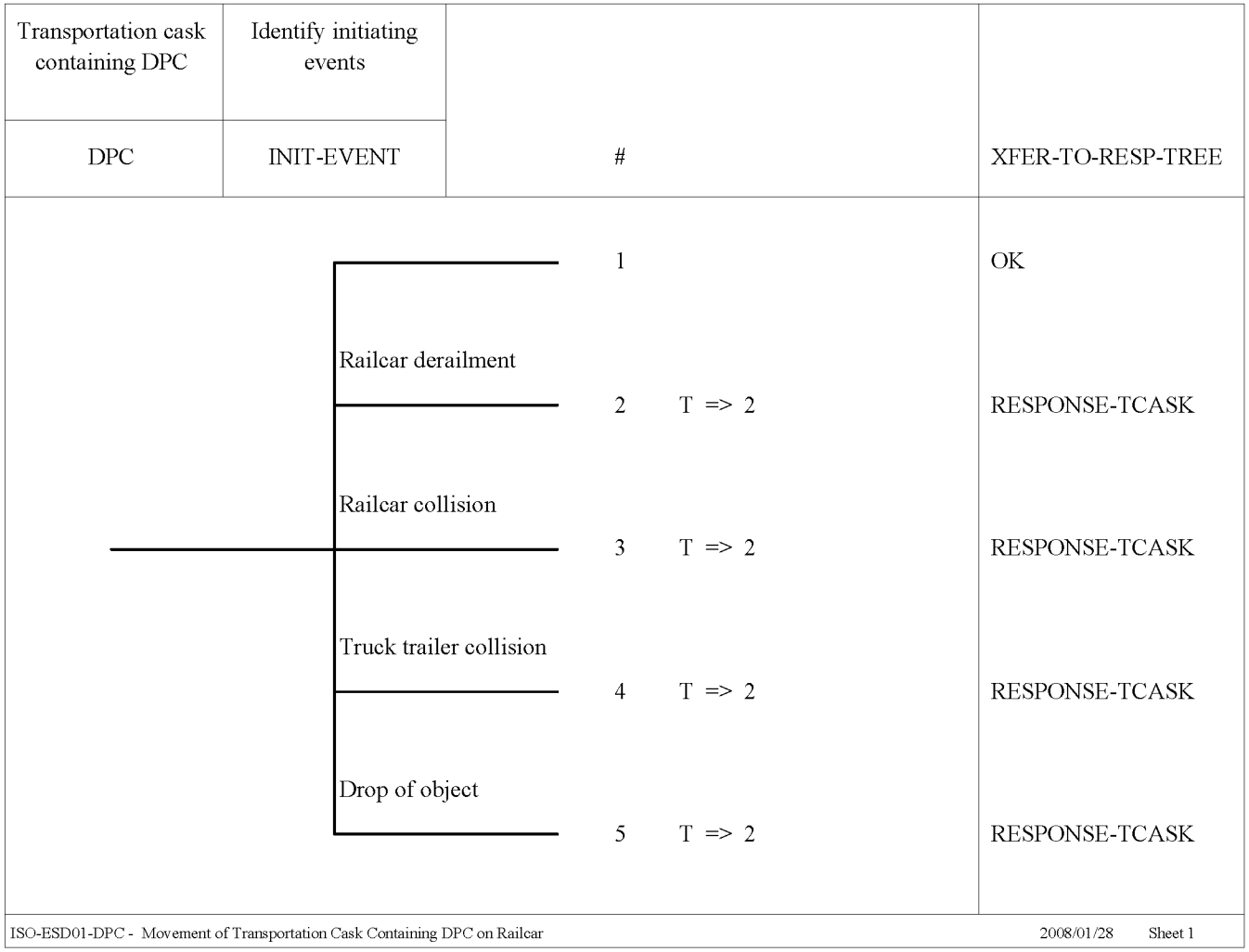
Table A5-1. Correspondence between Event Trees and ESDs (Continued)

| ESD# | ESD Title | IE Event Tree Name | IE Event Tree Location | Response Tree Name | Response Tree Location |
|---|---|---|---|---|---|
| ISO-ESD-07 | Event Sequences Associated with Fire Events for All Combustible Low-Level Radioactive Waste in the Low-Level Waste Facility | ISO-ESD07-LLW | Figure A5-22 | N/A | N/A |
| ISO-ESD-08 | Event Sequences for Activities Associated with Waste Transfers to the Low-Level Waste Facility | ISO-ESD08-LLWDAW<br>IS0-ESD08-LLWLIQ<br>ISO-ESD08-LLWWETnr<br>ISO-ESD08-LLWWETr | Figure A5-23<br>Figure A5-25<br>Figure A5-26<br>Figure A5-27 | RESPONSE-LLW | Figure A5-24 |
| ISO-ESD-09 | Event Sequences for Fire Occurring during Site Transportation Activities or at the Aging Facility | ISO-ESD09-DPC<br>ISO-ESD09-DSTD<br>ISO-ESD09-HDPC<br>ISO-ESD09-HLW<br>ISO-ESD09-MCO<br>ISO-ESD09-NAV<br>ISO-ESD09-TAD<br>ISO-ESD09-UCSNF | Figure A5-28<br>Figure A5-30<br>Figure A5-31<br>Figure A5-32<br>Figure A5-33<br>Figure A5-34<br>Figure A5-35<br>Figure A5-36 | RESPONSE-FIRE | Figure A5-29 |

NOTE: AO = aging overpack; DAW = dry active low-level radioactive waste; DPC = dual-purpose canister; DSTD = DOE standardized canister; ESD = event sequence diagram; HAM = horizontal aging module; HDPC = horizontal dual-purpose canister; HLW = high-level radioactive waste; HSTC = horizontal shielded transfer cask; HTC = a transportation cask that is never upended; ISO = Intra-Site Operations; LLW = low-level radioactive waste; LLWF = Low-Level Waste Facility; MCO = multicanister overpack; NAV = naval; nr = nonresin; r = resin; TAD = transportation, aging and disposal; TCASK = transportation cask; UCSNF = uncanistered commercial spent nuclear fuel.

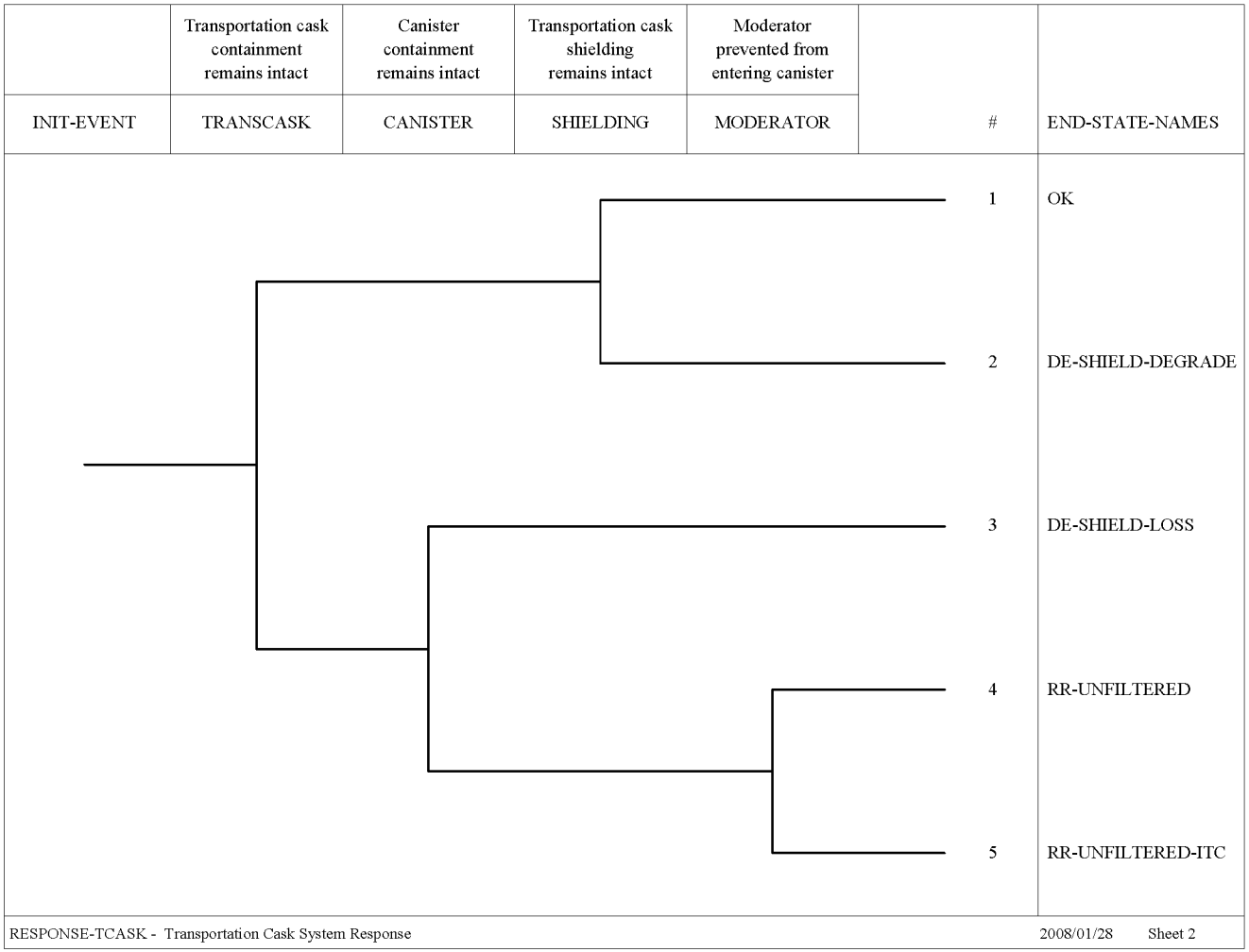
Source: Original




NOTE: DPC = dual-purpose canister; ESD = event sequence diagram; IET = initiator event tree; INIT-EVENT = initiating event; ISO = Intra-Site Operations; RC = railcar; RESP = response; T = transfer; TCASK = transportation cask; XFER = transfer.

Source: Original

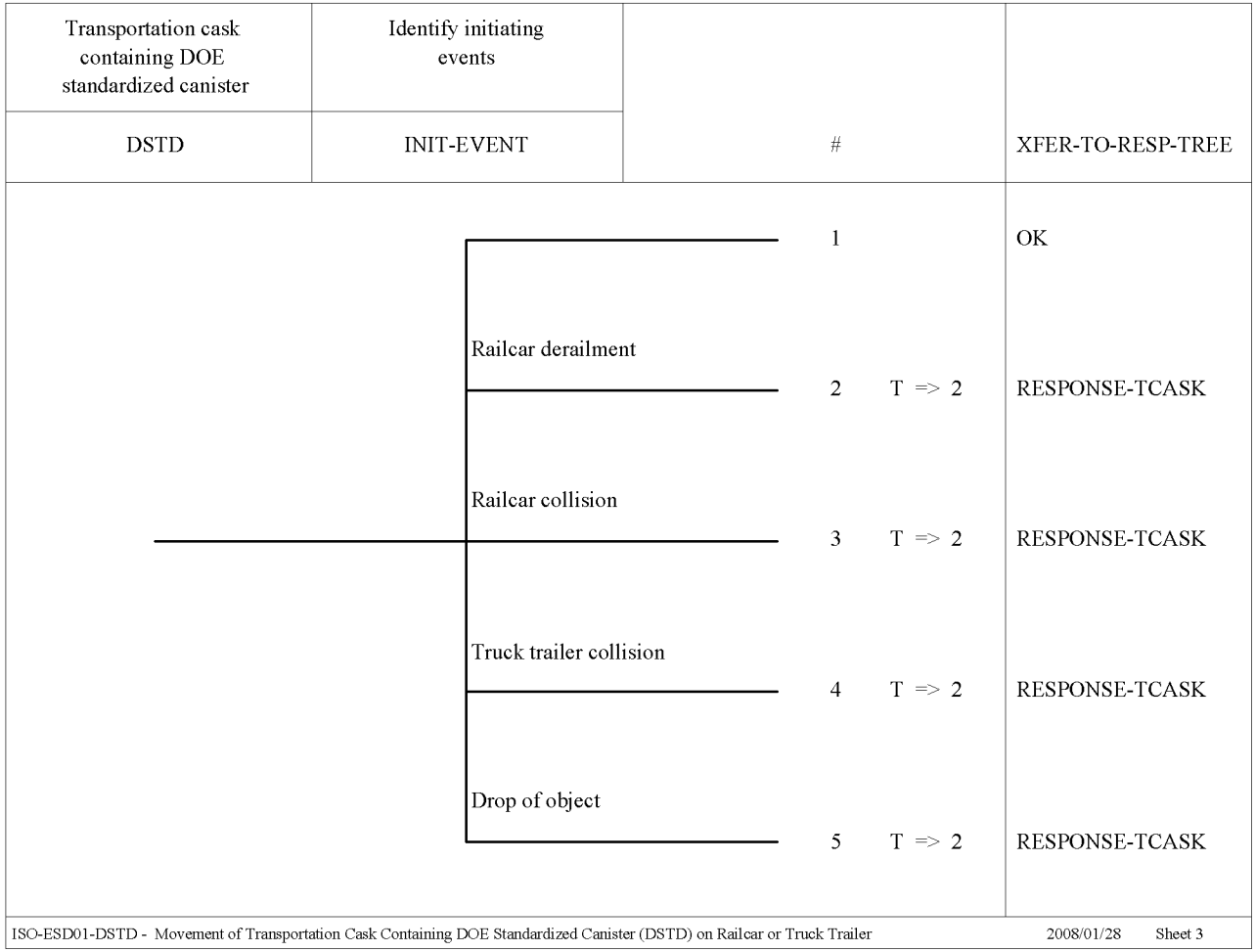
Figure A5-2. IET for ISO-ESD-01 – DPC – Movement of Transportation Cask Containing DPC on Railcar




NOTE: DE = direct exposure; ESD = event sequence diagram; INIT-EVENT = initiating event; ISO = Intra-Site Operations; ITC = important to criticality; RR = radionuclide release; TC = transportation cask; TCASK = transportation cask; TRANSCASK = transportation cask.

