Orano TN
7160 Riverwood Drive
Suite 200
Columbia, MD 21046
USA
Tel: 410-910-6900
Fax: 434-260-8480

April 18, 2022
E-60146

U. S. Nuclear Regulatory Commission
Attn: Document Control Desk
One White Flint North
11555 Rockville Pike
Rockville, MD 20852

Subject: TN-32 Updated Final Safety Analysis Report (UFSAR), Revision 7 and 10 CFR 72.48 Summary Report for the Period 04/17/20 to 04/18/22

Reference: Certificate of Compliance (CoC) 1021 TN-32 Updated Final Safety Analysis Report (UFSAR), Revision 6 and 10 CFR 72.48 Summary Report for the Period 04/17/18 to 04/16/20

Pursuant to 10 CFR 72.248, TN Americas LLC (TN) has updated the TN-32 UFSAR, last updated by the above reference, and herewith submits UFSAR Revision 7 changes for docketing. This update to the UFSAR incorporates changes implemented by TN pursuant to 10 CFR 72.48 for the time period 04/17/20 to 04/18/22. Renewal of the Certificate of Compliance (CoC) for Amendment 0 and Amendment 1 was effective on January 19, 2022. Revision 7 incorporates the UFSAR changes that were associated with renewed Amendments 0 and 1, which also satisfies the 90-day UFSAR update requirements of renewed CoC Condition 12. Changes made as a result of the CoC renewal are annotated as such.

I certify that this submittal accurately presents changes made since the last submittal (Reference).

The enclosure to this letter provides new and replacement UFSAR pages, including a List of Effective Pages that identifies the Revision 7 pages. The changed areas are marked as follows:

- New or changed pages show Rev. 7, 04/22 in the footer.
- Changed areas are indicated using revision bars in the margin.
- Newly inserted text is shown by italics.

Regarding the summary report required to be submitted pursuant to 10 CFR 72.48(d)(2), TN made no changes in facilities or spent fuel storage cask design, no changes in procedures, and no tests or experiments pursuant to paragraph (c)(2) of 10 CFR 72.48 during the period 04/17/20 to 04/18/22 for the TN-32.

Should the NRC staff require additional information to support review of this application, please do not hesitate to contact Mr. Douglas Yates at 434-832-3101, or by email at Douglas.Yates@orano.group.

Sincerely,

A. Prakash

Prakash Narayanan
Chief Technical Officer

cc: Christian Jacobs (NRC DFM)

Enclosure:

New and Replacement Pages for TN-32 UFSAR, Revision 7 (Public Version)

Enclosure to E-60146

New and Replacement Pages for TN-32 UFSAR, Revision 7
(Public Version)

Non-Proprietary

TN-32 UPDATED FINAL SAFETY ANALYSIS REPORT
Revision 7

TN Americas LLC
7160 Riverwood Drive
Suite 200
Columbia, MD 21046

REVISION LOG SHEET

FSAR Revision	Date	Record of Changes/FCNs	Changed Pages
3	4/19/2004	FCN-02-020 FCN-02-050 FCN-02-065 FCN-02-066 FCN-02-067 FCN-02-068 FCN-02-069 FCN-02-073 FCN 721021-003	Drawing 1049-70-1 Drawing 1049-70-6 Page 3.1-2 Page 3.1-4 Page 3.2-1 Page 3.3-2 Page 3.4-8 Page 3E-14 Page 7.1-3 Table 3.3-6 sheet 1 Table 3.3-6 sheet 2
3	4/17/2006	No changes	N/A
3	4/17/2008	No changes	N/A
4	4/16/2010	FCN 721021-008	Page 4A.3-1 Page 4A.9-1
5	4/16/2012	FCN 721021-009 FCN 721021-010	Table 8.1-1 Chapter 12 Technical Specifications pages removed
6	04/16/2014	FCN 721021-011	Page 2.3-4
7	*04/18/2022*	*FCN 721021-012*	*See LOEP*

LIST OF EFFECTIVE PAGES

Page Number/ Description	Revision	Date
Title Page	*7*	*4/22*
Revision Log Sheet	*7*	*4/22*
LOEP-1	*7*	*4/22*
LOEP-2	*7*	*4/22*
LOEP-3	*7*	*4/22*
LOEP-4	*7*	*4/22*
LOEP-5	*7*	*4/22*
LOEP-6	*7*	*4/22*
LOEP-7	*7*	*4/22*
LOEP-8	*7*	*4/22*
LOEP-9	*7*	*4/22*
LOEP-10	*7*	*4/22*
LOEP-11	*7*	*4/22*
i	*7*	*4/22*
ii	0	1/00
iii	0	1/00
iv	0	1/00
v	1	5/00
vi	1	5/00
vii	0	1/00
viii	0	1/00
ix	0	1/00
x	0	1/00
xi	*7*	*4/22*
xii	0	1/00
xiii	0	1/00
xiv	0	1/00
xv	0	1/00
xvi	0	1/00
xvii	0	1/00
xviii	*7*	*4/22*
xix	0	1/00
xx	0	1/00
xxi	0	1/00
xxii	0	1/00
xxiii	0	1/00
xxiv	0	1/00
1.1-1	*7*	*4/22*
1.1-2	0	1/00
1.1-3	0	1/00
1.2-1	0	1/00
1.2-2	0	1/00
1.2-3	0	1/00
1.2-4	0	1/00
1.2-5	0	1/00
1.2-6	1	5/00
1.2-7	*7*	*4/22*
1.3-1	0	1/00
1.3-2	0	1/00
1.4-1	0	1/00
1.5-1	0	1/00
1049-70-1	6	4/16/04
1049-70-2	8	4/19/02
1049-70-3	6	4/19/02
1049-70-4	3	4/19/02
1049-70-5	5	1/3/00
1049-70-6	8	4/16/04
1049-70-7	1	n/a
1049-70-8	1	4/19/02
"Supplemental drawing prepared to support…"	Not shown	Not shown
1049-70-27	0	5/18/00
1.6-1	0	1/00
Table 1.2-1	0	1/00
Figure 1.2-1	0	1/00
Figure 1.4-1	0	1/00
2.1-1	1	5/00
2.1-2	1	5/00
2.1-3	0	1/00
2.2-1	0	1/00
2.2-2	0	1/00
2.2-3	0	1/00
2.2-4	0	1/00
2.2-5	0	1/00
2.2-6	0	1/00
2.2-7	0	1/00
2.2-8	0	1/00
2.2-9	0	1/00
2.2-10	0	1/00
2.2-11	0	1/00
2.2-12	0	1/00
2.2-13	0	1/00
2.2-14	0	1/00
2.2-15	0	1/00
2.2-16	0	1/00
2.2-17	0	1/00
2.2-18	0	1/00
2.2-19	0	1/00
2.2-20	0	1/00
2.2-21	0	1/00

LIST OF EFFECTIVE PAGES

Page Number/ Description	Revision	Date
2.2-22	0	1/00
2.2-23	0	1/00
2.2-24	0	1/00
2.2-25	0	1/00
2.2-26	0	1/00
2.2-27	0	1/00
2.2-28	0	1/00
2.2-29	0	1/00
2.2-30	0	1/00
2.3-1	*7*	*4/22*
2.3-2	0	1/00
2.3-3	*7*	*4/22*
2.3-4	*7*	*4/22*
2.3-5	0	1/00
2.3-6	1	5/00
2.3-7	1	5/00
2.3-8	0	1/00
2.4-1	*7*	*4/22*
2.4-2	0	1/00
2.5-1	*7*	*4/22*
2.6-1	0	1/00
2.6-2	0	1/00
2.6-3	*7*	*4/22*
Table 2.1-1	1	5/00
Table 2.1-2	0	1/00
Table 2.1-3	0	1/00
Table 2.1-4	0	1/00
Table 2.2-1	0	1/00
Table 2.2-2	0	1/00
Table 2.2-3	0	1/00
Table 2.2-4	0	1/00
Table 2.2-5	0	1/00
Table 2.2-6	0	1/00
Table 2.2-7	0	1/00
Table 2.2-8	0	1/00
Table 2.2-9	0	1/00
Table 2.3-1	1	5/00
Table 2.5-1	*7*	*4/22*
Figure 2.1-1	0	1/00
Figure 2.1-2	0	1/00
Figure 2.1-3	0	1/00
Figure 2.1-4	0	1/00
Figure 2.1-5	0	1/00
Figure 2.1-6	0	1/00
Figure 2.2-1	0	1/00
Figure 2.2-2	0	1/00
Figure 2.2-3	0	1/00
Figure 2.3-1	0	1/00
Figure 2.3-2	0	1/00
Figure 2.3-3	0	1/00
Figure 2.3-4	0	1/00
3.1-1	0	1/00
3.1-2	3	4/04
3.1-3	0	1/00
3.1-4	3	4/04
3.1-5	0	1/00
3.1-6	0	1/00
3.2-1	3	4/04
3.3-1	*7*	*4/22*
3.3-2	*7*	*4/22*
3.3-3	0	1/00
3.4-1	0	1/00
3.4-2	0	1/00
3.4-3	0	1/00
3.4-4	0	1/00
3.4-5	0	1/00
3.4-6	0	1/00
3.4-7	0	1/00
3.4-8	3	4/04
3.4-9	0	1/00
3.4-10	0	1/00
3.4-11	0	1/00
3.4-12	0	1/00
3.4-13	0	1/00
3.4-14	0	1/00
3.4-15	0	1/00
3.4-16	0	1/00
3.4-17	0	1/00
3.5-1	*7*	*4/22*
3.5-2	1	5/00
3.5-3	1	5/00
3.5-4	1	5/00
3.5-5	1	5/00
3.6-1	0	1/00
3.6-2	*7*	*4/22*
Table 3.1-1	0	1/00
Table 3.1-1 (continued)	0	1/00
Table 3.1-2	0	1/00
Table 3.1-3	0	1/00
Table 3.1-4	0	1/00

LIST OF EFFECTIVE PAGES

Page Number/ Description	Revision	Date
Table 3.1-5	0	1/00
Table 3.2-1	0	1/00
Table 3.3-1	0	1/00
Table 3.3-2 Sheet 1 of 3	0	1/00
Table 3.3-2 Sheet 2 of 3	0	1/00
Table 3.3-2 Sheet 3 of 3	0	1/00
Table 3.3-3	0	1/00
Table 3.3-4	0	1/00
Table 3.3-5 Sheet 1 of 3	0	1/00
Table 3.3-5 Sheet 2 of 3	0	1/00
Table 3.3-5 Sheet 3 of 3	0	1/00
Table 3.3-6 Sheet 1	3	4/04
Table 3.3-6 Sheet 2	3	4/04
Table 3.3-6 Sheet 3	0	1/00
Table 3.3-6 Sheet 4	0	1/00
Table 3.4-1A and Table 3.4-1B	0	1/00
Table 3.4-2A and Table 3.4-2B	0	1/00
Table 3.4-3A and Table 3.4-3B	0	1/00
Table 3.4-4	0	1/00
Table 3.4-5	0	1/00
Table 3.4-6	0	1/00
Table 3.4-7	0	1/00
Table 3.4-8	0	1/00
Table 3.4-9	0	1/00
Figure 3.4-1A	0	1/00
Figure 3.4-1B	0	1/00
Figure 3.4-1C	0	1/00
Figure 3.4-2	0	1/00
Figure 3.4-3	0	1/00
Figure 3.4-4	0	1/00
Figure 3.4-5	0	1/00
Figure 3.5-1	0	1/00
Figure 3.5-2	0	1/00
Figure 3.5-3	0	1/00
Figure 3.5-4	0	1/00
3A.1-1	0	1/00
3A.2-1	0	1/00
3A.2-2	0	1/00
3A.2-3	0	1/00
3A.2-4	0	1/00
3A.2-5	0	1/00
3A.2-6	0	1/00

Page Number/ Description	Revision	Date
3A.2-7	0	1/00
3A.2-8	0	1/00
3A.2-9	0	1/00
3A.2-10	0	1/00
3A.2-11	0	1/00
3A.2-12	0	1/00
3A.2-13	0	1/00
3A.2-14	0	1/00
3A.2-15	0	1/00
3A.2-16	0	1/00
3A.3-1	0	1/00
3A.3-2	0	1/00
3A.3-3	0	1/00
3A.3-4	0	1/00
3A.3-5	0	1/00
3A.3-6	0	1/00
3A.3-7	0	1/00
3A.3-8	0	1/00
3A.3-9	0	1/00
3A.3-10	0	1/00
3A.3-11	0	1/00
3A.4-1	0	1/00
3A.4-2	0	1/00
3A.4-3	0	1/00
3A.5-1	0	1/00
3A.5-2	0	1/00
3A.6-1	0	1/00
Table 3A.2.3-1	0	1/00
Table 3A.2.3-2	0	1/00
Table 3A.2.3-3	0	1/00
Table 3A.2.3-4	0	1/00
Table 3A.2.3-5	0	1/00
Table 3A.2.3-6	0	1/00
Table 3A.2.3-7	0	1/00
Table 3A.2.3-8	0	1/00
Table 3A.2.3-9	0	1/00
Table 3A.2.3-10	0	1/00
Table 3A.2.3-11	0	1/00
Table 3A.2.3-12	0	1/00
Table 3A.2.3-13	0	1/00
Table 3A.2.3-14	0	1/00
Table 3A.2.3-15	0	1/00
Table 3A.2.3-16	0	1/00
Table 3A.2.3-17	0	1/00
Table 3A.2.3-18	0	1/00

