February 2019

Revision 10

MAGNASTOR®

(Modular Advanced Generation Nuclear All-purpose STORage)

10 CFR 72.248 and 10 CFR 72.48(d)(2) Partial 24-Month Updates

NON-PROPRIETARY VERSION

Docket No. 72-1031

NAC INTERNATIONAL

Atlanta Corporate Headquarters: 3930 East Jones Bridge Road, Norcross, Georgia 30092 USA
Phone 770-447-1144, Fax 770-447-1797, www.nacintl.com

Enclosure 1

10 CFR 72.48 Determination Summary Report

for the

MAGNASTOR® FSAR, Revision 10

(Docket No 72-1031)

Period Covered: October 2017 thru January 2019

NAC International

72.48 Determination ID #NAC-17-MAG-026

Change Description

Revise Drawings 71160-656, revision 0P and 0NP and 71160-657 0P and 0NP

Source of Change: 72.48 Determination ID #NAC-17-MAG-026

Originating Documents: DCR(L)s 71160-656-0PA, 71160-656-0NPA, 71160-657-0PA, and 71160-657-0NPA

Originating Document: DCR(L) 71160-656-0PA

71160-656, Cask Body Weldment, Passive Transfer Cask, MAGNASTOR, Revision 1P

[redacted]

[redacted]

[redacted]

Originating Document: DCR(L) 71160-656-0NPA

71160-656, Cask Body Weldment, Passive Transfer Cask, MAGNASTOR, Revision 1NP

1. This Non-Proprietary license drawing was updated per DCR(L) 71160-656-0PA and added Items 37 through 47 as well as delta notes 14 through 17. Additionally, Items 9, 20, 29, 30 and 36 and delta note 9 were revised accordingly.

Originating Document: DCR(L) 71160-657-0PA

71160-657, Passive Transfer Cask Assembly, MAGNASTOR, Revision 1P

[redacted]

[redacted]

Originating Document: DCR(L) 71160-657-0NPA

71160-657, Passive Transfer Cask Assembly, MAGNASTOR, Revision 1NP

1. This Non-Proprietary license drawing was updated per DCR(L) 71160-657-0PA and added proprietary Items 34 through 48 as well as delta note 8 and note 9.

72.48 Determination ID #NAC-18-MAG-032

Change Description

FSAR Sections 4.9.1, 4.9.2, 4.9.3 and Section 9.1.1 were changed for clarification and internal consistency.

Chapter 4, page 4.9.1-1, 4.9.2-1 thru 4.9.2-4 and 4.9.3-2.
Chapter 9, page 9.1-4, 9.1-6, and 9.1-9 thru 9.1-11.

Source of Change: 72.48 Determination ID #NAC-18-MAG-032

Originating Document: DCR(L) 71160-FSAR-9F

[redacted]

72.48 Determination ID #NAC-19-MAG-002

Change Description

The list of License Drawings for the proprietary and non-proprietary versions of the FSAR are being revised for changes made via the 72.48 process.

Chapter 1, page 1.8-1

Source of Change: 72.48 Determination ID #NAC-19-MAG-002

Originating Document: DCR(L)s 71160-FSAR-9G

This DCR(L) also incorporates the list of License Drawings with the latest approved drawing revisions to the following license drawings.

1. 71160-656, Rev. 1P
2. 71160-656, Rev. 1NP
3. 71160-657, Rev. 1P
4. 71160-657, Rev. 1NP

72.48 Determination ID #NAC-19-MAG-003

Change Description

The FSAR is being revised to incorporate changes made via the DCR(L) process

Chapter 1, 4 and 9.

Source of Change: 72.48 Determination ID #NAC-19-MAG-003

Originating Document: DCR(L) 71160-FSAR-9H

The following DCR(L) is being incorporated: 71160-FSAR-9F.