Source: Original

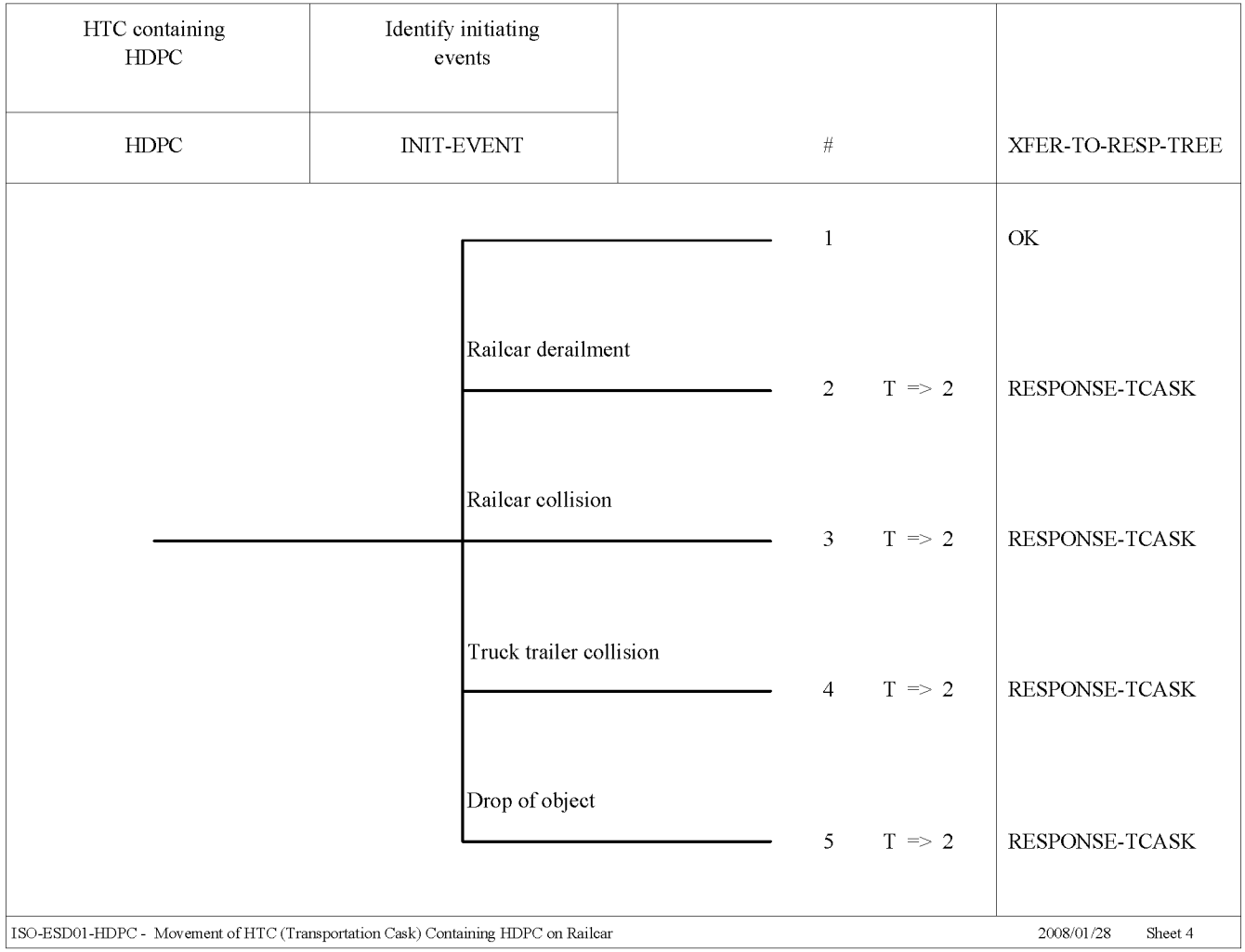
Figure A5-3. System-Response Event Tree for ISO-ESD-01 – RESPONSE-TCASK – Transportation Cask System Response




NOTE: DSTD = Department of Energy standardized canister; ESD = event sequence diagram; IET = initiator event tree; INIT-EVENT = initiating event; ISO = Intra-Site Operations; RC = railcar; RESP = response; ST = site transporter; T = transfer; TCASK = transportation cask; TT = transportation cask; XFER = transfer.

Source: Original

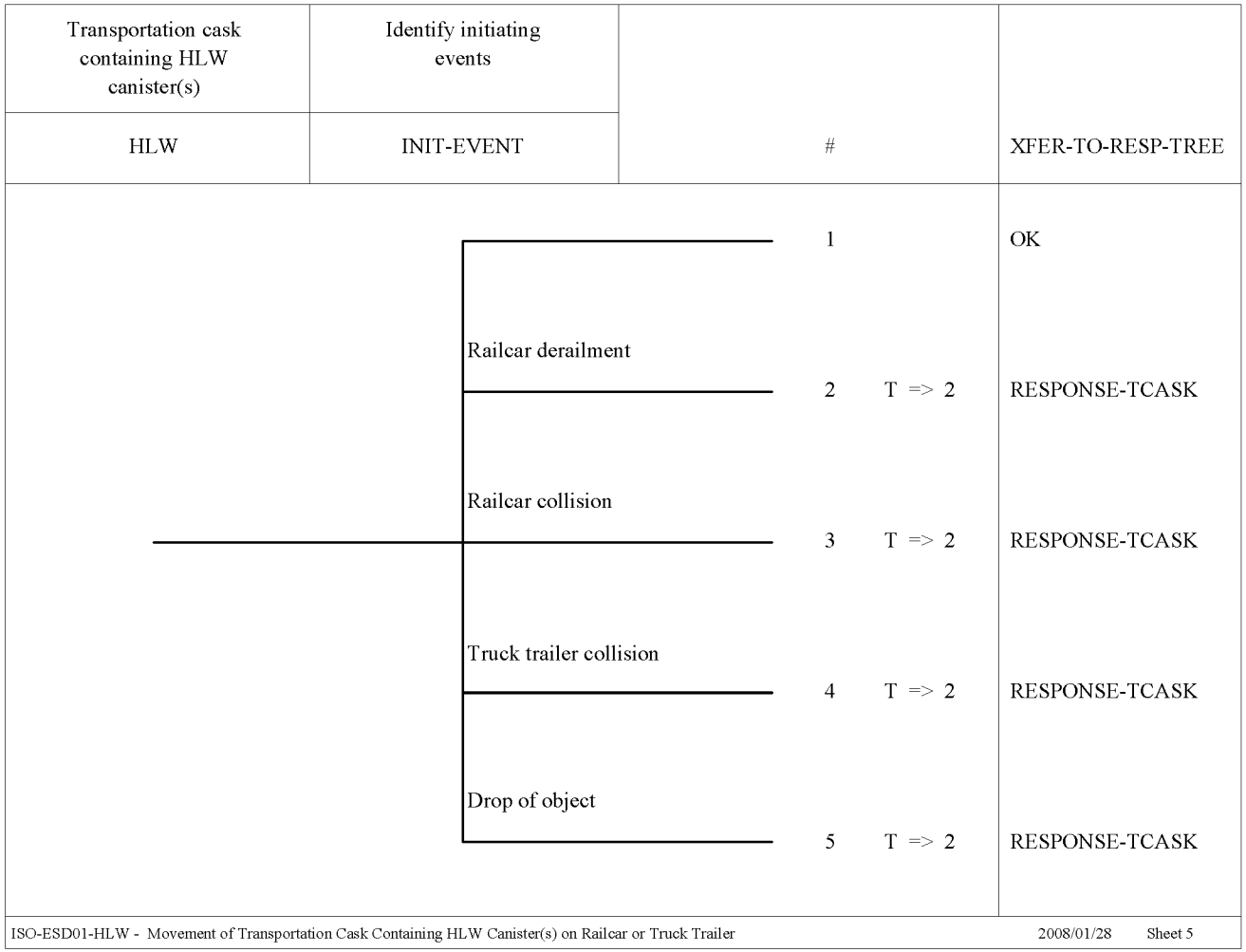
Figure A5-4. IET for ISO-ESD-01 – DSTD – Movement of Transportation Cask Containing DOE Standardized Canister on Railcar or Truck Trailer




NOTE: ESD = event sequence diagram; HDPC = horizontal dual-purpose canister; HTC = a transportation cask that is never upended; IET = initiator event tree; INIT-EVENT = initiating event; ISO = Intra-Site Operations; RC = railcar; RESP = response; TCASK = transportation cask; T = transfer.

Source: Original

Figure A5-5. IET for ISO-ESD-01 – HDPC – Movement of HTC (Transportation Cask) Containing HDPC on Railcar




NOTE: ESD = event sequence diagram; HLW = high-level radioactive waste; IET = initiator event tree; INIT-EVENT = initiating event; ISO = Intra-Site Operations; RC = railcar; RESP = response; T = transfer; TCASK = transportation cask; TT = truck trailer; XFER = transfer.

Source: Original

Figure A5-6. IET for ISO-ESD-01 – HLW – Movement of Transportation Cask Containing HLW Canister(s) on Railcar or Truck Trailer

| Transportation cask containing DOE MCO | Identify initiating events | | | |
|---|---|---|---|---|
| MCO | INIT-EVENT | | # | XFER-TO-RESP-TREE |
| | | | 1 | OK |
| | | Railcar derailment | 2 T => 2 | RESPONSE-TCASK |
| | | Railcar collision | 3 T => 2 | RESPONSE-TCASK |
| | | Truck trailer collision | 4 T => 2 | RESPONSE-TCASK |
| | | Drop of object | 5 T => 2 | RESPONSE-TCASK |

ISO-ESD01-MCO - Movement of Transportation Cask Containing DOE MCO on Railcar or Truck Trailer 2008/01/28 Sheet 6

NOTE: ESD = event sequence diagram; MCO = multicanister overpack; IET = initiator event tree; INIT-EVENT = initiating event; ISO = Intra-Site Operations; RC = railcar; RESP = response; T = transfer; TCASK = transportation cask; TT = truck trailer; XFER = transfer.

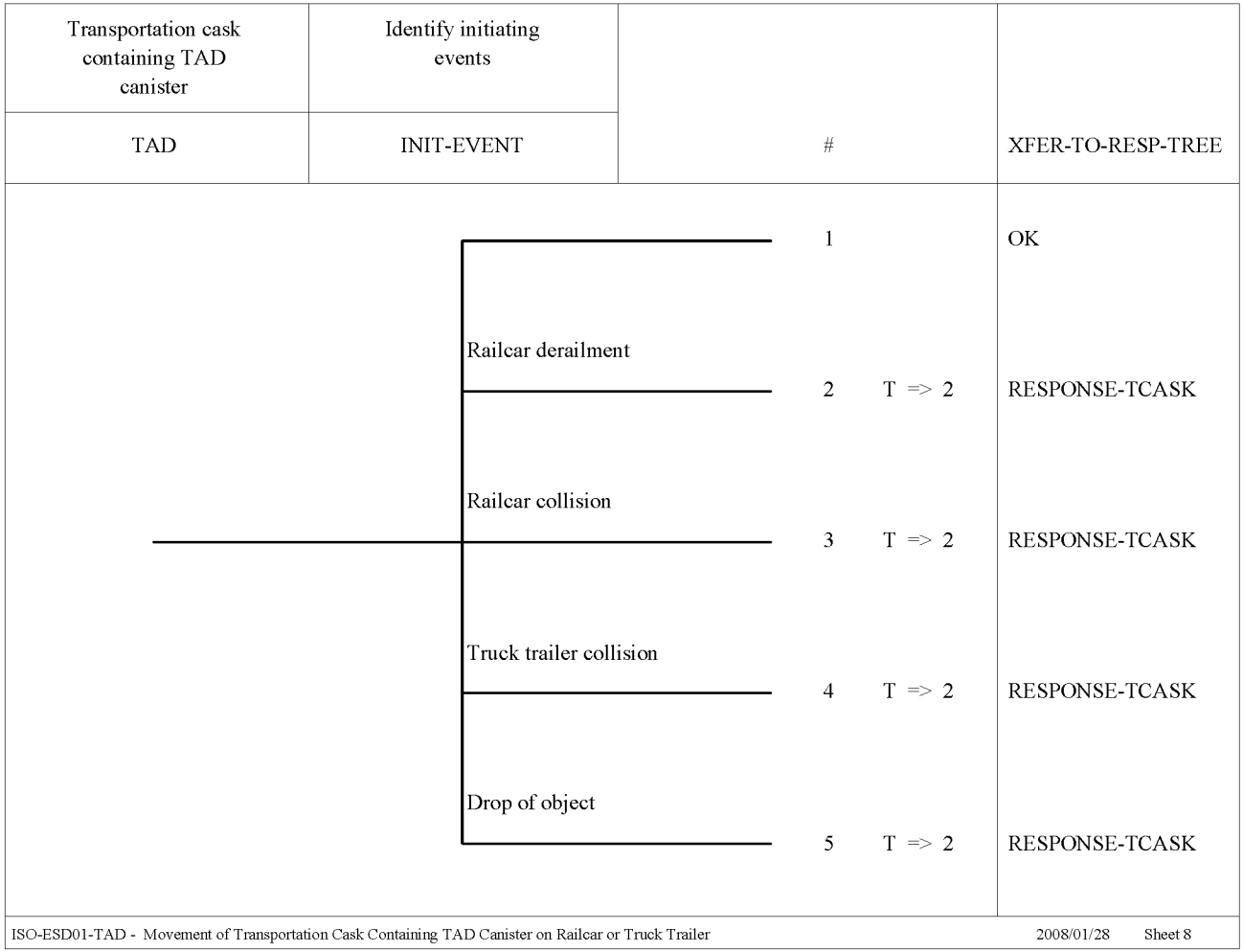
Source: Original

Figure A5-7. IET for ISO-ESD-01 – MCO – Movement of Transportation Cask Containing DOE MCO on Railcar or Truck Trailer

NOTE: ESD = event sequence diagram; IET = initiator event tree; INIT-EVENT = initiating event; ISO = Intra-Site Operations; NAV = naval; RESP = response; TCASK = transportation cask; XFER = transfer.

Source: Original

Figure A5-8. IET for ISO-ESD-01 – NAV – Movement of Transportation Cask Containing Naval Canister on Railcar




NOTE: ESD = event sequence diagram; IET = initiator event tree; INIT-EVENT = initiating event; ISO = Intra-Site Operations; RC = railcar; RESP = response; T = transfer; TAD = transportation, aging, and disposal; TCASK = transportation cask; TT = truck trailer; XFER = transfer.

