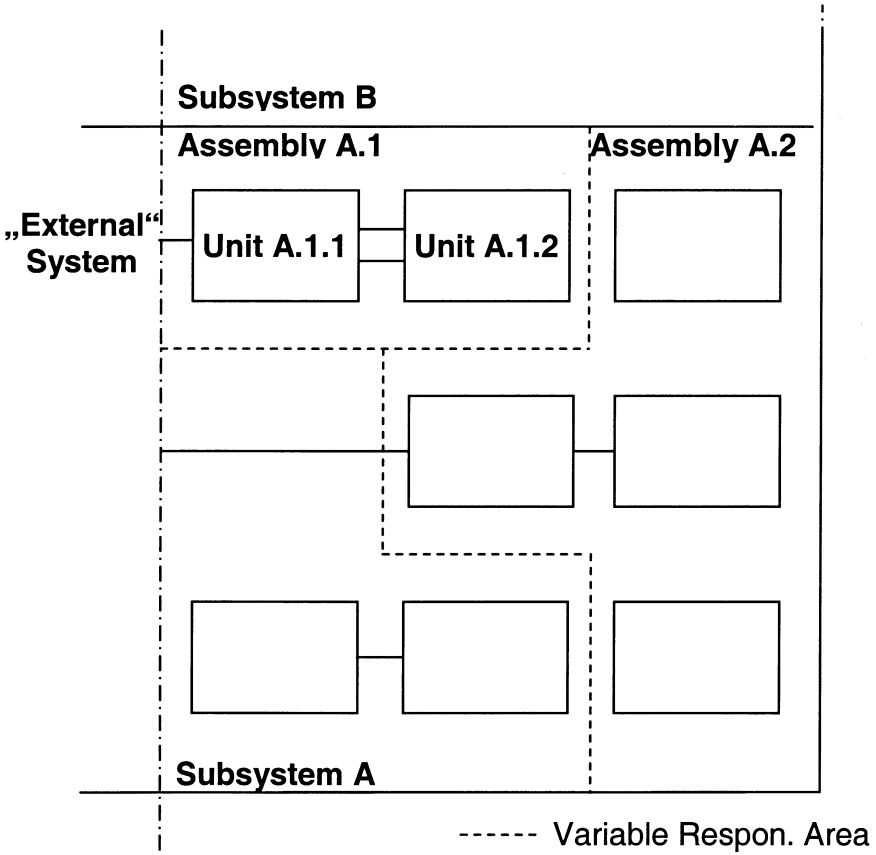
- Subsystem level for technically complex entities (e.g. Data Management Subsystem, Env. Control / Life Support)

- Hardware units, software programs

- **Interface definitions:**

- Unambiguous / Complete

- Controllable / Verifiable



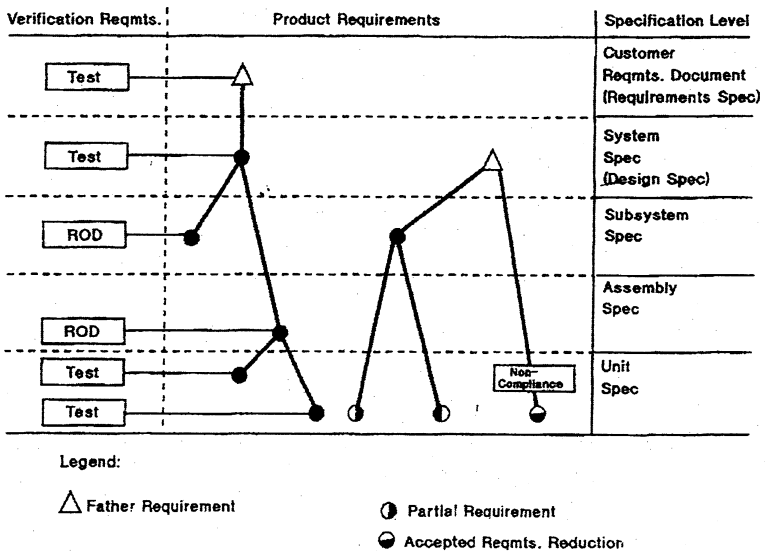
Specifications Set-up

- **Different objectives for negotiation / contract signature for requirements**
  - **Customer: Minimum (e.g. mass) for contractor giving him margin versus upper level e.g. launch vehicle.**
  - **Contractor: Maximum versus customer for high confidence that requirements are met up to end of contract.**
- **Specifications to be complete**
  - **Mass: Attachment hardware / bonding straps, with/without fluids**
  - **Power: Within specified voltage range and within specified temperature range for all modes**
- **Responsibility more than one end item:**
  - **Margin to cover spec failures**
- **End item responsibility:**
  - **Contingency to cover uncertainties up to design finalization /acceptance**

Qualification Reference: Specifications

- System to be split in subsystems, assemblies and units with unambiguous and objectively verifiable interfaces
- Specification /

Requirements tracing →



- Quality of Specifications
  - -Tailored to products (i.e. not just copy of father requirements)
  - - Non-ambiguous / complete interrelations
  - - Verification method(s)

Requirements Trace Example

Daimler-Benz Aerospace
Raumfahrtinfrastruktur

COLUMBUS

Dok.Nr./Doc.No.: COL–RIBRE–SPE–0101
Ausgabe/Issue: 1 Datum/Date: 18.01.1995
Überarbtg./Rev.: E Datum/Date: 28.07.1998
Seite/Page: 16 of 51

3.9.4.1.5 1/A T COL–ESA–RQ–001 4.5.3.9

Change of authorized threshold settings shall only be possible in a procedurally controlled, stepwise (min. two steps) way and shall require verification of the new setting prior to release for execution in the system.

estec

COLUMBUS System Requirements Document – Space Segment

COL–ESA–RQ–001
Issue 4 Rev. A
Date 10.12.2001
Page 75 of 274

	VERIFICATION METHOD			REMARKS
	ID. No	FC	ASSY	
4. 5. 3. 7. Messages annunciating emergency and warning events shall be transmitted by the APM to the Space Station upon detection of out of limits conditions in the associated parameters.	ID.54	T ROD		
4. 5. 3. 8. Thresholds shall be adjustable and protected from inadvertent operations by 2–step command.	ID.1281	T ROD		
4. 5. 3. 9. Change of authorized threshold settings shall only be possible in a procedurally controlled, stepwise (min. 2 steps) way and shall require a check of the new setting prior to release for execution in the system.	ID.1282	T ROD		

AIVDB Trace Example Print-Out

Program: COLUMBUS
VCD Title:
Specification Number: COL-ESA-RQ-001 Iss/Rev: 3/H Date: 04 JUL 1999
Specification Title: CSRD Phase: QUAL

