
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.....	19.1-180
Table 19.1-2—Features for U.S. EPR that Address Challenges for Current PWRs.....	19.1-182
Table 19.1-3—Example Review of Initiating Events for Applicability to U.S. EPR.....	19.1-187
Table 19.1-4—Summary of Initiating Events for the U.S. EPR PRA	19.1-189
Table 19.1-5—Systems Analyzed in U.S. EPR PRA.....	19.1-192
Table 19.1-6—U.S. EPR Significant Initiating Event Contributions – Level 1 Internal Events	19.1-196
Table 19.1-7—U.S. EPR Important Cutset Groups – Level 1 Internal Events	19.1-197
Table 19.1-8—U.S. EPR Risk-Significant Equipment based on FV Importance – Level 1 Internal Events.....	19.1-213
Table 19.1-9—U.S. EPR Risk-Significant Equipment based on RAW Importance – Level 1 Internal Events	19.1-214
Table 19.1-10—U.S. EPR Risk-Significant Human Actions based on FV Importance – Level 1 Internal Events	19.1-215
Table 19.1-11—U.S. EPR Risk-Significant Human Actions based on RAW Importance – Level 1 Internal Events	19.1-216
Table 19.1-12—U.S. EPR Risk-Significant Common Cause Events based on RAW Importance – Level 1 Internal Events	19.1-217
Table 19.1-13—U.S. EPR Risk-Significant Common Cause I&C Events based on RAW Importance – Level 1 Internal Event	19.1-218
Table 19.1-14—U.S. EPR Risk-Significant PRA Parameters – Level 1 Internal Events	19.1-219
Table 19.1-15—U.S. EPR Level 1 Internal Events Sensitivity Studies	19.1-221
Table 19.1-16—Core Damage End States and their Treatment in the CETs	19.1-223
Table 19.1-17—Summary of Long Term Challenges Probabilistic Evaluation	19.1-229
Table 19.1-18—Description of Level 2 Containment Event Trees.....	19.1-230

Table 19.1-19—Release Category Definitions.....	19.1-232
Table 19.1-20—Source Terms for Each Release Category	19.1-234
Table 19.1-21—Probability Distributions (Lognormal) for the Six Dominant Failure Modes	19.1-235
Table 19.1-22—Containment Isolation Valves Assessed in Level 2 PRA	19.1-236
Table 19.1-23—Evaluation of Equipment Survivability for Level 2	19.1-240
Table 19.1-24—Internal Events Release Category Results – Large Release Frequency.....	19.1-247
Table 19.1-25—Level 2 Internal Events Large Release Significant Cutsets	19.1-249
Table 19.1-26—U.S. EPR Core Damage End States Contributions – Level 2 Internal Events	19.1-261
Table 19.1-27—U.S. EPR Initiating Events Contributions – Level 2 Internal Events	19.1-262
Table 19.1-28—U.S. EPR Risk-Significant Phenomena based on FV Importance – Level 2 Internal Events	19.1-263
Table 19.1-29—U.S. EPR Risk-Significant Phenomena based on RAW Importance – Level 2 Internal Events	19.1-264
Table 19.1-30—U.S. EPR Risk-Significant Equipment based on FV Importance – Level 2 Internal Events	19.1-265
Table 19.1-31—U.S. EPR Risk-Significant Equipment based on RAW Importance – Level 2 Internal Events	19.1-266
Table 19.1-32—U.S. EPR Risk-Significant Human Actions based on FV Importance – Level 2 Internal Events	19.1-268
Table 19.1-33—U.S. EPR Risk-Significant Human Actions based on RAW Importance – Level 2 Internal Events	19.1-269
Table 19.1-34—U.S. EPR Risk-Significant Common Cause Events based on RAW Importance – Level 2 Internal Events	19.1-270
Table 19.1-35—U.S. EPR Risk-Significant I&C Events based on RAW Importance – Level 2 Internal Events	19.1-272
Table 19.1-36—U.S. EPR Risk-Significant PRA Parameters – Level 2 Internal Events	19.1-273
Table 19.1-37—Summary of Cutsets for Seismic Sequences with LOOP	19.1-275
Table 19.1-38—U.S. EPR Locations Selected for the Flooding Analysis and Corresponding Flooding Frequencies	19.1-277
Table 19.1-39—Flooding Scenarios Description and Frequency Calculation.....	19.1-278
Table 19.1-40—U.S. EPR Initiating Events Contributions – Level 1 Internal Flooding	19.1-280