<u>**Enclosure 2**</u>

List of Changes

for

MAGNASTOR® FSAR, Revision 10

(Docket No 72-1031)

NAC International

List of Changes for the MAGNASTOR® FSAR, Revision 10

Incorporates 72.48 changes for the period August 2017 thru January 2019

Chapter/Page/ Figure/Table	Source of Change	Description of Change
Note: The List of Effective Pages and the Chapter Table of Contents, List of Figures, and List of Tables have been revised accordingly to reflect the list of changes detailed below.		
Chapter 1		
Page 1.8-1	NAC-19-MAG-002 71160-FSAR-9G	Revised Drawings 71160-656 (P and NP) and 71160-657 (P and NP) to Section 1.8, "License Drawings."
Chapter 2		
No changes.		
Chapter 3		
No changes.		
Chapter 4		
Page 4.9.1-1	NAC-18-MAG-032 71160-FSAR-9F	Modified the fourth and fifth paragraphs on the page in Section 4.9.1.
Pages 4.9.2-1 thru 4.9.2-4	NAC-18-MAG-032 71160-FSAR-9F	Modified text throughout Section 4.9.2, where indicated.
Page 4.9.3-2	NAC-18-MAG-032 71160-FSAR-9F	Modified the fourth paragraph on the page in Section 4.9.3.
Chapter 5		
No changes.		
Chapter 6		
No changes.		
Chapter 7		
No changes.		
Chapter 8		
No changes.		

Chapter/Page/ Figure/Table	Source of Change:	Description of Change
Chapter 9		
Page 9.1-4	NAC-18-MAG-032 71160-FSAR-9F	Modified text in the middle of the "Caution" note in Item 20.
Page 9.1-5	NAC-18-MAG-032 71160-FSAR-9F	Text flow changes.
Page 9.1-6	NAC-18-MAG-032 71160-FSAR-9F	Modified the last "Note" if Item 29 where indicated.
Page 9.1-9	NAC-18-MAG-032 71160-FSAR-9F	Modified the second "Note" in Item 52 and the only "Note" in Item 55.
Pages 9.1-10 thru 9.1-11	NAC-18-MAG-032 71160-FSAR-9F	Modified the last "Note" of Item 58, where indicated.
Chapter 10		
No changes.		
Chapter 11		
No changes.		
Chapter 12		
Page 12.1-1	Editorial Correction	Page 12.1-1 was inadvertently replaced in FSAR Rev 9 with Page 12.1-6. The Correct page 12.1-1 should be Rev 5 August 2013. There are no new changes to this page.
Chapter 13		
No changes.		
Chapter 14		
No changes.		
Chapter 15		
No changes.		

Enclosure 3

List of Drawing Changes

for

MAGNASTOR® FSAR, Revision 10

(Docket No 72-1031)

NAC International

February 2019

<u>Drawing 71160-656, Cask Body Weldment, Passive Transfer Cask, MAGNASTOR, Revision 1P</u>

[redacted]

[redacted]

Drawing 71160-656, Cask Body Weldment, Passive Transfer Cask, MAGNASTOR, Revision 1NP

1. This Non-Proprietary license drawing was updated per DCR(L) 71160-656-0PA and added Items 37 through 47 as well as delta notes 14 through 17. Additionally, Items 9, 20, 29, 30 and 36 and delta note 9 were revised accordingly.

Drawing 71160-657, Passive Transfer Cask, Assembly, MAGNASTOR, Revision 1P

[redacted]

[redacted]

Drawing 71160-657, Passive Transfer Cask, Assembly, MAGNASTOR, Revision 1NP

1. This Non-Proprietary license drawing was updated per DCR(L) 71160-657-0PA and added proprietary Items 34 through 48 as well as delta note 8 and note 9.

Enclosure 4

Certification of Accuracy

of the

MAGNASTOR® FSAR, Revision 10

(Docket No 72-1031)

NAC International

NAC INTERNATIONAL

CERTIFICATION OF ACCURACY
PURSUANT TO 10 CFR 72. 248(c)(4)(i)

George Carver (Affiant), Vice President, Engineering and Licensing, of NAC International, hereinafter referred to as NAC, at 3930 East Jones Bridge Road, Norcross, Georgia 30092, being duly sworn, deposes and certifies that:

1. Affiant has reviewed the information described in Item 2, is personally familiar with the preparation, checking and verification of that information and is authorized to certify its accuracy.

