**ESBWR DCD Tier 2 Chapter 4**

**26A6642AP Revision 5 to Revision 6 Change List**

| Item | Location | Description of Change |
|---|---|---|
| 1. | Entire Chapter | Global chapter editorial changes to correct misspelling and grammar, spell out or integrate acronyms where appropriate, and updated references as needed and where required. |
| 2. | S4.1.1, 1st para., 1st sentence | Deleted "brackets", no longer used in design. |
| 3. | F4.1-1 | Figure revised in response to RAI 4.2-29. |
| 4. | S4.2.1.1.5, 1st para, 6th sentence | Revised sentence in response to RAI 4.2-2 S04. |
| 5. | S4.2.3.12, 1st para., 8th and 9th sentences | Replaced 8th and 9th sentences with "The Fuel Assembly Mechanical Design Report LTR (Reference 4.2-4) contains the fuel-specific acceptance criteria." In response to RAI 14.3-398. |
| 6. | S4.2.7, references | Updated references to latest revision and added "Class III Proprietary" for consistency. |
| 7. | S4.2.7, note | Added note for clarification in response to RAI 4.2-28. |
| 8. | S4.3.1.3 | Replaced "abnormal operational occurrences" with "anticipated operational occurrences (AOOs)" for clarity. |
| 9. | S4.3.1.3, Maximum Linear Heat Generation Rate para., 3rd sentence | Replaced "abnormal" with "AOO" for clarity. |
| 10. | S4.3.3.1, 1st para., 2nd sentence | Replaced "Figure 4.3-1" with "Reference 4.3-8" for clarity. |
| 11. | S4.3.3.2.2, 2nd para., 4th sentence | Deleted sentence for DCD consistency and clarity. |
| 12. | S4.3.3.2.2, 2nd para., 5th sentence | Replaced "Figure 4.3-2" with "Reference 4.3-8" for clarity. |
| 13. | S4.3.3.2.3 3rd para., 2nd sentence | Replaced "Figure 4.3-3" with "Reference 4.3-8" for clarity |
| 14. | S4.3.3.2.3 4th para. | Deleted paragraph for DCD consistency and clarity |
| 15. | S4.3.3.3, 2nd para., 2nd sentence | Replaced "Figure 4.3-5 shows" with "Reference 4.3-8 provides" and added "…used to verify SDM." For consistency and clarity. |

PRELIMINARY

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|---|---|---|
| 16. | S4.3.3.3.1, 4th para., 1st sentence | Replaced "Table 4.3-1" with "Reference 4.3-8" for clarity. |
| 17. | S4.3.3.3.3, 2nd para. 5th sentence | Replaced "Figure 4.3-4" with "Reference 4.3-8" for clarity. |
| 18. | S4.3.3.6.2, 1st para., last sent. | Replaced "core decay ratio vs channel decay ratio" with "channel, core wide, and regional decay ratios" for consistency. |
| 19. | S4.3.6 References | Updated references to latest revision and added "Class III (Proprietary)" and "Class I (Non-proprietary)" for consistency. |
| 20. | S4.3.6, note | Added note for clarification in response to RAI 4.2-28. |
| 21. | T4.3-1 | Deleted for consistency. |
| 22. | F4.3-1 | Deleted for consistency. |
| 23. | F4.3-2 | Deleted for consistency. |
| 24. | F4.3-3 | Deleted for consistency. |
| 25. | F4.3-4 | Deleted for consistency. |
| 26. | F4.3-5 | Deleted for consistency. |
| 27. | S4.4.2.3.1, 2nd para., 2nd sentence | Added additional reference "…and 4.4-22" due to RAI 4.4-66 S01. |
| 28. | S4.4.2.3.2, 2nd para., 1st sentence | Revised equation due to RAI 4.4-66 S01. |
| 29. | S4.4.2.3.2, 2nd para., 3rd sentence | Added "…elevation…" due to RAI 4.4-66 S01. |
| 30. | S4.4.2.3.2, 2nd para., new 10th sentence | Added "However, full-scale pressure drop testing for a simulated GE14E fuel was performed to better characterize the differences in active fuel length, spacer separation, and part-length rod height between the GE14 and GE14E fuel design and the spacer loss coefficients for the GE14E fuel are determined to best fit the full-scale data obtained from the GE14E testing as discussed in Reference 4.4-22." Due to RAI 4.4-66 S01. |

