CHAPTER 19—PRA AND SEVERE ACCIDENT
LIST OF TABLES

Table 19.1-1—Characterization of U.S. EPR PRA Relative to Supporting Requirements in ASME PRA Standard 19.1-200

Table 19.1-2—Features for U.S. EPR that Address Challenges for Current PWRs 19.1-202

Table 19.1-3—Example Review of Initiating Events for Applicability to U.S. EPR 19.1-207

Table 19.1-4—Summary of Initiating Events for the U.S. EPR PRA 19.1-209

Table 19.1-5—Systems Analyzed in U.S. EPR PRA 19.1-212

Table 19.1-6—U.S. EPR Significant Initiating Event Contributions - Level 1 Internal Events 19.1-216

Table 19.1-7—U.S. EPR Important Cutset Groups - Level 1 Internal Events 19.1-217

Table 19.1-8—U.S. EPR Risk-Significant Equipment based on FV Importance - Level 1 Internal Events 19.1-233

Table 19.1-9—U.S. EPR Risk-Significant Equipment based on RAW Importance - Level 1 Internal Events 19.1-234

Table 19.1-10—U.S. EPR Risk-Significant Human Actions based on FV Importance - Level 1 Internal Events 19.1-235

Table 19.1-11—U.S. EPR Risk-Significant Human Actions based on RAW Importance - Level 1 Internal Events 19.1-236

Table 19.1-12—U.S. EPR Risk-Significant Common Cause Events based on RAW Importance - Level 1 Internal Events 19.1-237

Table 19.1-13—U.S. EPR Risk-Significant Common Cause I&C Events based on RAW Importance - Level 1 Internal Event 19.1-238

Table 19.1-14—U.S. EPR Risk-Significant PRA Parameters - Level 1 Internal Events 19.1-239

Table 19.1-15—U.S. EPR Level 1 Internal Events Sensitivity Studies 19.1-241

Table 19.1-16—Core Damage End States and their Treatment in the CETs 19.1-243

Table 19.1-17—Summary of Long Term Challenges Probabilistic Evaluation 19.1-249

Table 19.1-18—Description of Level 2 Containment Event Trees 19.1-250

Table 19.1-19—Release Category Definitions 19.1-252
Table 19.1-20—Source Terms for Each Release Category 19.1-254
Table 19.1-21—Failure Modes and Pressure Capacities of the Containment Six Sub-areas under an Accident Temperature Condition of 309°F 19.1-255
Table 19.1-22—Containment Isolation Valves Assessed in Level 2 PRA 19.1-256
Table 19.1-23—Evaluation of Equipment Survivability for Level 2 ..... 19.1-259
Table 19.1-24—Internal Events Release Category Results - Large Release Frequency 19.1-266
Table 19.1-25—Level 2 Internal Events Large Release Significant Cutsets 19.1-268
Table 19.1-26—U.S. EPR Core Damage End States Contributions - Level 2 Internal Events 19.1-280
Table 19.1-27—U.S. EPR Initiating Events Contributions - Level 2 Internal Events 19.1-281
Table 19.1-28—U.S. EPR Risk-Significant Phenomena based on FV Importance - Level 2 Internal Events 19.1-282
Table 19.1-29—U.S. EPR Risk-Significant Phenomena based on RAW Importance - Level 2 Internal Events 19.1-283
Table 19.1-30—U.S. EPR Risk-Significant Equipment based on FV Importance - Level 2 Internal Events 19.1-284
Table 19.1-31—U.S. EPR Risk-Significant Equipment based on RAW Importance - Level 2 Internal Events 19.1-285
Table 19.1-32—U.S. EPR Risk-Significant Human Actions based on FV Importance - Level 2 Internal Events 19.1-286
Table 19.1-33—U.S. EPR Risk-Significant Human Actions based on RAW Importance - Level 2 Internal Events 19.1-287
Table 19.1-34—U.S. EPR Risk-Significant Common Cause Events based on RAW Importance - Level 2 Internal Events 19.1-288
Table 19.1-35—U.S. EPR Risk-Significant I&C Events based on RAW Importance - Level 2 Internal Events 19.1-290
Table 19.1-36—U.S. EPR Risk-Significant PRA Parameters - Level 2 Internal Events 19.1-291
Table 19.1-37—Summary of Cutsets for Seismic Sequences with LOOP 19.1-293
Table 19.1-38—U.S. EPR Locations Selected for the Flooding Analysis and Corresponding Flooding Frequencies 19.1-295