Table 19.1-41—U.S. EPR Important Cutsets – Level 1 Flooding	19.1-281
Table 19.1-42—U.S. EPR Risk-Significant Equipment based on FV Importance – Level 1 Flooding	19.1-284
Table 19.1-43—U.S. EPR Risk-Significant Equipment based on RAW Importance – Level 1 Flooding	19.1-285
Table 19.1-44—U.S. EPR Risk-Significant Human Actions based on FV Importance – Level 1 Flooding	19.1-286
Table 19.1-45—U.S. EPR Risk-Significant Human Actions based on RAW Importance – Level 1 Flooding	19.1-287
Table 19.1-46—U.S. EPR Risk-Significant Common Cause Events based on RAW – Level 1 Flooding	19.1-288
Table 19.1-47—U.S. EPR Risk-Significant Common Cause I&C Events based on RAW Importance – Level 1 Flooding	19.1-289
Table 19.1-48—U.S. EPR Risk-Significant PRA Parameters – Level 1 Flooding	19.1-290
Table 19.1-49—U.S. EPR Level 1 Flooding Events Sensitivity Studies	19.1-292
Table 19.1-50—Level 2 Flooding Events Release Category Results – LRF	19.1-294
Table 19.1-51—Level 2 Flooding Events Large Release Significant Cutsets.....	19.1-296
Table 19.1-52—U.S. EPR Core Damage End States Contributions – Level 2 Internal Flooding	19.1-311
Table 19.1-53—U.S. EPR Initiating Event Contributions-Level 2 Internal Flooding	19.1-312
Table 19.1-54—U.S. EPR Risk-Significant Phenomena Based on FV Importance-Level 2 Internal Flooding	19.1-313
Table 19.1-55—U.S. EPR Risk-Significant Phenomena based on RAW Importance-Level 2 Internal Flooding	19.1-314
Table 19.1-56—U.S. EPR Risk-Significant Equipment based on FV Importance – Level 2 Internal Flooding	19.1-315
Table 19.1-57—U.S. EPR Risk-Significant Equipment based on RAW Importance – Level 2 Internal Flooding.....	19.1-317
Table 19.1-58—U.S. EPR Risk-Significant Human Actions based on FV Importance-Level 2 Internal Flooding.....	19.1-319
Table 19.1-59—U.S. EPR Risk-Significant Human Actions based on RAW Importance-Level 2 Internal Flooding.....	19.1-320
Table 19.1-60—U.S. EPR Risk-Significant Common Cause Events based on RAW – Level 2 Internal Flooding	19.1-321

Table 19.1-61—U.S. EPR Risk-Significant I&C Events based on RAW Importance – Level 2 Internal Flooding.....	19.1-323
Table 19.1-62—U.S. EPR Fire Areas and Corresponding Fire Areas Modeled in the PRA (PFAs).....	19.1-324
Table 19.1-63—Basis for PFA Fire Frequencies	19.1-328
Table 19.1-64—Fire Scenarios Description and Frequency Calculation	19.1-330
Table 19.1-65—U.S. EPR Initiating Event Contributions – Level 1 Internal Fires	19.1-333
Table 19.1-66—U.S. EPR Important Cutset Groups – Level 1 Fire Events	19.1-334
Table 19.1-67—U.S. EPR Risk-Significant Equipment based on FV Importance – Level 1 Fire Events	19.1-345
Table 19.1-68—U.S. EPR Risk-Significant Equipment based on RAW Importance – Level 1 Fire Events	19.1-346
Table 19.1-69—U.S. EPR Risk-Significant Human Actions based on FV Importance – Level 1 Fire Events	19.1-347
Table 19.1-70—U.S. EPR Risk-Significant Human Actions based on RAW Importance – Level 1 Fire Events	19.1-348
Table 19.1-71—U.S. EPR Risk-Significant Common Cause Events based on RAW Importance – Level 1 Fire Events	19.1-349
Table 19.1-72—U.S. EPR Risk-Significant Common Cause I&C Events based on RAW Importance – Level 1 Fire Events	19.1-350
Table 19.1-73—U.S. EPR Risk-Significant PRA Parameters – Level 1 Fire	19.1-351
Table 19.1-74—U.S. EPR Level 1 Fire Events Sensitivity Studies.....	19.1-353
Table 19.1-75—Level 2 Fire Events Release Category Results – LRF	19.1-356
Table 19.1-76—Level 2 Fire Events Significant Cutsets and Sequences.....	19.1-358
Table 19.1-77—U.S. EPR Core Damage End States Contributions – Level 2 Internal Fires.....	19.1-374
Table 19.1-78—U.S. EPR Initiating Events Contributions – Level 2 Internal Fires	19.1-375
Table 19.1-79—U.S. EPR Risk-Significant Phenomena Based on FV Importance – Level 2 Internal Fires.....	19.1-376
Table 19.1-80—U.S. EPR Risk-Significant Phenomena Based on RAW Importance-Level 2 Internal Fires	19.1-377
Table 19.1-81—U.S. EPR Risk-Significant Equipment based on FV Importance -Level 2 Internal Fires	19.1-378