Source: Original

Figure A5-9. IET for ISO-ESD-01 – TAD – Movement of Transportation Cask Containing TAD Canister on Railcar or Truck Trailer

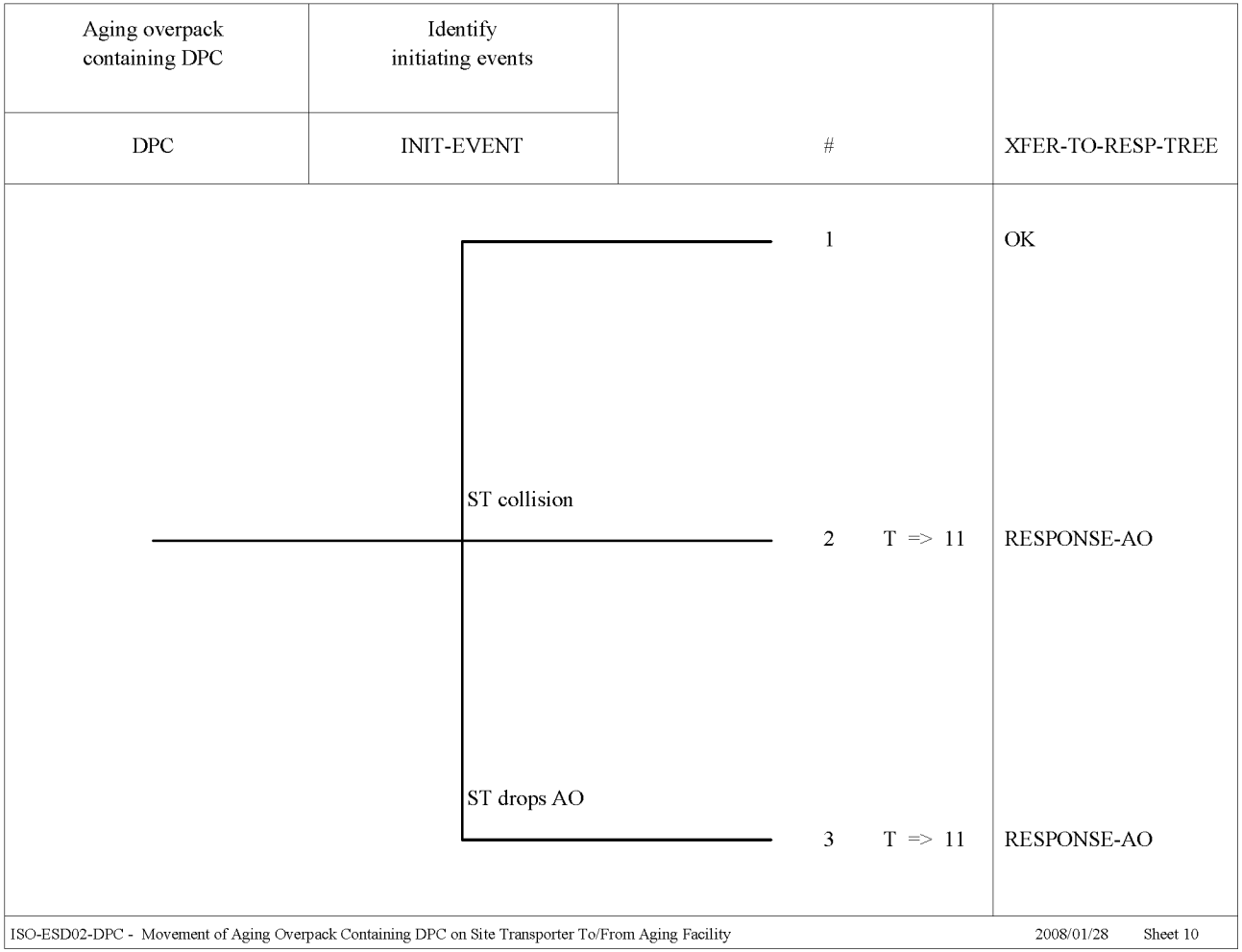
| Transportation cask containing UCSNF | Identify initiating events | | | |
|---|---|---|---|---|
| UCSNF | INIT-EVENT | | # | XFER-TO-RESP-TREE |
| | | | 1 | OK |
| | | Railcar derailment | 2 T => 2 | RESPONSE-TCASK |
| | | Railcar collision | 3 T => 2 | RESPONSE-TCASK |
| | | Truck trailer collision | 4 T => 2 | RESPONSE-TCASK |
| | | Drop of object | 5 T => 2 | RESPONSE-TCASK |

ISO-ESD01-UCSNF - Movement of Transportation Cask Containing UCSNF on Railcar or Truck Trailer 2008/01/28 Sheet 9

NOTE: ESD = event sequence diagram; IET = initiator event tree; INIT-EVENT = initiating event; ISO = Intra-Site Operations; RC = railcar; RESP = response; T = transportation cask; TCASK = transportation cask; TT = truck trailer; UCSNF = uncanistered commercial spent nuclear fuel; XFER = transfer.

Source: Original

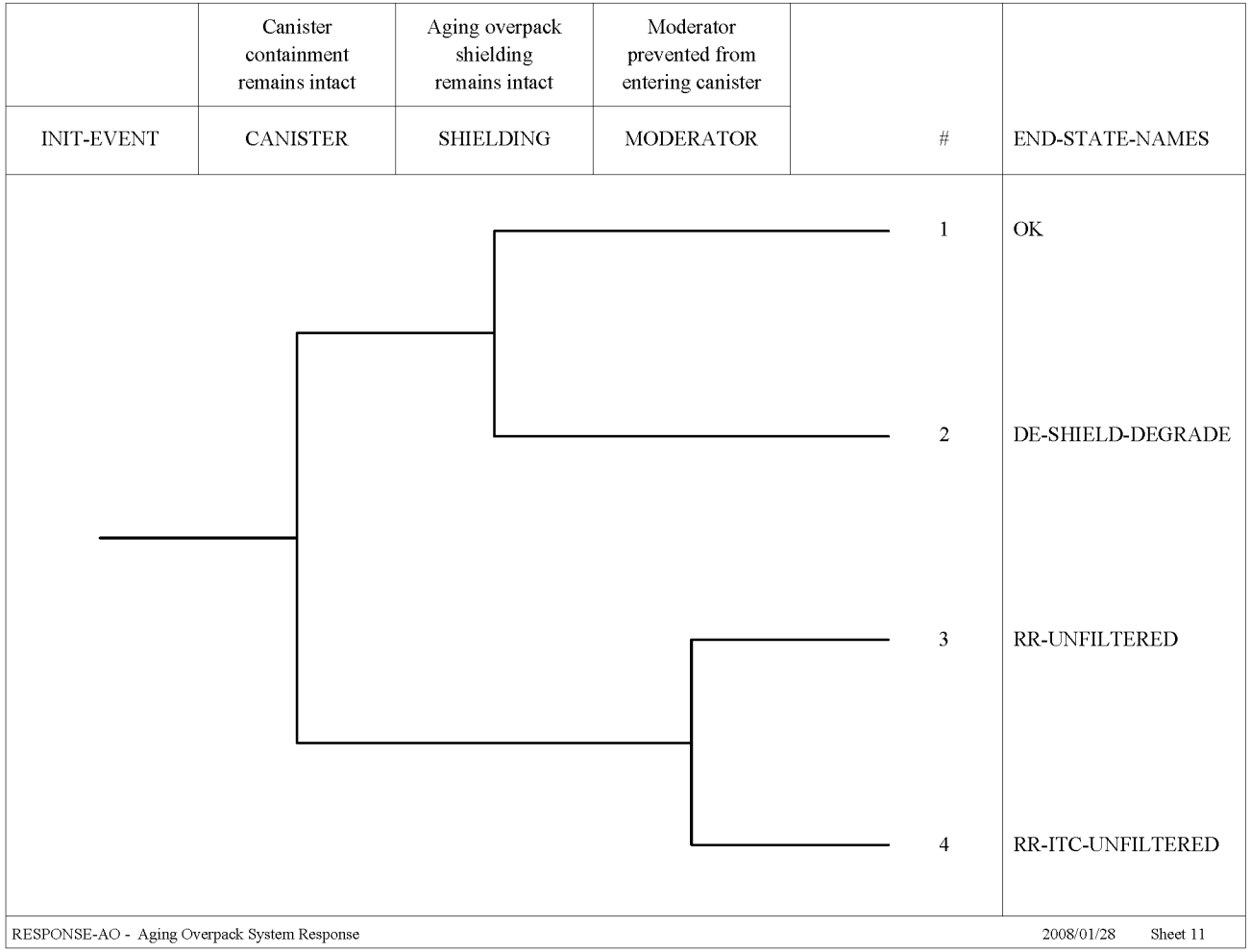
Figure A5-10. IET for ISO-ESD-01 – UCSNF – Movement of Transportation Cask Containing UCSNF on Railcar or Truck Trailer




NOTE: AO = aging overpack; DPC = dual-purpose canister; ESD = event sequence diagram; IET = initiator event tree; INIT-EVENT = initiating event; ISO = Intra-Site Operations; RESP = response; ST = site transporter; T = transfer; XFER = transfer.

Source: Original

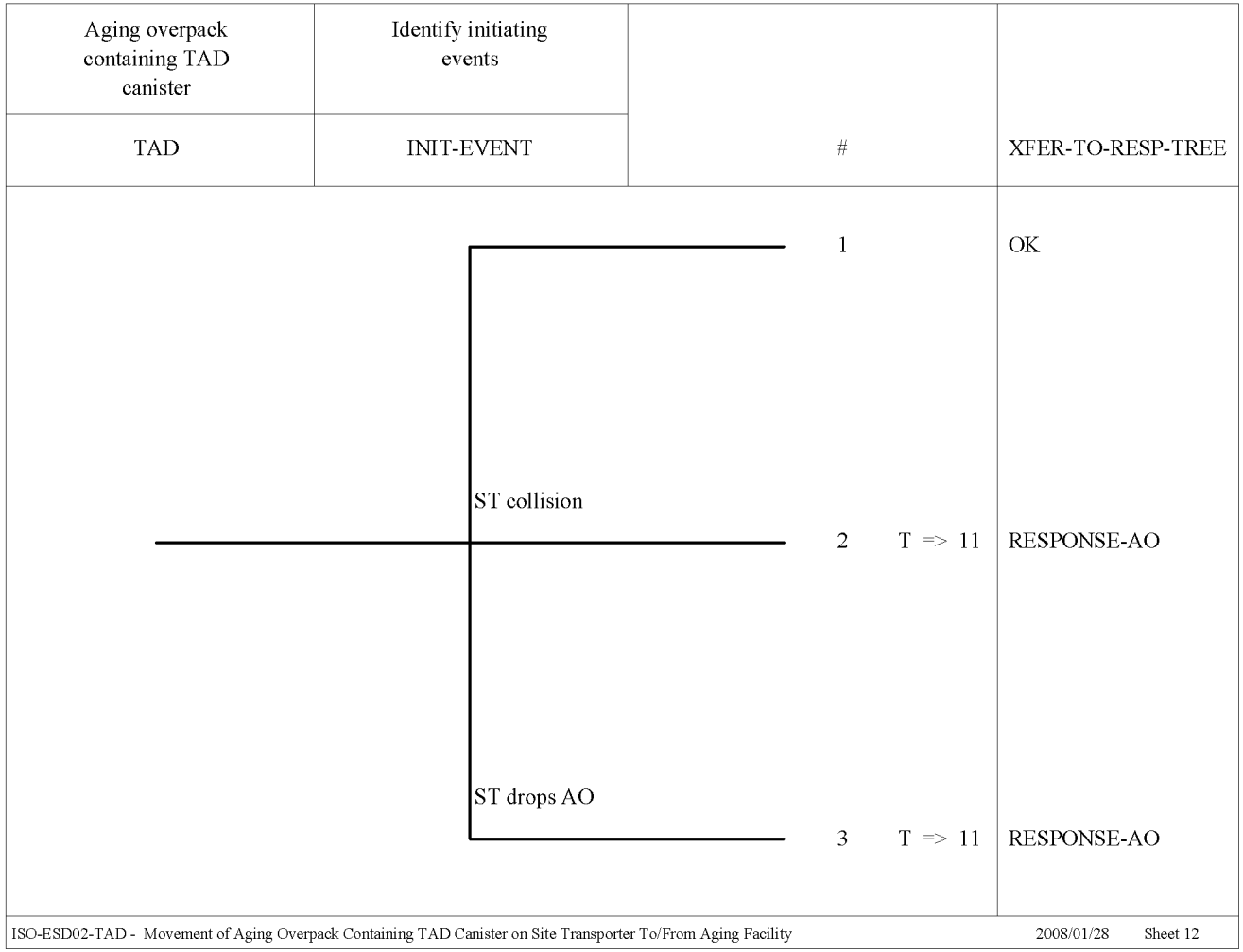
Figure A5-11. IET for ISO-ESD-02 – DPC – Movement of Aging Overpack Containing DPC on Site Transporter To/From Aging Facility




NOTE: AO = aging overpack; DE = direct exposure; ESD = event sequence diagram; IET = initiator event tree; INIT-EVENT = initiating event; ISO = Intra-Site Operations; ITC = important to criticality; RR = radionuclide release.

Source: Original

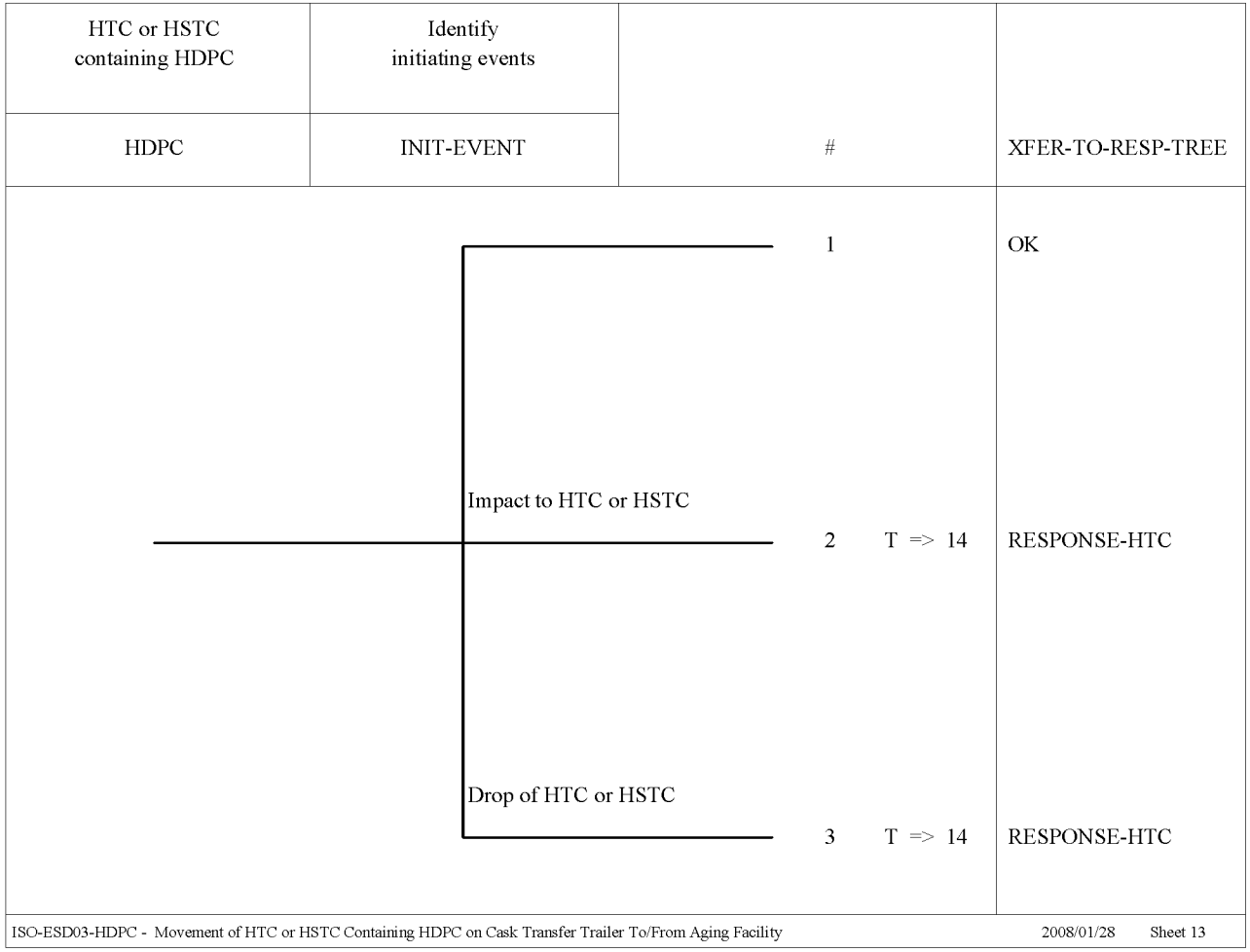
Figure A5-12. System-Response Event Tree for ISO-ESD-02 – RESPONSE-AO – Aging Overpack System Response




NOTE: AO = aging overpack; ESD = event sequence diagram; IET = initiator event tree; INIT-EVENT = initiating event; ISO = Intra-Site Operations; RESP = response; ST = site transporter; T= transfer; TAD = transportation, aging, and disposal; XFER = transfer.