DOC.:
ISSUE: PAG: 4
DATE:
CI Identifier: 1213800-00----

Level / Req TEXT	Spec_Number / Header	Req_Number	S/N	RFW	Lev/Meth FC	SS	AS	EQ	EXECUTION Documents	REPORTING Documents	Remarks	O/C	VCB Ref:
4	COL-RIBRE-SPE-0094 (PA&S § 3.18.3.1)(T)	4.1.1.176	-	COL-RFW-AI-0031			A					O	
5	COL-SS-AI-0008 Derating. The derating of electronic and electrical components shall be performed according to ESA PSS 01-301 or SSP 30312.	4.1.1.108	-									-	
6	SPE1216325 Derating. [RQ-0003_3.10.11] The derating of electronic and electrical components shall be performed according to ESA PSS 01-301 [AD 2.1.1] or SSP 30312 [AD 2.3.21].	4.1.1.108	-				A R					O	
6	SPE1216328 Derating. [RQ-0003_3.10.11] The derating of electronic and electrical components shall be performed according to ESA PSS 01-301 [AD 2.1.1] or SSP 30312 [AD 2.3.21].	4.1.1.108	-				A					O	COL-DOR-MN-0 0 2/00
6	SPE1216373 Derating. [RQ-0003_3.10.11] The derating of electronic and electrical components shall be performed according to ESA PSS 01-301 [AD 2.1.1] or SSP 30312 [AD 2.3.21].	4.1.1.108	-				A R					O	COL-DOR-MN-0 0 3/00

Interface Control Documents (ICD‘s)

- Interface requirements defined by customer; normally paragraph 5 of specification or specific Interface Requirement Documents (IRD's)
- ICD's are based on interface requirements and grow gradually in line with design progress, i.e. in addition to the wider requirements range the design capabilities as well as additional data are included as deemed necessary by the custodian to ensure interface compatibility
- Interface Control Documents
  - Describe Actual status at design level (i.e. no repetition of interface requirements!)
  - Formally agreements between interfacing design responsibles under control of upper design level (= approval of design).
  - ICD's must be verified as early as possible to ensure successful integration on upper level
  - Verification method depending on selected design.
  - ICD's are valid for EM and FM units except as explicitly stated

Verification Methods

- **Qualification**
  - **- Analysis** **(shall be final at PDR *)**
  - **- Review of Design (ROD)** **(shall be final at PDR *)**
  - **- Test**
  - **- Inspection**

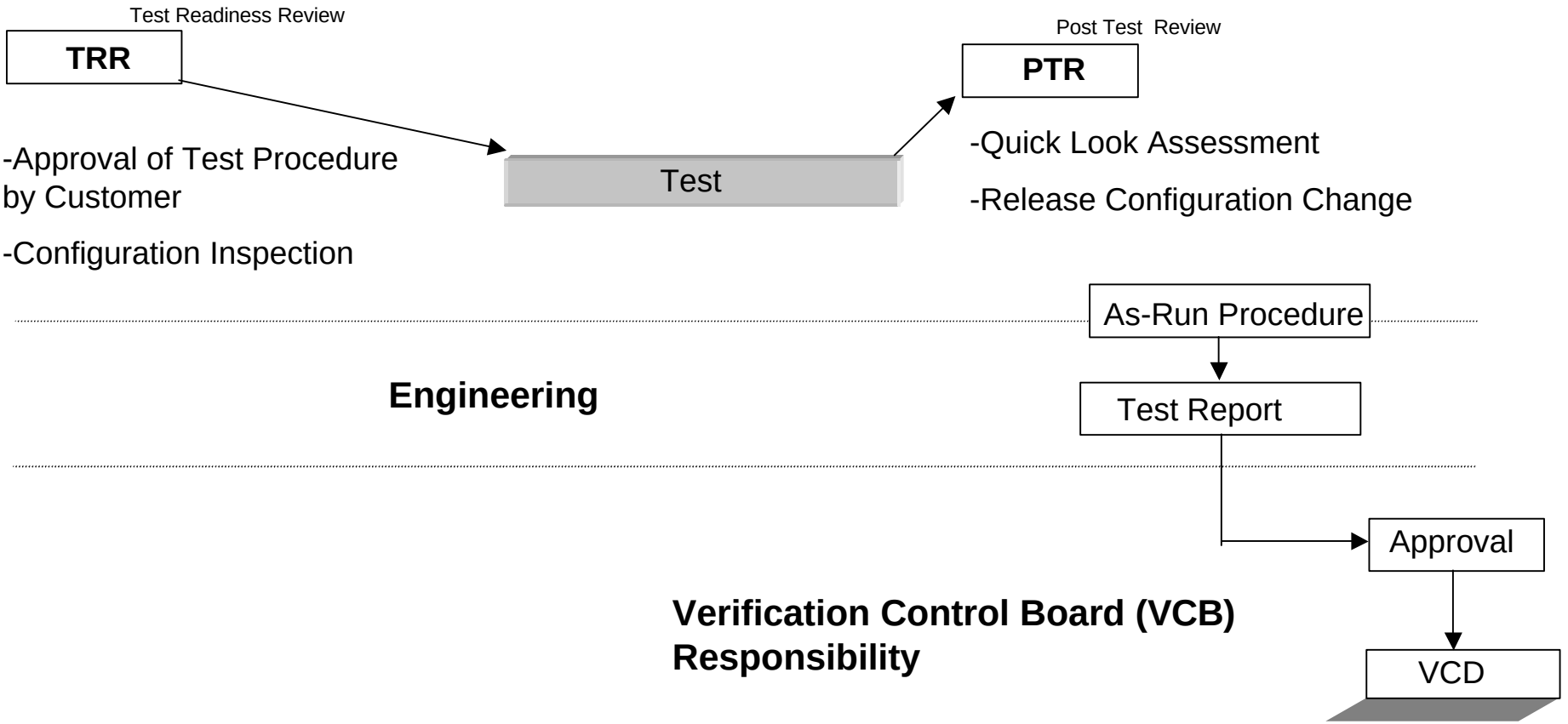
  Note: „Similarity“ maybe used for any method or the complete qualification
- **ICD's have additional verification close-out options**
  - **- Marking of ICD parameters on manufacturing drawings**
  - **- Reference to acceptance test procedure**
- **Acceptance**
  - **- Test**
  - **- Inspection**

Note: Acceptance criteria to be tailored to selected design to find especially workmanship failures