Table 19.1-82—U.S. EPR Risk-Significant Equipment based on RAW Importance – Level 2 Internal Fires.....	19.1-379
Table 19.1-83—U.S. EPR Risk-Significant Human Actions based on FV Importance-Level 2 Internal Fires	19.1-381
Table 19.1-84—U.S. EPR Risk-Significant Human Actions based on RAW Importance-Level 2 Internal Fires.....	19.1-382
Table 19.1-85—U.S. EPR Risk-Significant Common Cause Events based on RAW Importance – Level 2 Internal Fires.....	19.1-383
Table 19.1-86—U.S. EPR Risk-Significant I&C Common Cause Events based on RAW Importance – Level 2 Internal Fires	19.1-384
Table 19.1-87—Plant Operating States (POS).....	19.1-385
Table 19.1-88—LPSD Initiating Event List.....	19.1-387
Table 19.1-89—System Availability During Shutdown.....	19.1-388
Table 19.1-90—U.S. EPR Initiating Events Contributions – Level 1 Shutdown.....	19.1-390
Table 19.1-91—U.S. EPR Shutdown State (POS) Contributions – Level 1 Shutdown	19.1-391
Table 19.1-92—U.S. EPR Important Cutset Groups – Level 1 Shutdown.....	19.1-392
Table 19.1-93—U.S. EPR Risk-Significant Equipment based on FV Importance – Level 1 Shutdown	19.1-406
Table 19.1-94—U.S. EPR Risk-Significant Equipment based on RAW Importance – Level 1 Shutdown	19.1-407
Table 19.1-95—U.S. EPR Risk-Significant Human Actions at Shutdown based on FV Importance – Level 1 Shutdown.....	19.1-408
Table 19.1-96—U.S. EPR Risk-Significant Human Actions based on RAW Importance – Level 1 Shutdown	19.1-409
Table 19.1-97—U.S. EPR Risk-Significant Common Cause Events based on RAW Importance – Level 1 Shutdown.....	19.1-410
Table 19.1-98—U.S. EPR Risk-Significant Common Cause I&C Events based on RAW Importance – Level 1 Shutdown	19.1-411
Table 19.1-99—U.S. EPR Risk-Significant PRA Parameters – Level 1 Shutdown.....	19.1-412
Table 19.1-100—U.S. EPR LEVEL 1 Internal Events Sensitivity Studies - Level 1 Shutdown	19.1-413
Table 19.1-101—Level 2 Low Power Shutdown Plant Operating States Release Categories	19.1-414
Table 19.1-102—Summary of Insights from the PRA for the U.S. EPR	19.1-415

Table 19.1-103—U.S. EPR Level 1 Top Initiating Event Contributions to the Total CDF at Power	19.1-421
Table 19.1-104—U.S. EPR Level 1 Total Events Sensitivity Studies	19.1-422
Table 19.1-105—U.S. EPR Release Category Contributions to Total LRF from at Power Internal Events, Fire and Flooding	19.1-425
Table 19.2-1—Chronology of a Bounding Severe Accident through RPV Failure	19.2-57
Table 19.2-2—SAHRS Design and Operating Parameters	19.2-58
Table 19.2-3—Severe Accident Instrumentation and Equipment	19.2-59
Table 19.2-4—SAMG Technical Basis – Mapping Challenge Mechanism to Operator Action	19.2-63
Table 19.2-5—SAMDA Candidates – Already Implemented	19.2-64
Table 19A-1—Event-Tree Headings for Initiating Event 31BDA: Loss of Divisional Emergency AC Power	19.A-3
Table 19A-2—Event-Tree Headings for ATWS: Failure to Scram Following Loss of Main Feedwater	19.A-6
Table 19A-3—Event-Tree Headings for Initiating Event GT: General Transient ...	19.A-8
Table 19A-4—Event-Tree Headings for Initiating Event IND SGTR: Induced Steam Generator Tube Rupture	19.A-9
Table 19A-5—Event-Tree Headings for Initiating Event ISL-CCW RCPTB: ISLOCA Due to RCP Thermal Barrier Tube Break.....	19.A-10
Table 19A-6—Event-Tree Headings for Initiating Event ISL-CVCS HPTR: ISLOCA Due to Tube Rupture in CVCS High Pressure Cooler.....	19.A-10
Table 19A-7—Event-Tree Headings for Initiating Event ISL-CVCS INJ: ISLOCA Due to Rupture of High Pressure CVCS Pipe Outside Containment	19.A-11
Table 19A-8—Event-Tree Headings for Initiating Event ISL-CVCS REDS: ISLOCA Due to Spurious Opening of Reducing Station.....	19.A-11
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	19.A-12
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	19.A-12
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	19.A-12

