

Contents

Generic Requirements Notice of Disclaimer	iii
List of Figures	xi
List of Tables	xii
Preface	xiii
1 Introduction	
1.1 Summary	1-1
1.2 Motivation	1-1
1.2.1 Design for Reliability and Quality	1-2
1.2.2 Keys to Product Reliability	1-3
1.3 Relationship to Other Requirements Documents	1-4
1.4 Conformance to Requirements	1-5
1.5 Updating the RQSSGR	1-5
1.6 Definitions	1-6
1.6.1 Requirements Terminology	1-6
1.6.2 Definition of Terms	1-6
1.7 Reason for Reissue	1-7
1.7.1 Major Areas of Change from TR-TSY-000284, Issue 1, to TR-NWT-000284, Issue 2	1-7
2 System Design and Architecture	
2.1 Introduction	2-1
2.2 System Reliability Performance	2-1
2.2.1 Circuit Switch	2-2
2.2.2 Public Packet Switched Network (PPSN) Network Elements	2-3
2.2.3 Common Channel Signaling (CCS) Network	2-4
2.2.3.1 Signaling Transfer Point (STP)	2-6
2.2.3.2 Service Control Point (SCP)	2-6
2.2.3.3 Service Switching Point (SSP)	2-6
2.2.4 Operator Services System	2-6
2.2.5 Integrated Services Digital Network (ISDN)	2-7
2.2.6 Operations Capability	2-8
2.2.6.1 Automatic Message Accounting	2-8
2.2.6.2 Switching Control and Surveillance System Interface	2-8
2.2.6.3 Other Operations Systems Interfaces	2-9
2.2.6.4 Visibility, Diagnostics, and Control	2-9
2.2.7 Maintenance	2-10
2.3 Hardware Design and Architecture	2-10
2.3.1 Reliability Assurance Program	2-10
2.3.2 Reliability Architecture	2-11
2.3.2.1 Design Objectives	2-11

2.3.2.2	Fault Tolerance	2-11
2.3.2.3	Maintenance Labor	2-14
2.3.3	Reliability Analysis	2-14
2.3.3.1	System Architecture	2-16
2.3.3.2	Fault Detection	2-19
2.3.3.3	System Recovery	2-20
2.3.3.4	Maintenance and Repair	2-21
2.3.3.5	Equipment Reliability Prediction	2-22
2.3.3.6	System Reliability Modeling	2-23
2.3.4	Reliability and Quality Specification	2-28
2.3.4.1	Reliability Design Objectives	2-28
2.3.4.2	System Reliability Models	2-29
2.3.4.3	Component Reliability and Quality Program	2-29
2.3.4.4	Software Reliability and Quality	2-29
2.3.4.5	Circuit Pack Reliability	2-29
2.3.4.6	Physical Design	2-30
2.3.4.7	Testing	2-30
2.3.4.8	Supplier's Quality and Inspection Program	2-30
2.3.4.9	Manufacturing Process	2-30
2.3.4.10	Product Support	2-31
2.3.4.11	In-Service Performance	2-31
2.3.5	Traffic	2-31
2.3.6	Subcontracted Design, Development, and Manufacture	2-31
2.3.7	Physical Design and System Environment	2-32
2.3.7.1	Physical Design	2-32
2.3.7.2	Network Equipment-Building System	2-34
2.3.7.3	Power	2-34
2.3.8	Human Factors	2-35
2.4	Software Design and Architecture	2-36
2.4.1	Definitions	2-36
2.4.2	Design for Reliability and Quality	2-38
2.4.2.1	Fault Detection, Containment, Recovery and Reporting	2-38
2.4.2.2	Fault History	2-39
2.4.2.3	Trend Detection	2-39
2.4.2.4	Prevention of Interference	2-40
2.4.2.5	Concurrency	2-40
2.4.2.6	Modularity/Interdependency	2-40
2.4.2.7	High-Level Languages	2-41
2.4.2.8	Design and Architecture Documentation	2-41
2.4.2.9	Database Translations	2-41
2.4.2.10	Data Integrity	2-42
2.4.2.11	Operations Systems (OS) Compatibility	2-42
2.4.2.12	Site Configuration	2-42
2.4.3	Firmware	2-42
2.4.3.1	Design Methodology	2-43
2.4.3.2	Firmware/Software Coupling	2-43
2.4.3.3	Stability	2-43