Source: Original

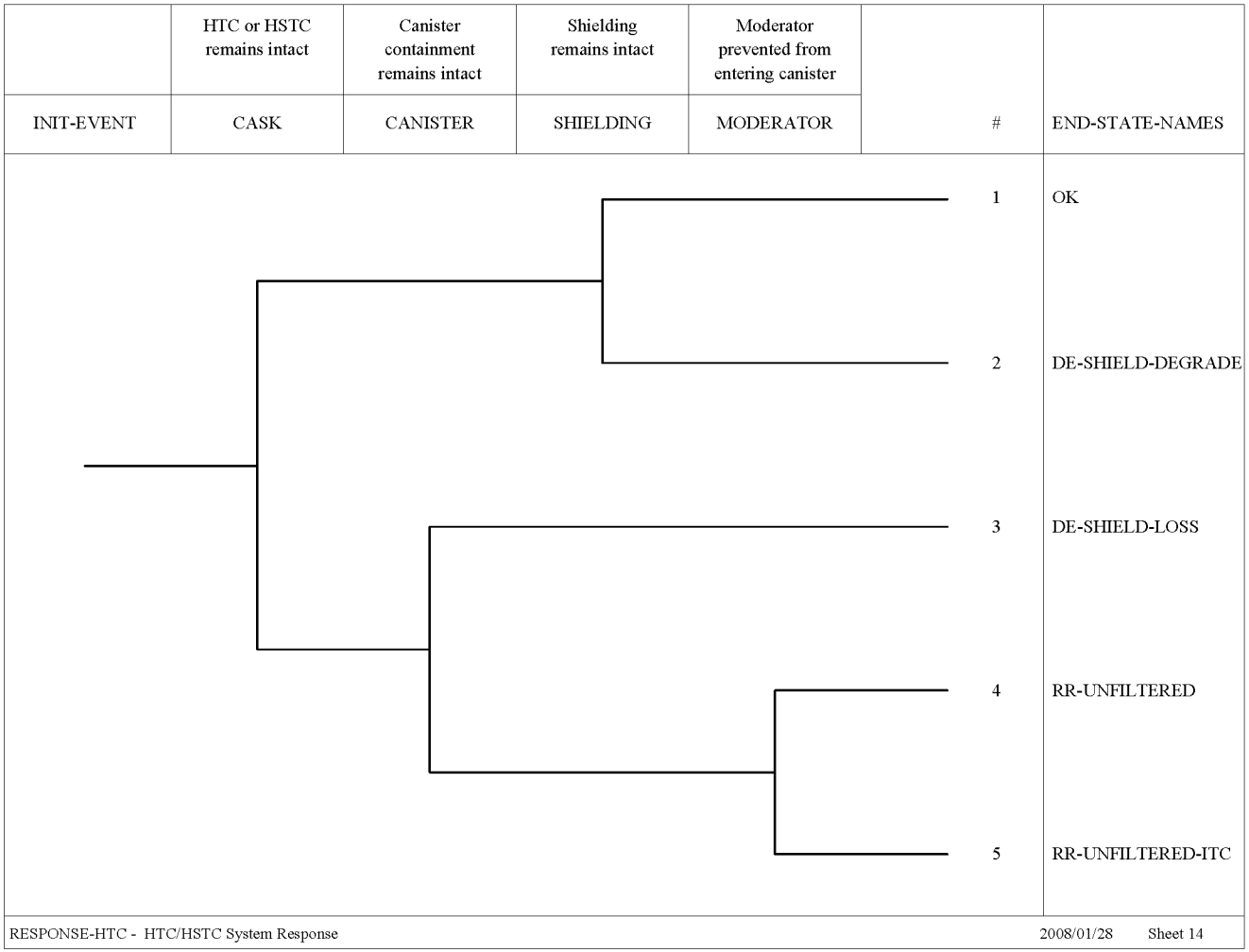
Figure A5-13. IET for ISO-ESD-02 – TAD – Movement of Aging Overpack Containing TAD Canister on Site Transporter To/From Aging Facility




NOTE: ESD = event sequence diagram; HDPC = horizontal dual-purpose canister; HSTC = horizontal shielded transfer cask; HTC = a transportation cask that is never upended; IET = initiator event tree; INIT-EVENT = initiating event; ISO = Intra-Site Operations; RESP = response; T= transportation cask; TC = transportation cask; XFER = transfer.

Source: Original

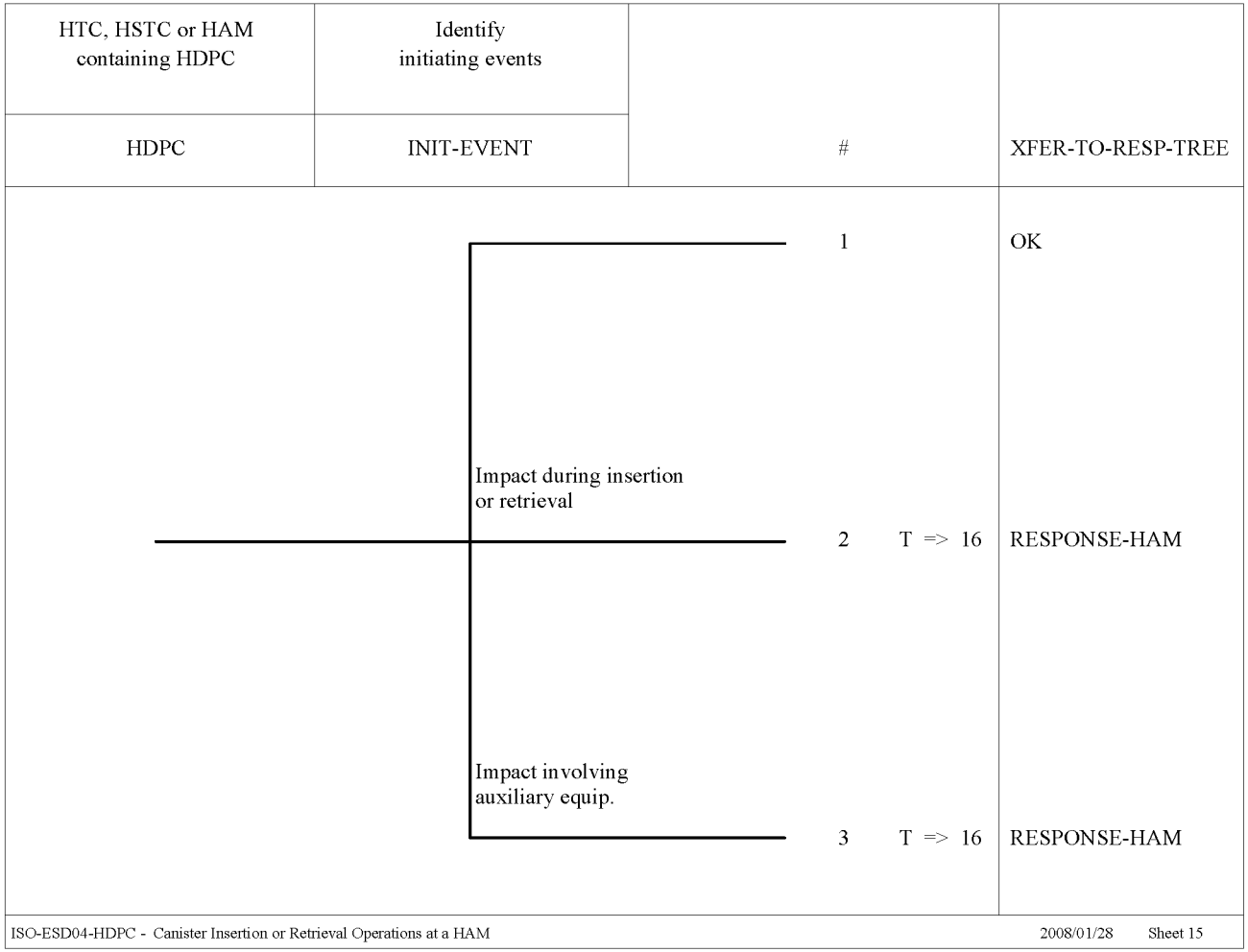
Figure A5-14. IET for ISO-ESD-03 – HDPC– Movement of HTC or HSTC Containing HDPC on Cask Transfer Trailer To/From Aging Facility




NOTE: DE = direct exposure; ESD = event sequence diagram; HSTC = horizontal shielded transfer cask; HTC = a transportation cask that is never upended; INIT-EVENT = initiating event; ISO = Intra-Site Operations; ITC = important to criticality; RR = radionuclide release.

Source: Original

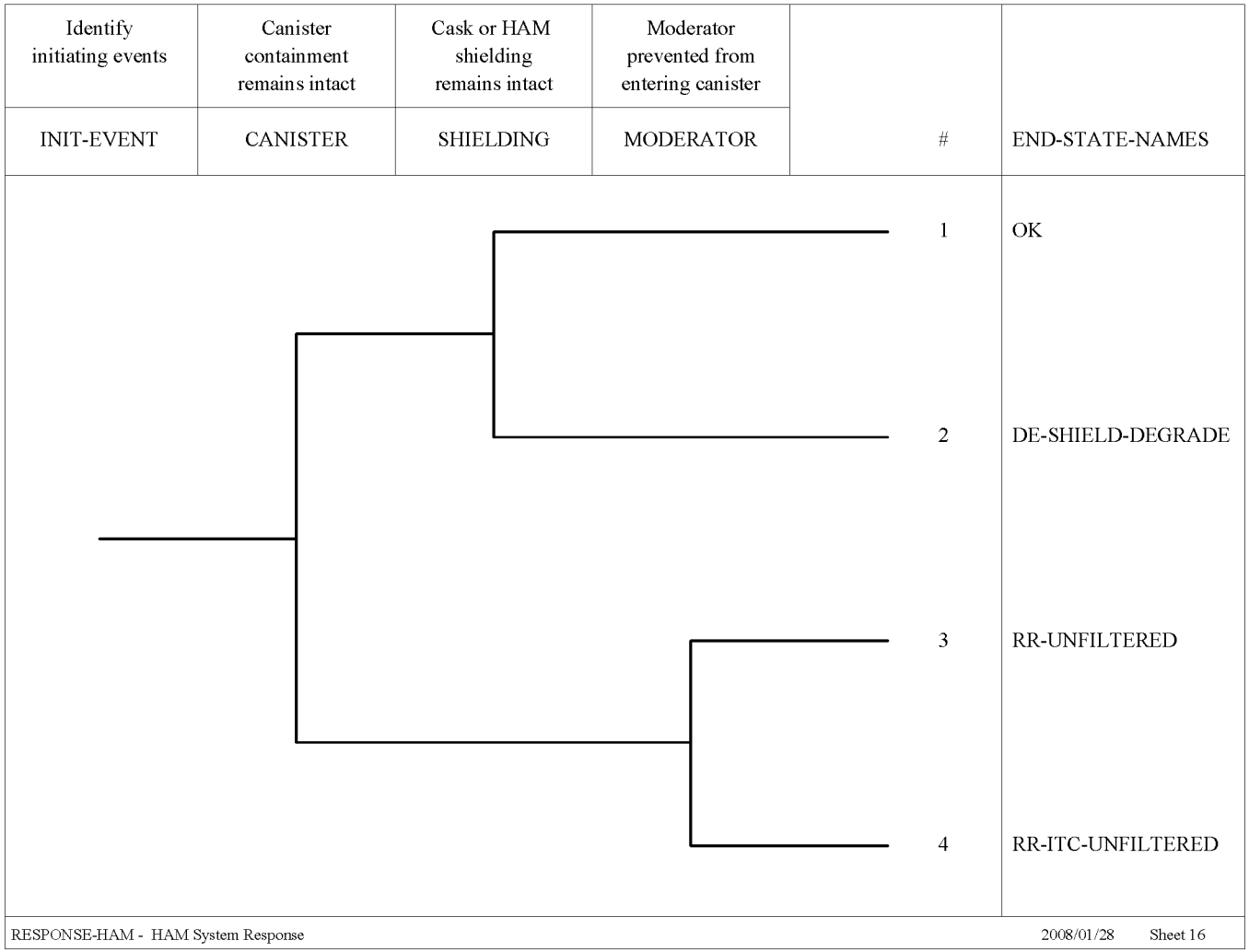
Figure A5-15. System-Response Event Tree for ISO-ESD-03 –RESPONSE-HTC – HTC/HSTC System Response




NOTE: ESD = event sequence diagram; HAM = horizontal aging module; HDPC = horizontal dual-purpose canister; HSTC = horizontal shielded transfer cask; HTC = a transportation cask that is never upended; IET = initiator event tree; INIT-EVENT = initiating event; ISO = Intra-Site Operations; RESP = response; XFER = transfer.

Source: Original

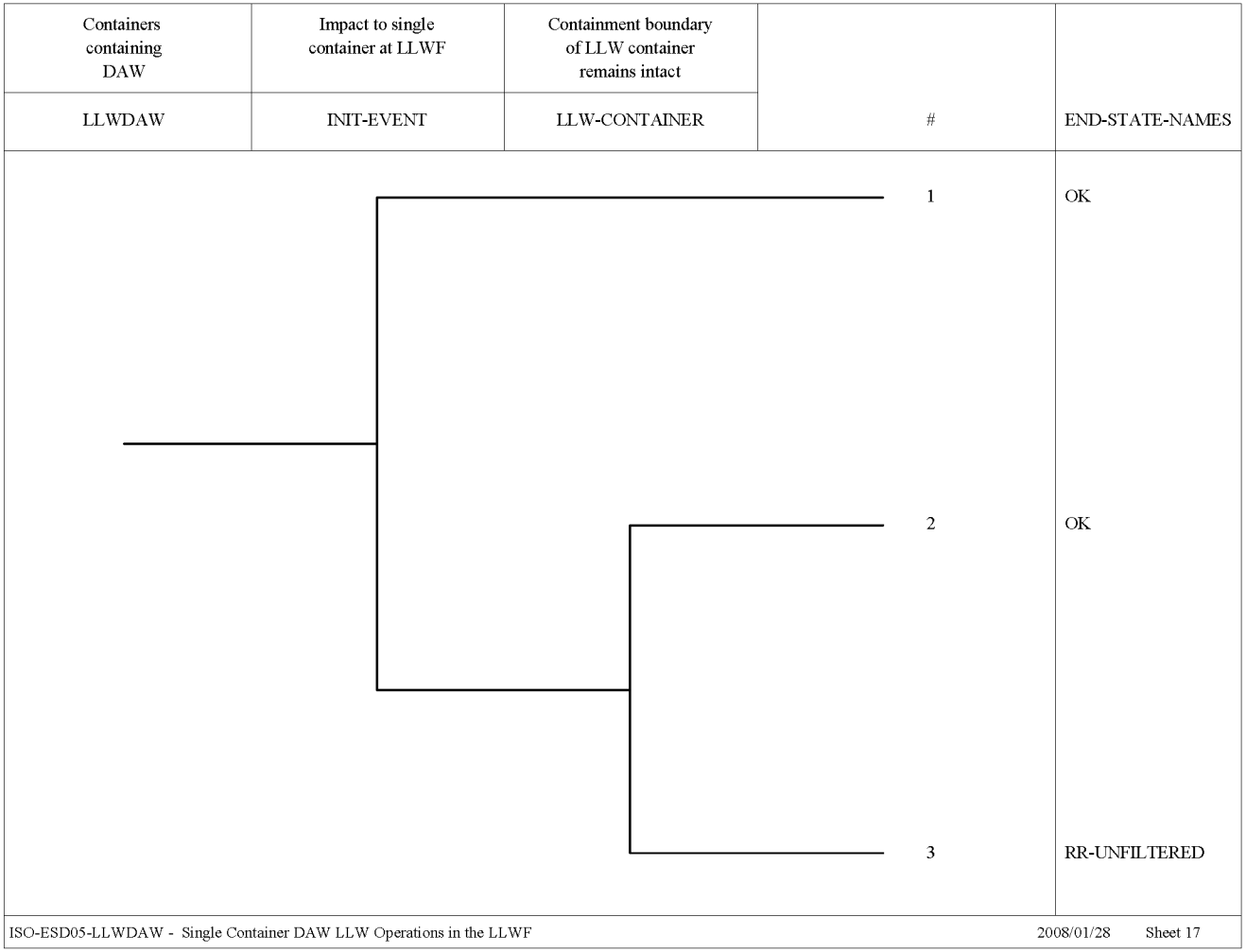
Figure A5-16. IET for ISO-ESD-04 – HDPC– Canister Insertion or Retrieval Operations at a HAM




NOTE: DE = direct exposure; ESD = event sequence diagram; HAM = horizontal aging module; INIT-EVENT = initiating event; ISO = Intra-Site Operations; ITC = important to criticality; RR = radionuclide release.