2. The information being certified as accurate includes all of the changes incorporated into the MAGNASTOR Final Safety Analysis Report, Revision 10.

STATE OF GEORGIA, COUNTY OF GWINNETT

Mr. George Carver, being duly sworn, deposes and says:

That he has read the foregoing affidavit and the matters stated therein are true and correct to the best of his knowledge, information and belief.

Executed at Norcross, Georgia, this 31st day of January, 2019.

George Carver
Vice President, Engineering and Licensing
NAC International

Subscribed and sworn before me this 31st day of January, 2019.

Deborah R Chapman
Notary Public

DEBORAH R CHAPMAN
My Commission Expires
NOTARY PUBLIC
02-27-2021
GWINNETT COUNTY, GEORGIA

<u>Enclosure 5</u>

FSAR Changed Pages and LOEP

Docket No. 72-1031

MAGNASTOR® FSAR, Revision 10

NAC International

February 2019

Revision 10

MAGNASTOR®

(Modular Advanced Generation Nuclear All-purpose STORage)

FINAL SAFETY ANALYSIS REPORT

NON-PROPRIETARY VERSION

Docket No. 72-1031

NAC INTERNATIONAL

Atlanta Corporate Headquarters: 3930 East Jones Bridge Road, Norcross, Georgia 30092 USA
Phone 770-447-1144, Fax 770-447-1797, www.nacintl.com

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1.8 License Drawings

This section presents the list of License Drawings for MAGNASTOR.

Drawing Number	Title	Revision No.
71160-551	Fuel Tube Assembly, MAGNASTOR – 37 PWR	10NP*
71160-556	Assembly, MAGNASTOR Transfer Cask (MTC), Stainless Steel	4
71160-560	Assembly, Standard Transfer Cask, MAGNASTOR	2
71160-561	Structure, Weldment, Concrete Cask, MAGNASTOR	9
71160-562	Reinforcing Bar and Concrete Placement, Concrete Cask, MAGNASTOR	9
71160-571	Details, Neutron Absorber, Retainer, MAGNASTOR – 37 PWR	8
71160-572	Details, Neutron Absorber, Retainer, MAGNASTOR – 87 BWR	8NP*
71160-574	Basket Support Weldments, MAGNASTOR – 37 PWR	6
71160-575	Basket Assembly, MAGNASTOR – 37 PWR	11NP*
71160-581	Shell Weldment, TSC, MAGNASTOR	5
71160-584	Details, TSC, MAGNASTOR	9
71160-585	TSC Assembly, MAGNASTOR	12
71160-590	Loaded Concrete Cask, MAGNASTOR	8
71160-591	Fuel Tube Assembly, MAGNASTOR – 87 BWR	8NP*
71160-598	Basket Support Weldments, MAGNASTOR – 87 BWR	7NP*
71160-599	Basket Assembly, MAGNASTOR – 87 BWR	8NP*
71160-600	Basket Assembly, MAGNASTOR – 82 BWR	5NP*
71160-601	Damaged Fuel Can (DFC), Assembly, MAGNASTOR	0
71160-602	Damaged Fuel Can (DFC), Details, MAGNASTOR	1
71160-656	Cask Body Weldment, Passive Transfer Cask, MAGNASTOR	1NP*
71160-657	Passive Transfer Cask, Assembly, MAGNASTOR	1NP*
71160-671	Details, Neutron Absorber, Retainer, For DF Corner Weldment, MAGNASTOR – 37 PWR	0
71160-673	Damaged Fuel Can (DFC), Spacer, MAGNASTOR	0
71160-674	DF Corner Weldment, MAGNASTOR	3NP*
71160-675	DF Basket Assembly, 37 Assembly PWR, MAGNASTOR	3NP*
71160-681	DF, Shell Weldment, TSC, MAGNASTOR	1
71160-684	Details, DF Closure Lid, MAGNASTOR	2
71160-685	DF, TSC Assembly, MAGNASTOR	6

* Proprietary drawing replaced by nonproprietary version.