LIST OF EFFECTIVE PAGES

Page Number/ Description	Revision	Date
Table 3A.2.3-19	0	1/00
Table 3A.2.3-20	0	1/00
Table 3A.2.5-1	0	1/00
Table 3A.2.5-2	0	1/00
Table 3A.2.5-3	0	1/00
Table 3A.2.5-4	0	1/00
Table 3A.2.5-5	0	1/00
Table 3A.2.5-6	0	1/00
Table 3A.2.5-7	0	1/00
Table 3A.2.5-8	0	1/00
Table 3A.2.5-9	0	1/00
Table 3A.2.5-10	0	1/00
Table 3A.2.5-11	0	1/00
Table 3A.2.5-12	0	1/00
Table 3A.2.5-13	0	1/00
Table 3A.2.5-14	0	1/00
Table 3A.2.5-15	0	1/00
Table 3A.2.5-16	0	1/00
Table 3A.2.5-17	0	1/00
Table 3A.2.5-18	0	1/00
Table 3A.2.5-19	0	1/00
Table 3A.2.5-20	0	1/00
Table 3A.2.5-21	0	1/00
Table 3A.2.5-22	0	1/00
Table 3A.2.5-23	0	1/00
Table 3A.2.5-24	0	1/00
Table 3A.2.5-25	0	1/00
Table 3A.2.5-26	0	1/00
Table 3A.2.5-27	0	1/00
Table 3A.2.5-28	0	1/00
Table 3A.4-1	0	1/00
"This page intentionally blank"	0	1/00
Figure 3A.1-1	0	1/00
Figure 3A.2-1	0	1/00
Figure 3A.2-2	0	1/00
Figure 3A.2-3	0	1/00
Figure 3A.2-4	0	1/00
Figure 3A.2-5	0	1/00
Figure 3A.2-6	0	1/00
Figure 3A.2-7	0	1/00
Figure 3A.2-8	0	1/00
Figure 3A.2-9	0	1/00
Figure 3A.2-10	0	1/00
Figure 3A.2-11	0	1/00
Figure 3A.2-12	0	1/00

Page Number/ Description	Revision	Date
Figure 3A.2-13	0	1/00
Figure 3A.2-14	0	1/00
Figure 3A.2-15A	0	1/00
Figure 3A.2-15B	0	1/00
Figure 3A.2-16	0	1/00
Figure 3A.3-1	0	1/00
Figure 3A.3-2	0	1/00
Figure 3A.3-3	0	1/00
Figure 3A.3-4	0	1/00
Figure 3A.3-5	0	1/00
Figure 3A.3-6	0	1/00
Figure 3A.3-7	0	1/00
Figure 3A.4-1	0	1/00
Figure 3A.4-2	0	1/00
Figure 3A.4-3	0	1/00
Figure 3A.4-4	0	1/00
Figure 3A.4-5	0	1/00
Figure 3A.4-6	0	1/00
"This page intentionally blank"	Not shown	Not shown
3B.1-1	0	1/00
3B.1-2	0	1/00
3B.1-3	0	1/00
3B.2-1	Not Shown	1/00
3B.3-1	0	1/00
3B.3-2	0	1/00
3B.3-3	0	1/00
3B.3-4	0	1/00
3B.3-5	0	1/00
3B.3-6	0	1/00
3B.4-1	0	1/00
3B.4-2	0	1/00
3B.4-3	0	1/00
3B.4-4	0	1/00
3B.4-5	0	1/00
3B.4-6	0	1/00
3B.4-7	0	1/00
3B.4-8	0	1/00
3B.4-9	0	1/00
3B.4-10	0	1/00
3B.4-11	0	1/00
3B.4-12	0	1/00
3B.4-13	0	1/00
3B.4-14	0	1/00

LIST OF EFFECTIVE PAGES

Page Number/ Description	Revision	Date
3B.5-1	0	1/00
"This page intentially blank"	0	1/00
Table 3B.3-1	0	1/00
Table 3B.3-2	0	1/00
Table 3B.3-3	0	1/00
Table 3B.3-4	0	1/00
Table 3B.3-5	0	1/00
Table 3B.4-1	0	1/00
Table 3B.4-2	0	1/00
Table 3B.4-3	0	1/00
Table 3B.4-4	0	1/00
Table 3B.4-5	0	1/00
Table 3B.4-6	0	1/00
Table 3B.4-7	0	1/00
Table 3B.4-8	0	1/00
Table 3B.4-9	0	1/00
Table 3B.4-10	0	1/00
Table 3B.4-10 (continued)	0	1/00
Table 3B.4-11	0	1/00
Table 3B.4-11 (continued)	0	1/00
Table 3B.4-12	0	1/00
Table 3B.4-12 (continued)	0	1/00
Table 3B.4-13	0	1/00
Table 3B.4-14	0	1/00
Table 3B.4-15	0	1/00
Table 3B.4-16	0	1/00
Table 3B.4-17	0	1/00
Table 3B.4-18	0	1/00
Table 3B.4-19 and Table 3B.4-20	0	1/00
"This page intentially blank"	0	1/00
Figure 3B.1-1	0	1/00
Figure 3B.2-1	0	1/00
Figure 3B.2-2	0	1/00
Figure 3B.2-3	0	1/00
Figure 3B.2-4	0	1/00
Figure 3B.3-1	0	1/00
Figure 3B.3-2	0	1/00
Figure 3B.3-3	0	1/00
Figure 3B.3-4	0	1/00
Figure 3B.3-5	0	1/00
Figure 3B.3-6	0	1/00

Page Number/ Description	Revision	Date
Figure 3B.3-7	0	1/00
Figure 3B.4-1	0	1/00
Figure 3B.4-2	0	1/00
Figure 3B.4-3	0	1/00
Figure 3B.4-4	0	1/00
Figure 3B.4-5	0	1/00
Figure 3B.4-6	0	1/00
Figure 3B.4-7	0	1/00
Figure 3B.4-8	0	1/00
Figure 3B.4-9	0	1/00
Figure 3B.4-10	0	1/00
Figure 3B.4-11	0	1/00
Figure 3B.4-12	0	1/00
Figure 3B.4-13	0	1/00
Figure 3B.4-14	0	1/00
Figure 3B.4-15	0	1/00
Figure 3B.4-16	0	1/00
Figure 3B.4-17	0	1/00
Figure 3B.4-18	0	1/00
Figure 3B.4-19	0	1/00
3C.1-1	0	1/00
3C.1-2	0	1/00
3C.1-3	0	1/00
3C.2-1	0	1/00
3C.2-2	0	1/00
3C.2-3	0	1/00
3C.2-4	0	1/00
3C.2-5	0	1/00
3C.2-6	0	1/00
3C.2-7	0	1/00
3C.2-8	0	1/00
3C.2-9	0	1/00
3C.2-10	0	1/00
3C.3-1	0	1/00
3C.3-2	0	1/00
3C.3-3	0	1/00
3C.3-4	0	1/00
3C.3-5	0	1/00
3C.3-6	0	1/00
3C.3-7	0	1/00
3C.3-8	0	1/00
3C.3-9	0	1/00
3C.3-10	0	1/00
3C.3-11	0	1/00
3C.3-12	0	1/00

LIST OF EFFECTIVE PAGES

Page Number/ Description	Revision	Date
3C.4-1	0	1/00
Figure 3C.1-1	0	1/00
Figure 3C.2-1	0	1/00
Figure 3C.2-2	0	1/00
Figure 3C.2-3	0	1/00
Figure 3C.2-4	0	1/00
Figure 3C.2-5	0	1/00
Figure 3C.2-6	0	1/00
Figure 3C.3-1	0	1/00
Figure 3C.3-2	0	1/00
Figure 3C.3-3	0	1/00
Figure 3C.3-4	0	1/00
Figure 3C.3-5	0	1/00
Figure 3C.3-6	0	1/00
Figure 3C.3-7	0	1/00
Figure 3C.3-8	0	1/00
Figure 3C.3-9	0	1/00
Figure 3C.3-10	0	1/00
Figure 3C.3-11	0	1/00
Figure 3C.3-12	0	1/00
Figure 3C.3-13	0	1/00
3D.1-1	0	1/00
3D.2-1	0	1/00
3D.2-2	0	1/00
3D.2-3	0	1/00
3D.2-4	0	1/00
3D.2-5	0	1/00
3D.2-6	0	1/00
3D.2-7	0	1/00
3D.3-1	0	1/00
3D.4-1	0	1/00
3D.4-2	0	1/00
3D.5-1	0	1/00
3D.5-2	0	1/00
Figure 3D.1-1	0	1/00
Figure 3D.1-2	0	1/00
Figure 3D.1-3	0	1/00
Figure 3D.1-4	0	1/00
Figure 3D.2-1	0	1/00
Figure 3D.2-2	0	1/00
Figure 3D.2-3	0	1/00
Figure 3D.2-4	0	1/00
Figure 3D.2-5	0	1/00
Figure 3D.2-6	0	1/00
Figure 3D.2-7	0	1/00

Page Number/ Description	Revision	Date
Figure 3D.2-8	0	1/00
Figure 3D.2-9	0	1/00
Figure 3D.4-1	0	1/00
Figure 3D.4-2	0	1/00
Figure 3D.4-3	0	1/00
Figure 3D.4-4	0	1/00
Figure 3D.4-5	0	1/00
Figure 3D.4-6	0	1/00
Figure 3D.4-7	0	1/00
3E-1	0	1/00
3E-2	0	1/00
3E-3	0	1/00
3E-4	0	1/00
3E-5	0	1/00
3E-6	0	1/00
3E-7	0	1/00
3E-8	0	1/00
3E-9	0	1/00
3E-10	0	1/00
3E-11	0	1/00
3E-12	0	1/00
3E-13	0	1/00
3E-14	3	4/04
3E-15	0	1/00
3E-16	0	1/00
3E-17	0	1/00
3E-18	0	1/00
3E-19	0	1/00
3E-20	0	1/00
3E-21	0	1/00
"This page intentially blank"	0	1/00
Figure 3E-1	0	1/00
Figure 3E-2	0	1/00
Figure 3E-3	0	1/00
4.1-1	0	1/00
4.1-2	0	1/00
4.1-3	0	1/00
4.2-1	0	1/00
4.2-2	0	1/00
4.2-3	0	1/00
4.2-4	0	1/00
4.3-1	0	1/00
4.4-1	0	1/00
4.4-2	0	1/00
4.4-3	0	1/00

LIST OF EFFECTIVE PAGES

Page Number/ Description	Revision	Date
4.4-4	0	1/00
4.4-5	0	1/00
4.4-6	0	1/00
4.4-7	0	1/00
4.4-8	0	1/00
4.4-9	0	1/00
4.5-1	0	1/00
4.5-2	0	1/00
4.5-3	0	1/00
4.5-4	0	1/00
4.6-1	0	1/00
4.6-2	0	1/00
4.6-3	0	1/00
4.7-1	0	1/00
4.8-1	0	1/00
4.8-2	0	1/00
Table 4.1-1	0	1/00
Table 4.4-1	0	1/00
Table 4.4-2	0	1/00
Table 4.5-1	0	1/00
Figure 4.4-1	0	1/00
Figure 4.4-2	0	1/00
Figure 4.4-3	0	1/00
Figure 4.4-4	0	1/00
Figure 4.4-5	0	1/00
Figure 4.4-6	0	1/00
Figure 4.4-7	0	1/00
Figure 4.4-8	0	1/00
Figure 4.4-9	0	1/00
Figure 4.4-10	0	1/00
Figure 4.5-1	0	1/00
Figure 4.5-2	0	1/00
Figure 4.5-3	0	1/00
4A.1-1	1	5/00
4A.2-1	1	5/00
4A.2-2	1	5/00
4A.3-1	4	4/10
4A.4-1	0	1/00
4A.5-1	0	1/00
4A.6-1	0	1/00
4A.6-2	0	1/00
4A.7-1	0	1/00
4A.7-2	0	1/00
4A.8-1	0	1/00
4A.9-1	4	4/10

Page Number/ Description	Revision	Date
5.1-1	1	5/00
5.1-2	1	5/00
5.2-1	1	5/00
5.2-2	1	5/00
5.2-3	0	1/00
5.2-4	0	1/00
5.2-5	0	1/00
5.2-6	0	1/00
5.2-7	1	5/00
5.2-8	1	5/00
5.2-9	1	5/00
5.3-1	1	5/00
5.3-2	0	1/00
5.3-3	0	1/00
5.3-4	0	1/00
5.3-5	0	1/00
5.4-1	0	1/00
5.4-2	0	1/00
5.4-3	0	1/00
5.5-1	0	1/00
5.5-2	0	1/00
5.5-3	0	1/00
5.5-4	0	1/00
5.5-5	0	1/00
5.5-6	0	1/00
5.5-7	0	1/00
5.5-8	0	1/00
5.5-9	0	1/00
5.5-10	0	1/00
5.5-11	0	1/00
5.5-12	0	1/00
5.5-13	0	1/00
5.5-14	0	1/00
5.5-15	0	1/00
5.5-16	0	1/00
5.5-17	0	1/00
5.5-18	0	1/00
5.5-19	0	1/00
5.5-20	0	1/00
5.5-21	0	1/00
5.5-22	0	1/00
5.5-23	0	1/00
5.5-24	0	1/00
5.5-25	0	1/00
5.5-26	0	1/00