*** As at PDR lower level design released for manufacturing of those units used for functional system qualification**

Test Approval Flow

Test Review Board (TRB) Responsibility



Test Success Criteria Definition Options

I. After-Test-Evaluation

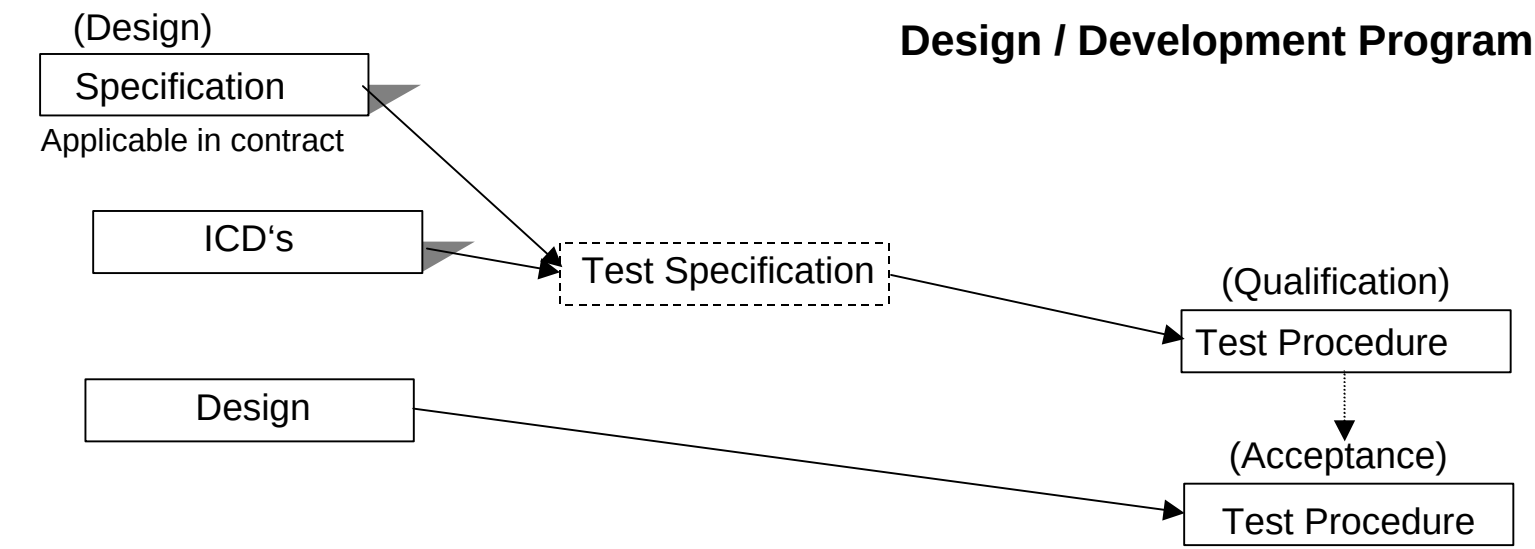
- **Qual. Test success criteria / test procedure based an design specification data / limits**
- **As-run procedure extended by "Engineering evaluation" for:**
  - **Variations due to temperatures, min./max. supply voltages**
  - **Measurement tolerances**
  - **Manufacturing tolerances**
  - **Wear-out / degradation versus time etc.**

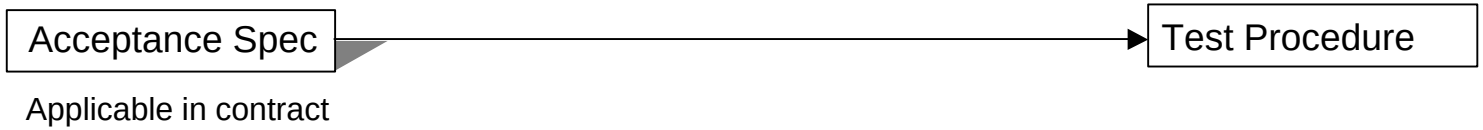
II. Pre-Test-Evaluation

- **Success criteria / test specification and / or procedure more stringent than specification or ICD, i.e. margins for tolerances, lifetime etc. are subtracted prior to test.**
- **No engineering evaluation necessary -> Prefered for Acceptance Tests**

Note: <u>Option II is more efficient but critical for marginal performances</u>; also customer approval of "extented" reqmts. prior to test