2.4.3.4	Mounting	2-44
2.4.3.5	Classification	2-44
2.4.3.6	Considerations for Update Procedures	2-44
2.4.3.7	Circuit Pack Level Testing	2-45
2.4.3.8	Pass/Fail Indication	2-45
2.4.3.9	Record Administration	2-45
2.4.3.10	Change History	2-45
2.4.3.11	Identification	2-46
2.4.3.12	Downward/Upward Compatibility	2-46
2.4.3.13	Traceability	2-46
2.4.3.14	Spare Circuit Pack Administration	2-46
2.4.3.15	Documentation	2-47
2.4.4	Patching	2-47
2.4.4.1	Patch Monitoring	2-47
2.4.4.2	Patch Assurance	2-48
2.4.4.3	Patch Sequence Numbers and Identification	2-50
2.4.4.4	Patch Propagation to Other Releases	2-50
2.4.4.5	Patch Space	2-51
2.4.4.6	Defective Patches	2-51
2.4.4.7	Writable Firmware Devices	2-51
2.4.4.8	Feature Patching	2-52
2.4.4.9	Patch Information	2-52
2.4.4.10	Patching Tools	2-54
2.4.4.11	Patch Measurements	2-57
2.4.5	Testing	2-57
2.4.5.1	Requirements Common to Test Phases	2-59
2.4.5.2	Module Testing	2-63
2.4.5.3	Functional Unit Testing	2-64
2.4.5.4	Integration Test	2-65
2.4.5.5	System Test	2-68
2.4.5.6	First Office Application (FOA) Testing	2-71
2.4.6	Feature/Release Delivery Information	2-73
2.4.6.1	Feature/Release Availability Information	2-74
2.4.6.2	Feature Request Dates	2-74
2.4.6.3	Release Support Period	2-74
2.4.6.4	Dropped or Delayed Features or Releases	2-74
2.4.7	Referenced Requirements	2-74
2.4.7.1	Software Quality Program Generic Requirements	2-75
2.4.7.2	Software Reliability and Quality Acceptance Requirements	2-75
2.4.7.3	R&Q Measurements for Telecommunications Systems (RQMS)	2-76
2.5	Conformance to Requirements	2-76
2.5.1	Customer's Technical Analysis Program	2-77
2.5.1.1	Design Analysis	2-77
2.5.1.2	Implementation Analysis	2-78
2.5.1.3	System Change Analysis	2-79
2.5.2	Customer's Reliability and Quality Analysis Program	2-79
2.5.2.1	Design Reliability Analysis	2-80

2.5.2.2	Reliability and System Architecture Testing	2-81
2.5.2.3	In-Service Performance	2-81
2.5.2.4	Product Support	2-83
2.5.2.5	Physical Design	2-83
2.5.2.6	Devices and Components	2-83
2.5.2.7	Quality Program	2-84
2.5.2.8	Manufacturing Program	2-84
2.5.2.9	Product Testing	2-85
2.5.2.10	Product Inspection	2-85
2.5.2.11	Process Audit Program	2-85
2.5.2.12	Software	2-86
2.5.2.13	Customer Documentation Needs	2-87
2.5.3	Generic Source Inspection Program	2-88
2.5.3.1	Introduction	2-88
2.5.3.2	Scope	2-89
2.5.3.3	Sampling Plans	2-98
2.5.3.4	Quality Standard Calculation	2-99
2.5.3.5	Reporting	2-104
2.5.3.6	Software	2-105
2.5.3.7	Circuit Switch Performance Tests	2-105
2.5.3.8	Supplementary Information	2-106

3 Manufacturing and Production

3.1	Introduction	3-1
3.2	Testing	3-1
3.2.1	Overview	3-1
3.2.2	Background	3-2
3.2.3	General Definitions of Completed Items	3-3
3.2.4	Overall Test Process Requirements	3-4
3.2.4.1	On-Going Production	3-4
3.2.4.2	Retest/Repair of Field Returned Circuit Packs	3-6
3.2.4.3	Sampling and Standards of R&Q in Independent Product Inspection	3-8
3.2.4.4	Product and Process Requalification	3-8
3.2.5	Product Testing Requirements	3-8
3.2.5.1	Common Testing Requirements	3-8
3.2.5.2	Detailed Completed Item Testing Requirements (for On-Going Production)	3-13
3.2.5.3	Detailed Field-Returned Circuit Pack Testing Requirements	3-23
3.3	Component and Device Reliability	3-25
3.3.1	Overview	3-25
3.3.2	Supplier and Component Qualification	3-26
3.3.2.1	Vendor Location Visits	3-26
3.3.2.2	Device Qualification	3-26
3.3.2.3	Component Requalification	3-27
3.3.2.4	Equipment Supplier Notification	3-27