LIST OF EFFECTIVE PAGES

LIST OF EFFECTIVE PAGES

Page Number/ Description	Revision	Date
6.6-15	0	1/00
6.6-16	0	1/00
6.6-17	0	1/00
6.6-18	1	5/00
6.7-1	1	5/00
Table 6.2-1	1	5/00
Table 6.3-1	1	5/00
Table 6.3-2	1	5/00
Table 6.4-1	1	5/00
Table 6.4-2	0	1/00
Table 6.4-2 (continued)	0	1/00
Table 6.4-3	0	1/00
Table 6.5-1	0	1/00
Table 6.5-2	0	1/00
Table (“P3314AL”))	0	1/00
Table 6.5-2 (continued)	0	1/00
Table (“P3926SL”)	0	1/00
Table 6.5-3	0	1/00
Table 6.5-4	0	1/00
6A-1	0	1/00
6A-2	0	1/00
6A-3	0	1/00
6A-4	0	1/00
6A-5	0	1/00
6A-6	0	1/00
6A-7	0	1/00
6A-8	0	1/00
6A-9	1	5/00
Table 6A-1	1	5/00
Table 6A-2	1	5/00
Table 6A-3	1	5/00
Figure 6A-1	Not shown	Not shown
Figure 6A-2	0	1/00
7.1-1	0	1/00
7.1-2	0	1/00
7.1-3	3	4/04
7.1-4	0	1/00
7.1-5	2	4/02
7.1-6	2	4/02
7.1-7	0	1/00
7.1-8	*7*	*4/22*
7.1-9	0	1/00
7.2-1	*7*	*4/22*
7.2-2	1	5/00

Page Number/ Description	Revision	Date
7.2-3	1	5/00
7.2-4	1	5/00
7.3-1	1	5/00
7.3-2	0	1/00
7.3-3	0	1/00
7.3-4	0	1/00
7.3-5	0	1/00
7.3-6	0	1/00
7.3-7	0	1/00
7.4-1	0	1/00
Table 7.3-1	0	1/00
Table 7.3-2	0	1/00
Table 7.3-3	0	1/00
Table 7.3-3 (continued)	0	1/00
Table 7.3-4	0	1/00
Table 7.3-4 (continued)	0	1/00
Figure 7.1-1	0	1/00
Figure 7.1-2	0	1/00
Figure 7.1-3	0	1/00
8.1-1	0	1/00
8.1-2	0	1/00
8.1-3	0	1/00
8.1-4	0	1/00
8.1-5	0	1/00
8.2-1	0	1/00
8.2-2	0	1/00
8.3-1	0	1/00
8.3-2	0	1/00
8.4-1	0	1/00
8.4-2	0	1/00
8.5-1	0	1/00
8.6-1	0	1/00
Table 8.1-1 (A. Receiving)	0	1/00
Table 8.1-1 (“B. Cask Loading”)	0	1/00
Table 8.1-1 (“C. Decontamination”)	5	4/12
Table (“leak test shall”)	5	4/12
Table 8.1-1 (“11. Pressurize”)	0	1/00
Table 8.2-1(“A. Storage”)	0	1/00
Table 8.2-1 (“10. Vent”)	0	1/00
Table 8.2-1 (“1. Begin”)	0	1/00
Figure 8.2-1	0	1/00

LIST OF EFFECTIVE PAGES

Page Number/ Description	Revision	Date
9.1-1	0	1/00
9.1-2	0	1/00
9.1-3	0	1/00
9.1-4	0	1/00
9.1-5	0	1/00
9.1-6	0	1/00
9.1-7	0	1/00
9.1-8	0	1/00
9.1-9	0	1/00
9.2-1	0	1/00
9.3-1	0	1/00
Figure 9.1-1	0	1/00
9A-1	0	1/00
9A-2	0	1/00
9A-3	0	1/00
Table 9A-1	0	1/00
Figure 9A-1	0	1/00
10.1-1	0	1/00
10.1-2	0	1/00
10.1-3	0	1/00
10.2-1	0	1/00
10.2-2	0	1/00
10.3-1	0	1/00
10.3-2	0	1/00
10.3-3	0	1/00
10.3-4	0	1/00
10.4-1	0	1/00
Table 10.2-1	0	1/00
Table 10.3-1	0	1/00
Table (“Connect the Vacuum Drying System”)	0	1/00
Table (“Storage Area”)	0	1/00
Table 10.3-1 (continued)	0	1/00
Table (“Connect the Vacuum Drying System”)	0	1/00
Table (“Connect over pressure system”)	0	1/00
Table 10.3-2	0	1/00
Figure 10.2-1	0	1/00
Figure 10.2-2	0	1/00
11.1-1	0	1/00
11.1-2	0	1/00
11.1-3	0	1/00
11.1-4	*7*	*4/22*
11.1-5	0	1/00

Page Number/ Description	Revision	Date
11.2-1	0	1/00
11.2-2	0	1/00
11.2-3	0	1/00
11.2-4	0	1/00
11.2-5	0	1/00
11.2-6	0	1/00
11.2-7	0	1/00
11.2-8	0	1/00
11.2-9	0	1/00
11.2-10	0	1/00
11.2-11	0	1/00
11.2-12	0	1/00
11.3-1	0	1/00
12.1-1	5	04/12
B-i	Not shown	Not shown
B 2.0-1	Not shown	Not shown
B 3.0-1	Not shown	Not shown
B 3.0-2	Not shown	Not shown
B 3.0-3	Not shown	Not shown
B 3.0-4	Not shown	Not shown
B 3.0-5	Not shown	Not shown
B 3.0-6	Not shown	Not shown
B 3.0-7	Not shown	Not shown
“This page intentionally blank”	0	1/00
B 3.1.1-1	Not shown	Not shown
B 3.1.1-2	Not shown	Not shown
B 3.1.1-3	Not shown	Not shown
B 3.1.2-1	Not shown	Not shown
B 3.1.2-2	Not shown	Not shown
B 3.1.2-3	Not shown	Not shown

LIST OF EFFECTIVE PAGES

Page Number/ Description	**Revision**	**Date**
B 3.1.3-1	Not shown	Not shown
B 3.1.3-2	Not shown	Not shown
B 3.1.4-1	Not shown	Not shown
B 3.1.4-2	Not shown	Not shown
B 3.1.5-1	Not shown	Not shown
B 3.1.5-2	Not shown	Not shown
B 3.1.5-3	Not shown	Not shown
B 3.1.6-1	Not shown	Not shown
B 3.1.6-2	Not shown	Not shown
B 3.2.1-1	Not shown	Not shown
B 3.2.1-2	Not shown	Not shown
B 3.3.1-1	Not shown	Not shown
B 3.3.1-2	Not shown	Not shown
B 3.3.1-3	Not shown	Not shown
13-1	0	1/00
13-2	0	1/00
Table 13-1	0	1/00
"This page intentionally blank"	Not shown	Not shown
14.1-1	*7*	*4/22*
14.1-2	0	1/00
14.1-3	0	1/00
14.2-1	0	1/00
14.2-2	0	1/00
14.2-3	0	1/00
14.2-4	0	1/00
14.3-1	0	1/00
Table 14.1-1	0	1/00
Table 14.1-2	0	1/00
Table 14.1-3	0	1/00
15-1	*7*	*4/22*
15-2	*7*	*4/22*
15-3	*7*	*4/22*
15-4	*7*	*4/22*
15-5	*7*	*4/22*
15-6	*7*	*4/22*
15-7	*7*	*4/22*
15-8	*7*	*4/22*
15-9	*7*	*4/22*
15-10	*7*	*4/22*
15-11	*7*	*4/22*
15-12	*7*	*4/22*
15-13	*7*	*4/22*
15-14	*7*	*4/22*
15-15	*7*	*4/22*
15-16	*7*	*4/22*
15-17	*7*	*4/22*
15-18	*7*	*4/22*
Table 15-1 (page 1)	*7*	*4/22*
Table 15-1 (page 2)	*7*	*4/22*
Table 15-1 (page 3)	*7*	*4/22*
Table 15-1 (page 4)	*7*	*4/22*
Table 15-1 (page 5)	*7*	*4/22*
Table 15-2 (page 1)	*7*	*4/22*
Table 15-2 (page 2)	*7*	*4/22*
Table 15-3	*7*	*4/22*

TN-32 SAFETY ANALYSIS REPORT
TABLE OF CONTENTS

TABLE OF CONTENTS

LIST OF TABLES

CHAPTER 1

GENERAL DESCRIPTION

This Safety Analysis Report addresses the safety related aspects of storing spent fuel in the TN-32 dry storage cask. The format follows the guidance provided in NRC Regulatory Guide 3.61[1]. (Throughout this report, superscripted numbers in parentheses refer to reference numbers for the Section.) The report is intended for review by the NRC under 10 CFR 72[2].

The TN-32 dry storage cask provides confinement, shielding, criticality control and passive heat removal independent of any other facility structures or components. The cask also maintains structural integrity of the fuel during storage. It can be used either singly or as the basic storage module in an ISFSI.

This Safety Analysis Report analyzes the safety related aspects of one cask and also the interactions among casks at an ISFSI.

It is intended that a Certificate of Compliance under the requirements of 10 CFR 72 Subpart L be issued such that the casks can be used for the storage of spent fuel in an independent spent fuel storage installation (ISFSI) at power reactor sites under the conditions of a general license in accordance with 10 CFR 72 Subpart K.

NOTE: CoC 1021 was originally licensed for 20 years. On 01/19/22, the NRC approved renewal of CoC 1021 for an additional 40 years. The aging management activities (AMA) associated with this renewal apply to the previously approved amendments, and future amendments will include an aging management review (AMR) and any resultant, required aging management activities. The current aging management results are detailed in Chapter 15.

1.1 Introduction

The TN-32 cask accommodates 32 intact PWR fuel assemblies with or without burnable poison rod assemblies (BPRAs) or thimble plug assemblies (TPAs) and consists of the following components:

- A basket assembly which locates and supports the fuel assemblies, transfers heat to the cask body wall, and provides neutron absorption to satisfy nuclear criticality requirements.
- A confinement vessel including a closure lid which provides radioactive material confinement and a cavity with an inert gas atmosphere.
- Gamma Shielding surrounding the confinement vessel.

Radial neutron shielding surrounding the gamma shield, enclosed in an outer steel shell, which provides additional radiation shielding.

- A protective cover which provides weather protection for the closure lid and seal components, the top neutron shield and the overpressure system.

they meet the burnup, enrichment and cooling times required. The BPRA's and TPA's which may be stored in the TN-32 are shown in Figures 2.1-4 and 2.1-5 respectively. A description of the fuel assemblies is provided in Section 2.1.

The quantity and type of radionuclides in the spent fuel assemblies are described and tabulated in Chapter 5. Chapter 6 covers the criticality safety of the TN-32 cask and its contents, listing material densities, moderator ratios, and geometric configurations.

1.2.4 Aging Management Program Requirements

Aging management program (AMP) requirements for use of the TN-32 storage system during the period of extended storage operations are contained in Section 15.3.

2.3 Safety Protection Systems

2.3.1 General

The TN-32 dry storage cask is designed to provide storage of spent fuel for at least *60* years. The cask materials are selected such that degradation would not be expected during the storage period. The cask cavity pressure is always above ambient during the storage period as a precaution against the in-leakage of air which might be harmful to the fuel. Since the confinement vessel consists of a steel cylinder with an integrally-welded bottom closure, the cavity gas can escape only through the lid closure system. In order to ensure cask leak tightness, two systems are employed. A double barrier system for all potential lid leakage paths consisting of covers with multiple seals is utilized. Additionally, pressurization of monitored seal interspaces provides a continuous positive inward and outward pressure gradient which guards against a release of the cavity gas to the environment and the admission of air to the cavity.

The components of the cask are classified as "Important to Safety" and "Not Important to Safety." A tabulation of the components and their classification is shown in Table 2.3-1. The classification of structures, components, and systems which are part of the ISFSI, but not part of the cask, is included in the Safety Analysis Report submitted by the applicant for a license under 10CFR72.

The following items are considered not important to safety:

- Drain tube with all associated hardware including drain tube clamp, drain tube adapter, attachment screws, and o-ring seals. The drain tube is for operational convenience only and does not perform any safety function. The drain tube can be removed and replaced with a lance that can perform the same function.

- Quick disconnect couplings and associated o-ring seals. The couplings are for operational purposes only. These couplings do not form part of the confinement boundary.