Procedure Relations



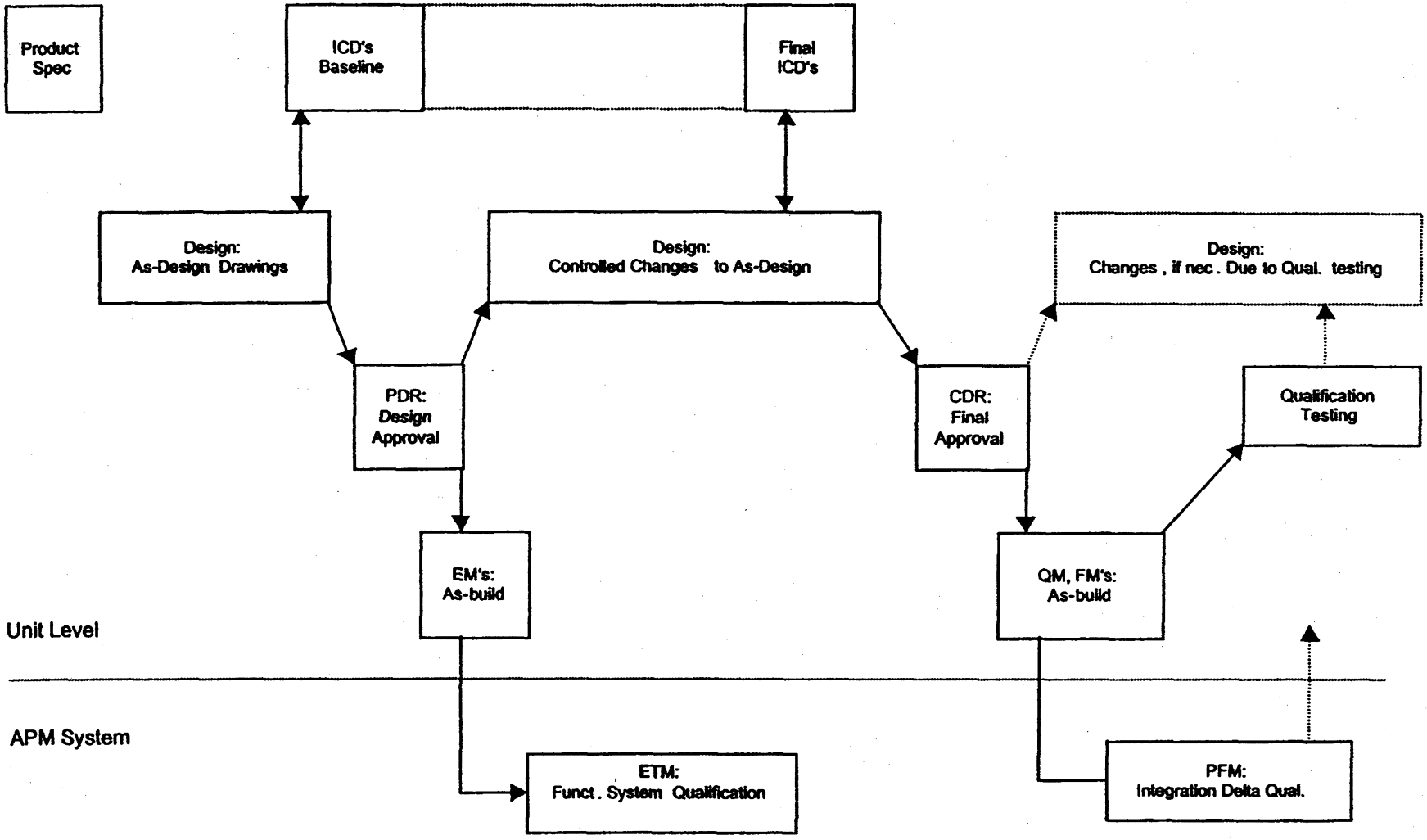


Qualification Model Philosophy

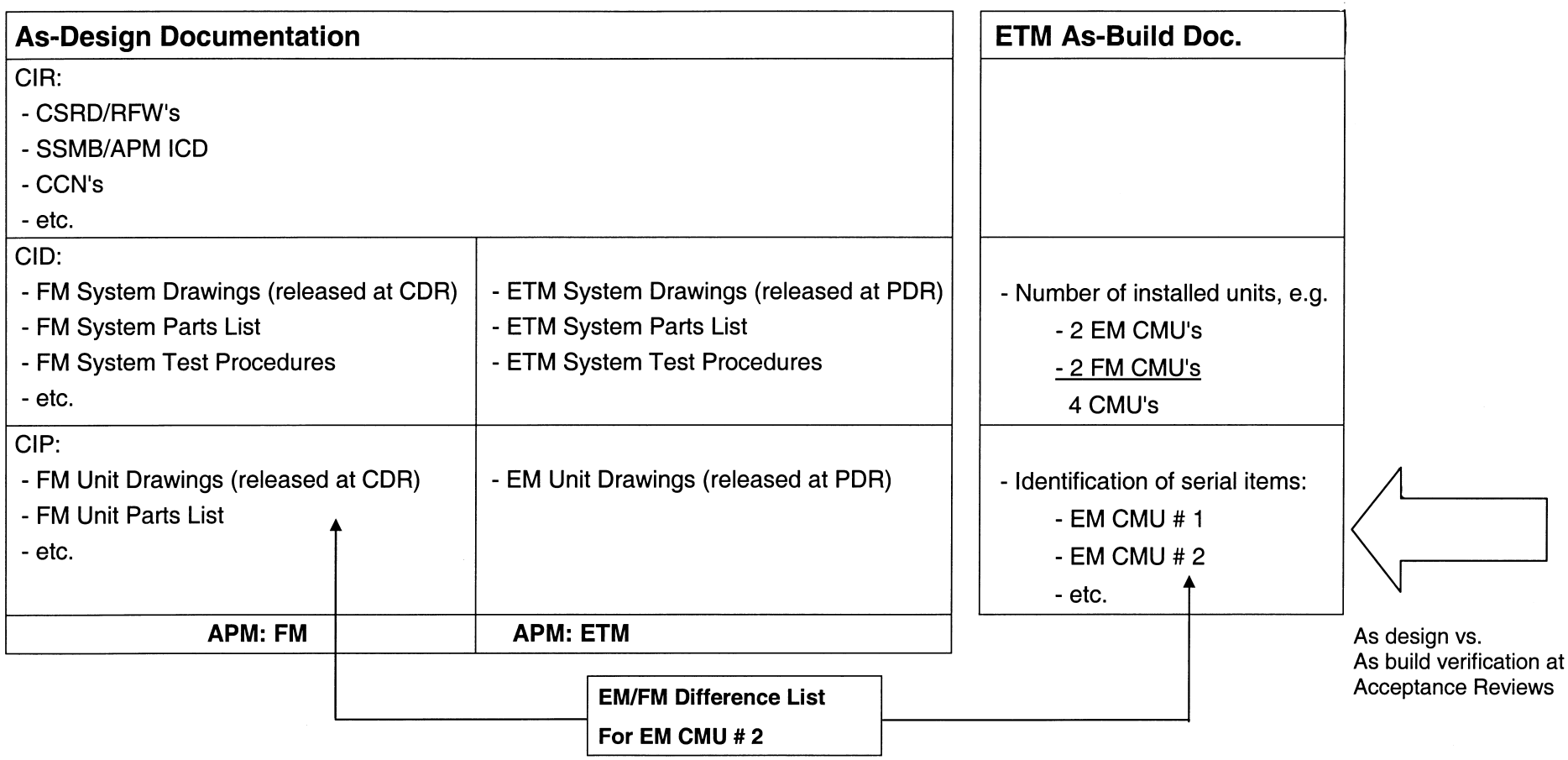
- **Qualification Model**
  - **Identical Flight Model design and manufacturing**
  - **High-reliability parts as for FM**
- **EQM**
  - **Identical Flight Model design and manufacturing**
  - **Commercial parts**
- **EM**
  - **Limited differences to Flight Model design (to be documented as EM/FM differences) and manufacturing**
  - **Commercial parts**
- **Protoflight Model**
  - **Flight Model tested with reduced levels/test durations**
  - **Acceptable for units with low complexity and/or similar to items qualified in different programs**

Notes:
- **QM best from technical point of view but high costs and late results**
- **EQM / EM needs extensive evaluations to proof that differences do not invalidate qualification objective.**

System Level Qual Philosophy (Columbus)



CIDL-ABCL-EM/FM Differences List Relations



EM/FM Differences Assessment

Equipment	Para.	Ref. To EM/FM Diff. Doc.	Impact on ETM Test Results (T40/T60) Yes	No	Assessment/Remark EM to FM FFF difference	Reference to FM CIDL
ATU	4.2.1	N/A		X	FM type is integrated and flight suitable	N/A
CFA, IRFA, ISFA inclusive DPS	4.2.10	RD 2.2.3.5		X	EU: EM functionality in line with FM; Fan motor: No significant difference, for details see para 4.2.10	COL-SREM-LI-0055, Iss. 1/-
CTCU	4.2.11	RD 2.2.4.1		X	No significant difference, QM is used for tesing	COL-KAY-LI-0046, Iss. 3/A
CTS	4.2.12	RD 2.2.3.5		X	EM identical to FM	*1; refer to para. 6.1
HCU	4.2.13	RD 2.2.4.1		X	No significant difference	COL-KAY-LI-0047, Iss. 3/A
CWSA	4.2.14	RD 2.2.3.5		X	EU: EM functionality in line with FM	COL-SREM-LI-0056, Iss. 1/-
FSU	4.2.15	Not existing		X	No significant difference	N/A
HS	4.2.16	RD 2.2.3.5,2.2.4.1		X	No significant difference	COL-DOR-HS-LI-0009, Iss. 4/7
IRSOV, ISSOV	4.2.17	RD 2.2.3.5		X	EM identical to FM	COL-CTI-LI-0026, Iss. 1/-
PPCS	4.2.18	RD 2.2.4.1		(X)	QM is timely not available; retest with representative model on PFM mandatory	N/A
PPOS	4.2.19	RD 2.2.4.1		(X)	QM is timely not available; retest with representative model on PFM mandatory	N/A
CDA	4.2.2	RD 2.2.3.5		X	No significant difference	*1; refer to para. 1.2
PPRA	4.2.20	RD 2.2.3.5		X	EM identical to FM	*1; refer to para. 1.3
TPS	4.2.21	RD 2.2.3.5,2.2.4.1		X	No significant difference	072530-154-553 (30.9.1999)
VVDD	4.2.22	RD 2.2.3.5		X	EM identical to FM	*1; refer to para. 8.1
RVPS, VVPS	4.2.23	RD 2.2.3.5		X	No significant difference	*1; refer to para. 9.1
TCV	4.2.24	RD 2.2.3.5		X	No significant difference	Parts List 2357123-1 Rev. D
MLU,ELS,RPCS	4.2.25	Not existing		X	EM and STE identical to FM	
OSS	4.2.26	Not existing		X	EM identical to FM	
PDU	4.2.27	RD 2.2.3.1		X	No significant difference	
PPSB	4.2.28	RD 2.2.3.2		X	No difference	COL-CIR-CDL-1003, Iss. 2/A

