BSC

Calculation/Analysis Change Notice

Complete only applicable items.

1. QA: QA
2. Page 1 of 5

3. Document Identifier:	4. Rev.:	5. CACN:
000-PSA-MGR0-00700-000	00A	001

6. Title:
Characteristics for the Representative Commercial Spent Fuel Assembly for Preclosure Normal Operations

7. Reason for Change:
This CACN is associated with CR 12381-001.

Calculation 000-PSA-MGR0-00700-000-00A calculates radionuclide inventories for commercial PWR and BWR spent fuel assemblies. Inventories are developed based on the results of ORIGEN isotope generation computer runs for PWRs and BWRs in Calculations 000-00C-MGR0-00100-000-00B and 000-00C-MGR0-00200-000-00A, respectively. The results of the ORIGEN runs are imported into Excel spreadsheets in Calculation 000-PSA-MGR0-00700-000-00A and radionuclide inventories determined by summing contributions from up to four different fuel regions in the ORIGEN runs. The method to perform the summation involves using Microsoft Excel spreadsheet named ranges to identify the location of values within worksheets of a given spreadsheet.

For three light elements, C-14, Cl-36 and H-3, the spreadsheet for PWR representative fuel did not reference the correct worksheet containing the ORIGEN results. As a result, the PWR representative fuel inventory values for those radionuclides are not correct. The values for C-14 and Cl-36 are higher and H-3 is lower than the correct values.

This CACN corrects the PWR worksheet cell references and the spent fuel inventories for C-14, Cl-36 and H-3. Additionally this CACN corrects a minor typo related to crud activity units from cubic centimeters to square centimeters.

8. Supersedes Change Notice: ☐ Yes If, Yes, CACN No.: _____ ☒ No

9. Change Impact:

Inputs Changed:	☐ Yes	☒ No	Results Impacted:	☒ Yes	☐ No
Assumptions Changed:	☐ Yes	☒ No	Design Impacted:	☐ Yes	☒ No

10. Description of Change:
There is no change to the calculation method of this calculation by this CACN.

The Excel spreadsheet for PWR representative fuel, *PWR-50-GWd-curies total.xls*, was corrected to reference the proper worksheet containing the ORIGEN results for the three light elements, C-14, Cl-36 and H-3. The named range definition for *LE_fuel* in the worksheet *FP-ACT-GAS* was changed from 'PWR-4.2%-60GWd-fuel'!$B$5:$M$32 to 'PWR-4.2%-50GWd-fuel'!$A$5:$M$67. Also the VLOOKUP function in cells B4 to B6 was changed, for example, from (A4, *LE_fuel*, 10, FALSE) to (A4, *LE_fuel*, 13, FALSE). This corrected the PWR representative fuel inventory values for the three light elements, C-14, Cl-36 and H-3 in *PWR-50-GWd-curies total.xls*. The corrected results for those radionuclides were incorporated into Tables 16 and 20.

The units in the "Note" following Table 7 were corrected from cubic centimeters to square centimeters.

To implement the changes: Replace pages: 26, 44, 48 and I-1 with the attached pages and replace the CD with the attached CD that includes the updated Excel spreadsheet *PWR-50-GWd-curies total.xls*.

This CACN also carries out the action plan for CR 12381-001.

11. REVIEWS AND APPROVAL

Printed Name	Signature	Date
11a. Originator: Dale T. Dexheimer	D. Dexheimer	10/1/08
11b. Checker: John H. C. Wang	John Wang	10/1/08
11c. EGS: Sen-Sung Tsai	Sen-Sung Tsai	10/1/08
11d. DEM: Michael V. Frank	Michael V. Frank	10/2/08
11e. Design Authority: Barbara Rusinko	B Rusinko	10/3/08

6.1.5. Crud Activity and Surface Area

Commercial spent nuclear fuel assembly initial crud activity is provided in Table 7. Spent Fuel Project Office Interim Staff Guidance – 5 (Reference 2.2.10 [DIRS 160582], Table 7.1) provides the initial ^{60}Co crud activity per cm^2 and *Spent Fuel Corrosion Product and Fuel Cleaning Assessment* (Reference 2.2.13 ([DIRS 146405], Tables 1 and 2) provides the initial ^{55}Fe crud activity per cm^2. The use of ^{55}Fe crud activity per cm^2 is appropriate since it is conservative and overstates the activity by as much as a factor of 10 (Reference 2.2.13 [DIRS 146405], page 7).