R-236725

REV	CHANGE
0NP	INTIAL ISSUE
1NP	INC DCR 0NPA

PROPRIETARY INFORMATION REMOVED

NOTES:

1. ALL WELDING PROCEDURES AND QUALIFICATIONS TO BE IN ACCORDANCE WITH AWS D1.1 OR ASME SECTION IX.
2. VISUALLY INSPECT (VT) ALL WELDS. AFTER LOAD TESTING LIQUID PENETRANT INSPECT (PT) ALL ACCESSIBLE LOAD BEARING WELDS WITH ACCEPTANCE CRITERIA PER NF-5350.
3. BACKING BAR MATERIAL SHALL BE COMPATIBLE WITH THE BASE METAL.
4. TYPICAL FOR LONGITUDINAL AND CIRCUMFERENTIAL WELDS, NUMBER AND LOCATION OPTIONAL. SEAM WELDS SHALL BE OFFSET.
5. CUT ONE ROW OF BRICKS IN HALF. PLACE A ROW OF FLAT BOTTOM BRICKS IN THE CAVITY FIRST AND A ROW OF BRICKS WITH FLAT TOPS LAST.
6. STEEL STAMP/ENGRAVE APPROXIMATELY AS SHOWN AND FILL WITH BLACK WEATHER RESISTANT PAINT.
7. SUBSTITUTION OF ASTM A336 IS ACCEPTABLE.
8. SUBSTITUTION OF 304 ST. STL. ASTM A240 IS ACCEPTABLE.
9. (1)
10. THREADED HOLES AT USER'S OPTION.
11. FIRST AND FINAL BRICK (ITEM 8) PER ROW MUST BE TRIMMED TO FIT WITH AN OVERLAP PATTERN IN THE CIRCUMFERENTIAL DIRECTION TO ENSURE NO GAPS BETWEEN BRICKS.
12. AS A FABRICATION OPTION, LEAD POUR MAY BE USED IN LIEU OF GAMMA SHIELD BRICKS (ITEM 8).
13. STEEL STAMP/ENGRAVE TEXT "FILL-TO" APPROXIMATELY AS SHOWN AND FILL WITH BLACK WEATHER RESISTANT PAINT.
14. (1)
15. (1)
16. (1)
17. (1)