Table 5-1: EM to FM difference List - Equipment Level Synthesis for Functional Qualification Test

Verification Management and Control

- Verification needs strict and formal control
  - Requirements / Spec coherence over all responsibility levels (product and verification requirements)
  - Verification activities definition and planning
  - Implementation of RFW's and DDR's
  - Close-out status accounting
  - Generation of VCD's and COQ's
- Technical Competence / know-how to "control" technical results by experienced System Engineers
- Should be separate organizational element

Verification Status Accounting

- Due to high amount of data and changes computerized AIVDB (Assembly, Integration and Verification Data Base) mandatory generating / maintaining the VCD (Verification Control Document)
- Nowadays several options available (DOORS etc)
  - „ReqTrace“ from TRW used for Spacelab SW qualification status tracking
  - Spacelab VCD maintained manually
- For Columbus dedicated AIVDB developed during phase C / D; used on System Level (based on ORACLE with VCD extraction by ACCESS)

4.2.2

Primary structure and other non-replaceable items shall have the capability to remain functionally operational in-orbit for 15 years. All such items shall be accessible, inspectable and repairable in situ throughout their lifetime as required to restore system performance. This shall specifically include ORU interface hardware items which are part of a non-replaceable unit. Note (Requirement Clarification): Damage to sections of tubing is considered a non-credible failure. However, the repair of leakage due to maintenance of tubing loops and possible damage (e.g. thread damage) is required. There will be some non-removable items which cannot be qualified against 15 years but somewhere between 15 and 10 years based on existing qualification data.

Spec requirement					Closeout Docs	RFWs/DDRs	VCB Reference	Close-out status	Remarks
Para	Verification Method FC	SS	AS	EQ					
4.2.2	A				COL-RP-AI-0094(1) Iss 7/1	COL-RFW-AI-0028	COL-RIBRE-MIN-0106-04*	P	ESA pending. QDs and Cold Plates are addressed in COL-TN-AI-0150 and COL-TN-AI-0160.
					COL-TN-AI-0150(1) Iss 4/2				
					COL-TN-AI-0160(4) Iss 4/4				
					COL-TN-AI-0205 Iss 2/1				
	T				COL-ASA-TR-0003 Iss 2/-				
					COL-RP-AI-0204 Iss 1/-				
					COL-RP-AI-0248 Iss 1/1				
			A						

COLUMBUS System Requirements Document 4.2.2 **Lower Level close-out material**

CI ID	Product	Spec. Para		RFWs	Close-out Docs	Remarks
1083735------	Fire Annunciation and Suppression Panel	4.1.7.78	A		COL-RP-AI-0192 Iss 02/-	ME
		6.1.9.1.2	R		COL-TN-AI-0160 Iss 04/02	OL
		6.1.9.1.2	R		4000CA200 Iss -/-	OL
1216270------	Condensing Heat Exchanger Assy	3.1.1.1	T		COL-SEC-TN-0015(1) Iss 1/-;complete	
		3.1.1.1	T		COL-SEC-RP-0021(1) Iss 3/B;complete	
		3.1.1.1	T		COL-SEC-LI-0007(1) Iss 11/-;complete	
		4.1.7.78	A		COL-SEC-RP-0021 Iss 3/B	ME
1216293------	N2 Supply Line	3.1.1.1	T		COL-KAY-TR-0068(2) Iss 01/A;8;Annex	
		3.1.1.1	T		COL-KAY-TR-0101(2) Iss 01/A;8;Annex	
		3.1.1.1	T		COL-KAY-TR-0055(3) Iss 01/A;8;Annex	
		3.1.1.1	T		COL-KAY-TR-0041(3) Iss 01/00;AnnexA/B	
		3.1.1.1	T		COL-KAY-RP-0032 Iss 02/02;1.2	
		3.1.1.1	T		COL-KAY-RP-0016 Iss 01/00	
		3.1.1.1	T		COL-KAY-RP-0007 Iss 01/D;3.2	

astrium

COLUMBUS

Dok.Nr./Doc.No.: COL-RIBRE-RFW-0136

Ausgabe/Issue: 1/- Datum/Date: 09.01.2002
Überarb./Rev.: A Datum/Date: 18.04.2002
Seite/Page: 1 von/of: 2

Request for Waiver (RFW)

(3) TITLE OF WAIVER

XCMU Data Connectors

(4) INITIATOR OF WAIVER		(5) INITIATED BY	(5) IN PRODUCTION
CONTRACTOR: ASTRIUM ORGANIZATION: IO 41	NAME: D.Lepand		[x] YES [ ] NO

(7) S/S AFFECTED	(8) CI AFFECTED	(9) MODEL/VERSION	(10) SERIAL/LOT NO.
XCMU	CI: 1083703	PFM	S/N:1

(11) RQMT. DOCUMENT AFFECTED

DOCUMENT NUMBER, ISS/REV	DOCUMENT TITLE:	AFFECTED PARAS/RQMT. ID:
ESA RQ001 4/-	COLUMBUS Syst. Requirement Document	4.7.6.1/ID 155;

(12) OTHER RELATED DOCUMENTS AFFECTED

DOCUMENT NUMBER, ISS/REV	DOCUMENT TITLE:	AFFECTED PARAS/RQMT. ID:
COL-RIBRE-SPE-0101, 1/ E	PA / Safety Specification	3.7.17

(13) SIMILAR PREVIOUS RFW	(14)RFW AFFECTS.		(15) CLASS	
COL-RIBRE-RFW-0136	[x] SYSTEM	[ ] SUBSYSTEM	[x] EQUIPMENT	[ ] 1 [ ] 2

(16) DETAILS

The data connectors J95, J96, J105, J106, J115 and J125, as shown in the attachment violates the referenced CSRD requirements 4.7.6.1. In all cases two adjacent connectors have the same keying.

XCMU connector keying is provided on attached drawing

(17) JUSTIFICATION

To CSRD para 4.7.6.1 (no wrong connection shall be possible):

Nominal and redundant connectors of modules have the same keying due to possible interchangeability without replacement of connectors.

Erroneous misconnection of the test or system harness due to the same keyed connectors cannot damage the CXMU nor the interfacing units.

Box connector and harness connectors are color coded labeled and the installation/ replacement procedures will ensure, that wrong mating is avoided on-orbit.

SEE ATTACHED TWO PICTURES.