PRELIMINARY

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|---|---|---|
| 31. | S4.4.2.3.5, 1st para., 5th sentence | Replaced "Moreover," with "However, full-scale pressure drop testing for a simulated GE14E fuel was performed to better characterize…" and replaced " …are accounted for in determining the local loss coefficients from the experimental data as explained in Subsection 4.4.2.3.2" with "…and to qualify the spacer loss coefficients for the ESBWR application. Test results and associated analysis are provide in Reference 4.4-22." due to RAI 4.4-66 S01. |
| 32. | S4.4.2.3.5, 1st para., 6th sentence | Added "…for the upper-tie plate, water rods, and bundle inlet based on the GE14 pressure drop data…" due to RAI 4.4-66 S01. |
| 33. | S4.4.2.3.5, 1st para., 7th sentence | Added "The spacer loss coefficients for the GE14E fuel are determined to best fit the full-scale data obtained from the GE14E testing." Due to RAI 4.4-66 S01. |
| 34. | S4.4.2.4, 2nd para., 3rd sentence | Added reference 4.4-22 due to RAI 4.4-66 S01. |
| 35. | S4.4.3.2, 2nd para. | Corrected "0.93" with "0.92", corrected "0.90" with "0.89", and "4.4-15" with "4.4-11" due to TRACG re-analysis committed in MFN 09-114. |
| 36. | S4.4.8, ref. 4.4-1 | Corrected reference to "Critical Power and Pressure Drop Tests of Simulated 10X10 Bundle Designs Applicable to GE14, NEDC-32874P, Class III (Proprietary), March 2000" due to TRACG re-analysis committed in MFN 09-114. |
| 37. | S4.4.8 | Updated references to latest revision and added "Class III (Proprietary)" and "Class I (Non-proprietary)" for consistency. |
| 38. | S4.4.8 | Updated reference 4.4-12 in response to RAI 4.4-86 and added reference 4.4-22 due to RAI 4.4-66 S01. |
| 39. | S4.4.8 | Added Tier 2* note and added "[ ]*" to reference 4.4-20 and 4.4-21 due to RAI 4.2-28. |
| 40. | T4.4-1a | Updated values for consistency. |
| 41. | T4.4-1b | Updated values for consistency. |
| 42. | T4.4-2a | Corrected values due to TRACG re-analysis committed in MFN 09-114. |
| 43. | T4.4-2b | Corrected values due to TRACG re-analysis committed in MFN 09-114. |

PRELIMINARY

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| 44. | T4.4-3a | Corrected values due to TRACG re-analysis committed in MFN 09-114. |
| 45. | T4.4-3b | Corrected values due to TRACG re-analysis committed in MFN 09-114. |
| 46. | T4.4-4a | Corrected values due to TRACG re-analysis committed in MFN 09-114. |
| 47. | T4.4-4b | Corrected values due to TRACG re-analysis committed in MFN 09-114. |
| 48. | T4.4-5 | Corrected values due to TRACG re-analysis committed in MFN 09-114. |
| 49. | F4.4-1 | Updated figure due to RAI 4.3-16. |
| 50. | S4.5.1.2.1, 1st para, 2nd sent. | Corrected "0.020%" with "0.02% for 300 series austenitic stainless steel". |
| 51. | S4.5.2.1, 1st para., 4th sentence. | Added "300 series stainless steel" for clarity. |
| 52. | S4.5.2.1, 3rd para., 2nd sentence. | Added "300 series" for clarity. |
| 53. | S4.5.2.2, 1st para., 2nd sent. | Added "300 series" for clarity. |
| 54. | S4.5.2.2, 1st para, 2nd sentence. | Replaced "Welded austenitic…assemblies…" with "Austenitic… weldments…" for clarity. |
| 55. | S4.5.2.2, 1st para, 3rd sentence. | Increased large forgings to .03% C content due to product capability. |
| 56. | S4.5.2.2, 1st para., new 4th sent. | Added "Type XM-19 materials are exempt from this requirement" for consistency. |
| 57. | S4.5.2.2, 2nd para, 2nd bullet | Deleted 2nd sentence due to RAI 5.2-71 S01. |
| 58. | T4.5-1 | For support legs, shroud and support ring, peripheral fuel supports, control rod drive housings, stub tubes, chimney, chimney head, steam separator, chimney head bolts, steam dryer seismic blocks, feedwater spargers, SLC, in-core guide tube restraints and guide rod, added product form and corresponding or missing ASME material specifications for manufacturing. |