Source: Original

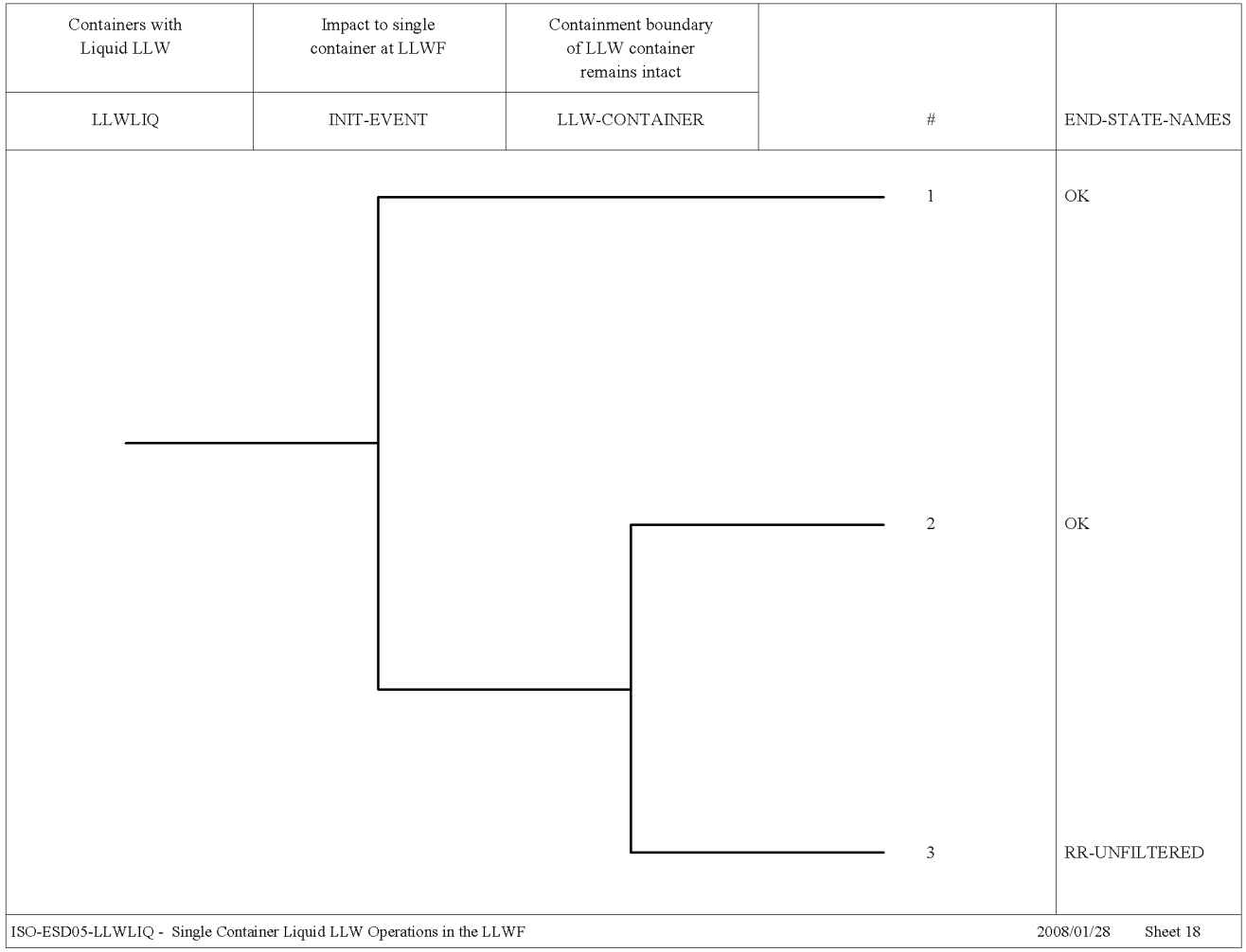
Figure A5-17. System-Response Event Tree for ISO-ESD-04 – RESPONSE-HAM – HAM System Response




NOTE: DAW = dry active LLW; ESD = event sequence diagram; IET = initiator event tree; INIT-EVENT = initiating event; ISO = Intra-Site Operations; LLW = low-level radioactive waste; LLWF = Low-Level Waste Facility; RR = radionuclide release.

Source: Original

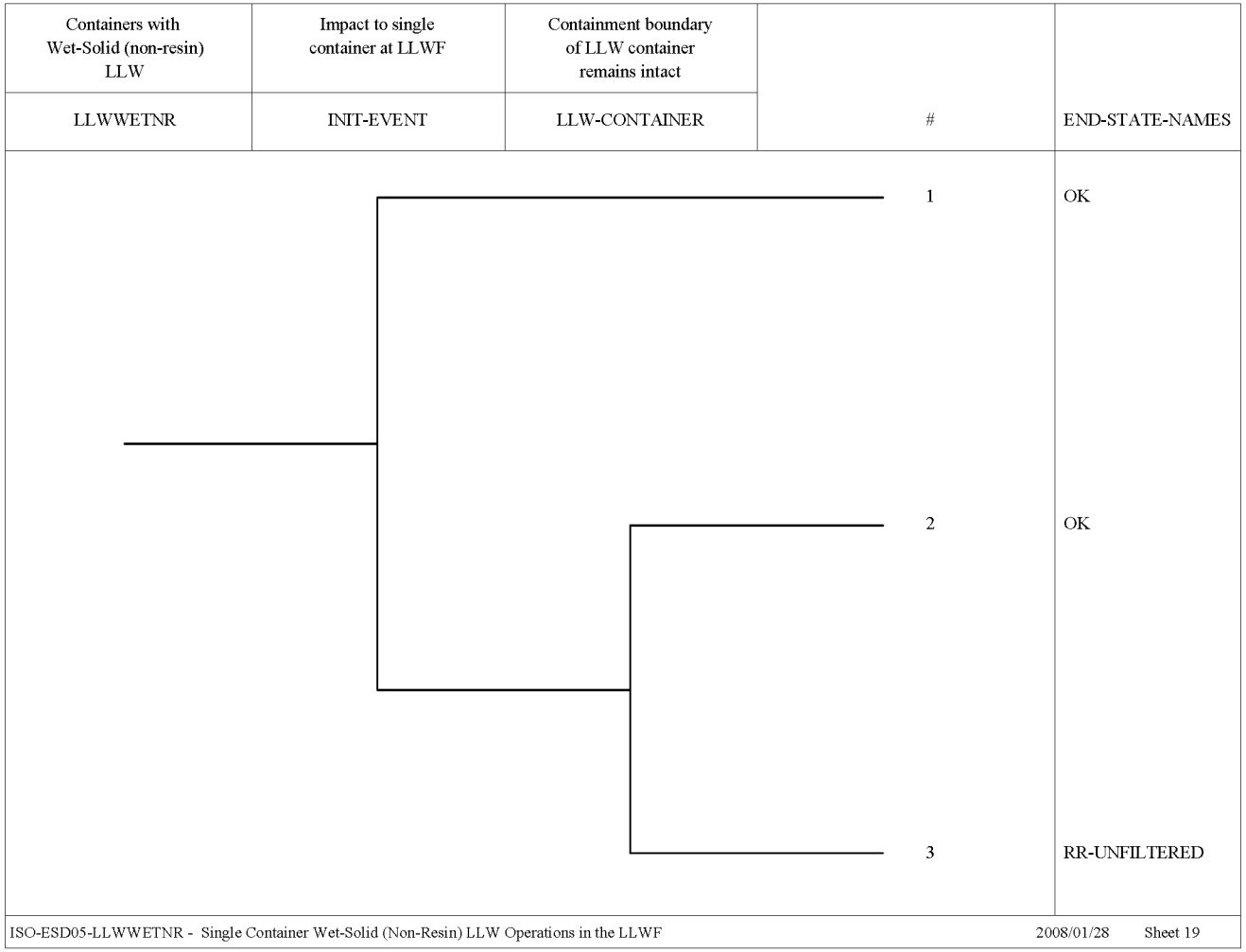
Figure A5-18. Event Tree for ISO-ESD-05-LLWDAW –Single Container DAW LLW Operations in LLWF




NOTE: ESD = event sequence diagram; INIT-EVENT = initiating event; IET = initiator event tree; ISO = Intra-Site Operations; LIQ = Liquid LLW; LLW = low-level radioactive waste; LLWF = Low-Level Waste Facility; RR = radionuclide release.

Source: Original

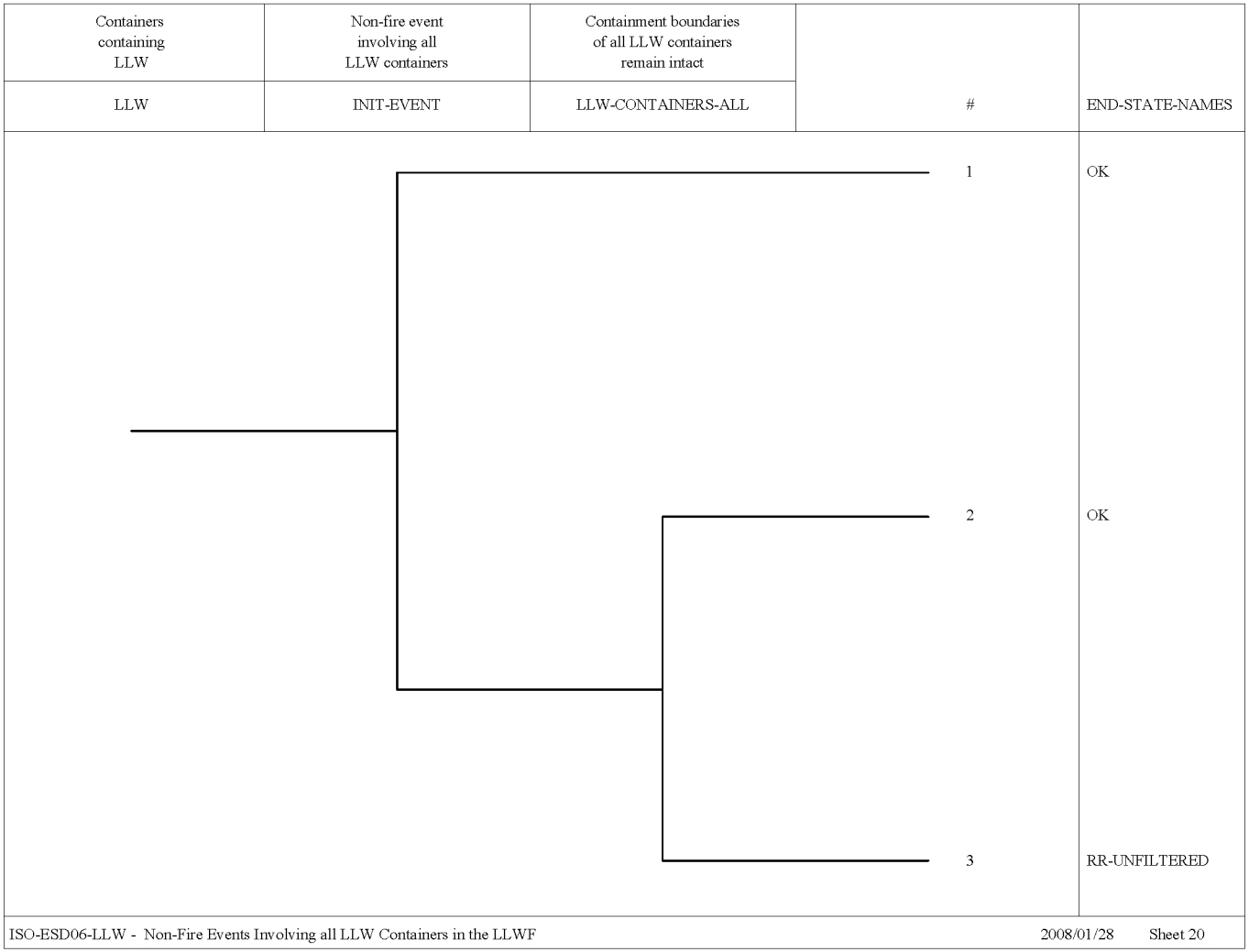
Figure A5-19. Event Tree for ISO-ESD-05-LLWLIQ –Single Container Liquid LLW Operations in the LLWF




NOTE: ESD = event sequence diagram; IET = initiator event tree; INIT-EVENT = initiating event; ISO = Intra-Site Operations; LLW = low-level radioactive waste; LLWF = Low-Level Waste Facility; RR = radionuclide release; WETnr = wet-solid LLW (non-resin).