(18) DISPOSITION

AUTHORITY	ENGINEERING	PRODUCT ASSURANCE	PROJECT MANAGER/ CCB CHAIRMAN	DISPOSITION	CONF. MGMT.
CONTRACTOR EQUIPMENT LEVEL DATE:					
CONTRACTOR SUBSYSTEM LEVEL DATE:					
CONTRACTOR SYSTEM LEVEL DATE:	19.4.02	19.04.02	23.4.02	Approved	24-4-2
CUSTOMER DATE:	02 Feb 04	02.02.04		APPROVED	23/04/2004

Document/Design Development Record (DDR) To ESA

(2) CI Nomenclature	(3) CI Number	(4) Affected organisation
Columbus APM	1211382	ESA

(5) Document title	(6) Doc.-Id., iss/rev	(7) Production affected?
APM Human Factors Engineering Requirements	COL-ESA-RQ-013 Iss.3, Rev.E	[X] NO [ ] YES

(8) Description of proposed interpretation/detailization/clarification

(Paragraph/Issue/rev if necessary)

1. Colour temperature, para 8.4.3

It is assumed that the space station common luminaries fulfill the changed colour temperature.

2. EVA (IVA) Connectors Spacing, para 13.6.3.2

The new requirement is more restrictive than for the ISS asking for 360° clearance around the connectors (ISS: 270°). It is assumed that ESA changes requirement in accordance with approved ISPR Utility Panel lay-out PIRN.

(9) Reason/Initiated by

COL-ESA-ECR-024, COL-RIBRE-CCN-1034

(10) Instruction

The revised doc is accepted with above assumptions (box 8)

Signatures:

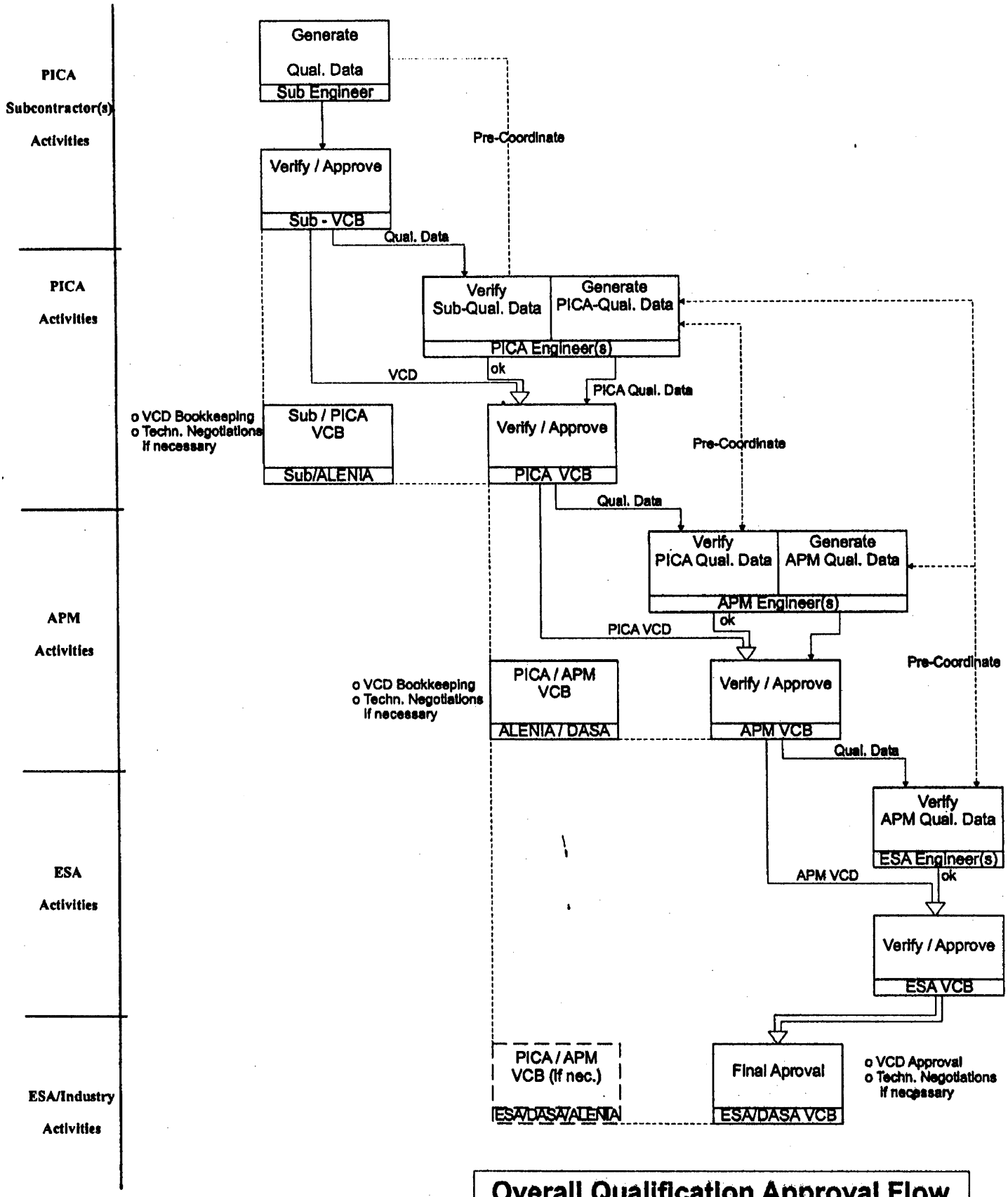
(11) Author of DDR	(12) Systemeng. responsible	(13) Project manager
	4.11.98	10.11.98

ESA disposition:

(14) Disposition		(15) Technical responsible	(16) Project manager
Agreed:	[X]	Engineering:	
Rejected:	[ ]		
- Rationale:		PA/S: 27.11.98	27 NOV '98

(17) Implementation/Close out reference

Date: Signature:



Overall Qualification Approval Flow

CERTIFICATE OF QUALIFICATION

Cl. No. : 1081625	Cl. Spec. no : COL.RIBRE.SPE.0010 Issue/Rev : 6	Cl. Nomenclature: Data Management Sub-System
Part No. :	Model/Serial No: EM V2.1/V4.0	

The following is certified :

1. All exceptions listed against lower level certifications have been resolved and closed out.

2. The item has successfully been qualified against all requirements of specification(s) :

   DMS sub/system specification : COL.RIBRE.SPE.0010 issue 6

   and in accordance with the associated methods/processes as documented in the related

   Verification Control Document DMS.MMT.VCD.0002 issue 5 & Verification Status Report :

3. ~~**The item has successfully passed all safety related tests.**~~ *Not Applicable at S/S level*

4. All hazards identified in the Safety Analyses are eliminated or controlled and all Hazard Reports are closed.

5. A configuration inspection has been performed with the result that the item complies with the contractual baseline as per **CIDL DMS.MMT.COL.0004 , Issue 5, Rev.-.**

6. Each deviation from the specification/drawing has been approved by the Material Review Board or by a contractual waiver.