- Pressure Monitoring equipment including pressure switches or transducers and electrical cables. If the monitoring system were not to function, no safety function of the cask would be impaired. There would be no leakage in or out of the cask. The overpressure system and monitoring instrumentation is designated as not important to safety since the failure of the system will not result in a release of radioactive material. The monitoring system has not been designed to prevent failure during accident loadings. If an accident were to occur, the sealing surface is ensured by the outward force exerted by the helically-wound spring.

The metallic seals consist of an inner spring, a lining, and a jacket. The spring is Nimonic 90 or an equivalent material. The lining and jacket are stainless steel or nickel alloy and aluminum respectively.

The review of corrosion and galvanic reactions in Section 3.4.1 demonstrates the corrosion resistance of aluminum and stainless 304. The exposure to the borated pool environment is short term. The long term environment of the seals is helium, except for the outside of the outer seal. That is exposed to the air under the protective cover, but it is not exposed to rain or snow. If crevice corrosion at the outer seal were to cause a leak, it would be detected by the overpressure monitoring system.

The maximum seal temperature is 256 °F (Chapter 4). The neutron flux is 2.37×10^{5} n/cm^{2}s (Chapter 14) equivalent to less than *4.5*$\times 10^{14}$ n/cm^{2} after *60* years. The temperature and neutron fluence are low enough that for these materials, the environment is no more challenging than a non-radiation, ambient air environment.

Cefilac has conducted twice yearly leak testing of Helicoflex seals that were installed in 1973. The test fixture has been indoors, and has never been disassembled. The spring, lining, and jacket on the test seals are music wire, soft steel, and aluminum, respectively. The seal dimensions are 13 mm minor diameter x 3620 mm major diameter and 9.6 mm x 1935 mm. From 1973 to 1984, the seals were cycled 700 times between 20 and 150 °C. From 1984 to present, the seals have been maintained at 20 °C. The leak rates have remained below 10^{-7} Pa m^{3}/m s for the entire test duration. Plots showing test data are attached as Figures 2.3-2 through 2.3-4.

Additionally, all metallic seal seating areas are stainless steel overlay for improved surface control. The overlay technique has been used for Transnuclear's transport casks and storage casks including the TN-24, TN-40 and TN-32 designs.

For protection against the environment, a torispherical protective cover equipped with an elastomer seal is provided above the lid. The lid and cover seals described above are contained in grooves. A high level of sealing over the storage period is assured by utilizing seals in a deformation-controlled design. The deformation of the seals is constant since bolt loads assure that the mating surfaces remain in contact. The seal deformation is set by its original diameter and the depth of the groove.

Metal gasket face seal fittings, diaphragm valves and metallic seals are all capable of limiting leak rates to less than 1 x 10^{-7} atm-cc/sec of helium.

The initial operating pressure of the monitoring system's overpressure tank is set at 5.5 atm minimum. Over the storage period, the pressure is postulated to decrease as a result of leakage from the system and as a result of temperature reduction of the gas in the system. Since the level of permeation through the confinement vessel is negligible and leakage past the higher pressure of the monitoring system is physically impossible, a decrease in cavity pressure during the storage period occurs only as a result of a reduction in the cavity gas temperature with time. As long as the cavity pressure is greater than ambient pressure and the pressure in the monitoring system is greater than that of the cavity, no in-leakage of air nor out-leakage of cavity gas is possible.

The calculations provided in Chapter 7 define the monitoring system leakage test rate which ensures that no cavity gas can be released to the environment nor air admitted to the casks for the *first* 20 year storage period. *If needed, the monitoring system may be re-pressurized to maintain design conditions.* All seals are considered collectively in the analysis as the monitoring system pressure boundary. This analysis is performed in accordance with ANSI N14.5[11].

As shown in Chapter 7, the monitoring system pressure is always greater than the cask cavity or atmospheric pressure. Thus, no leakage can occur from the cask cavity during the storage period. The pressure monitoring system alarm will be set to at least 3.2 atm abs. This is less than the minimum expected monitoring system pressure and greater than the maximum cavity pressure.

2.3.2.2 Cask Cooling

To establish the heat removal capability of the TN-32 cask, several thermal design criteria are established for the normal conditions. These are:

- Confinement of radioactive material and gases is a major design requirement. Seal temperatures must be maintained within specified limits to satisfy the leak tight confinement function during normal and accident conditions. A maximum temperature limit of 536 °F (280 °C) is set for the seals (double metallic O-rings) in the confinement vessel closure lid and vent and drain covers.

- Maintaining fuel cladding integrity during storage is

2.4 Decommissioning Considerations

The dry cask design concept to be utilized at the ISFSI features inherent ease and simplicity of decommissioning. At the end of its service lifetime, cask decommissioning could be accomplished by one of several options described below.

The casks, including the spent fuel stored inside, could be shipped to a suitable fuel repository for permanent storage. Depending on licensing requirements existing at the time of shipment off site, placement of the entire cask inside a supplemental shipping container or overpack would be considered.

The spent fuel could be removed from the ISFSI cask and shipped in a licensed shipping container to a suitable fuel repository. If desirable, cask decontamination could be accomplished through the use of conventional high pressure water sprays to further reduce contamination on the cask interior. The sources of contamination on the interior of the cask would be crud from the outside of the fuel pins and the crud left by the spent fuel pool water. The expected low levels of contamination from these sources could be easily removed with a high pressure water spray. After decontamination, the ISFSI cask could either be cut-up for scrap or partially scrapped and any remaining contaminated portions shipped as low level radioactive waste to a disposal facility.

For surface decontamination of the ISFSI cask, chemical etching using hydrochloric acid or nitric acid can be applied to remove the contaminated surface of the cask. Alternatively, electropolishing can also be used to achieve the same result.

Cask activation analyses have been performed to quantify specific activity levels of cask materials after years of storage. *This analysis may need to be updated at the time of decommissioning to reflect the actual storage conditions, e.g., years of storage.* The following assumptions were made:

- The cask contains 32 design basis PWR assemblies.
- The neutron flux is assumed constant for 20 years.

The cask activation analyses are presented in Chapter 14. The results of these calculations show that the TN-32 will be far below the specific activity limits for both long and short lived nuclides for Class A waste. Consequently, it is expected that after application of the surface decontamination process as described above, the radiation level due to activation products will be negligible and the cask could be disposed of as Class A waste. A detailed evaluation will be performed at the time of decommissioning to determine the appropriate method of disposal.

Due to the leak tight design of the storage casks, no

2.5 Summary of Cask Design Criteria

The principal design criteria for the TN-32 cask are presented in Table 2.5-1. The TN-32 dry storage cask is designed to store 32 intact PWR spent fuel assemblies with or without burnable poison rod assemblies or thimble plugs with a maximum assembly average burnup of 45,000 MWD/MTU, maximum initial enrichment of 4.05% and a minimum cooling time of 7 years.

The maximum total heat generation rate of the stored fuel (including BPRA'S and TPA's) is limited to 32.7 kW in order to keep the maximum fuel cladding temperature below the limit necessary to ensure cladding integrity for 40 years storage(12). The fuel cladding integrity is assured by the limited fuel cladding temperature and maintenance of a nonoxidizing environment in the cask(17). *While the cladding temperature limits were based on a 40-year storage design life, the methodology used pre-dates the current accepted limit for low burnup fuel in ISG-11 [28], i.e., 752 °F. Since the fuel cladding temperature limits applied to the fuel stored in the TN-32 are less than, i.e., more restrictive than, the ISG-11 limit, they remain valid for the period of extended operation and demonstrates that the cladding will continue to perform its intended function through the end of the period of extended operation (PEO).*

The confinement vessel (body and lid) is designed and fabricated to the maximum practicable extent as a Class I component in accordance with the rules of the ASME Boiler and Pressure Vessel Code, Section III, Subsection NB, Articles NB-3200. Deviations to the code are listed in Chapter 7. The cask design, fabrication and testing are covered by a Quality Assurance Program which conforms to the criteria in Subpart G of 10CFR72.

The cask is designed to maintain a subcritical configuration during loading, handling, storage and accident conditions. Poison materials in the fuel basket are employed to maintain $k_{eff} \leq 0.95$ including statistical uncertainties. The TN-32 cask is designed to withstand the effects of severe environmental conditions and natural phenomena such as earthquakes, tornadoes, lightning, hurricanes and floods. Chapter 11 describes the cask behavior under these environmental conditions.

26. Regulatory Guide 1.60, “Design Response Spectra for Seismic Design of Nuclear Power Plants.”

27. NUREG/CR-6361, “Criticality Benchmark Guide for Light-Water-Reactor Fuel in Transportation and Storage Packages,” 1997.

28. U.S. Nuclear Regulatory Commission, Interim Staff Guidance No. 11, ISG-11, Revision 3, “Cladding Considerations for the Transportation and Storage of Spent Fuel,” Revision 3, November 2003.

TABLE 2.5-1

DESIGN CRITERIA FOR TN-32 CASKS

Maximum gross weight on crane (with lift beams, without water)	120 tons
Maximum cask height with lid removed	179.5 in.
Minimum design life	*60* years
Maximum k_{eff}, including bias and uncertainties	<0.95 Normal <0.95 Accident
Payload Capacity, Fuel assemblies	32 intact W PWR 14x14, 14x14 O.F.A. 15x15, 17x17,17x17 O.F.A. or B&W 17x17 Mark BW with or without BPRA's or TPA's 1533 lb maximum
Spent Fuel Characteristics	
a) Initial Enrichment	4.05%
b) Burnup (max)	45,000 MWD/MTU
c) Cooling time (min)	7 years
d) Decay Heat	32.7 kw (total including BPRA'S or TPA'S)
Max Clad Temperature	328°C
Cask Cavity Atmosphere	Helium gas
Maximum Internal Pressure	100 psig
Ambient Temperature	-30 to 115°F
Daily Averaged Ambient Temperature Over 24 hr. period (min-max)	-20 to 100°F
Maximum Solar Heat Load	2950 BTU/ft^2 (Flat Surfaces) 1474 BTU/ft^2 (Curved Surfaces)
Tornado Wind	290 mph rotational 70 mph translational
Tornado Missiles	1800 kg auto 125 kg 8 in. armor piercing shell 1 in. solid steel sphere
Cask Drop	18" Drop and 5' Drop
Cask Tip	Tip onto ISFSI pad
Seismic Design Earthquake	0.26 g horizontal 0.17 g vertical
Snow and Ice	50 psf load

3.3 Mechanical Properties of Materials

3.3.1 Cask Material Properties

This section provides the mechanical properties of materials used in the structural evaluation of the TN-32 storage cask. Table 3.3-1 lists the materials selected, the applicable components, and the minimum yield, ultimate, and design stress values specified by the ASME Code. All values reported in Table 3.3-1 are for metal temperatures up to 100 °F. For higher temperatures, the temperature dependency of the material properties is reported in Table 3.3-2.

Table 3.3-3 is provided to summarize thermal analysis results from Chapter 4 which support the selection of cask body component design temperatures for structural analysis purposes.
The temperatures specified in Table 3.3-3 are used to determine the allowable stresses. They are not a maximum use temperature for the material.

3.3.2 Basket Material Properties

The material properties of the 304 stainless steel plates are taken from the ASME Code[1]. The material properties of the aluminum alloy (6061-T6) are also taken from the ASME code except at elevated temperatures. The elevated temperature properties not available in the ASME code are obtained from the Aluminum Association [5]. These properties are listed with specific references in Tables 3.3-4 and 3.3-5. The full strength of the aluminum was considered when performing dynamic impact analyses. For long term sustained loading (under normal operation condition), the aluminum strength is generally neglected under primary loading where it can share the load with the stainless steel.

3.3.3 Material Properties Summary

Table 3.3-6 provides a table which summarized the components of the TN-32 cask, their primary function, and an overview of the general conditions (stresses, temperatures, pressures, coatings, etc., during storage. This table is intended to summarized the information provided elsewhere in the SAR.

3.3.4 Materials Durability

Materials must maintain the ability to perform their safety-related functions over the cask’s lifetime under the cask’s thermal, radiological, corrosion, and stress environment.

Metallic components:

Gamma radiation has no significant effect on metals. The effect of fast neutron irradiation of metals is a function of the integrated fast neutron flux, which is on the order of 10^{14} n/cm^2 inside the TN-32. Studies on fast neutron damage in aluminum, stainless steel, and low alloy steels rarely evaluate damage below 10^{17} n/cm^2 because it is not significant. Extrapolation of the data available down to the 10^{14} range confirms that there will be virtually no neutron damage to any of the TN-32 metallic components.

The effect of the TN-32 temperature environment on the required structural properties is evaluated in the SAR. There is no long term degradation of metals in the TN-32 temperature environment. The effect of creep at temperature is the basis for establishing the seal temperature limits. Additional information on the seals, including construction, corrosion evaluation and long term test data, is provided in Sections 2.3.2.1 and 7.1.3.

The cask exterior carbon steel components are protected from corrosion by thermal spray and/or paint (epoxy, acrylic urethane or equivalent). The interior is protected by the aluminum thermal spray and by the helium environment inside the cask. The aluminum and stainless steel components are not subject to significant corrosion as discussed in Section 3.4-1.