Table 19.1-39—Flooding Scenarios Description and Frequency Calculation 19.1-296
Table 19.1-40—U.S. EPR Initiating Events Contributions - Level 1 Internal Flooding 19.1-297
Table 19.1-41—U.S. EPR Important Cutsets - Level 1 Flooding 19.1-298
Table 19.1-42—U.S. EPR Risk-Significant Equipment based on FV Importance - Level 1 Flooding 19.1-301
Table 19.1-43—U.S. EPR Risk-Significant Equipment based on RAW Importance - Level 1 Flooding 19.1-302
Table 19.1-44—U.S. EPR Risk-Significant Human Actions based on FV Importance - Level 1 Flooding 19.1-303
Table 19.1-45—U.S. EPR Risk-Significant Human Actions based on RAW Importance - Level 1 Flooding 19.1-304
Table 19.1-46—U.S. EPR Risk-Significant Common Cause Events based on RAW - Level 1 Flooding 19.1-305
Table 19.1-47—U.S. EPR Risk-Significant Common Cause I&C Events based on RAW Importance - Level 1 Flooding 19.1-306
Table 19.1-48—U.S. EPR Risk-Significant PRA Parameters - Level 1 Flooding 19.1-307
Table 19.1-49—U.S. EPR Level 1 Flooding Events Sensitivity Studies 19.1-309
Table 19.1-50—Level 2 Flooding Events Release Category Results - LRF 19.1-311
Table 19.1-51—Level 2 Flooding Events Large Release Significant Cutsets 19.1-313
Table 19.1-52—U.S. EPR Core Damage End States Contributions - Level 2 Internal Flooding 19.1-329
Table 19.1-53—U.S. EPR Initiating Event Contributions - Level 2 Internal Flooding 19.1-330
Table 19.1-54—U.S. EPR Risk-Significant Phenomena Based on FV Importance - Level 2 Internal Flooding 19.1-331
Table 19.1-55—U.S. EPR Risk-Significant Phenomena based on RAW Importance - Level 2 Internal Flooding 19.1-332
Table 19.1-56—U.S. EPR Risk-Significant Equipment based on FV Importance - Level 2 Internal Flooding 19.1-333
Table 19.1-57—U.S. EPR Risk-Significant Equipment based on RAW Importance - Level 2 Internal Flooding 19.1-335
Table 19.1-58—U.S. EPR Risk-Significant Human Actions based on FV Importance - Level 2 Internal Flooding 19.1-336

Table 19.1-59—U.S. EPR Risk-Significant Human Actions based on RAW Importance - Level 2 Internal Flooding 19.1-337

Table 19.1-60—U.S. EPR Risk-Significant Common Cause Events based on RAW - Level 2 Internal Flooding 19.1-338

Table 19.1-61—U.S. EPR Risk-Significant I&C Events based on RAW Importance - Level 2 Internal Flooding 19.1-340

Table 19.1-62—U.S. EPR Fire Areas and Corresponding Fire Areas Modeled in the PRA (PFAs)..... 19.1-341

Table 19.1-63—Basis for PFA Fire Frequencies 19.1-345

Table 19.1-64—Fire Scenarios Description and Frequency Calculation 19.1-347

Table 19.1-65—U.S. EPR Initiating Event Contributions - Level 1 Internal Fires 19.1-350

Table 19.1-66—U.S. EPR Important Cutset Groups - Level 1 Fire Events 19.1-351

Table 19.1-67—U.S. EPR Risk-Significant Equipment based on FV Importance - Level 1 Fire Events 19.1-362

Table 19.1-68—U.S. EPR Risk-Significant Equipment based on RAW Importance - Level 1 Fire Events 19.1-363

Table 19.1-69—U.S. EPR Risk-Significant Human Actions based on FV Importance - Level 1 Fire Events 19.1-364

Table 19.1-70—U.S. EPR Risk-Significant Human Actions based on RAW Importance - Level 1 Fire Events 19.1-365