7. The item has successfully performed its specified function in the integrated flight configuration, as reported in :

	DMSS contractor		Prime		ESA	
	NAME	DATE	NAME	DATE	NAME	DATE
ENGINEERING	[signature]	10.2.02				
PRODUCT ASSURANCE	[signature]	13.2.02				

Certificate of Qualification

CI No.:	CI Spec No.:	CI Nomenclature:
1211382	COL-ESA-RQ-001, Iss. 4, Rev. B	Columbus/APM System

Respecting also changes and additions made to the item since issue of the lower level Certificate of Qualification the following is certified:	Exceptions
1. All exceptions against lower level certifications have been resolved and closed out.	Annex 1
2. The item has successfully been qualified against all requirements of specification(s): a) COL-ESA-RQ-001, 4/B b) COL-ESA-RQ-013, 3/H,m plus errata sheets 04.11.03, 15.01.04, 23.03.04 c) COL-RIBRE-SPE-0020, 5/E (for COL-ESA-RQ-014, 2/E) d) SSP 41150, Rev. H: IRD SSMB to APM e) SSP 41152, Rev. D: ISPR IRD f) SSP 411017/Part 1, Rev. F: Rack to Press. Logistics Module ICD g) SSP 41004/Part 1, Rev. G: CBM to Press. Elements ICD h) SSP 41015/Part 1, Rev. F: Common Hatch & Mechanisms to Press. Elements ICD in accordance with the associated methods/processes as documented in the related Verification Control documents: a) COL-RIBRE-VCD-0030, 2/A b) COL-RIBRE-VCD-0031, 2/A c) COL-RIBRE-VCD-0032, 2/A d) COL-RIBRE-VCD-0033, 2/A* e) COL-RIBRE-VCD-0034, 2/A* f) COL-RIBRE-VCD-0035, 2/A g) COL-RIBRE-VCD-0036, 2/A h) COL-RIBRE-VCD-0037, 2/- * Verification methods as defined in COL-ESA-RQ-032, 2/E	Annex 2
3. The item has successfully passed all safety-related tests.	Annex 3
4. All hazards identified in the Safety Analyses are eliminated or controlled and all Hazard Reports are closed.	Annex 4
5. A configuration inspection has been performed with the result that the item complies with the contractual baseline as per CIDL COL-RIBRE-CDL-0002, iss. 3/A. Differences between the configuration used for system qualification tests and the released design have been identified and judged by the Test Review Board as having no impacts on the qualification objectives.	
6. Each deviation from the specification/drawing has been approved by the Material Review Board or by a contractual waiver.	Annex 5

Contractor	Prime	ESA
Engineering: N.A. Date:	Engineering: Date: 1.10.2004	Engineering: Date:
PA: N.A. Date:	PA: Date: 1.10.2004	PA: Date:

Certificate of Qualification

CI No.:	CI Spec No.:	CI Nomenclature:
1211382	COL-ESA-RQ-001, Iss. 4, Rev. B	Columbus/APM System

Annex 1:

Exceptions against lower level Certificates of Qualification

The following lower level Certificates of Qualification are not completed (for details see section 3 of volume 1 of the QR 2 Data Package):

Item	CI	Status/Remarks
PICA	1235173	To be finalized, some RFW's open
WPA	1216187	To be finalized, some RFW's open
Hydrocyclone (OSE)	157115	To be prepared
CP	1216222	To be finalized
ECLSS	1081612	Exceptions open
PPOS	1216237	PAD-05 open
CHX	1216270	Delta vibration qualification open; no issue expected (COL-RP-AI-0104, iss. 5/-, appendix N)
HCU	1216327	COL-DOR-RFW-0235 open
MMU	1235142	Delta qualification for Winchester replacement by Solid State Memory open
HRM	1235108	Delta qualification for "Enhancements" open
HUB/LAN Switch	1235143	Delta qualification for "Enhancements" open
VDPU	1235172	To be finalized
PBU	1138547	Design/qualification of Power Branching Unit for supply to Ext. P/L Parking interface was delayed due to programmatic reasons
Laptop/Power converter	TBD	To be provided by NASA

Certificate of Qualification

CI No.:	CI Spec No.:	CI Nomenclature:
1211382	COL-ESA-RQ-001, Iss. 4, Rev. B	Columbus/APM System

Annex 2:

Open Qualification Items

For all customer requirements documents, which are the qualification reference, 100% close-out has not been achieved yet. For the following line items industry has still to provide formal qualification evidence (detailed in the related VCD's).

EADS SPACE TRANSPORTATION

Log of open items/exceptions Status Sheet

COL-RIBRE-COQ-0001, 2/A

Open Item	Exception	Actionee Due Date	Exception Sheet Prep Date	Close-Out Date	Resolution of Exception
	COL-ESA-RQ-001: CSRD				
2.1	10.1.11	EADS tbd	01.10.2004		Partially open:. Data on fluid connectors open.
2.2	10.1.8	EADS tbd	01.10.2004		Partially open: Data for ASCU and PFM integration stand open.
2.3	10.2.1	EADS tbd	01.10.2004		Partially open: Data for GLTS open.
2.4	11.1.3	EADS tbd	01.10.2004		Open: Lower level to be provided
2.5	11.2.1.2.2	EADS tbd	01.10.2004		Open
2.6	11.6.3.1	EADS tbd	01.10.2004		Open: -Procedure: Generic P/L I/F Module: GEN PL 028; -Test planned in Nov. 2004
2.7	4.4.1.1	EADS tbd	01.10.2004		Open: Test planned up to end 2004
2.8	4.4.2.3	EADS tbd	01.10.2004		Open
2.9	4.4.4.2	EADS tbd	01.10.2004		Partially open: Data for fluid fault propagation part open
2.10	4.5.1.3	EADS tbd	01.10.2004		Status: 1. Verification of "A" at FC-level: Closed by COL-RIBRE-TN-1713 2. Verification "T" at FC-level: Agreed with ESA open for FAR I 3. Verification "T" at Assy-level: OPEN
2.11	4.5.20.2	EADS tbd	01.10.2004		Partially open: Flaking paint / MRB not conclusive yet

Certificate of Qualification

CI No.:	CI Spec No.:	CI Nomenclature:
1211382	COL-ESA-RQ-001, Iss. 4, Rev. B	Columbus/APM System

Annex 4:
Hazard Reports

All Hazard Reports are available though some are not yet finalized as shown on the following page.

In several cases the verification has to be completed (Safety Verification Tracking Log).