Non-metallic components:

The radial neutron shield resin is a proprietary reinforced polymer. Appendix 9A provides information on the composition and the radiation and temperature resistance of the resin. Polyester is inert with respect to water, and the fire retardant mineral fill makes it self-extinguishing. Furthermore, the resin is contained in aluminum tubes inside a steel shell, so that the material is retained in place, and isolated from both water and from sources of ignition.

Elastomer o-rings or gaskets in the weather cover, quick disconnects, drain tube, and pressure relief valve are Not safety related; note that the quick disconnects are not part of the containment boundary.

Stem tips on overpressure system valves are Kel-F or similar material, and are not safety related; at the valve locations, the radiation level and temperatures are low.

The top neutron shield (polypropylene) is not safety related.

Paint is subject to routine maintenance and touch-up. Radiation levels and temperature on the cask exterior are not high enough to damage the paint. This is confirmed by dry cask experience.

3.5 Fuel Rods

The handling of spent fuel within the Nuclear Generating Plant will be conducted in accordance with existing fuel handling procedures. Fuel with gross cladding defects will not be considered for storage at the ISFSI.

3.5.1 Fuel Rod Temperature Limits

The design criteria for the TN-32 dry storage cask requires that the maximum fuel cladding temperature of the hottest fuel rod in the cask shall not exceed the temperature limit calculated according to PNL-6189[(7)]. This temperature limit has been calculated as a function of fuel age to account for the effect of fuel age on creep deformation and fuel cladding rupture. As the age of fuel increases, its cooling rate rapidly decreases. If the initial fuel temperature is too high at loading, significant creep deformation can occur as a result of the decreasing cooling rates with fuel age. The Commercial Spent Fuel Management Program (CSFM) used the TN-24P packaging as one of its models for developing generic fuel cladding temperature limit curves for 40 year dry storage. The CSFM generic curves are used to establish the fuel cladding temperature limit for 10-year cooled fuel. *While the cladding temperature limits were based on a 40-year storage design life, the methodology used pre-dates the current accepted limit for low burnup fuel in ISG-11 [24], i.e., 752 °F. Since the fuel cladding temperature limits applied to the fuel stored in the TN-32 are less than, i.e., more restrictive than, the ISG-11 limit, they remain valid for the period of extended operation and demonstrates that the cladding will continue to perform its intended function through the end of the period of extended operation (PEO).*

From Reference 7, the midwall hoop stress is given by the equation,

$$S_{mhoop},\ T_2 = (PD_{mid}/2t)(a)(T_2/T_1)$$

where

S_{mhoop}, T_2 = the midwall hoop=stress (psi) at temperature of interest T_2 (°K)

P = the internal pressure (psi) at the hot-volume average temperature, T_1 (°K)

D_{mid} = the midwall diameter (in.) after accounting for Cladding corrosion

t = the cladding thickness (in.) after accounting for cladding corrosion

a = 0.95 for PWR fuel assemblies

Using fuel data provided in Reference 8, a Westinghouse 15x15 assembly with a burnup of 45,000 MWD/MTU has a lead fuel rod pressure of 1073 psia at 100 °C. The corresponding pressure for a 17x17 assembly is 1053 psia. The pressure for a Westinghouse 14x14 fuel assembly with a burnup of 50,000 MWD/MTU is 591 psia at 21 °C.

14. Telefax from Ed Novinski, Sulzer-Metco, Inc., Sept 23, 1996.

15. ANSI/AWS C2.18-93, Guide for the Protection of Steel with Thermal Sprayed Coatings of Aluminum and Zinc and their Alloys and Composites, Table B1.

16. Erich Rabald, ed., Corrosion Guide, 2nd ed., Elsevier Publishing Co., 1968, p 108.

17. Shrier, Jarman, and Burstein, ed, Corrosion, 3rd ed, Butterworth-Heinemann Ltd, 1994, pp 12-91, 92.

18. BNL-NUREG-24532, Hydrogen Release Rates from Corrosion of Zinc and Aluminum, 1978.

19. Pacific Northwest Laboratory Annual Report - FY 1979, Spent Fuel and Fuel Pool Component Integrity, May, 1980.

20. G. Wranglen, An Introduction to Corrosion and Protection of Metals, Chapman and Hall, 1985, pp. 109-112.

21. 19.A.J. McEvily, Jr., ed., Atlas of Stress Corrosion and Corrosion Fatigue Curves, ASM Int'l, 1995, p. 185.

22. Vectra document No. 31-B9604-102, Rev 2, An Assessment of Chemical, Galvanic, and other Reactions in NUHOMS Spent Fuel Storage and Transportation Casks, Proprietary Appendix C (response to NRC Bulletin 96-04).

23. Harper, Charles A., ed., Handbook of Plastics and Elastomers, McGraw-Hill, 1975.

24. *U.S. Nuclear Regulatory Commission, Interim Staff Guidance No. 11, ISG-11, "Cladding Considerations for the Transportation and Storage of Spent Fuel", Revision 3, November 2003.*

$L_{u,He}$ = helium volumetric leakage rate
P_u = 6.53 atm abs
P_d = 1.0 atm abs
D = 4.83 x 10^{-4} cm
a = 0.5 cm
μ = 0.0224 cP (for helium at 354 K)
T = 354 K
M = 4.0 g/mol
P_a = ½ (P_u + P_d) = 3.77 atm abs

Substituting:

$F_c = \{2.49E+06 \times (4.825E-04)^4\}/(0.5 \times 0.0224) = 1.21E-05$

$F_m = \{3.81E+03 \times (4.825E-04)^3 \times (354/4)^{0.5}\} / (0.5 \times 3.7668) = 2.14E-06$

$L_{u,He} = (F_c + F_m)(P_u - P_d)(P_a/P_u)$
$L_{u,He} = (1.21E-05 + 2.14E-06)(6.53 - 1.0)(3.77 / 6.53)$
$L_{u,He}$ = 4.53E-05 cc/sec of Helium

Over the first year, the maximum volume leaked from the overpressure system is:

V = 4.53E-05 cc/sec×(365 days/yr)×(24 hrs/day)×(3600 sec/hr)
V = 1428 cc of helium at T_u, P_u.

The OP system tank basically consists of a 6" diameter schedule 80 pipe (27" long) and two 6" diameter schedule 80 end caps. The volume of the tank is 835 in^3. The volume of the OP system is increased to 900 in^3 (14750 cc) to include the OP system tubing and the space between the metallic seals in the lid and penetrations. Corresponding, the pressure is reduced by the following in the first year:

$P_{OP\ released} = P_{OP\ Sys,\ Initial} \times \{V_{released} / V_{OP\ Sys}\}$
$P_{OP\ released}$ = 6.53 atm (1428cc / 14750cc) = 0.63 atm

The overpressure system pressure is also corrected for the corresponding drop in temperature over the first year. At the end of the first year, the overpressure system pressure is 5.88 atm abs (71.7 psig). These calculations are repeated every year for 20 years. *If needed, the monitoring system may be re-pressurized to maintain design conditions.* Figure 7.1-1 illustrates the pressure drop from the overpressure system to the atmosphere. Figure 7.1-1 also illustrates the pressure drop in the cask cavity due to fuel cooling.

If a leak is to the cask cavity rather than the atmosphere, the pressure drop in the overpressure system is calculated using a downstream pressure of 2.5 atm abs, or 17.6 psig (see Section 7.2.2.1). Figure 7.1-1 also illustrates the results of this

7.2 Requirements for Normal Conditions of Storage

7.2.1 Release of Radioactive Material

The TN-32 dry storage cask is designed to provide storage of spent fuel for at least *60* years. The cask cavity pressure is always above ambient during the storage period as a precaution against the in-leakage of air which might be harmful to the fuel. Since the confinement vessel consists of a steel cylinder with an integrally-welded bottom closure, the cavity gas can escape only through the lid closure system. In order to ensure cask leak tightness, two systems are employed. A double barrier system for all potential lid leakage paths consisting of covers with multiple seals is utilized. Additionally, pressurization of monitored seal interspace provides a continuous positive inward and outward pressure gradient which guards against a release of the cavity gas to the environment and the admission of air to the cavity.

The cask loadings for normal conditions of storage are given in Section 2.2.5. It is shown that the seals are not disturbed by any of the loadings and thus, the cask confinement is maintained.

A gas sample may be taken utilizing the quick connect fitting in the vent port penetration to check the confinement vessel gas for radioactive material,. However, the over pressure monitoring system would have to be disabled in order to perform this test.

7.2.2 Pressurization of Confinement Vessel

7.2.2.1 Pressure under 100 °F Ambient Air Temperature, Maximum Insolation

The pressure at completion of backfill is 2.2 atm abs. The average temperature of the helium when backfilling is completed is assumed to be at 313 °F (773 °R), the same as the average cavity gas temperature under conditions of -20 °F ambient air and no solar load. The average cavity gas temperature with 100 °F ambient air and maximum solar load is 411 °F (871 °R).

2.2 atm abs (871 °R /773 °R) = 2.5 atm abs (22.1 psig)

7.2.2.2 Pressure Under 100 °F Ambient Air Temperature, Maximum Insolation, 10% Fuel Rod Failure, 10% BPRA Rod Failure

Fuel clad failure would result in an increase in cavity pressure due to free gas release of the fuel and BPRA rods. The Westinghouse 15x15 assembly contains the most free gas[3],

- The overpressure system is not functioning and the inner seal is intact. In this case there is no release of radioactive material to the environment; or

- The overpressure system is not functioning and the inner seal is leaking at some rate.

In this latter case, leakage out of the interspace to the atmosphere and the cask cavity would occur. This would not result in release of radioactive material from the cask cavity until the pressure fell to the cask cavity pressure. At the test leak rate of 1 x 10^{-5} std cc/sec, this would not occur during *a* 20 year period. *If needed, the monitoring system may be re-pressurized to maintain design conditions.*

However, a leak of this magnitude in combination with a loss of the over pressure system has been evaluated as both an off-normal and accident condition in Section 7.3.

The results of these calculations assuming off-normal conditions indicate that an individual located at the site boundary (100 m from the cask) for an entire year would receive an effective dose equivalent of 1.92 mrem, a thyroid dose of 0.262 mrem, and a bone surface dose of 19.1 mrem. These doses are below the regulatory limits of 10 CFR 72.104(a) of 2.5 x 10^{-1} msv (25 mrem) to the whole body, 7.5 x 10^{-1} msv (75 mrem) to the thyroid and 2.5 x 10^{-1} msv (25 mrem) to any other critical organ.

The results of these calculations assuming accident conditions indicated that at the site boundary (100m from the cask), for a 30 day release, the total effective dose equivalent is 58.9 mrem. The sum of the deep dose equivalent and the committed dose equivalent to any individual organ (the critical organ in this case is the bone surface) is 664 mrem for a 30 day release. These values are well below the limiting off site doses defined in 10 CFR 72.106(b).

Another accident condition under consideration is that the overpressure system is not functioning and the inner seal has experienced a latent seal failure. This analysis is presented in 7.3.3. This accident analysis demonstrates that a latent failure up to 100 times greater that the test value could occur and there is ample time for recovery before the limiting off site doses in 10 CFR 72.106(b) are met. The probability that a gross leak of an inner seal in combination with a gross leak in the outer seal is not considered a credible event.

11.1.2.4 Corrective Actions

The overpressure system leak would be repaired at the ISFSI

CHAPTER 14

DECOMMISSIONING

14.1 Decommissioning Considerations

The TN-32 cask design features inherent ease and simplicity of decommissioning. At the end of its service life, cask decommissioning could be performed by one of the options listed below:

- Option 1, the TN-32, including spent fuel in storage, could be shipped (by special transport license) to either a monitored retrievable storage system (MRS) or a geological repository for final disposal, or

- Option 2, the spent fuel could be removed from the TN-32 cask (either at the ISFSI site or at another off site location) and shipped in an NRC approved cask.

The first option requires that the Part 72 storage only cask be upgraded to current Part 71 regulations. Although that opportunity is beyond the bounds of this application, TN and its customers may evaluate this option on a case by case basis.

The first option does not require any decommissioning of the TN-32 cask. No residual contamination is expected to be left behind on the concrete base pad. The base pad, fence, and periphery utility structures will require no decontamination or special handling after the last cask is removed. The ISFSI pad could be demolished with normal construction techniques.

The second option would require decontamination of the TN-32 cask. The sources of contamination in the interior of the cask would primarily be contamination left from the spent fuel pool water; or crud, hot particles and fines from the spent fuel pins. This low level contamination could simply be removed with high pressure water spray. If further surface decontamination of the TN-32 is necessary, electropolishing or chemical etching can be used to remove the contaminated surface of the cask. After decontamination, the TN–32 cask could either be cut up for scrap, partially scrapped, or refurbished for reuse. Any activated metal would be shipped as low level radioactive waste to a near surface disposal facility.

Cask activation analyses have been performed to quantify the specific activities of the cask materials after years of storage. *This analysis may be updated at the time of decommissioning to reflect actual storage conditions, e.g., years of storage.* The following assumptions were made:

- the cask contains 32 design basis PWR fuel assemblies, and
- the neutron flux is assumed constant for 20 years.