Table 19.1-71—U.S. EPR Risk-Significant Common Cause Events based on RAW Importance - Level 1 Fire Events..... 19.1-366

Table 19.1-72—U.S. EPR Risk-Significant Common Cause I&C Events based on RAW Importance - Level 1 Fire Events..... 19.1-367

Table 19.1-73—U.S. EPR Risk-Significant PRA Parameters - Level 1 Fire 19.1-368

Table 19.1-74—U.S. EPR Level 1 Fire Events Sensitivity Studies..... 19.1-370

Table 19.1-75—Level 2 Fire Events Release Category Results - LRF..... 19.1-373

Table 19.1-76—Level 2 Fire Events Significant Cutsets and Sequences..... 19.1-375

Table 19.1-77—U.S. EPR Core Damage End States Contributions - Level 2 Internal Fires 19.1-391

Table 19.1-78—U.S. EPR Initiating Events Contributions - Level 2 Internal Fires 19.1-392

Table 19.1-79—U.S. EPR Risk-Significant Phenomena Based on FV Importance - Level 2 Internal Fires 19.1-393

Table 19.1-80—U.S. EPR Risk-Significant Phenomena Based on RAW Importance-Level 2 Internal Fires 19.1-394

Table 19.1-81—U.S. EPR Risk-Significant Equipment based on FV Importance - Level 2 Internal Fires 19.1-395
Table 19.1-82—U.S. EPR Risk-Significant Equipment based on RAW Importance - Level 2 Internal Fires 19.1-396
Table 19.1-83—U.S. EPR Risk-Significant Human Actions based on FV Importance-Level 2 Internal Fires 19.1-398
Table 19.1-84—U.S. EPR Risk-Significant Human Actions based on RAW Importance-Level 2 Internal Fires 19.1-399
Table 19.1-85—U.S. EPR Risk-Significant Common Cause Events based on RAW Importance - Level 2 Internal Fires..... 19.1-400
Table 19.1-86—U.S. EPR Risk-Significant I&C Common Cause Events based on RAW Importance - Level 2 Internal Fires 19.1-401
Table 19.1-87—Plant Operating States (POS) 19.1-402
Table 19.1-88—LPSD Initiating Event List..... 19.1-404
Table 19.1-89—System Availability During Shutdown..... 19.1-405
Table 19.1-90—U.S. EPR Significant Initiating Events Contributions - Level 1 Shutdown 19.1-407
Table 19.1-91—U.S. EPR Shutdown State (POS) Contributions - Level 1 Shutdown 19.1-408
Table 19.1-92—U.S. EPR Important Cutset Groups - Level 1 Shutdown..... 19.1-409
Table 19.1-93—U.S. EPR Risk-Significant Equipment based on FV Importance - Level 1 Shutdown 19.1-422
Table 19.1-94—U.S. EPR Risk-Significant Equipment based on RAW Importance - Level 1 Shutdown 19.1-423
Table 19.1-95—U.S. EPR Risk-Significant Human Actions at Shutdown based on FV Importance - Level 1 Shutdown..... 19.1-424
Table 19.1-96—U.S. EPR Risk-Significant Human Actions based on RAW Importance - Level 1 Shutdown 19.1-425
Table 19.1-97—U.S. EPR Risk-Significant Common Cause Events based on RAW Importance - Level 1 Shutdown..... 19.1-426
Table 19.1-98—U.S. EPR Risk-Significant Common Cause I&C Events based on RAW Importance - Level 1 Shutdown 19.1-427
Table 19.1-99—U.S. EPR Risk-Significant PRA Parameters - Level 1 Shutdown 19.1-428
Table 19.1-100—U.S. EPR LEVEL 1 Internal Events Sensitivity Studies - Level 1 Shutdown 19.1-429