Table 7. Commercial Spent Nuclear Fuel Assembly Initial Crud Activities

Radionuclide	PWR ($\mu Ci/cm^2$)	BWR ($\mu Ci/cm^2$)
^{60}Co	140	1,254
^{55}Fe	5,902	7,415

NOTE: $\mu Ci/cm^2$ = micro curies/square centimeters

Source: ^{60}Co crud activities are from Reference 2.2.10 ([DIRS 160582], Table 7.1)

^{55}Fe crud activities are from Reference 2.2.13 ([DIRS 146405], Tables 1 and 2)

6.1.6 Commercial Fuel Assembly Surface Area

Commercial SNF fuel assemblies have the following surface areas, A_{SFA}:

- PWR = 449,003 cm^2/assembly (Reference 2.2.8, p. 27)
- BWR = 168,148 cm^2/assembly (Reference 2.2.9, Table 45).

These surface areas are bounding estimates based on spent fuel assemblies with the highest known surface areas, which are a South Texas PWR fuel assembly (Reference 2.2.8, p. 27) and an ANF 9 × 9 JP-4 BWR fuel assembly (Reference 2.2.9, Table 45).

6.1.7 Waste Stream Input

Reference 2.2.6, Section 7, provides a waste stream scenario that is based on receiving commercial SNF in 25-kW TAD canisters at an annual receipt rate of 3,600 MTHM (Assumption 3.2.1 and Section 6.1.1), which is represented by the file "AvailShipCD-1YFF525kW3600-Norm_Rev.xls", worksheet "Revised Report". This spreadsheet provides the identification and characteristics of each fuel assembly including, enrichment, burnup, discharge year, arrival year, MTHM, and thermal power. The "Revised Report" worksheet of the Excel spreadsheet contains 23,250 records for commercial SNF batches containing 221,714 fuel assemblies totaling 63,000 MTHM arriving at the repository.

Table 16. Radionuclide Inventory For Representative Commercial Spent Nuclear Fuel Excluding Crud

Radionuclide	Representative PWR (Ci/fuel assembly)	Representative BWR (Ci/fuel assembly)
^{241}Am	1.18×10^{3}	3.73×10^{2}
^{242}Am	7.27	2.87
^{242m}Am	7.30	2.88
^{243}Am	2.30×10^{1}	8.63
^{137m}Ba	5.70×10^{4}	2.27×10^{4}
^{14}C	3.35×10^{-1}	2.12×10^{-1}
^{113m}Cd	1.39×10^{1}	5.24
^{144}Ce	7.26×10^{1}	1.73×10^{1}
^{36}Cl	6.84×10^{-3}	3.48×10^{-3}
^{242}Cm	6.03	2.38
^{243}Cm	1.57×10^{1}	5.55
^{244}Cm	2.59×10^{3}	9.23×10^{2}
^{245}Cm	3.37×10^{-1}	9.07×10^{-2}
^{246}Cm	1.16×10^{-1}	4.26×10^{-2}
^{134}Cs	4.08×10^{3}	1.31×10^{3}
^{135}Cs	3.74×10^{-1}	1.81×10^{-1}
^{137}Cs	6.04×10^{4}	2.41×10^{4}
^{154}Eu	2.36×10^{3}	7.73×10^{2}
^{155}Eu	4.94×10^{2}	1.92×10^{2}
^{3}H	2.70×10^{2}	1.05×10^{2}
^{129}I	2.27×10^{-2}	9.22×10^{-3}
^{85}Kr	3.11×10^{3}	1.17×10^{3}
^{93m}Nb	3.44×10^{-1}	1.58×10^{-1}
^{94}Nb	6.31×10^{-5}	2.56×10^{-5}
^{237}Np	2.53×10^{-1}	8.74×10^{-2}
^{239}Np	2.30×10^{1}	8.63
^{231}Pa	3.00×10^{-5}	1.86×10^{-5}
^{107}Pd	8.65×10^{-2}	3.45×10^{-2}
^{147}Pm	6.36×10^{3}	2.11×10^{3}
^{144}Pr	7.26×10^{1}	1.73×10^{1}
^{238}Pu	2.77×10^{3}	1.02×10^{3}
^{239}Pu	1.80×10^{2}	5.41×10^{1}
^{240}Pu	3.20×10^{2}	1.27×10^{2}
^{241}Pu	5.20×10^{4}	1.57×10^{4}
^{242}Pu	1.68	7.08×10^{-1}
^{106}Ru	3.40×10^{2}	9.05×10^{1}
^{125}Sb	3.90×10^{2}	1.20×10^{2}
^{79}Se	4.75×10^{-2}	1.97×10^{-2}
^{151}Sm	2.45×10^{2}	6.73×10^{1}
^{126}Sn	3.97×10^{-1}	1.61×10^{-1}
^{90}Sr	4.10×10^{4}	1.66×10^{4}