PRELIMINARY

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|---|---|---|
| 59. | T4.5-1 | For core plate, top guide, and control rod guide tube, added missing ASME material specifications for manufacturing. |
| 60. | T4.5-1 | Added in-core housings, data was missing from table. |
| 61. | T4.5-1 | For steam dryer, added product form and corresponding ASME material specifications for manufacturing, also deleted nickel alloy which is not used. |
| 62. | T4.5-1 | Deleted bottom head drain line, no longer used in design. |
| 63. | T4.5-1, note 1 | Clarified Nb terminology outside US. |
| 64. | T4.5-2, note 2 | Revised to clarify 300 series austenitic stainless steel use. |
| 65. | S4.6.1.1.1 | Added bullet "The design provides for isolation capability terminating high pressure makeup water injection (HP CRD) to ensure containment pressure remains within design limits." In response to RAI 21.6-103. |
| 66. | S4.6.1.1.2 4th bullet | Added "The design provides for isolation bypass capability allowing high pressure makeup water injection (HP CRD) into the RPV if GDCS is unsuccessful in injecting water into the RPV." In response to RAI 21.6-103. |
| 67. | S4.6.1.2 3rd para., 2nd sentence | Added "…scram…" in response to RAI 16.2-186. |
| 68. | S4.6.1.2 4th para., 1st sentence | Deleted "…HCU…" in response to RAI 16.2-186. |
| 69. | S4.6.1.2 4th paragraph | Deleted "bypass" and added "During certain LOCA events the makeup water is isolated from the RPV and directed to the CST through the CRD pump minimum flow lines. The high pressure makeup isolation is bypassed, in response to signals indicating unsuccessful GDCS injection, to allow normal high pressure makeup injection to the RPV." In response to RAI 21.6-103. |
| 70. | S4.6.1.2 new bullets | Added "Isolates high pressure makeup from the reactor in response to certain LOCA events to ensure containment pressure remains within design limits" and "Bypasses the high pressure makeup isolation in response to signals indicating unsuccessful GDCS injection to allow normal high pressure makeup mode". In response to RAI 21.6-103. |
| 71. | S4.6.1.2, 8th para., 2nd sentence | Replaced "HCU" with "scram accumulator" due to RAI 16.2-186. |

PRELIMINARY

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| 72. | S4.6.1.2.1, 1st para., 2nd sentence | Corrected "a minimum…increments…" with "nominal increments" and corrected speed tolerance with "nominal". |
| 73. | S4.6.1.2.4 CRD Supply Pump, 2nd paragraph, 4th sentence | Deleted "bypass" in response to RAI 21.6-103. |
| 74. | S4.6.1.2.4 CRD Supply Pump 3rd paragraph 4th sentence | Added "-low scram accumulator" due to RAI 16.2-186 |
| 75. | S4.6.1.2.4 Accumulator Charging Water Header | Replaced "accumulator charging water header" with "scram accumulator charging water header" numerous times and for consistency due to RAI 16.2-186. |
| 76. | S4.6.1.2.4 Accumulator Charging Water Header | Added "scram" to accumulator numerous times for clarification in response to RAI 16.2-186. |
| 77. | S4.6.1.2.4 "High Pressure Makeup Line" 2nd paragraph, 3rd sentence and last two sentences | Added new valve description "…two in-series air-operated HP CRD isolation valves, and in parallel with the two air-operated HP CRD isolation valves are two motor-operated isolation bypass valves." and "The two air-operated HP CRD isolation valves isolate the high pressure makeup water from the RPV to ensure containment pressure remains within design limits during certain LOCA events. The two motor-operated HP CRD isolation bypass valves provide a flow path around the two air-operated HP CRD isolation valves in the event of a GDCS injection failure or loss of air." In response to RAI 21.6-103. |
| 78. | S4.6.1.2.5 Normal Operation 2nd paragraph 4th sentence | Replace "bypass" with "minimum line" in response to RAI 21.6-103. |
| 79. | S4.6.1.2.5 Normal Operation 5th and 6th paragraph | Replaced "accumulator charging water header" with "scram accumulator charging water header" numerous times and for consistency due to RAI 16.2-186. Added "scram" to accumulator numerous times for clarification in response to RAI 16.2-186 |