Chapter 15

AGING MANAGEMENT

15.1 Aging Management Review

The aging management review (AMR) of the TN-32 dry storage cask system contained in the application for initial Certificate of Compliance (CoC) renewal [15.1] provides an assessment of aging effects that could adversely affect the ability of in-scope structures, systems, and components (SSCs) to perform their intended functions during the period of extended operation. Aging effects, and the mechanisms that cause them, were evaluated for the combinations of materials and environments identified for the subcomponent of the in-scope SSCs based on a review of the Managing Aging Processes in Storage (MAPS) Report [15.2] (and EPRI 1015078 [15.3] for an earthen berm). Aging effects that could adversely affect the ability of the in-scope SSCs to perform their safety function(s) require an aging management activity (AMA) to address potential degradation that may occur during the extended storage period. The AMA may consist of a time-limited-aging-analysis (TLAA) or an aging management program (AMP). TLAAs and AMPs that are credited with managing aging effects during the extended storage period are discussed in Sections 15.2 and 15.3, respectively.

15.2 Time-Limited Aging Analyses

A comprehensive review to identify the TLAAs for the in-scope SSCs of the TN-32 Dry Storage System was performed to determine the analyses that could be credited with managing aging effects over the period of extended operation. The TLAAs identified involved the in-scope SSCs, considered the effects of aging, involved explicit time-limited assumptions, provided conclusions regarding the capability of an SSC to perform its intended function through the operating term, and were contained or incorporated in the design basis. The identified TLAAs were dispositioned by demonstrating the existing analysis remains valid for the PEO or the analysis was updated. The identified TLAAs were:

- Boron depletion in the borated aluminum plates
- Establishment of cladding temperature limits
- Ensuring cavity pressure remains above one atmosphere on the coldest day at the end of the storage period.

15.3 Aging Management Program

Aging effects that could result in the loss of in-scope SSCs' intended function(s) are managed during the period of extended operation. Many aging effects are adequately managed for the extended storage period using TLAA, as discussed in Section 15.2. An AMP is used to manage those aging effects that are not managed by TLAA. The AMPs that manage each of the identified aging effects for all in-scope SSCs include the following:

- TN-32 Aging Management Program
- Storage Pad Aging Management Program
- Earthen Berm Aging Management Program

15.3.1 TN-32 Aging Management Program

15.3.1.1 TN-32 AMP – Scope of Program

This program visually inspects and monitors the condition of the TN-32 subcomponents listed in Table 15-1. The table also lists the material and environments for each subcomponent along with the aging mechanisms and aging effects to be managed. The following aging effects and mechanisms will be managed via this AMP:

- Steel
  - Loss of material due to general, pitting, crevice, and galvanic corrosion
  - Loss of preload due to stress relaxation of bolts
- Stainless Steel
  - Loss of material due to pitting, crevice, and galvanic corrosion
- Polymers
  - Shrinkage/cracking due to thermal aging and radiation embrittlement
- Aluminum
  - Loss of material due to general, pitting, crevice, and galvanic corrosion

15.3.1.2 TN-32 AMP – Preventive Actions

The program is a condition-monitoring program that does not include preventive actions.

15.3.1.3 TN-32 AMP – Parameters Monitored or Inspected

The TN-32 AMP consists of monitoring the interseal pressure, radiation monitoring, and visual inspections.

Interseal Pressure Monitoring

The interseal pressure of the TN-32 dry storage cask seals is monitored to verify the integrity of the TN-32 dry storage cask seals. The interseal region is pressurized via the overpressure system to provide indication of cask seal integrity. A reduction of interseal pressure could indicate leakage due to loss of material of the seals or loss of preload of the bolts and would occur before there is a loss of the confinement intended safety function.

Radiation Monitoring

Periodic radiation monitoring, both gamma and neutron monitoring, will be conducted to ensure that there is no loss of the shielding intended safety function (i.e., met the requirements of 10 CFR Part 20 and 10 CFR Part 72.104) due to loss of material of the steel and stainless steel subcomponents or due to shrinkage/cracking of the polymer subcomponents. Trending the results of the radiation monitoring will enable detection of aging-related degradation before there is a loss of the shielding intended safety function.

Visual Inspections

Periodic visual inspections will be performed on the TN-32 casks looking for loss of material for steel and stainless steel subcomponents, i.e., corrosion. The frequency of these inspections will ensure that the loss of material is detected prior to the loss of an intended safety function.

15.3.1.4 TN-32 AMP – Detection of Aging Effects

This program manages the TN-32 aging effects by monitoring the interseal pressure, radiation monitoring, and visual inspections.

15.3.1.4.1 TN-32 AMP – Interseal Pressure Monitoring

The interseal pressure is monitored by measuring the pressure in the overpressure system. The TN-32 AMP utilizes the same equipment, methods, and frequency used to comply with Technical Specification 3.1.5, "Cask Interseal Pressure." Technical Specification Surveillance Requirement SR 3.1.5.1 requires verification that the cask interseal helium pressure is above 3.2 atm absolute every seven days.

15.3.1.4.2 TN-32 AMP – Radiation Monitoring

Detection of gamma and neutron radiation is accomplished by the placement of thermoluminescent dosimeters (TLDs) at the ISFSI perimeter fence. The TLDs for monitoring neutron radiation shall be capable of detecting low, intermediate and high energy neutrons (e.g., using a CR 39 polycarbonate chip or equivalent dosimetry.) While the TLDs may not be capable of measuring an accurate neutron dose rate (due to calibration difficulties), they are effective in detecting adverse trends in neutron dose rates.

The placement of the TLDs around the ISFSI shall be determined by the licensee considering the following:

- The objective is to monitor for increasing dose rates that could approach the 10 CFR 20.1301 and 10 CFR 72.104 regulatory limits, and dose to individuals outside the ISFSI.
- Casks that have been in service the longest would generally be expected to be more susceptible to potential degradation.
- Shadowing or shielding by other casks or structures.

The licensee shall document the basis for the placement of the TLDs within their program document.

Thermoluminescent dosimeter readings are obtained quarterly.

In addition to the TLDs, annual neutron radiation surveys shall be performed around the entire perimeter of the storage pad(s). Survey points are to be located centrally between every two adjacent casks and approximately one foot outward from the outer edge of the storage pad (or one foot outward from a line connecting the outer edges of individual storage pads).

Results from these monitoring activities provide a means to detect deterioration of the TN-32 dry storage cask gamma and neutron shielding due to loss of material, shrinkage, or cracking.

15.3.1.4.3 TN-32 AMP – Visual Inspections

Accessible surfaces of all TN-32 casks will be visually inspected on an annual basis (plus 25% allowed by Technical Specification SR 3.0.2). Visual (direct or by remote means) inspections of opportunity (e.g., in the event a TN-32 cask is lifted or a protective cover is removed) will be performed on the surfaces of in-scope subcomponents in the normally non-accessible areas. A scheduled visual inspection of normally non-accessible areas of a lead TN-32 cask will be performed within two years prior to 20 years of the first loaded TN-32 cask being placed in storage, or no later than eighteen months after the effective date of the CoC renewal, whichever is later (i.e., a base line inspection), and on a frequency of every 20 ± 1 years thereafter. The lead cask is defined as the cask that has been in-service the longest. The visual inspections of the normally non-accessible areas shall be VT-3 examinations in accordance with ASME Section XI, IWA-2213.

Note: Eighteen months allows one year for development of infrastructure for AMP implementation plus six months to complete subsequent baseline inspections.

The visual inspections are looking for loss of material indicated by corrosion or rust stains of in-scope subcomponents. Since the identification of corrosion or rust stains is a simple skill, ASME non-destructive examination (NDE) qualifications are not required to perform the visual inspections of accessible areas; however, the inspectors of accessible areas shall be trained/qualified per the licensee's specific procedures. Personnel performing visual examinations of the normally non-accessible areas shall be qualified and certified in accordance with ASME Section XI, IWA-2300.

Visual inspection of the flange stainless steel weld overlay and carbon steel subcomponents serve as a leading indicator for stainless and carbon steel subcomponents that are not visible during the opportunistic and scheduled inspections, e.g., seals, vent and drain port covers. Similarly, this AMP relies upon these leading indicators to manage aging effects of installed bolts, such that removal of bolts for inspection is not required.

15.3.1.5 TN-32 AMP – Monitoring and Trending

The inspections and monitoring activities in this AMP are performed periodically in order to identify areas of degradation. Conditions that do not meet the acceptance criteria are entered into the licensee's corrective action program. Visual inspections appropriately consider cumulative OE from previous inspections and assessments, in order to monitor and trend the progression of aging effects over time. Data taken from these inspections and monitoring activities is to be monitored by comparison to past site data taken as well as comparison to industry OE, including data gathered by the Institute of Nuclear Power Operations (INPO) Aging Management INPO Database (AMID) as discussed in Nuclear Energy Institute (NEI) 14-03 [15.5].

As described in Section 15.3.1.4.3, one lead TN-32 cask is to be selected for the baseline inspection and subsequent inspections of normally non-accessible areas (e.g., the bottom of the cask and under the protective weather cover). If the lead TN-32 cask is not available for subsequent inspections (e.g., has been shipped off-site), another TN-32 cask is to be selected for a new baseline inspection following the considerations/criteria in Section 15.3.1.4.3.

The quarterly gamma and neutron radiation readings from the TLDs on the ISFSI perimeter fence, and the annual neutron surveys around the storage pad perimeter are evaluated to determine if there is an annual increasing trend.

15.3.1.6 TN-32 AMP – Acceptance Criteria

The TN-32 AMP acceptance criteria ensure that the particular structure and component intended functions are maintained under the existing design basis conditions during the PEO. If any of the acceptance criteria below are not met, further evaluation is required through the licensee's corrective action program.

15.3.1.6.1 TN-32 AMP – Interseal Pressure

The acceptance criterion for interseal pressure monitoring is the limit specified in Technical Specification 3.1.5, i.e., the cask interseal pressure shall be maintained at a pressure of a least 3.2 atm abs.

15.3.1.6.2 <u>TN-32 AMP – Radiation Monitoring</u>

The acceptance criterion for radiation monitoring is the absence of an annual increasing trend in neutron or gamma quarterly TLD readings at the ISFSI perimeter fence, and the annual neutron surveys around the storage pad perimeter.

15.3.1.6.3 <u>TN-32 AMP – Visual Inspections</u>

To ensure that an evaluation is performed before there is a loss of intended functions due to a loss of material, the acceptance criteria (for both the accessible and normally non-accessible areas) for the visual inspections are.

- No observed corrosion
- No rust stains on steel or stainless steel surfaces
- No rust stains on the concrete pad

15.3.1.7 <u>TN-32 AMP – Corrective Actions</u>

Site QA procedures, review and approval processes, and administrative controls are implemented according to the requirements of 10 CFR Part 50, Appendix B. The licensee's corrective action program ensures that conditions adverse to quality are promptly identified and corrected, including root cause determination and prevention of recurrence. Deficiencies are either corrected or are evaluated to be acceptable for continued service through engineering analysis, which provides reasonable assurance that the intended safety function is maintained consistent with current licensing basis conditions. Extent of condition investigation per the licensee's corrective action program may cause additional inspections through means of a different method, increased inspection frequency, and/or expanded inspection sample size.

15.3.1.8 <u>TN-32 AMP – Confirmation Process</u>

The confirmation process will be commensurate with the general licensee QA program approved under 10 CFR Part 50, Appendix B. The QA program ensures that the confirmation process includes provisions to verify that appropriate corrective actions have been completed and are effective. It also contains provisions to preclude repetition of significant conditions adverse to quality.

15.3.1.9 TN-32 AMP – Administrative Controls

Administrative controls under the CoC holder or licensee’s QA procedures and corrective action program provide a formal review and approval process. Administrative controls are implemented in accordance with the requirements of 10 CFR Part 50, Appendix B, and will continue for the PEO. Licensees and the CoC holder use the 10 CFR Part 72 regulatory requirements to determine if a particular aging-related degradation condition or event identified via OE, research, monitoring, or inspection is reportable to the U.S. Nuclear Regulatory Commission (NRC). Individual events and conditions not rising to the level of NRC reportability based on the criteria in 10 CFR Part 72 are communicated to the CoC holder as outlined in NEI 14-03 [15.5].

15.3.1.10 TN-32 AMP – Operating Experience

Appendix 3C documents the review of various sources of OE relevant to the TN-32 dry storage cask system. This review included inspections of TN-32 and TN-40 casks that have been in service for several years. While the review identified several conditions that were aging-related, no incidents were identified where aging effects lead to the loss of intended safety functions of a SSC. This OE review supports the conclusion that the effects of aging will be managed adequately so that the SSC’s intended safety functions will be maintained during the PEO.

This AMP will be updated, as necessary, to incorporate new information on degradation due to aging effects identified from plant-specific inspection findings, related industry OE, and related industry research. Future plant-specific and industry aging management and aging-related OE are captured through the licensee’s OE review process. The ongoing review of both plant-specific and industry OE will continue through the PEO to ensure that this AMP continues to be effective in managing the identified aging effects.