Table 19.1-101—Level 2 Low Power Shutdown Plant Operating States Release Categories 19.1-430
Table 19.1-102—U.S. EPR Design Features Contributing to Low Risk 19.1-431
Table 19.1-103—U.S. EPR Level 1 Top Initiating Event Contributions to the Total CDF at Power 19.1-438
Table 19.1-104—U.S. EPR Level 1 Total Events Sensitivity Studies 19.1-439
Table 19.1-105—U.S. EPR Release Category Contributions to Total LRF from at Power Internal Events, Fire and Flooding 19.1-442
Table 19.1-106—SSC HCLPF Capacities 19.1-444
Table 19.1-107—Seismic Fragility and HCLPF Capacity for Safeguard Building Division 1 ..... 19.1-451
Table 19.1-108—U.S. EPR PRA Based Insights 19.1-452
Table 19.1-109—U.S. EPR PRA General Assumptions 19.1-457
Table 19.1-110—Level 2 Low Power Shutdown Plant Operating States Definition 19.1-474
Table 19.1-111—Level 2 Low Power Shutdown Core Damage End States Definition 19.1-474
Table 19.1-112—Level 2 Low Power Shutdown Containment Isolation 19.1-475
Table 19.1-113—Level 2 Low Power Shutdown Source Term for Plant State CA 19.1-476
Table 19.1-114—Level 2 Low Power Shutdown Source Term for Plant State CB 19.1-477
Table 19.1-115—Level 2 Low Power Shutdown Source Term for Plant States D and E 19.1-478
Table 19.1-116—U.S. EPR Large Release Category Results - Level 2 Shutdown 19.1-479
Table 19.1-117—U.S. EPR Large Release Frequency for each POS - Level 2 Shutdown 19.1-481
Table 19.1-118—U.S. EPR Large Release Frequency for each Initiating Event - Level 2 Shutdown 19.1-482
Table 19.1-119—U.S. EPR Release Category Frequencies for each POS - Level 2 Shutdown 19.1-483
Table 19.1-120—U.S. EPR Important Cutset Groups - Level 2 Shutdown 19.1-484
Table 19.1-121—U.S. EPR CDES Contribution to the LRF - Level 2 Shutdown 19.1-515
Table 19.1-122—U.S. EPR Risk-Significant Phenomena based on FV Importance - Level 2 Shutdown 19.1-516

Table 19.1-123—U.S. EPR Risk-Significant Phenomena based on RAW Importance - Level 2 Shutdown 19.1-517

Table 19.1-124—U.S. EPR Risk Significant Level 2 Human Actions based on either FV or RAW Importance - Level 2 Shutdown 19.1-517

Table 19.1-125—U.S. EPR Risk Significant Components based on FV Importance Measure Related to Level 2 Specific Importance - Level 2 Shutdown 19.1-518

Table 19.1-126—U.S. EPR Risk Significant Components based on RAW Importance Measure Related to Level 2 Specific Importance - Level 2 Shutdown 19.1-519

Table 19.1-127—U.S. EPR Important Sequences – Level 1 Internal Events 19.1-523

Table 19.1-128—U.S. EPR Important Sequences – Level 1 Flooding Events 19.1-526

Table 19.1-129—U.S. EPR Important Sequences – Level 1 Fire Events 19.1-527

Table 19.1-130—U.S. EPR Important Sequences – Level 1 Shutdown 19.1-528

Table 19.2-1—Chronology of a Bounding Severe Accident through RPV Failure 19.2-67

Table 19.2-2—SAHRS Design and Operating Parameters 19.2-68

Table 19.2-3—Severe Accident Instrumentation and Equipment 19.2-69

Table 19.2-4—SAMG Technical Basis - Mapping Challenge Mechanism to Operator Action 19.2-73

Table 19.2-5—SAMDA Candidates - Already Implemented 19.2-74

Table 19A-1—Event Tree Headings for Initiating Event 31BDA: Loss of Divisional Emergency AC Power 19A-3

Table 19A-2—Event Tree Headings for ATWS: Failure to Scram Following Loss of Main Feedwater 19A-6

Table 19A-3—Event Tree Headings for Initiating Event GT: General Transient 19A-8

Table 19A-4—Event Tree Headings for Initiating Event IND SGTR: Induced Steam Generator Tube Rupture 19A-10

Table 19A-5—Event Tree Headings for Initiating Event ISL-CCW RCPTB: ISLOCA Due to RCP Thermal Barrier Tube Break 19A-11

Table 19A-6—Event Tree Headings for Initiating Event ISL-CVCS HPTR: ISLOCA Due to Tube Rupture in CVCS High Pressure Cooler 19A-11