PRELIMINARY

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| 80. | S4.6.1.2.5 Scram 1st paragraph 1st sentence | Added " In response to an automatic or a manual scram from the RPS, power is interrupted to both scram solenoid pilot valve coils (for each HCU) and safety-related power is supplied to each backup scram valve solenoid, either action resulting in insertion of all control rods."<br>Replaced "…HCU opens to apply the…" with "HCU opens inserting the control rods. Also, after the backup scram valve solenoids are energized, the backup scram valves exhaust air from the scram air header, allowing the HCU scram valves to open ensuring / causing a hydraulic scram. The hydraulic scram occurs by applying …". In response to RAI 16.2-135 S01. |
| 81. | S4.6.1.2.5 Scram | Added "scram" to accumulator numerous times for clarification in response to RAI 16.2-186 |
| 82. | S4.6.1.2.5 "High Pressure Makeup | Replaced "charging water header" with "scram accumulator charging water header" numerous times and for consistency due to RAI 16.2-186. |
| 83. | S4.6.1.2.5 "High Pressure Makeup" 1st paragraph, 3rd bullet | Deleted "bypass" in response to RAI 21.6-103. |
| 84. | S4.6.1.2.5 "High Pressure Makeup" 2nd paragraph, 2nd sentence | Replaced "The pump minimum flow bypass valve…" with "Each pump minimum flow valve…" in response to RAI 21.6-103. |
| 85. | S4.6.1.2.5 "High Pressure Makeup" 4th paragraph, 1st & 2nd sentence | Changed from "…the CRD pumps tripped by…GDCS pools." To "…the high pressure makeup flow to the RPV isolated… GDCS pools or drywell pressure high and drywell level high. The flow is directed to the CST through the pump minimum flow lines." In response to RAI 21.6-103. |
| 86. | S4.6.1.2.5 "High Pressure Makeup" 4th paragraph, 5th sentence | Deleted "…that could be…". Editorial |

PRELIMINARY

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| 87. | S4.6.1.2.5 "High Pressure Makeup" 4th paragraph, last two sentences | Added new description "In the event of a GDCS failure (GDCS initiation logic and a time delay to allow for system actuation and a not low signal from two out of three GDCS pools) to successfully inject water into the reactor the HP CRD isolation bypass valves provide a flow path around the HP CRD isolation valves for high pressure makeup water injection to the RPV. Manual inhibit capability exists for the high pressure makeup isolation function and manual initiation capability exists for the isolation bypass function for either GDCS injection failure or loss of air." In response to RAI 21.6-103. |
| 88. | S4.6.1.2.6 "Controls and Interlocks" | Replaced "charging water header" with "scram accumulator charging water header" for consistency due to RAI 16.2-186. |
| 89. | S4.6.1.2.6 "Controls and Interlocks" 4th dash of 1st bullet | Deleted "bypass" in response to RAI 21.6-103. |
| 90. | S4.6.1.2.6 "Controls and Interlocks" last dash of 1st bullet | Changed "The…" to "Each…" and deleted " bypass" twice in response to RAI 21.6-103. |
| 91. | S4.6.1.2.6 "Controls and Interlocks" 5th bullet | Replaced "CRD" with "scram accumulator" and added "water" in response to RAI 16.2-186. |
| 92. | S4.6.1.2.6 "Controls and Interlocks" 5th bullet 1st dash | Replaced "…low charging header pressure" with "scram accumulator charging water header pressure-low" in response to RAI 16.2-186. |
| 93. | S4.6.1.2.6 "Controls and Interlocks" 5th bullet 2nd dash | Replaced "…low- low charging header pressure" with "scram accumulator charging water header pressure-low-low" in response to RAI 16.2-186. |
| 94. | S4.6.1.2.6 "Controls and Interlocks" 7th bullet 2nd dash | Added "accumulator" and "water" in response to RAI 16.2-186. |
| 95. | S4.6.1.2.6 "Controls and Interlocks" 9th bullet | Changed from "… the CRD pumps are tripped to terminate CRD system flow…GDCS pools." To "… the high pressure makeup flow to the RPV is isolated…GDCS pools or drywell pressure high and drywell level high." Added "The flow is directed to the CST through the pump minimum flow lines." In response to RAI 21.6-103. |