Table 19A-12—Event-Tree Headings for Initiating Event LBOP: Loss of Balance of Plant Closed Loop Cooling Water or Auxiliary Cooling Water.....	19.A-13
Table 19A-13—Event-Tree Headings for Initiating Event LLOCA: Large Loss-of-Coolant Accident	19.A-14
Table 19A-14—Event-Tree Headings for Initiating Event LOC: Loss of Main Condenser	19.A-15
Table 19A-15—Event-Tree Headings for Initiating Event LOCCW: Loss of CCWS or ESWS.....	19.A-17
Table 19A-16—Event-Tree Headings for Initiating Event LOMFW: Loss of Main Feedwater.....	19.A-20
Table 19A-17—Event-Tree Headings for Initiating Event LOOP: Loss of Offsite Power	19.A-22
Table 19A-18—Event-Tree Headings for Initiating Event MLOCA: Medium Loss-of-Coolant-Accident	19.A-25
Table 19A-19—Event-Tree Headings for Initiating Event MSSV: Spurious Opening of Main Steam Safety Valve.....	19.A-27
Table 19A-20—Event-Tree Headings for Initiating Event SGTR: Steam Generator Tube Rupture	19.A-29
Table 19A-21—Event-Tree Headings for Initiating Event SLBI: Steam-Line Break Inside Containment	19.A-31
Table 19A-22—Event-Tree Headings for Initiating Event SLBO: Steam-Line Break Outside Containment	19.A-34
Table 19A-23—Event-Tree Headings for Initiating Event SLOCA: Small Loss-of-Coolant Accident	19.A-36
Table 19B-1—Event-Tree Headings for Initiating Event IE LOCA: LOCA During Shutdown State C	19.B-2
Table 19B-2—Event-Tree Headings for Initiating Event IE LOCA: LOCA During Shutdown State D or E.....	19.B-4
Table 19B-3—Event-Tree Headings for Initiating Event IE RHR: Loss of RHR During Shutdown State C	19.B-5
Table 19B-4—Event-Tree Headings for Initiating Event IE RHR: Loss of RHR During Shutdown State D	19.B-7
Table 19B-5—Event-Tree Headings for Initiating Event IE ULD: Uncontrolled Level Drop During State CB	19.B-8
Table 19B-6—Event-Tree Headings for Initiating Event IE ULD: Uncontrolled Level Drop During State D	19.B-10

Table 19C-1—Containment Event Tree #CET CF - CET for Sequences Leading to Direct Containment Failure	19.C-2
Table 19C-2—Containment Event Tree #CET ISL - CET for IS LOCA Sequences	19.C-2
Table 19C-3—Containment Event Tree #CET LIMITED CD - CET for Sequences Identified as Limited Core Damage Cases in CDES Link Trees	19.C-3
Table 19C-4—Containment Event Tree #CET LO PRESSURE - CET for Low Pressure CDES or Depressurized HI CDES	19.C-4
Table 19C-5—Containment Event Tree #CET SGTR - CET for SGTR Sequences	19.C-10
Table 19C-6—Containment Event Tree #CET SGTR FW - CET for SGTR Sequences, FW Running	19.C-11
Table 19C-7—Containment Event Tree #CET1 HI PRESSURE - Initial CET for High Pressure CDES	19.C-12
Table 19C-8—Containment Event Tree #CET2 HI PRESSURE - CET for Low pressure CDES or Depressurized HI CDES	19.C-14