15.3.2 Storage Pad Aging Management Program

15.3.2.1 Storage Pad AMP – Scope of Program

This program visually inspects the surfaces of the storage pad subcomponents listed in Table 15-2. The table also lists the material and environments for each subcomponent along with the aging mechanisms and aging effects to be managed. The following aging effects/mechanisms will be managed via this AMP:

- Steel
  - Loss of material due to general, pitting, and crevice corrosion
- Concrete
  - Loss of material due to freeze-thaw, aggressive chemical attack, corrosion of reinforcing steel, delayed ettringite formation [1], salt scaling, and microbiological degradation
  - Cracking due to freeze-thaw, reaction with aggregates, differential settlement, aggressive chemical attack, corrosion of reinforcing steel, and delayed ettringite formation [1]
  - Loss of strength due to reaction with aggregates, aggressive chemical attack, corrosion of reinforcing steel, leaching of calcium hydroxide, delayed ettringite formation [1], and microbiological degradation
  - Reduction of concrete pH due to aggressive chemical attack, leaching of calcium hydroxide, and microbiological degradation
  - Loss of concrete/steel bond due to corrosion of reinforcing steel
  - Increase in porosity and permeability due to leaching of calcium hydroxide and microbiological degradation

15.3.2.2 Storage Pad AMP – Preventive Actions

The program is a condition-monitoring program that does not include preventive actions.

15.3.2.3 Storage Pad AMP – Parameters Monitored or Inspected

The Storage Pad AMP consists of visual inspections to monitor for material degradation.

The following accessible areas of the storage pad will undergo direct visual inspection for the aging effects listed in Table 15-2:

- The aboveground exposed surface of the storage pad

[1] Delayed ettringite formation may be ruled out as a credible aging mechanism by the general licensee based on an ISFSI-specific evaluation.

The normally non-accessible areas of the storage pad include:

- External surfaces of the storage pad under the TN-32 casks

The inaccessible areas of the storage pad include:

- Below-grade surfaces of the storage pad
- Components embedded in concrete

15.3.2.4 Storage Pad AMP – Detection of Aging Effects

Direct visual inspections utilizing American Concrete Institute (ACI) report ACI-349.3R [15.6], Section 3.6.1 are to be conducted of the above-grade portions of the concrete storage pad, allowing for detection of aging effects from Table 15-2. The visual inspector(s) shall meet the qualification requirements of ACI-349.3R [15.6] Chapter 7.

For storage pad concrete, crack maps are developed. Dimensioning is documented in photographic records by inclusion of a tape measure/crack gauge, a comparator, or both.

Potential degradation of the below-grade portion of the concrete pad is managed by assessing the results of the inspections of the accessible surfaces and ensuring that it is in a nonaggressive environment via groundwater sampling at a minimum of three locations in the area of the ISFSI.

The baseline AMP visual inspection and groundwater sampling is to be conducted within two years prior to 20 years of the first loaded TN-32 being placed in storage, or no later than eighteen months after the effective date of the CoC renewal, whichever is later. Subsequent inspections and groundwater sampling are to be conducted every 5 years ± 1 year following the baseline inspection.

Note: Eighteen months allows one year for development of the infrastructure for AMP implementation plus six months to complete subsequent baseline inspections.

15.3.2.5 Storage Pad AMP – Monitoring and Trending

The inspections and monitoring activities in this AMP are performed periodically in order to identify areas of degradation. Conditions that do not meet the acceptance criteria are entered into the licensee’s corrective action program. Other conditions that are noted during the inspection and monitoring activities, such as non-conformances, failures, malfunctions, deficiencies, and deviations are addressed in accordance with the licensee’s practices and expectations. Visual inspections appropriately consider cumulative OE from previous inspections and assessments in order to monitor and trend the progression of aging effects over time. Data taken from these inspections and sampling is to be monitored by comparison to past site data taken as well as comparison to industry OE, including data gathered by the AMID as discussed in NEI 14-03 [15.5].

For storage pad concrete, crack maps are monitored and trended as a means of identifying progressive growth of defects that may indicate degradation due to specific aging effects, such as rebar corrosion. Crack maps and photographic records are compared with those from previous inspections to identify accelerated degradation of the concrete during the PEO.

15.3.2.6 Storage Pad AMP – Acceptance Criteria

Concrete acceptance criteria from ACI 349.3R [15.6] represent acceptable conditions for observed degradation that has been determined to be inactive. Note that the passive settlement or deflection criteria is not included because settlement would manifest itself as cracks which is already a separate criterion. These criteria are termed second-tier for structures possessing a concrete cover in excess of the minimum requirements of ACI 349. Inactive degradation can be determined by the quantitative comparison of current observed conditions with that of prior inspections. If there is a high potential for progressive degradation or propagation to occur at its present or an accelerated rate, the disposition should consider more frequent evaluations of the specific structure or initiation of repair planning.

The following findings from a visual inspection are considered acceptable:

- Absence of leaching and chemical attack, including microbiological chemical attack
- Absence of signs of corrosion in the steel reinforcement

- Drummy areas that cannot exceed the cover concrete thickness in depth
- Popouts and voids less than 50 mm (2 in.) in diameter or equivalent surface area
- Scaling less than 30 mm (1.125 in.) in depth
- Spalling less than 20 mm (0.75 in.) in depth and 200 mm (8 in.) in any dimension
- Absence of corrosion staining of undefined source on concrete surfaces
- Passive cracks less than 1 mm (0.04 in.) in maximum width
- Absence of visible signs of deterioration from alkali-aggregate reaction such as excessive out-of-plane expansion, delayed ettringite formation, or other cement/aggregate reaction

The acceptance criteria for the groundwater chemistry-sampling program are:

- pH $\geq$ 5.5
- Chlorides $\leq$ 500 ppm
- Sulfates $\leq$ 1500 ppm

If any of the above acceptance criteria are not met, further evaluation is required through the licensee’s corrective action program.

15.3.2.7 Storage Pad AMP – Corrective Actions

Site QA procedures, review and approval processes, and administrative controls are implemented according to the requirements of 10 CFR Part 50 Appendix B. The licensee's corrective action program ensures that conditions adverse to quality are promptly identified and corrected, including root cause determination and prevention of recurrence. Deficiencies are either corrected or are evaluated to be acceptable for continued service through engineering analysis, which provides reasonable assurance that the intended safety function is maintained consistent with current licensing basis conditions. Extent of condition investigation per the licensee's corrective action program may cause additional inspections through means of a different method, increased inspection frequency and/or expanded inspection sample size.

15.3.2.8 Storage Pad AMP – Confirmation Process

The confirmation process will be commensurate with the general licensee QA program approved under 10 CFR Part 50, Appendix B. The QA program ensures that the confirmation process includes provisions to verify that appropriate corrective actions have been completed and are effective. It also contains provisions to preclude repetition of significant conditions adverse to quality.

15.3.2.9 Storage Pad AMP – Administrative Controls

Administrative controls under the CoC holder or licensee's QA procedures and corrective action program provide a formal review and approval process. Administrative controls are implemented in accordance with the requirements of 10 CFR Part 50, Appendix B, and will continue for the PEO. Licensees and CoC holder use the 10 CFR Part 72 regulatory requirements to determine if a particular aging-related degradation condition or event identified via OE, research, monitoring, or inspection is reportable to the NRC. Individual events and conditions not rising to the level of NRC reportability based on the criteria in 10 CFR Part 72 are communicated to the CoC holder as outlined in NEI 14-03 [15.5].

15.3.2.10 Storage Pad AMP – Operating Experience

Appendix 3C documents the review of various sources of OE relevant to the TN-32 dry storage casks. This review included inspections of TN-32 and TN-40 casks that have been in service for several years. While the review identified several conditions that were aging-related, no incidents were identified where aging effects lead to the loss of intended safety functions of a TN-32 cask or storage pad. This OE review supports the conclusion that the effects of aging will be managed adequately so that the SSC's intended safety functions will be maintained during the PEO.

This AMP will be updated, as necessary, to incorporate new information on degradation due to aging effects identified from plant-specific inspection findings, related industry OE, and related industry research. Future plant-specific and industry aging management and aging-related OE are captured through the licensee's OE review process. The ongoing review of both plant-specific and industry OE will continue through the PEO to ensure that this AMP continues to be effective in managing the identified aging effects.

15.3.3 Earthen Berm Aging Management Program

15.3.3.1 Earthen Berm AMP – Scope of Program

This program visually inspects the exterior surfaces of an earthen berm if a general licensee credits a berm in meeting regulatory dose limits. Table 15-3 lists the material and environments for each subcomponent along with the aging mechanisms and aging effects to be managed. The following aging effects/mechanisms will be managed via this AMP:

- Soil
  - Loss of material due to wind erosion and surface flow
  - Loss of form due to surface flow, settlement, and frost action
  - Change in material properties due to desiccation.

15.3.3.2 Earthen Berm AMP – Preventive Actions

The program is a condition-monitoring program that does not include preventive actions.

15.3.3.3 Earthen Berm AMP – Parameters Monitored or Inspected

The Earthen Berm AMP consists of periodic visual inspections of the berm’s surface looking for signs of erosion, formation of gullies, settlement, or frost heaving.

The frequency of these inspections will ensure that the loss of material or change in the size/shape of the berm is detected prior to the loss of an intended safety function.

15.3.3.4 Earthen Berm AMP – Detection of Aging Effects

Direct visual inspections are to be conducted on all accessible surfaces of the earthen berm.

The baseline AMP visual inspection is to be conducted within two years prior to 20 years of the first loaded TN-32 cask being placed in storage, or no later than eighteen months after the effective date of the CoC renewal, whichever is later. Subsequent inspections are to be conducted every 5 ± 1 years following the baseline inspection.

Note: Eighteen months allows one year for development of the infrastructure for AMP implementation plus six months to complete subsequent baseline inspections.

15.3.3.5 Earthen Berm AMP – Monitoring and Trending

The inspections and monitoring activities in this AMP are performed periodically in order to identify areas of degradation. Conditions that do not meet the acceptance criteria are entered into the licensee’s corrective action program. Other conditions that are noted during the inspection and monitoring activities, such as non-conformances, failures, malfunctions, deficiencies, and deviations are addressed in accordance with the licensee’s practices and expectations. Visual inspections appropriately consider cumulative OE from previous inspections and assessments in order to monitor and trend the progression of aging effects over time. Data taken from these inspections is to be monitored by comparison to past site data taken as well as comparison to industry OE, including data gathered by the AMID as discussed in NEI 14-03 [15.5].

15.3.3.6 Earthen Berm AMP – Acceptance Criteria

The acceptance criteria for the earthen berm AMP is the absence of any of the following:

- Erosion
- Scours or gullies
- Settlement
- Frost heaving

If any of the above acceptance criteria are not met, further evaluation is required through the licensee's corrective action program.

15.3.3.7 Earthen Berm AMP – Corrective Actions

Site QA procedures, review and approval processes, and administrative controls are implemented according to the requirements of 10 CFR Part 50, Appendix B. The licensee's corrective action program ensures that conditions adverse to quality are promptly identified and corrected, including root cause determination and prevention of recurrence. Deficiencies are either corrected or are evaluated to be acceptable for continued service through engineering analysis, which provides reasonable assurance that the intended safety function is maintained consistent with current licensing basis conditions. Extent of condition investigation per the licensee's corrective action program may cause additional inspections through means of a different method, increased inspection frequency, and/or expanded inspection sample size.

15.3.3.8 Earthen Berm AMP – Confirmation Process

The confirmation process will be commensurate with the general licensee QA program approved under 10 CFR Part 50, Appendix B. The QA program ensures that the confirmation process includes provisions to verify that appropriate corrective actions have been completed and are effective. It also contains provisions to preclude repetition of significant conditions adverse to quality.

15.3.3.9 Earthen Berm AMP – Administrative Controls

Administrative controls under the CoC holder or licensee’s QA procedures and corrective action program provide a formal review and approval process. Administrative controls are implemented in accordance with the requirements of 10 CFR Part 50, Appendix B, and will continue for the PEO. Licensees and CoC holder use the 10 CFR Part 72 regulatory requirements to determine if a particular aging-related degradation condition or event identified via OE, research, monitoring, or inspection is reportable to the NRC. Individual events and conditions not rising to the level of NRC reportability based on the criteria in 10 CFR Part 72 are communicated to the CoC holder as outlined in NEI 14-03 [15.5].

15.3.3.10 Earthen Berm AMP – Operating Experience

Section 8.3.4 of Electric Power Research Institute (EPRI) Report 1015078 [15.3] summarizes an operational history review of generic communications related to earth structures and the aging-related effects. No correspondence was found that was directly related to aging of earthen structures. The lack of reports reflects the high reliability of earthen structures and the lack of significant aging-related degradation. This OE review supports the conclusion that the effects of aging will be managed adequately so that the SSC’s intended safety functions will be maintained during the PEO.