EADS SPACE TRANSPORTATION

Log of open items/exceptions Status Sheet

COL-RIBRE-COQ-0001, 2/A

Open Item	Exception	Actionee Due Date	Exception Sheet Prep Date	Close-Out Date	Resolution of Exception
4.1	ELE-0001 not signed	NASA Jan.2005	01.10.2004		Closure of NASA action SRP-03-043
4.2	HEC-0001 not signed	NASA tbd	01.10.2004		Approval of CBCS assessment
4.3	HEC-0005 not signed	NASA tbd	01.10.2004		Approval of CBCS assessment
4.4	HEC-0007 not signed	NASA tbd	01.10.2004		Approval of CBCS assessment
4.5	HEC-0010 not signed	NASA tbd	01.10.2004		Approval of CBCS assessment
4.6	HUM-0005 not signed	ESA tbd	01.10.2004		Approval of COL-RFW-AI-0094
4.7	MAT-0004 not signed	ESA tbd	01.10.2004		Approval of PIRN COL-RIBRE-SPE-0164-PIRN-0024
4.8	PRE-0001 not signed	NASA tbd	01.10.2004		Approval of CBCS assessment
4.9	STR-0001 not signed	NASA tbd	01.10.2004		1.Review EPF latch mech.assessment 2.Acceptance that no NDI test performed after proof-test
4.10	STR-0004 not signed	NASA tbd	01.10.2004		Approval of CBCS assessment
4.11	TEC-0002 not signed	EADS-ST end Nov. 2004	01.10.2004		Update cause 9 wrt hydrocyclone
4.12	TEC-0003 not signed	NASA tbd	01.10.2004		Approval of CBCS assessment
4.13	TEC-0004 not signed	NASA tbd	01.10.2004		Approval of CBCS assessment

Certificate of Qualification

CI No.:	CI Spec No.:	CI Nomenclature:
1211382	COL-ESA-RQ-001, Iss. 4, Rev. B	Columbus/APM System

Annex 5:

Deviations against specifications/drawings

Open Request For Deviations (RFW's) are presented and assessed in the following pages.

SPR's/NCR's are presented and assessed in the QR 2 Data Package volume 1, para. 2.3/2.4.

EADS SPACE TRANSPORTATION

Log of open items/exceptions Status Sheet

COL-RIBRE-COQ-0001, 2/A

Open Item	Exception	Actionee Due Date	Exception Sheet Prep Date	Close-Out Date	Resolution of Exception
5.1	COL-DOR-RFW--0215 open	Alenia 29.10.2004	01.10.2004		Update RFW based on ECS re-test results
5.2	COL-DOR-RFW--0220 open	Alenia 29.10.2004	01.10.2004		Update RFW based on ECS re-test results
5.3	COL-DOR-RFW--0230 open	EADS-ST mid 2005	01.10.2004		Implement colour coding and update RFW based on ECS re-test results
5.4	COL-DOR-RFW--0235 open	ESA tbd	01.10.2004		Approve RFW
5.5	COL-MT-RFW--0109 open	EADS-ST 29.10.2004	01.10.2004		Update RFW identifying ESA verification reqmts. differences
5.6	COL-MT-RFW--0110 open	EADS-ST 29.10.2004	01.10.2004		Update RFW identifying ESA verification reqmts. differences
5.7	COL-MT-RFW--0146 open	ESA tbd	01.10.2004		Approve RFW
5.8	COL-MT-RFW--0147 open	ESA tbd	01.10.2004		Approve RFW
5.9	COL-RFW-AI-0094 open	ESA tbd	01.10.2004		Approve RFW
5.10	COL-RFW-AI-0105 open	Alenia 29.10.2004	01.10.2004		Update RFW as requested by ESA
5.11	COL-RFW-AI-0130 open	ESA tbd	01.10.2004		Approve RFW
5.12	COL-RFW-AI-0134 open	Alenia 29.10.2004	01.10.2004		Update RFW as requested by ESA
5.13	COL-RIBRE-RFW--0191 open	ESA tbd	01.10.2004		Approve RFW
5.14	COL-RIBRE-RFW--0218 open	ESA tbd	01.10.2004		Approve RFW

Acceptance

- **Certificate of Acceptance (COA) for each serial number:**
  - **Configuration identical to "Qualified Design„ CIDL**
  - **Reference to COQ approved by customer**
  - **Acceptance activities performed in accordance with approved test procedure successful**

- **COA to be countersigned by customer as close-out for DIL line item**

- **Certificate of Conformance**
  - **Formal/legal declaration**

- **Detailed contents of documents differ depending an company standards; quite different approach for American items**

CERTIFICATE OF ACCEPTANCE

(2) The endorsements herein certify that the item offered for acceptance has been manufactured, assembled and tested in accordance with released engineering data and complies in all respects with contractual requirements, except as recorded in the List of Exceptions of this certificate.

(3) CI. NO.	(4) CI. SPEC. NO.	(5) CI. NAME
1235086	COL.RIBRE.SPE.0085 Issue 2 Rev. D	PDU

(6) PART NO.	INDEX	(7) SERIAL NO.	(8) ACCEPTANCE LEVEL
C22380CA01		FM1	TA&S-Plan Par. 15.3
			1 2 3 X 4

THE FOLLOWING IS CERTIFIED:	(10) EXCEPTIONS
(9)	
1. All exceptions listed against lower level certifications have been resolved and closed out. Except open work list/open test list	N/A
2. Qualification of the item is satisfactorily completed and recorded in COL.SXT.VCD.003 Issue 4 rev. -	LOE
3. A Configuration Inspection has been performed and the item complies with the contractual baseline.	OK
4. Each departure from specification and drawing has been approved by the Material Review Board or by contractual waiver.	Part I Sect 10.3 RLOE
5. Hazards identified in Safety Analyses are closed or accepted as controlled residual hazards.	OK
6. Acceptance testing in accordance with a approved test procedure has been successfully completed and all discrepancies have been resolved.	LOE
7. The Acceptance Data Package ADP No. COL.SXT.ADP.0011 Issue 1 Rev. - complete and is available for shipment with the configuration Item.	OK
8. Open work/test and unresolved non-conformances defined in the ADP are acceptable for transfer to the user site.	OK
9. Packaging and shipping arrangements are defined and agreed as per	Delivery Insp Rep COL.SXT.RP.0453

The undersigned certify that all exceptions listed can be satisfactorily resolved at the place and time stipulated in the Log of Exceptions without degradation of the required CI performance.

(11) LOWER TIER SUBCONTRACTOR	DATE	ALCATEL	DATE	ASTRIUM	DATE	ESA	DATE
PRODUCT/ QUALITY ASSURANCE	18/09/01	S.ZANINOTTI	19.09.01	W. Hoffmann			
PROJECT MANAGEMENT	19/09/01	C. Bayer					

CERTIFICATE OF CONFORMANCE

Nomenclature	Specification Number	
PDU	COL.RIBRE.SPE.0085 Issue 2 rev. D	
Drawing/Identification Number	Serial Number	Model
C22380CA01	FM1	FM
CI Number	Contract Number	
1235086	C.CD.SEXI.22 Issue 2	

CERTIFICATION:

We certify that the product defined above is found in accordance with the engineering documents, the quality requirements and the order for development / production and has been inspected and accepted.
The product Status is documented in the pertinent.
Acceptance Data Package: COL.SXT.ADP.0011 Issue 1 Rev. -

Prepared by: S. BERNA Dept: BO/EI/OC Date: 14/09/01

Approved by: S. ZANINOTTI Dept: Q/EVA Date: 14/09/01

Summary

o Fulfillment of all applicable requirements and ICD agreements by all deliverable items has to be rigorously controlled

o Effort for Requirements/Verification Management and Control very high

o Computerized tools allow for efficiency increase and failure avoidance (cost avoidance)

o For improvement: Cooperative entry of data and common useage of Requirements / Verification Data Base on all levels improves team cooperation and Program success