Source: Original

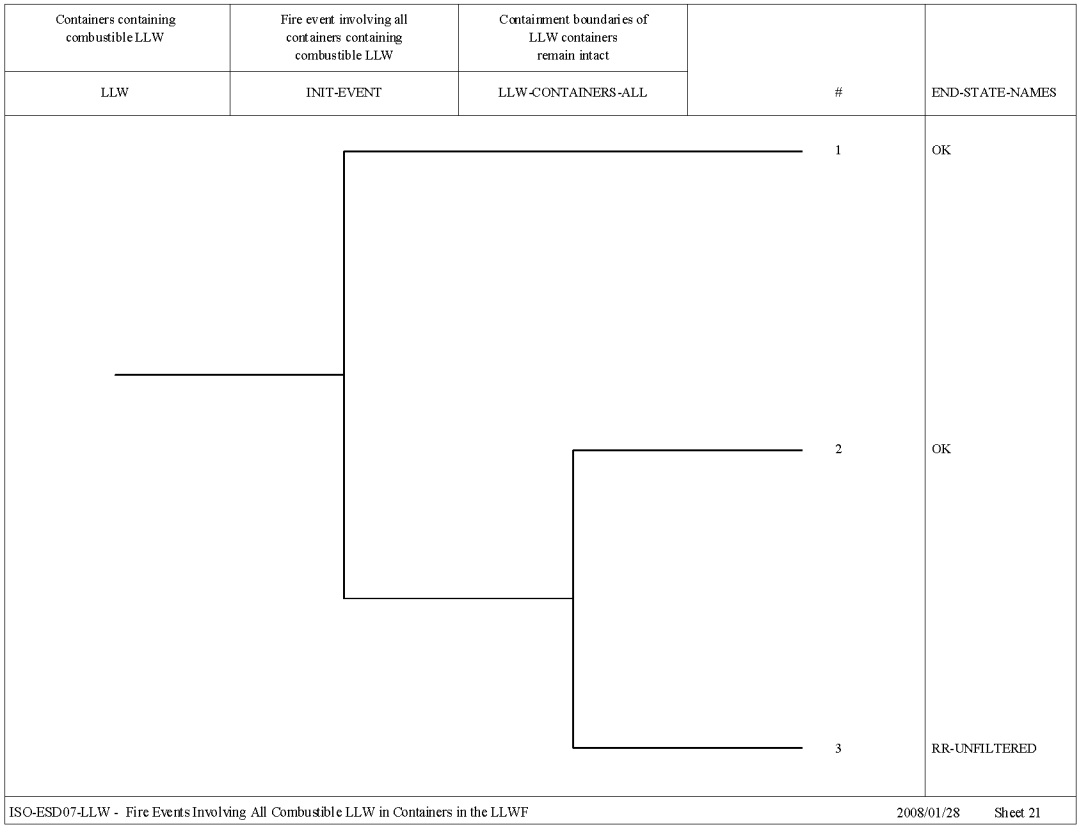
Figure A5-20. Event Tree for ISO-ESD-05-LLWWETnr –Single Container Wet-Solid (Non-Resin) LLW Operations in LLWF




NOTE: ESD = event sequence diagram; INIT-EVENT = initiating event; ISO = Intra-Site Operations; LLW = low-level radioactive waste; LLWF = Low-Level Waste Facility; RR = radionuclide release.

Source: Original

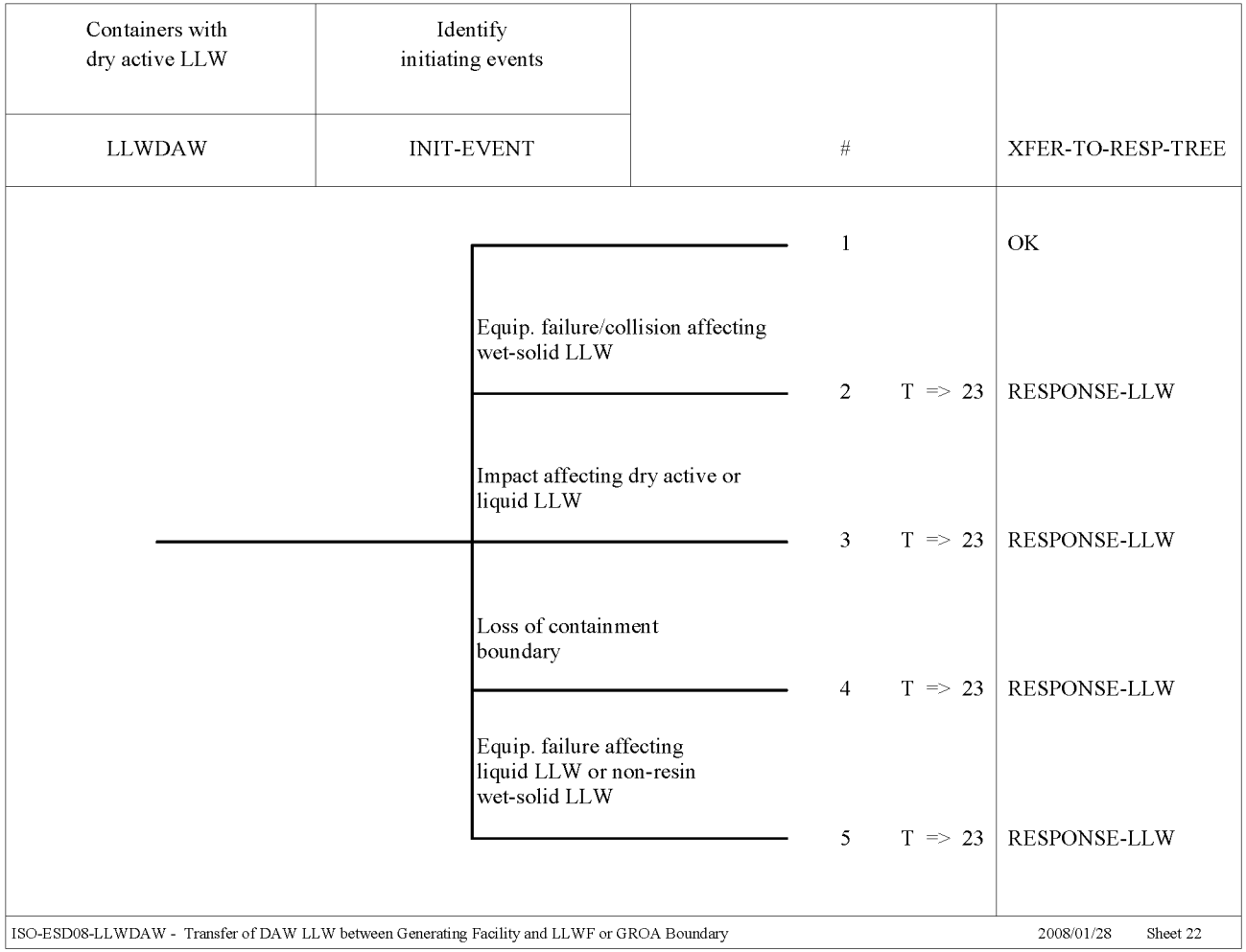
Figure A5-21. Event Tree for ISO-ESD-06-LLW –Non-Fire Events Involving all LLW Containers in the LLWF




NOTE: ESD = event sequence diagram; ISO = Intra-Site Operations; INIT-EVENT = initiating event; LLW = low-level radioactive waste; RR = radionuclide release.

Source: Original

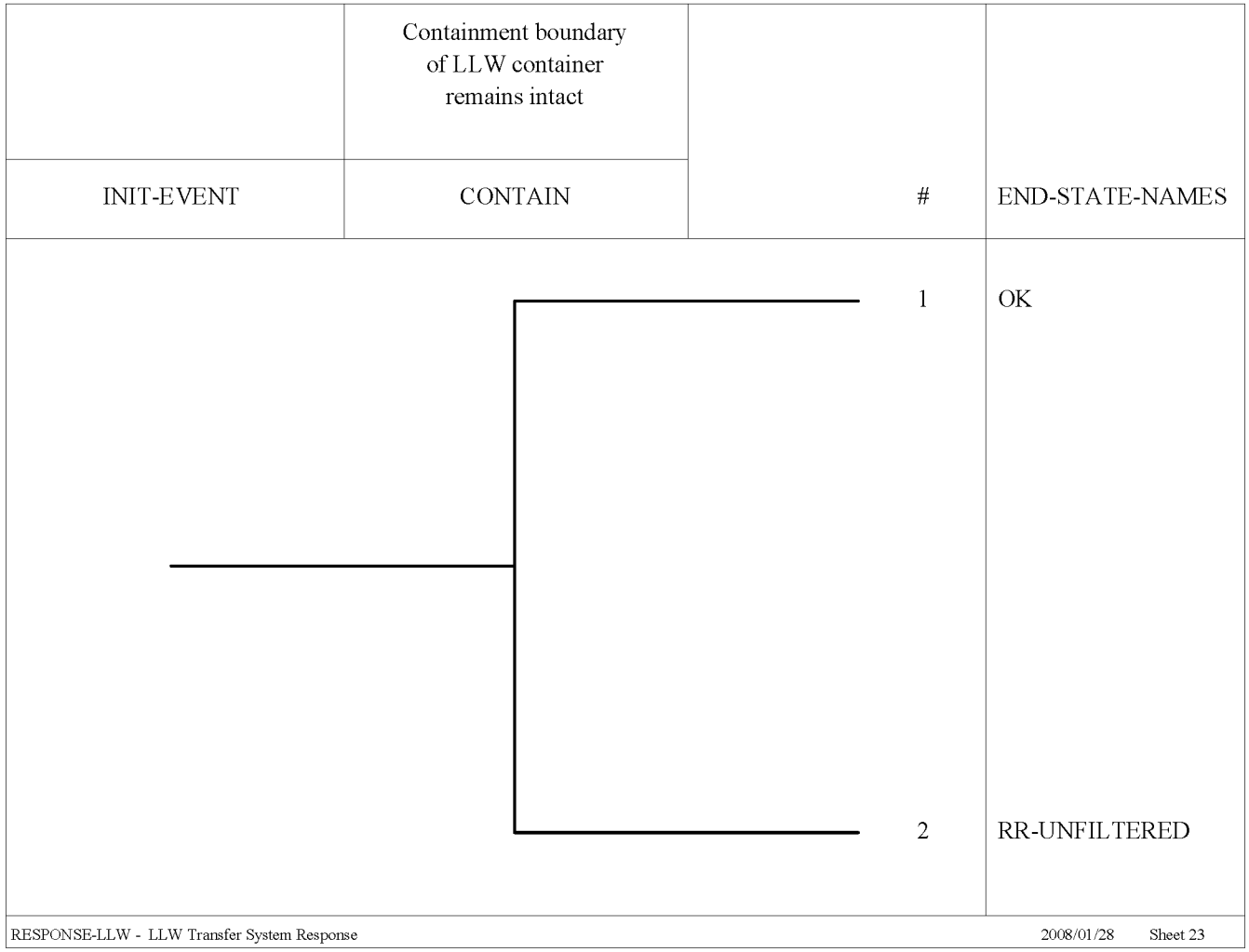
Figure A5-22. Event Tree for ISO-ESD-07-LLW – Fire Events Involving all Combustible LLW in Containers in the LLWF




NOTE: DAW = dry active low-level radioactive waste; ESD = event sequence diagram; IET = initiator event tree; GROA = geologic repository operations area; INIT-EVENT = initiating event; ISO = Intra-Site Operations; LLW = low-level radioactive waste; LLWF = Low-Level Waste Facility; RESP = response; T= transfer; XFER = transfer.

Source: Original

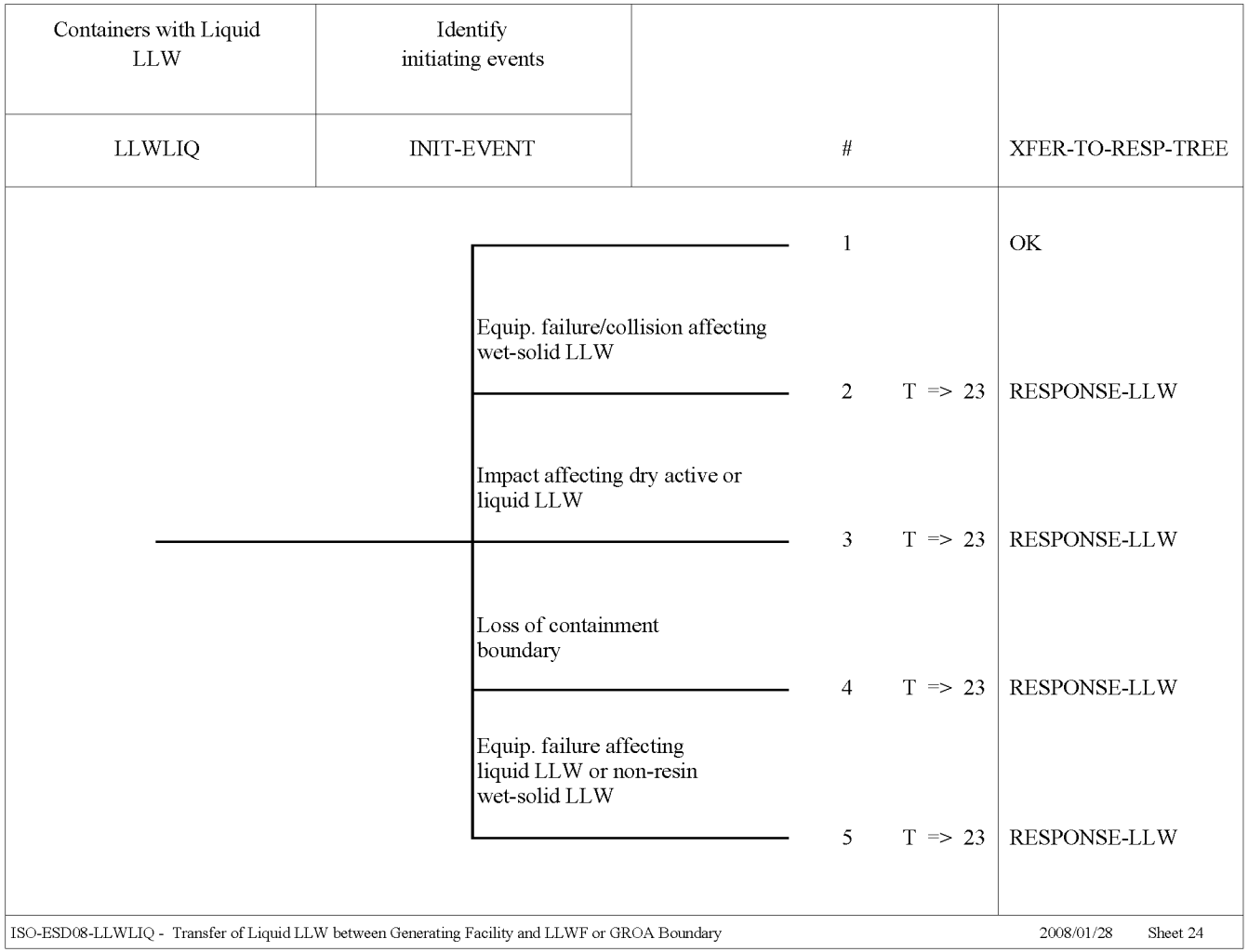
Figure A5-23. IET for ISO-ESD-08-LLWDAW – Transfer of DAW LLW between Generating Facility and LLWF or GROA Boundary




NOTE: ESD = event sequence diagram; ISO = Intra-Site Operations; INIT-EVENT = initiating event; LLW = low-level radioactive waste; RR = radionuclide release.

Source: Original

Figure A5-24. System-Response Event Tree for ISO-ESD-08 – RESPONSE-LLW – LLW Transfers-System Response




NOTE: ESD = event sequence diagram; IET = initiator event tree; INIT-EVENT = initiating event; GROA = geologic repository operations area; ISO = Intra-Site Operations; LIQ = Liquid LLW; LLW = low-level radioactive waste; LLWF = Low-Level Waste Facility; RESP = response; T= transfer; XFER = transfer.