This AMP will be updated, as necessary, to incorporate new information on degradation due to aging effects identified from plant-specific inspection findings, related industry OE, and related industry research. Future plant-specific and industry aging management and aging-related OE are captured through the licensee’s OE review process. The ongoing review of both plant-specific and industry OE will continue through the PEO to ensure that this AMP continues to be effective in managing the identified aging effects.

15.4 Supplemental Information

15.4.1 References

[15.1] Letter E-58416 from Prakash Narayanan (TN Americas LLC) to Document Control Desk (NRC), Supplemental Response to Request for Additional Information for Renewal of the TN-32 Dry Storage Cask, Certificate of Compliance No. 1021 (Docket No. 72-1021, CAC No. 001028, EPID: L-2020-RNW-0009), dated March 17, 2021.

[15.2] U.S. Nuclear Regulatory Commission, NUREG-2214, "Managing Aging Process in Storage (MAPS) Report" Final Report, July 2019.

[15.3] Electric Power Research Institute, (EPRI) 1015078, "Plant Support Engineering: Aging Effects for Structures and Structural Components (Structural Tools)," December 2007.

[15.4] U.S. Nuclear Regulatory Commission, NUREG-1927, "Standard Review Plan for Renewal of Specific Licenses and Certificates of Compliance for Dry Storage of Spent Nuclear Fuel," Revision 1, June 2016 (Adams Accession Number ML16179A148).

[15.5] Nuclear Energy Institute, NEI 14-03, "Format, Content, and Implementation Guidance for Cask Storage Operations-Based Aging Management," Revision 2, December 2016.

[15.6] American Concrete Institute, ACI-349.3R, "Evaluation of Existing Nuclear Safety Related Concrete Structures," 2018.

Table 15-1
Subcomponents Within Scope of TN-32 AMP
(5 Pages)

Subcomponent Parts	UFSAR Drawing (Part #s)	Intended Safety Function(s) [(1)]	Material Group	Environment [(2)]	Credible Aging Mechanism	Aging Effect
Gamma Shield	1049-70-2 (1)	SH, TH, SR, RT	Steel	Air-Outdoor (E)	General Corrosion	Loss of Material
					Pitting and Crevice Corrosion	Loss of Material
Lid	1049-70-2 (2)	CO, SH, TH, SR	Steel	Air-outdoor(E)	General Corrosion	Loss of Material
					Pitting and Crevice Corrosion	Loss of Material
					Galvanic Corrosion	Loss of Material
Bottom	1049-70-2 (4)	SH, TH, SR, RT	Steel	Air-Outdoor (E)	General Corrosion	Loss of Material
					Pitting and Crevice Corrosion	Loss of Material
Trunnion	1049-70-2 (6)	SH, SR, RT	Steel	Air-Outdoor (E)	General Corrosion	Loss of Material
					Pitting and Crevice Corrosion	Loss of Material
Radial Neutron Shield	1049-70-2 (8)	SH, TH	Polymer	Fully Enclosed	Thermal Aging	Shrinkage/Cracking
					Radiation Embrittlement	Shrinkage/Cracking
Outer Shell	1049-70-2 (9)	SH, TH, SR	Steel	Air-Outdoor (E)	General Corrosion	Loss of Material
					Pitting and Crevice Corrosion	Loss of Material

Table 15-1
Subcomponents Within Scope of TN-32 AMP
(5 Pages)

Subcomponent Parts	UFSAR Drawing (Part #s)	Intended Safety Function(s) (1)	Material Group	Environment (2)	Credible Aging Mechanism	Aging Effect
Protective Cover	1049-70-2 (10)	SH, TH, SR	Steel	Air-Outdoor	General Corrosion	Loss of Material
					Pitting and Crevice Corrosion	Loss of Material
					Galvanic Corrosion	Loss of Material
Top Neutron Shield	1049-70-2 (11 & 11A)	SH, TH	Polymer	Fully Enclosed	Thermal Aging	Shrinkage/Cracking
					Radiation Embrittlement	Shrinkage/Cracking
			Steel	Air Outdoor (E)	General Corrosion	Loss of Material
					Pitting and Crevice Corrosion	Loss of Material
					Galvanic Corrosion	Loss of Material
Lid Bolt	1049-70-2 (13)	CO, SH, TH, SR	Steel	Air-Outdoor	General Corrosion	Loss of Material
					Pitting and Crevice Corrosion	Loss of Material
					Galvanic Corrosion	Loss of Material
					Stress Relaxation	Loss of Preload
Protective Cover Bolt	1049-70-2 (14)	SR	Stainless Steel	Air-Outdoor	Pitting and Crevice Corrosion	Loss of Material
					Galvanic Corrosion	Loss of Material

Chapter 15 is newly added as part of CoC 1021 Renewal.

Table 15-1
Subcomponents Within Scope of TN-32 AMP
(5 Pages)

<table>
<tr><th>Subcomponent Parts</th><th>UFSAR Drawing (Part #s)</th><th>Intended Safety Function(s) (1)</th><th>Material Group</th><th>Environment (2)</th><th>Credible Aging Mechanism</th><th>Aging Effect</th></tr>
<tr><td rowspan="3">Lid Seal</td><td rowspan="3">1049-70-2 (15)</td><td rowspan="3">CO</td><td rowspan="3">Aluminum</td><td rowspan="3">Air-Outdoor</td><td>General Corrosion</td><td>Loss of Material</td></tr>
<tr><td>Pitting and Crevice Corrosion</td><td>Loss of Material</td></tr>
<tr><td>Galvanic Corrosion</td><td>Loss of Material</td></tr>
<tr><td rowspan="3">Overpressure Port Cover Seal</td><td rowspan="3">1049-70-2 (18)</td><td rowspan="3">CO</td><td rowspan="3">Aluminum</td><td rowspan="3">Air-Outdoor</td><td>General Corrosion</td><td>Loss of Material</td></tr>
<tr><td>Pitting and Crevice Corrosion</td><td>Loss of Material</td></tr>
<tr><td>Galvanic Corrosion</td><td>Loss of Material</td></tr>
<tr><td rowspan="2">Top Neutron Shield Bolt</td><td rowspan="2">1049-70-2 (19 &19A)</td><td rowspan="2">SR</td><td rowspan="2">Stainless Steel</td><td rowspan="2">Air-Outdoor</td><td>Pitting and Crevice Corrosion</td><td>Loss of Material</td></tr>
<tr><td>Galvanic Corrosion</td><td>Loss of Material</td></tr>
<tr><td>Drain Port Cover</td><td>1049-70-2 (21)</td><td>CO, SH, TH, SR</td><td>Stainless Steel</td><td>Air-Outdoor (E)</td><td>Pitting and Crevice Corrosion</td><td>Loss of Material</td></tr>
<tr><td>Vent Port Cover</td><td>1049-70-2 (22)</td><td>CO, SH, TH, SR</td><td>Stainless Steel</td><td>Air-Outdoor (E)</td><td>Pitting and Crevice Corrosion</td><td>Loss of Material</td></tr>
<tr><td rowspan="3">Vent & Drain Port Cover Seal</td><td rowspan="3">1049-70-2 (23)</td><td rowspan="3">CO</td><td rowspan="3">Aluminum</td><td rowspan="3">Air-Outdoor (E)</td><td>General Corrosion</td><td>Loss of Material</td></tr>
<tr><td>Pitting and Crevice Corrosion</td><td>Loss of Material</td></tr>
<tr><td>Galvanic Corrosion</td><td>Loss of Material</td></tr>
</table>

Table 15-1
Subcomponents Within Scope of TN-32 AMP
(5 Pages)

Subcomponent Parts	UFSAR Drawing (Part #s)	Intended Safety Function(s) [(1)]	Material Group	Environment [(2)]	Credible Aging Mechanism	Aging Effect
Vent & Drain Port Cover Bolts (SOC HD Cap)	1049-70-2 (24)	CO, SR	Steel	Air-Outdoor	General Corrosion	Loss of Material
					Pitting and Crevice Corrosion	Loss of Material
					Galvanic Corrosion	Loss of Material
					Stress Relaxation	Loss of Preload
			Stainless Steel	Air-Outdoor	Pitting and Crevice Corrosion	Loss of Material
					Galvanic Corrosion	Loss of Material
Overpressure Port Cover Bolts (SOC HD Cap)	1049-70-2 (25)	CO, SR	Steel	Air-Outdoor	General Corrosion	Loss of Material
					Pitting and Crevice Corrosion	Loss of Material
					Galvanic Corrosion	Loss of Material
					Stress Relaxation	Loss of Preload
			Stainless Steel	Air-Outdoor	Pitting and Crevice Corrosion	Loss of Material
					Galvanic Corrosion	Loss of Material
Flange	1049-70-2 (31)	CO, SH, TH, SR	Steel	Air-Outdoor (E)	General Corrosion	Loss of Material
					Pitting and Crevice Corrosion	Loss of Material
					Galvanic Corrosion	Loss of Material
			Stainless Steel	Air-Outdoor (E)	Pitting and Crevice Corrosion	Loss of Material

Table 15-1
Subcomponents Within Scope of TN-32 AMP
(5 Pages)

Subcomponent Parts	UFSAR Drawing (Part #s)	Intended Safety Function(s) [1]	Material Group	Environment [2]	Credible Aging Mechanism	Aging Effect
Top Trunnion	1049-70-2 (32)	SH, SR, RT	Steel	Air-Outdoor (E)	General Corrosion	Loss of Material
					Pitting and Crevice Corrosion	Loss of Material
Helicoil Inserts[3]	N/A	CO, SR	Stainless Steel	Air-Outdoor	Pitting and Crevice Corrosion	Loss of Material
					Galvanic Corrosion	Loss of Material

(1) The intended safety functions are: Confinement (CO), Radiation Shielding (SH), Sub-Criticality Control (CR), Structural Integrity (SR), Heat Removal Capability (TH), Retrievability (RT).

(2) If the subcomponent has an internal and external surface exposed to different environments, (I) refers to an internal (or towards the interior of the TN-32) environment and (E) refers to an external (or towards the exterior of the TN-32) environment.

(3) Use of helicoil inserts have been (or may be) evaluated and approved for use to repair damaged threads for various bolt holes, e.g., lid bolts.

Table 15-2
Subcomponents Within Scope of Storage Pad AMP
(2 Pages)

Subcomponent Parts	Intended Safety Function(s) [(2)]	Material Group	Environment	Credible Aging Mechanism	Aging Effect
Storage Pad	TH	Steel	Embedded in Concrete	General Corrosion	Loss of Material
				Pitting and Crevice Corrosion	Loss of Material
				Microbiologically Influenced Corrosion	Loss of Material
		Concrete	Air-Outdoor	Freeze-Thaw	Cracking
					Loss of Material
				Reaction with Aggregates	Cracking
					Loss of Strength
				Aggressive Chemical Attack	Cracking
					Loss of Strength
					Loss of Material
					Reduction of Concrete pH
				Corrosion of Reinforcing Steel	Loss of Concrete/Steel Bond
					Loss of Material
					Cracking
					Loss of Strength
				Leaching of Calcium Hydroxide	Loss of Strength
					Increase in Porosity and Permeability
					Reduction of Concrete pH
				Delayed Ettringite Formation [(1)]	Loss of Material
					Loss of Strength
					Cracking
				Salt Scaling	Loss of Material

Table 15-2
Subcomponents Within Scope of Storage Pad AMP
(2 Pages)

Subcomponent Parts	**Intended Safety Function(s)** [2]	**Material Group**	**Environment**	**Credible Aging Mechanism**	**Aging Effect**
Storage Pad	TH	Concrete	Groundwater / Soil	Freeze-Thaw	Cracking
					Loss of Material
				Reaction with Aggregates	Cracking
					Loss of Strength
				Differential Settlement	Cracking
				Aggressive Chemical Attack	Cracking
					Loss of Strength
					Loss of Material
					Reduction of Concrete pH
				Corrosion of Reinforcing Steel	Loss of Concrete/Steel Bond
					Loss of Material
					Cracking
					Loss of Strength
				Leaching of Calcium Hydroxide	Loss of Strength
					Increase in Porosity and Permeability
					Reduction of Concrete pH
				Microbiological Degradation	Loss of Strength
					Loss of Material
					Increase in Porosity and Permeability
					Reduction of Concrete pH
				Delayed Ettringite Formation [1]	Loss of Material
					Loss of Strength
					Cracking
				Salt Scaling	Loss of Material

Notes to Table 15-2:

(1) Delayed ettringite formation may be ruled out as a credible aging mechanism by the general licensee based on an ISFSI-specific evaluation.

(2) The Intended Safety Functions are: Confinement (CO), Radiation Shielding (SH), Sub-Criticality Control (CR), Structural Integrity (SR), Heat Removal Capability (TH), Retrievability (RT).

Table 15-3
Subcomponents Within Scope of Earthen Berm AMP

Subcomponent Parts	Intended Safety Function(s) (2)	Material Group	Environment	Credible Aging Mechanism	Aging Effect
Earthen Berm	SH	Soil	Air-Outdoor	Wind Erosion	Loss of Material
				Surface Flow	Loss of Material
					Loss of Form
				Settlement	Loss of Form
				Frost Action	Loss of Form
				Desiccation	Change in Material Properties