3.3.2.5	Lists of Approved Suppliers/Component Types	3-27
3.3.2.6	Equipment Purchased from Another Supplier	3-28
3.3.3	Lot Controls	3-28
3.3.3.1	Individual Device Tests	3-28
3.3.3.2	Device Screening/Reliability Audits	3-28
3.3.3.3	Lot Acceptance	3-28
3.3.3.4	Summary of Results	3-29
3.3.4	Feedback and Corrective Action	3-29
3.3.4.1	Component Drop-Out Levels	3-29
3.3.4.2	Analysis of Component Replacement Data	3-29
3.3.5	Device Quality Levels	3-29
3.4	Product Inspection	3-30
3.4.1	Overview	3-30
3.4.2	Inspection Activity	3-31
3.4.3	Standards of Reliability and Quality	3-31
3.4.4	Scope	3-31
3.4.5	Testing a Random Sample of All Product	3-31
3.5	Supplier Data Program	3-31
3.5.1	Overview	3-31
3.5.2	Forms of Inspection	3-32
3.5.3	Sample Size	3-32
3.5.4	Periodic Product and Process Requalification Test	3-33
3.5.5	Reinstitution of Inspection	3-33
3.5.6	Subcontractor Inspection Data	3-33
3.6	Quality Program	3-33
3.7	Manufacturing Program	3-34
3.8	Periodic Product and Process Requalification	3-36
3.8.1	Physical Design and NEBS	3-38
3.8.2	Circuit Switch Functional Parameters	3-39
3.8.2.1	Basic Call Processing	3-39
3.8.2.2	Call Processing Features	3-40
3.8.2.3	Loop Signaling	3-41
3.8.2.4	Trunk Signaling	3-42
3.8.2.5	AMA Testing	3-42
3.8.2.6	Transmission Testing	3-43
3.8.2.7	Service Recovery and Protection	3-44
3.8.2.8	Equal Access	3-45
3.8.2.9	Maintenance Activities	3-46
3.8.2.10	ISDN	3-48
3.8.2.11	Common Channel Signaling	3-48
3.8.3	Packet Switched Network Functional Capabilities	3-48

4 In-Service Performance and Product Support

4.1	In-Service Performance	4-1
4.1.1	Overview	4-1
4.1.1.1	Reliability and Quality Measurements	4-2

4.1.1.2	Outage Performance	4-2
4.1.1.3	Field Performance Studies	4-2
4.1.2	Supplier's Program	4-3
4.1.2.1	System Performance Monitoring	4-3
4.1.2.2	Software Performance Tracking	4-3
4.1.2.3	Hardware Replacement Tracking	4-4
4.2	Product Support	4-4
4.2.1	Reliability and Quality Cost	4-4
4.2.1.1	Introduction	4-4
4.2.1.2	Supplier's Reliability and Quality Cost Program	4-6
4.2.2	Engineering and Ordering	4-6
4.2.2.1	Overview	4-6
4.2.2.2	Requirements	4-7
4.2.3	Installation	4-12
4.2.3.1	Overview	4-12
4.2.3.2	Requirements	4-12
4.2.4	First Office Application	4-14
4.2.4.1	Overview	4-14
4.2.4.2	Requirements	4-15
4.2.5	Training	4-15
4.2.5.1	Overview	4-15
4.2.5.2	Requirements	4-15
4.2.6	Technical Assistance	4-16
4.2.6.1	Overview	4-16
4.2.6.2	Requirements	4-17
4.2.7	Deliverable Customer Documentation	4-18
4.2.7.1	Overview	4-18
4.2.7.2	Requirements	4-18
4.2.8	Product Change Procedures	4-19
4.2.8.1	Overview	4-19
4.2.8.2	Requirements	4-19
4.2.9	Repair	4-19
4.2.9.1	Overview	4-19
4.2.9.2	Requirements	4-19
4.2.10	Supplier's Spares Plan	4-20
4.2.10.1	Overview	4-20
4.2.10.2	Requirements	4-20
4.2.11	Engineering Complaints	4-21
4.2.11.1	Overview	4-21
4.2.11.2	Requirements	4-21

5 Acronyms and Abbreviations

6 References

Requirement-Object Index

List of Figures

Figure 2-1	Software Testing Life Cycle	2-58
Figure 2-2	Spares Reliability Requirement - All Circuit Packs Affecting Total System Downtime	2-92
Figure 2-3	Spares Reliability Requirement - All Circuit Packs Excluding Those Affecting Total System Downtime	2-93
Figure 2-4	Conceptual Infant Mortality Reliability Model	2-101
Figure 2-5	Generic Quality Trend Chart	2-104
Figure 3-1	Typical Manufacturing and Independent Product Inspection Testing	3-5
Figure 3-2	Typical Field Returned Circuit Pack (for Repair) Testing	3-7
Figure 3-3	Typical Temperature/Testing Scheme for Reliability Verification Test	3-11

List of Tables

Table 2-1	Summary of Circuit Switch Reliability Objectives	2-3
Table 2-2	Summary of PPSN Downtime Objectives	2-4
Table 2-3	Summary of Current Downtime Objectives for STP, SSP, and SCP	2-5
Table 2-4	Summary of Proposed New Downtime Objectives for STP, SSP, and SCP	2-5
Table 2-5	Summary of Circuit and Packet Switch Downtime Objectives . . .	2-6
Table 2-6	Summary of ISDN Switching System Reliability Parameters for Basic Rate Access	2-7
Table 2-7	Workmanship Standards	2-109
Table 2-8	Example of Quality Standard Calculation	2-111