Source: Original

Figure A5-25. IET for ISO-ESD-08-LLWLIQ – Transfer of Liquid LLW between Generating Facility and LLWF or GROA Boundary

| Containers with Wet-Solid (Non-Resin) LLW | Identify initiating events | | | |
|---|---|---|---|---|
| LLWWETNR | INIT-EVENT | # | | XFER-TO-RESP-TREE |
| | | 1 | | OK |
| | Equip. failure/collision affecting wet-solid LLW | 2 | T => 23 | RESPONSE-LLW |
| | Impact affecting dry active or liquid LLW | 3 | T => 23 | RESPONSE-LLW |
| | Loss of containment boundary | 4 | T => 23 | RESPONSE-LLW |
| | Equip. failure affecting liquid LLW or non-resin wet-solid LLW | 5 | T => 23 | RESPONSE-LLW |

ISO-ESD08-LLWWETNR - Transfer of Wet-Solid (Non-Resin) LLW between Generating Facility and LLWF or GROA Boundary 2008/01/28 Sheet 25

NOTE: ESD = event sequence diagram; IET = initiator event tree; INIT-EVENT = initiating event; ISO = Intra-Site Operations; LLW = low-level radioactive waste; RESP = response; T= transfer; XFER = transfer.

Source: Original

Figure A5-26. IET for ISO-ESD-08-LLWWETnr – Transfer of Wet-Solid (Non-Resin) LLW between Generating Facility and LLWF or GROA Boundary

| Containers with Wet-Solid (Resin) LLW | Identify initiating events | | | |
|---|---|---|---|---|
| LLWWETR | INIT-EVENT | # | | XFER-TO-RESP-TREE |
| | | 1 | | OK |
| | Equip. failure/collision affecting wet-solid LLW | 2 | T => 23 | RESPONSE-LLW |
| | Impact affecting dry active or liquid LLW | 3 | T => 23 | RESPONSE-LLW |
| | Loss of containment boundary | 4 | T => 23 | RESPONSE-LLW |
| | Equip. failure affecting liquid LLW or non-resin wet-solid LLW | 5 | T => 23 | RESPONSE-LLW |
| ISO-ESD08-LLWWETR - Transfer of Wet-Solid (Resin) LLW between Generating Facility and LLWF or GROA Boundary | | | 2008/01/28 | Sheet 26 |

NOTE: ESD = event sequence diagram; IET = initiator event tree; INIT-EVENT = initiating event; ISO = Intra-Site Operations; LLW = low-level radioactive waste; RESP = response; T= transfer; XFER = transfer.

Source: Original

Figure A5-27. IET for ISO-ESD-08-LLWWETr – Transfer of Wet-Solid (Resin) LLW between Generating Facility and LLWF or GROA Boundary

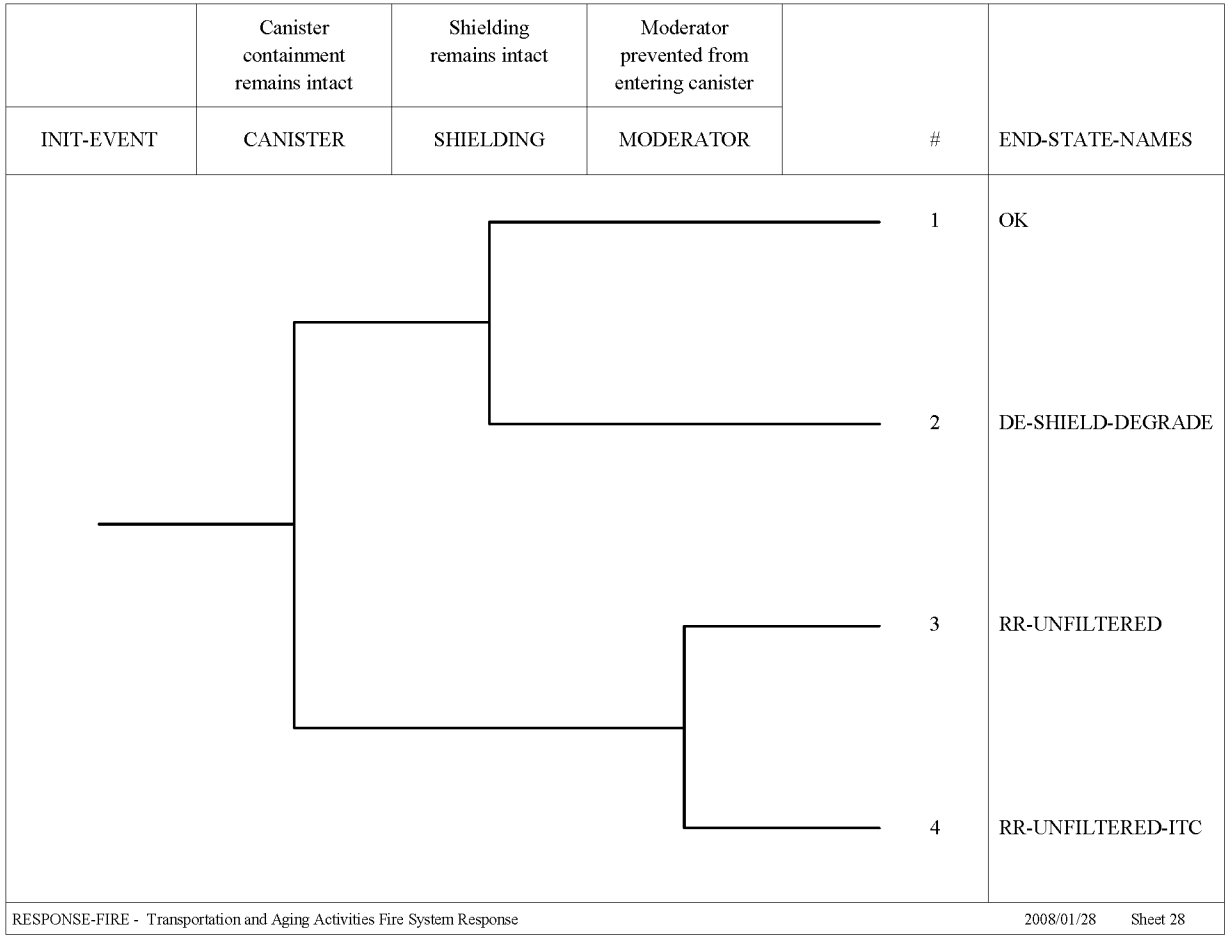
| Transportation cask or aging overpack containing DPC | Identify initiating events | | | |
|---|---|---|---|---|
| DPC | INIT-EVENT | | # | XFER-TO-RESP-TREE |
| | | | 1 | OK |
| | | Fire affects TC during staging | 2 | T => 28 RESPONSE-FIRE |
| | | Fire affects TC during movement | 3 | T => 28 RESPONSE-FIRE |
| | | Fire affects AO, HTC, or HSTC during movement | 4 | T => 28 RESPONSE-FIRE |
| | | Fire at Aging Facility | 5 | T => 28 RESPONSE-FIRE |

ISO-ESD09-DPC - Fire Affecting DPC during Transportation or Aging Activities 2008/01/28 Sheet 27

NOTE: AO = aging overpack; DPC = dual-purpose canister; ESD = event sequence diagram; HSTC = horizontal shielded transfer cask; HTC = a transportation cask that is never upended; IET = initiator event tree; INIT-EVENT = initiating event; ISO = Intra-Site Operations; ITC = important to criticality; RESP = response; ST = site transportation; T= transfer; TC = transportation cask; TFER = transfer.

Source: Original

Figure A5-28. IET for ISO-ESD-09 – DPC – Fire Affecting DPC during Transportation or Aging Activities




NOTE: ESD = event sequence diagram; INIT-EVENT = initiating event; ISO = Intra-Site Operations; ITC = important to criticality; RR = radionuclide release.

Source: Original

Figure A5-29. System-Response Event Tree for ISO-ESD-09 – RESPONSE-FIRE – Transportation and Aging Activities Fire System Response

| Transportation cask containing DOE standardized canister | Identify initiating events | | | |
|---|---|---|---|---|
| DSTD | INIT-EVENT | | # | XFER-TO-RESP-TREE |
| | | | 1 | OK |
| | | Fire affects TC during staging | 2 T => 28 | RESPONSE-FIRE |
| | | Fire affects TC during movement | 3 T => 28 | RESPONSE-FIRE |
| | | Fire affects AO, HTC, or HSTC during movement | 4 T => 28 | RESPONSE-FIRE |
| | | Fire at Aging Facility | 5 T => 28 | RESPONSE-FIRE |
| ISO-ESD09-DSTD - Fire Affecting DOE Standardized Canister (DSTD) during Transportation Activities | | | | 2008/01/28 Sheet 29 |

NOTE: AO = aging overpack; DSTD = Department of Energy standardized canister; ESD = event sequence diagram; IET = initiator event tree; INIT-EVENT = initiating event; ISO = Intra-Site Operations; HSTC = horizontal shielded transfer cask; HTC = a transportation cask that is never upended; RESP = response; ST = site transportation; T = transfer; TC = transportation cask; XFER = transfer.

Source: Original

Figure A5-30. IET for ISO-ESD-09 – DSTD – Fire Affecting DOE Standardized Canister during Transportation Activities

| HTC, HSTC or HAM containing HDPC | Identify initiating events | | | |
|---|---|---|---|---|
| HDPC | INIT-EVENT | | # | XFER-TO-RESP-TREE |
| | | | 1 | OK |
| | | Fire affects TC during staging | 2 T => 28 | RESPONSE-FIRE |
| | | Fire affects TC during movement | 3 T => 28 | RESPONSE-FIRE |
| | | Fire affects AO, HTC, or HSTC during movement | 4 T => 28 | RESPONSE-FIRE |
| | | Fire at Aging Facility | 5 T => 28 | RESPONSE-FIRE |
| ISO-ESD09-HDPC - Fire Affecting HDPC during Transportation or Aging Activities | | | 2008/01/28 | Sheet 30 |

NOTE: AO = aging overpack; ESD = event sequence diagram; HDPC = horizontal dual-purpose canister; HSTC = horizontal shielded transfer cask; HTC = a transportation cask that is never upended; IET = initiator event tree; INIT-EVENT = initiating event; ISO = Intra-Site Operations; RESP = response; T = transfer; TC = transportation cask; XFER = transfer.

Source: Original

Figure A5-31. IET for ISO-ESD-09 – HDPC – Fire Affecting HDPC during Transportation or Aging Activities

| Transportation cask containing HLW canister(s) | Identify initiating events | | | |
|---|---|---|---|---|
| HLW | INIT-EVENT | | # | XFER-TO-RESP-TREE |
| | | | 1 | OK |
| | | Fire affects TC during staging | 2 T => 28 | RESPONSE-FIRE |
| | | Fire affects TC during movement | 3 T => 28 | RESPONSE-FIRE |
| | | Fire affects AO, HTC, or HSTC during movement | 4 T => 28 | RESPONSE-FIRE |
| | | Fire at Aging Facility | 5 T => 28 | RESPONSE-FIRE |

ISO-ESD09-HLW - Fire Affecting HLW Canister(s) during Transportation Activities 2008/01/28 Sheet 31

NOTE: AO = aging overpack; ESD = event sequence diagram; IET = initiator event tree; ISO = Intra-Site Operations; HLW = high-level radioactive waste; HSTC = horizontal shielded transfer cask; HTC = a transportation cask that is never upended; INIT-EVENT = initiating event; RESP = response; T = transfer; TC = transportation cask; XFER = transfer.

Source: Original

Figure A5-32. IET for ISO-ESD-09 – HLW – Fire Affecting HLW Canister(s) during Transportation Activities

| Transportation cask containing DOE MCO | Identify initiating events | | | |
|---|---|---|---|---|
| MCO | INIT-EVENT | | # | XFER-TO-RESP-TREE |
| | | | 1 | OK |
| | | Fire affects TC during staging | 2 T => 28 | RESPONSE-FIRE |
| | | Fire affects TC during movement | 3 T => 28 | RESPONSE-FIRE |
| | | Fire affects AO, HTC, or HSTC during movement | 4 T => 28 | RESPONSE-FIRE |
| | | Fire at Aging Facility | 5 T => 28 | RESPONSE-FIRE |

ISO-ESD09-MCO - Fire Affecting DOE MCO during Transportation Activities 2008/01/28 Sheet 32

NOTE: AO = aging overpack; ESD = event sequence diagram; IET = initiator event tree; ISO = Intra-Site Operations; HSTC = horizontal shielded transfer cask; HTC = a transportation cask that is never upended; INIT-EVENT = initiating event; MCO = multicanister overpack; RESP = response; T = transfer; TC = transportation cask; XFER = transfer.

Source: Original

Figure A5-33. IET for ISO-ESD-09 – MCO – Fire Affecting DOE MCO during Transportation Activities

| Transportation cask containing naval canister | Identify initiating events | | | |
|---|---|---|---|---|
| NAV | INIT-EVENT | | # | XFER-TO-RESP-TREE |
| | | | 1 | OK |
| | | Fire affects TC during staging | 2 T => 28 | RESPONSE-FIRE |
| | | Fire affects TC during movement | 3 T => 28 | RESPONSE-FIRE |
| | | Fire affects AO, HTC, or HSTC during movement | 4 T => 28 | RESPONSE-FIRE |
| | | Fire at Aging Facility | 5 T => 28 | RESPONSE-FIRE |

ISO-ESD09-NAV - Fire Affecting Naval Canister during Transportation Activities 2008/01/28 Sheet 33

NOTE: AO = aging overpack; ESD = event sequence diagram; HSTC = horizontal shielded transfer cask; HTC = a transportation cask that is never upended; IET = initiator event tree; INIT = initiating event; ISO = Intra-Site Operations; NAV = naval; RESP = response; T = transfer; TC = transportation cask; XFER = transfer.

Source: Original

Figure A5-34. IET for ISO-ESD-09 – NAV – Fire Affecting Naval Canister during Transportation Activities

| Transportation cask or aging overpack containing TAD canister | Identify initiating events | | | |
|---|---|---|---|---|
| TAD | INIT-EVENT | | # | XFER-TO-RESP-TREE |
| | | | 1 | OK |
| | | Fire affects TC during staging | 2 T => 28 | RESPONSE-FIRE |
| | | Fire affects TC during movement | 3 T => 28 | RESPONSE-FIRE |
| | | Fire affects AO, HTC, or HSTC during movement | 4 T => 28 | RESPONSE-FIRE |
| | | Fire at Aging Facility | 5 T => 28 | RESPONSE-FIRE |

ISO-ESD09-TAD - Fire Affecting TAD Canister during Transportation or Aging Activities 2008/01/28 Sheet 34

NOTE: AO = aging overpack; ESD = event sequence diagram; HSTC = horizontal shielded transfer cask; HTC = a transportation cask that is never upended; IET = initiator event tree; INIT-EVENT = initiating event; ISO = Intra-Site Operations; RESP = response; T= transfer; TAD = transportation, aging, and disposal; TC = transportation cask; XFER = transfer.

Source: Original

Figure A5-35. IET for ISO-ESD-09 – TAD – Fire Affecting TAD Canister during Transportation or Aging Activities

| Transportation cask containing UCSNF | Identify initiating events | | | |
|---|---|---|---|---|
| UCSNF | INIT-EVENT | | # | XFER-TO-RESP-TREE |
| | | | 1 | OK |
| | | Fire affects TC during staging | 2 T => 28 | RESPONSE-FIRE |
| | | Fire affects TC during movement | 3 T => 28 | RESPONSE-FIRE |
| | | Fire affects AO, HTC, or HSTC during movement | 4 T => 28 | RESPONSE-FIRE |
| | | Fire at Aging Facility | 5 T => 28 | RESPONSE-FIRE |

ISO-ESD09-UCSNF - Fire Affecting UCSNF in a Transportation Cask during Transportation Activities 2008/01/28 Sheet 35

NOTE: AO = aging overpack; ESD = event sequence diagram; HSTC = horizontal shielded transfer cask; HTC = a transportation cask that is never upended; IET = initiator event tree; INIT-EVENT = initiating event; ISO = Intra-Site Operations; RESP = response; T= transfer; TC = transportation cask; UCSNF = uncanistered spent nuclear fuel; XFER = transfer.