PRELIMINARY

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|---|---|---|
| 96. | S4.6.1.2.6 "Controls and Interlocks" last bullet | Added description "When in the high pressure makeup mode of operation and the CRD pumps are isolated due to certain LOCA events and a GDCS failure (GDCS initiation logic and a time delay to allow for system actuation and a not low signal from two out of three GDCS pools) to successfully inject water into the reactor occurs the HP CRD isolation bypass valves open to provide a flow path around the HP CRD isolation valves for high pressure makeup water injection to the RPV. Manual inhibit capability exists for the high pressure makeup isolation function and manual initiation capability exists for the isolation bypass function for either GDCS injection failure or loss of air." In response to RAI 21.6-103. |
| 97. | S4.6.3.5 7th bullet last two sentences | Added "The HP CRD isolation valves will be tested as part of the IST program as shown in Table 3.9-8. The HP CRD isolation bypass valves will be tested at a frequency of every 24 months to verify the automatic response to a simulated or actual initiation signal." In response to RAI 21.6-103. |
| 98. | F4.6-8 | Added new valves and minimum flow line in response to RAI 21.6-103. Removed line sizes for DCD figure consistency. |
| 99. | F4.6-8 | Replaced "SCRAM AIR HEADER DUMP VALVES" with "BACKUP SCRAM VALVES". In response to RAI 16.2-135 S01. Removed line sizes for DCD figure consistency. |
| 100. | F4.6-9 | Removed line sizes and part number for DCD figure consistency |
| 101. | F4.6-9 Sheet 1 of 2 | Added new valves and minimum flow line in response to RAI 21.6-103. |
| 102. | S4A.1, 1st para., 1st sentence | Replaced "…presents…an" with "…identifies reference 4A-2 for…a representative…" for DCD consistency and clarification. |
| 103. | S4A.1, 1st para., 2nd sentence | Added "…in reference 4A-2…" and replaced "…to provide the…" with "…and result in…" and replaced "…shaping needed to meet the…" with "distributions that meet…" for DCD consistency and clarification. |
| 104. | S4A.2 | Replaced entire paragraph for DCD consistency and clarification. |

PRELIMINARY

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| 105. | S4A.4 | Updated existing reference and added new reference. Added Tier 2* brackets to references and note in response to RAI 4.2-28. |
| 106. | T4A-1 | Deleted |
| 107. | F4A-1 thru 4A-19 | Deleted |
| 108. | S4B.1 all bullets | Added Tier 2* brackets in response to RAI 4.2-29. |
| 109. | S4B.1, S4B.3, S4B.6 | Added Tier 2* note in response to RAI 4.2-34. Updated references. |
| 110. | T4B-1 | Added Tier 2* brackets to Governing Equation criterion 1-7 and added Tier 2* note in response to RAI 4.2-34. |
| 111. | S4D.1.3.1, Regional Stability, 2nd para., 4th sentence | Replaced "…ratio and oscillation frequency…" with "…ratios… for consistency. |
| 112. | S4D.1.3.1, Results, 4th para., 1st sentence | Replaced "…ratio and oscillation frequency…" with "…ratios… for consistency. |
| 113. | S4D.1.4.3, 1st para., 1st sentence | Deleted "…and BOC conditions as an example." For consistency. |
| 114. | S4D.1.4.3, 1st para., 7th sentence | Added "…where any underlying noise in the core power (typically less than 2%) is removed, consistent with past practice." For consistency. |
| 115. | S4D.1.6 title | Deleted "…Initial Core and…" to be consistent with changes identified in RAI 15.2-16 S01. |
| 116. | S4D.1.6, 1st para., 2nd sentence | Deleted "…an initial core and…" and added "…for initial and equilibrium cores" to be consistent with changes identified in RAI 15.2-16 S01. |
| 117. | S4D.2.2.2, 4th para., 2nd sentence | Replaced "40K" with "40°C (72°F) and replaced "10K" with "10°C (18°F) for consistency. |
| 118. | S4D.3.2.2, 2nd para., 1st sentence | Deleted "initial" in response to RAI 16.2-171. |
| 119. | S4D.3.2.2.2, last sentence | Replaced "Initial values" with "Values" in response to RAI 16.2-171. |
| 120. | S4D.3.2.2.3, 2nd para., 2nd sentence | Replaced "Initial values" with "Values" and added "$GR_3$" in response to RAI 16.2-171. |
| 121. | S4D.3.2.2.3, 2nd para., 3rd sentence | Deleted sentence in response to RAI 16.2-171. |

PRELIMINARY

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|---|---|---|
| 122. | S4D.5 | Updated reference with Class and proprietary identification and updated references with latest revision. Added Tier 2* brackets and note in response to RAI 4.2-28. |
| 123. | T4D-1 | Corrected values due to TRACG re-analysis committed in MFN 09-114. |
| 124. | T4D-2 | Corrected values due to TRACG re-analysis committed in MFN 09-114. |
| 125. | T4D-3 | Corrected values due to TRACG re-analysis committed in MFN 09-114. |
| 126. | T4D-4 | Corrected values due to TRACG re-analysis committed in MFN 09-114. |
| 127. | T4D-5 | Deleted note in response to RAI 16.2-171. |
| 128. | F4D-3 | Corrected figure due to TRACG re-analysis committed in MFN 09-114. |

PRELIMINARY