Table 19A-7—Event Tree Headings for Initiating Event ISL-CVCS INJ: ISLOCA Due to Rupture of High Pressure CVCS Pipe Outside Containment 19A-12

Table 19A-8—Event Tree Headings for Initiating Event ISL-CVCS REDS: ISLOCA Due to Spurious Opening of Reducing Station 19A-12

Table 19A-9—Event Tree Headings for Initiating Event ISL-SIS LHSI: ISLOCA Due to Break in LHSI Cold Leg Injection Valves with LHSI Rupture in Respective SAB 19A-13

Table 19A-10—Event Tree Headings for Initiating Event ISL-SIS MHSI: ISLOCA Due to Break in MHSI Cold Leg Injection Valves with MHSI Rupture in Respective SAB 19A-13

Table 19A-11—Event Tree Headings for Initiating Event ISL-SIS RHR: ISLOCA Due to Failure of Suction Line MOVs and Subsequent RHR Line Rupture in Respective SAB 19A-13

Table 19A-12—Event Tree Headings for Initiating Event LBOP: Loss of Balance of Plant Closed Loop Cooling Water or Auxiliary Cooling Water 19A-14

Table 19A-13—Event Tree Headings for Initiating Event LLOCA: Large Loss-of-Coolant Accident 19A-15

Table 19A-14—Event Tree Headings for Initiating Event LOC: Loss of Main Condenser 19A-16

Table 19A-15—Event Tree Headings for Initiating Event LOCCW: Loss of CCWS or ESWS 19A-18

Table 19A-16—Event Tree Headings for Initiating Event LOMFW: Loss of Main Feedwater 19A-21

Table 19A-17—Event Tree Headings for Initiating Event LOOP: Loss of Offsite Power 19A-23

Table 19A-18—Event Tree Headings for Initiating Event MLOCA: Medium Loss-of-Coolant-Accident 19A-26

Table 19A-19—Event Tree Headings for Initiating Event MSSV: Spurious Opening of Main Steam Safety Valve 19A-28

Table 19A-20—Event Tree Headings for Initiating Event SGTR: Steam Generator Tube Rupture 19A-30

Table 19A-21—Event Tree Headings for Initiating Event SLBI: Steam-Line Break Inside Containment 19A-32

Table 19A-22—Event Tree Headings for Initiating Event SLBO: Steam-Line Break Outside Containment 19A-34

Table 19A-23—Event Tree Headings for Initiating Event SLOCA: Small Loss-of-Coolant Accident 19A-37

Table 19B-1—Event Tree Headings for Initiating Event IE LOCA: LOCA During Shutdown State C 19B-2

Table 19B-2—Event Tree Headings for Initiating Event IE LOCA: LOCA During Shutdown State D or E 19B-4

Table 19B-3—Event Tree Headings for Initiating Event IE RHR: Loss of RHR During Shutdown State C 19B-5

Table 19B-4—Event Tree Headings for Initiating Event IE RHR: Loss of RHR During Shutdown State D 19B-6

Table 19B-5—Event Tree Headings for Initiating Event IE ULD: Uncontrolled Level Drop During State CB 19B-7

Table 19B-6—Event Tree Headings for Initiating Event IE ULD: Uncontrolled Level Drop During State D 19B-9

Table 19C-1—Containment Event Tree #CET CF - CET for Sequences Leading to Direct Containment Failure 19C-2

Table 19C-2—Containment Event Tree #CET ISL - CET for IS LOCA Sequences 19C-2

Table 19C-3—Containment Event Tree #CET LIMITED CD - CET for Sequences Identified as Limited Core Damage Cases in CDES Link Trees 19C-3

Table 19C-4—Containment Event Tree #CET LO PRESSURE - CET for Low Pressure CDES or Depressurized HI CDES 19C-4

Table 19C-5—Containment Event Tree #CET SGTR - CET for SGTR Sequences 19C-10

Table 19C-6—Containment Event Tree #CET SGTR FW - CET for SGTR Sequences, FW Running 19C-10

Table 19C-7—Containment Event Tree #CET1 HI PRESSURE - Initial CET for High Pressure CDES 19C-11

Table 19C-8—Containment Event Tree #CET2 HI PRESSURE - CET for Low pressure CDES or Depressurized HI CDES 19C-13

Next File