Source: Original

Figure A5-36. IET for ISO-ESD-09 – UCSNF – Fire Affecting UCSNF in a Transportation Cask during Transportation Activities

# ATTACHMENT B
# SYSTEM/PIVOTAL EVENT ANALYSIS – FAULT TREES

INTENTIONALLY LEFT BLANK

# CONTENTS

**Page**

ACRONYMS AND ABBREVIATIONS ..... B1-11
B1 SITE PRIME MOVER ANALYSIS – FAULT TREES ..... B1-13
B1.1 REFERENCES ..... B1-13
B1.2 SITE PRIME MOVER DESCRIPTION ..... B1-13
B1.3 SYSTEM DESCRIPTION ..... B1-14
B1.4 DEPENDENCIES AND INTERACTIONS ANALYSIS ..... B1-17
B1.5 SITE PRIME MOVER RELATED FAILURE SCENARIOS ..... B1-17
B2 SITE TRANSPORTER - FAULT TREE ANALYSIS ..... B2-1
B2.1 REFERENCES ..... B2-1
B2.2 SITE TRANSPORTER DESCRIPTION ..... B2-1
B2.3 DEPENDENCIES AND INTERACTIONS ANALYSIS ..... B2-9
B2.4 SITE TRANSPORTER FAILURE SCENARIOS ..... B2-10
B3 CASK TRACTOR AND CASK TRANSFER TRAILER FAULT TREE ANALYSIS ..... B3-1
B3.1 REFERENCES ..... B3-1
B3.2 CASK TRACTOR AND CASK TRANSFER TRAILER DESCRIPTION ..... B3-1
B3.3 DEPENDENCE AND INTERACTIONS ANALYSIS ..... B3-2
B3.4 CASK TRACTOR AND CASK TRANSFER TRAILER FAILURE SCENARIOS ..... B3-3
B4 ADDITIONAL FAULT TREES ..... B4-1

INTENTIONALLY LEFT BLANK

# FIGURES

**Page**

B1.3-1. Site Prime Mover Simplified Schematic Intra-Site and In-Facility ..... B1-15
B1.5-1. Uncertainty Results of the INT-1-SPMRC-COLLISION Fault Tree ..... B1-22
B1.5-2. Cut Set Generation Results for the INT-1-SPMRC-COLLISION Fault Tree ..... B1-22
B1.5-3. INT-1-SPMRC-COLLISION Sheet 1 of 3 ..... B1-24
B1.5-4. INT-1-SPMRC-COLLISION Sheet 2 of 3 ..... B1-25
B1.5-5. INT-1-SPMRC-COLLISION Sheet 3 of 3 ..... B1-26
B1.5-6. Uncertainty Results of the SPMTT Collision Fault Tree ..... B1-30
B1.5-7. Cut Set Generation Results for the SPMTT Collision Fault Tree ..... B1-31
B1.5-8. INT-1-SPMTT-COLLISION Sheet 1 of 3 ..... B1-33
B1.5-9. INT-1-SPMTT-COLLISION Sheet 2 of 3 ..... B1-34
B1.5-10. INT-1-SPMTT-COLLISION Sheet 3 of 3 ..... B1-35
B2.2-1 Site Transporter ..... B2-3
B2.2-2. Simplified Block Diagram of the Site Transporter Subsystems ..... B2-4
B2.4-1. Uncertainty Results Site Transporter Collision ..... B2-13
B2.4-2. Cut Set Generation Results ..... B2-13
B2.4-3. INT-2-ST-COLLISION -Site Transporter Collision Sheet 1 of 3 ..... B2-15
B2.4-4. INT-2-ST-COLLISION Site Transporter Collision Sheet 2 of 3 ..... B2-17
B2.4-5. INT-2-ST-COLLISION Site Transporter Collision Sheet 3 of 3 ..... B2-19
B2.4-6. Uncertainty Results for Site Transporter Load Drop during Lift/Movement Fault Tree ..... B2-26
B2.4-7. Cut Set Generation Results for Site Transporter Load Drop during Lift/Movement Fault Tree ..... B2-26
B2.4-8. INTRASITE-ST-AO-DROP Site Transporter Drop Load during Lift/Movement Sheet 1 of 12 ..... B2-30
B2.4-9. INTRASITE-ST-AO-DROP Site Transporter Drop Load during Lift/Movement Sheet 2 of 12 ..... B2-31
B2.4-10. INTRASITE-ST-AO-DROP Site Transporter Drop Load during Lift/Movement Sheet 3 of 12 ..... B2-32
B2.4-11. INTRASITE-ST-AO-DROP Site Transporter Drop Load during Lift/Movement Sheet 4 of 12 ..... B2-33
B2.4-12. INTRASITE-ST-AO-DROP Site Transporter Drop Load during Lift/Movement Sheet 5 of 12 ..... B2-34

## FIGURES (Continued)

**Page**

B2.4-13. INTRASITE-ST-AO-DROP Site Transporter Drop Load during Lift/Movement Sheet 6 of 12 ..... B2-35

B2.4-14. INTRASITE-ST-AO-DROP Site Transporter Drop Load during Lift/Movement Sheet 7 of 12 ..... B2-36

B2.4-15. INTRASITE-ST-AO-DROP Site Transporter Drop Load during Lift/Movement Sheet 8 of 12 ..... B2-37

B2.4-16. INTRASITE-ST-AO-DROP Site Transporter Drop Load during Lift/Movement Sheet 9 of 12 ..... B2-38

B2.4-17. INTRASITE-ST-AO-DROP Site Transporter Drop Load during Lift/Movement Sheet 10 of 12 ..... B2-39

B2.4-18. INTRASITE-ST-AO-DROP Site Transporter Drop Load during Lift/Movement Sheet 11 of 12 ..... B2-40

B2.4-19. INTRASITE-ST-AO-DROP Site Transporter Drop Load during Lift/Movement Sheet 12 of 12 ..... B2-41

B3.4-1. Uncertainty Results for the Cask Tractor and Cask Transfer Trailer Collision Fault Tree INT-HCTT-COLLISION ..... B3-6

B3.4-2. Cut Set Generation Results for Cask Tractor and Cask Transfer Trailer Collision Fault Tree INT-HCT-COLLISION ..... B3-7

B3.4-3. Fault Tree for Cask Tractor and Cask Transfer Trailer Collision (INT-HCTT-COLLISION) Sheet 1 of 5 ..... B3-10

B3.4-4. Fault Tree for Cask Tractor and Cask Transfer Trailer Collision (INT-HCTT-COLLISION) Sheet 2 of 5 ..... B3-11

B3.4-5. Fault Tree for Cask Tractor and Cask Transfer Trailer Collision (INT-HCTT-COLLISION) Sheet 3 of 5 ..... B3-12

B3.4-6. Fault Tree for Cask Tractor and Cask Transfer Trailer Collision (INT-HCTT-COLLISION) Sheet 4 of 5 ..... B3-13

B3.4-7. Fault Tree for Cask Tractor and Cask Transfer Trailer Collision (INT-HCTT-COLLISION) Sheet 5 of 5 ..... B3-14

B4-1. Fault Tree for INTRASITE-PMRC-COLLIDE ..... B4-4

B4-2. Fault Tree for INTRASITE-DERAIL ..... B4-5

B4-3. Fault Tree for INTRASITE-PMTT-COLLIDE ..... B4-6

B4-4. Fault Tree for INTRASITE-JIB-CRANE ..... B4-7

B4-5. Fault Tree for INTRASITE-ST-COLLIDE ..... B4-8

B4-6. Fault Tree for INTRASITE-HCTT-COLLISION ..... B4-9

## FIGURES (Continued)

**Page**

B4-7. Fault Tree for INTRASITE-HCTT-DROP ..... B4-10
B4-8. Fault Tree for INTRASITE-HAM-INSERT ..... B4-11
B4-9. Fault Tree for INTRASITE-HAM-AUX-EQUIPMENT ..... B4-12
B4-10. Fault Tree for INTRASITE-HEPA-TRANSFER ..... B4-13
B4-11. Fault Tree for INTRASITE-COLL-TRANSFER ..... B4-14

INTENTIONALLY LEFT BLANK

# TABLES

**Page**

B1.4-1 Dependencies and Interactions Analysis ....B1-17
B1.5-1. Basic Event Probability for SPMRC Collision ....B1-20
B1.5-2. Cut Sets for INT-1-SPMRC-COLLISION ....B1-23
B1.5-3. Basic Event Probability for SPMTT Collision ....B1-28
B1.5-4. Cut Sets for SPMTT Collision ....B1-31
B2.2-1. Site Transporter Remote or Pendant Controls ....B2-7
B2.3-1. Dependencies and Interactions Analysis ....B2-10
B2.4-1. Basic Event Probability for INT-2-ST-COLLISION ....B2-12
B2.4-2. Cut Sets for the Site Transporter Collision in Facility ....B2-14
B2.4-3. Basic Event Probability for the INTRASITE-ST-AO-DROP Fault Tree ....B2-23
B2.4-4. Cut Sets for Site Transporter Load Drop during Lift/Movement Fault Tree ....B2-27
B3.3-1. Dependencies and Interactions Analysis ....B3-2
B3.4-1. Basic Event Probabilities for Collision of the Cask Tractor and Cask Transfer Trailer, INT-HCTT-COLLISION ....B3-4
B3.4-2. Cut Sets for Collision of Cask Tractor and Cask Transfer Trailer (INT-HCTT-COLLISION) ....B3-7
B4-1. Top Level and Linking Fault Trees ....B4-1
B4-2. Basic Events for Additional Fault Trees ....B4-2
B4-3. Resulting Distribution Parameters Used in Quantification Spreadsheet ....B4-3

INTENTIONALLY LEFT BLANK

# ACRONYMS AND ABBREVIATIONS

## Acronyms

| | |
|---|---|
| AC | alternating current |
| CCF | common-cause failure |
| CRCF | Canister Receipt and Closure Facility |
| DPC | dual-purpose canister |
| DSTD | U.S. Department of Energy standardized canister |
| FRA | Federal Railroad Administration |
| HAM | horizontal aging module |
| HLW | high-level radioactive waste |
| HSTC | horizontal shielded transfer cask |
| IHF | Initial Handling Facility |
| MCO | multicanister overpack |
| PCSA | preclosure safety analysis |
| RF | Receipt Facility |
| SNF | spent nuclear fuel |
| SPM | site prime mover |
| SPMRC | site prime mover railcar |
| SPMTT | site prime mover truck trailer |
| STC | shielded transfer cask |
| WHF | Wet Handling Facility |

## Abbreviations

| | |
|---|---|
| HP | horsepower |
| Hz | hertz |
| in | inch |
| kW | kilowatt |
| mph | miles per hour |
| rpm | rotations per minute |
| V | volt |

INTENTIONALLY LEFT BLANK

# ATTACHMENT B
# SYSTEM/PIVOTAL EVENT ANALYSIS – FAULT TREES

This attachment describes the fault trees developed for Intra-Site Operations. The fault trees are described in relation to each of the major systems or equipment involved in operations, with subsections providing a physical description and brief operational description of the system or equipment. In addition, the specific functions that the system performs to prevent or mitigate initiating events and the conditions required for that function to be successful are also described, together with the system dependencies and interactions. Fault trees and basic events are identified as well.

## B1 SITE PRIME MOVER ANALYSIS – FAULT TREES

### B1.1 REFERENCES

The preclosure safety analysis (PCSA) is based on a snapshot of the design. The reference design documents are appropriately documented as design inputs in this section. Since the safety analysis is based on a snapshot of the design, referencing subsequent revisions to the design documents (as described in EG-PRO-3DP-G04B-00037, *Calculations and Analyses* (Ref. 2.1.1, Section 3.2.2.F) that implement PCSA requirements flowing from the safety analysis would not be appropriate for the purpose of the PCSA.

The inputs in this section noted with an asterisk (*) indicate that they fall into one of the designated categories described in Section 4.1, relative to suitability for intended use.

**Design Inputs**

B1.1.1 *AAR S-2043. 2003. *Performance Specification for Trains Used to Carry High-Level Radioactive Material.* Washington, D.C.: Association of American Railroads. TIC: 257585.

**Design Constraints**

B1.1.2 49 CFR 571. 2007. Transportation: Federal Motor Vehicle Safety Standards. Internet accessible.

B1.1.3 Motor Vehicle Safety. 49 U.S.C. 301. Internet accessible.

### B1.2 SITE PRIME MOVER DESCRIPTION

#### B1.2.1 Overview

The site prime mover (SPM) is a diesel/electric self-propelled vehicle that is designed to move railcars or truck trailers loaded with transportation casks. The transport occurs during Intra-Site Operations and within the Canister Receipt and Closure Facility (CRCF), the Wet Handling Facility (WHF), the Initial Handling Facility (IHF) and the Receipt Facility (RF).

Movement of the SPM railcar (SPMRC) or SPM truck trailer (SPMTT) within the facilities is limited to the Entry Vestibule and the Cask Preparation Area.

Transportation casks arriving at the facilities can contain:

- Dual-purpose canisters (DPCs)
- Horizontal DPCs
- Multicanister overpacks (MCOs)
- U.S. Department of Energy standardized canisters (DSTDs)
- Transportation, aging, and disposal canisters
- Naval spent nuclear fuel (SNF)
- High-level radioactive waste (HLW)
- Uncanistered commercial SNF canisters.

## B1.3 SYSTEM DESCRIPTION

### B1.3.1 Site Prime Mover

The SPM is a commercially available vehicle that has the capability of moving both railcars and truck trailers loaded with transportation casks. Retractable railroad wheels attached to the front and rear axles of the SPM are used for rail operations.

The driving and braking power comes directly from the road tires as they are in contact with the rails. Weight sharing between the flanged rail and regular road wheels is automatically varied to achieve the required power transmission needs. More weight can be distributed on the rail wheels when moving, or more on the road wheels when braking, accelerating, and negotiating inclines. The SPM has speed limiters that set the maximum speed of the vehicle to 9.0 mph or less.

A diesel engine provides the energy to operate the SPM outside the facilities. Inside any of the facilities, the SPM is electrically driven via an umbilical cable (or remote control) from the facility main electrical supply.

The SPM is equipped with both an automatic wagon coupling system for railcars and a fifth wheel coupling device for truck trailers. In addition, the SPM is equipped with the following: high-performance compressors, a priority filling system, an electronic regulating valve with filling speed adjustments, and a 100-gallon diesel fuel tank.

#### B1.3.1.1 Railcars

Railcars used for movement of transportation casks shall be designed in accordance with Federal Railroad Administration (FRA) requirements under authority delegated by the Secretary of Transportation. The FRA administers a safety program that oversees the movement of nuclear shipments throughout the national rail transportation system. Performance standards are addressed in the Association of American Railroads *Performance Specification for Trains Used to Carry High-Level Radioactive Material, Standard S-2043* (Ref. B1.1.1).