Table 20. Radionuclide Inventory For Representative Commercial Spent Nuclear Fuel Excluding Crud

Radionuclide	Representative PWR (Ci/fuel assembly)	Representative BWR (Ci/fuel assembly)
^{241}Am	1.18×10^{3}	3.73×10^{2}
^{242}Am	7.27	2.87
^{242m}Am	7.30	2.88
^{243}Am	2.30×10^{1}	8.63
^{137m}Ba	5.70×10^{4}	2.27×10^{4}
^{14}C	3.35×10^{-1}	2.12×10^{-1}
^{113m}Cd	1.39×10^{1}	5.24
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^{36}Cl	6.84×10^{-3}	3.48×10^{-3}
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^{243}Cm	1.57×10^{1}	5.55
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^{246}Cm	1.16×10^{-1}	4.26×10^{-2}
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^{135}Cs	3.74×10^{-1}	1.81×10^{-1}
^{137}Cs	6.04×10^{4}	2.41×10^{4}
^{154}Eu	2.36×10^{3}	7.73×10^{2}
^{155}Eu	4.94×10^{2}	1.92×10^{2}
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^{79}Se	4.75×10^{-2}	1.97×10^{-2}
^{151}Sm	2.45×10^{2}	6.73×10^{1}
^{126}Sn	3.97×10^{-1}	1.61×10^{-1}

ATTACHMENT I.
COMPUTER FILES

Attachment I consists of a compact disk that contains the following electronic files.

Table I-1. List of Computer Files

File Name	Size (kB)	Date	Time
AvailShipCD-1YFF525kW3600-Norm_Rev.xls	12,677	02/07/2007	12:43 PM
WASTESTREAM_TAD_YFF525kW3600.TXT	3,251	02/08/2007	10:28 AM
WPLOAD_OUTPUT_case1a.TXT	38,651	02/12/2007	7:33 PM
Representative SFA-3600.mdb	44,052	09/07/2007	3:23 PM
TAD-Based Representative SFA-3600.xls	829	05/03/2007	3:59 PM
Enrichment.xls	3,478	05/01/2007	5:44 PM
PWR-50Gwd-Curies total.xls	207	09/04/2008	12:54 PM
PWR-4.2-watts.xls	49	04/17/2007	11:23 AM
PWR-4.0-watts.xls	55	04/17/2007	10:56 AM
BWR-4.0%-50Gwd-Curies total.xls	148	05/03/2007	9:15 AM
BWR-4.0-watts.xls	46	04/17/2007	4:19 PM
PWR-80GWd-curies total.xls	114	05/03/2007	9:48 AM
BWR-75GWd-curies total.xls	121	05/03/2007	9:48 AM