97 ASSY	98 ASSY	99 ASSY	ITEM	NAME	MATERIAL	SPEC	DRAWING No.	DESCRIPTION
			47					
			46					
			45					
			44					
			43					
			42					
			41					
			40					
			39					
			38					
			37					
		4	36	THREAD INSERT	ST.STL.	COML		
		18	35	THREAD INSERT	ST.STL.	COML		
		8	34	THREAD INSERT	ST.STL.	COML		
1			33	BAFFLE BASE, SHORT	304 ST. STL.	ASTM A240/A276		PLATE/BAR
1			32	BAFFLE RIB, SHORT	304 ST. STL.	ASTM A240		PLATE
		10	31	BAFFLE, SHORT			71160-656-97	
		2	30	FILL-TO PORT	304 ST. STL.	ASTM A240/A276		PLATE/BAR
		2	29	EXPANSION TANK DRAIN PORT	304 ST. STL.	ASTM A240/A276		PLATE/BAR
		4	28	EXPANSION TANK SIDE PLATE	304 ST. STL.	ASTM A240		PLATE
		2	27	EXPANSION TANK BOTTOM PLATE	304 ST. STL.	ASTM A240		PLATE
		2	26	EXPANSION TANK TOP PLATE	304 ST. STL.	ASTM A240		PLATE
		4	25	EXPANSION TANK SHELL SECTOR-B	304 ST. STL.	ASTM A240		PLATE
		2	24	EXPANSION TANK SHELL SECTOR-A	304 ST. STL.	ASTM A240		PLATE
		2	23	TANK MANIFOLD TUBE	304 ST. STL.	ASTM A269		TUBE
		2	22	TANK MANIFOLD	304 ST. STL.	ASTM A240/A276		PLATE/BAR
		1	21	MAIN TANK DRAIN PORT	304 ST. STL.	ASTM A240/A276		PLATE/BAR
		1	20	MANIFOLD BOSS BASE	304 ST. STL.	ASTM A240		PLATE
		1	19	MANIFOLD PLATE	304 ST. STL.	ASTM A240		PLATE
		1	18	MANIFOLD RING	304 ST. STL.	ASTM A240		PLATE
	1		17	BAFFLE RIB, LONG	304 ST. STL.	ASTM A240		PLATE
	1		16	BAFFLE BASE, LONG	304 ST. STL.	ASTM A240/A276		PLATE/BAR
		12	15	BAFFLE, LONG			71160-656-98	
		4	14	VENT-B SHIELD, SIDE-B	304 ST. STL.	ASTM A240		PLATE
			13	(BLANK)				
		4	12	VENT-B SHIELD, FRONT	304 ST. STL.	ASTM A240		PLATE
		8	11	VENT-A SHIELD, SIDE	304 ST. STL.	ASTM A240		PLATE
		4	10	VENT-A SHIELD, FRONT	304 ST. STL.	ASTM A240		PLATE
		8	9	STANDOFF	304 ST. STL.	ASTM A276/A240		BAR/PLATE
		A/R	8	GAMMA SHIELD BRICK	LEAD	ASTM B29		CHEMICAL COPPER GRADE
		2	7	TRUNNION	F304 ST. STL.	ASTM A182		FORGING
		2	6	DOOR RAIL	F304 ST. STL.	ASTM A182		FORGING
		6	5	OUTER SHELL SECTOR	304 ST. STL.	ASTM A240		PLATE
		1	4	INTERMEDIATE SHELL	304 ST. STL.	ASTM A240		PLATE
		1	3	INNER SHELL	304 ST. STL.	ASTM A240		PLATE
		1	2	TOP FORGING	F304 ST. STL.	ASTM A182		FORGING
		1	1	BOTTOM FORGING	F304 ST. STL.	ASTM A182		FORGING

QUANTITY

NAC INTERNATIONAL

UNLESS OTHERWISE STATED
DIMENSIONING AND TOLERANCING SHALL BE PER ASME Y14.5M-94.
ALL THREAD DEPTH CALLOUTS ARE TO BE CONSIDERED AS A MIN. DEPTH OF PERFECT TREADS
ALL DIMENSIONS ARE IN INCHES
MACHINED SURFACES SHALL BE ∇/OR BETTER
NEXT ASSEMBLY: 71160-657
DRAWING TYPE: LICENSE

GROUP	NAME	DATE
PREPARER	[signature]	2-2-18
CHECKER	[signature]	2-2-18
PROJECT MANAGER	[signature]	2-2-18
ENGINEERING	[signature]	2-2-18
LICENSING	[signature]	2/2/18
QUALITY	[signature]	2/2/18

CASK BODY WELDMENT, PASSIVE TRANSFER CASK, MAGNASTOR

PROJECT 71160 | DRAWING 656 | REV 1NP
SCALE N.T.S. | WEIGHT N/A | SH 1 OF 1 | 12/20/2017

R-236721

REV	CHANGE
0NP	INITIAL ISSUE
1NP	INC DCR 0NPA

PROPRIETARY INFORMATION REMOVED

96 ASSY	97 ASSY	98 ASSY	99 ASSY	ITEM	NAME	MATERIAL	SPEC	DRAWING No.	DESCRIPTION
				48					
				47					
				46					
				45					
				44					
				43					
				42					
				41					
				40					
				39					
				38					
				37					
				36					
				35					
				34					
			A/R	33	SHIELD FLUID	SEE NOTE 6	COML		
			7	32	1 1/16 PLUG	ST. STL.	COML		SAE PLUG
			4	31	7/16 PLUG	ST. STL.	COML		SAE PLUG
			3	30	SHIELD/SEAL INSERT BOLT	ST. STL.	ASTM A193 Gr.B6		HHCS 1 1/2-6 UNC
			18	29	RETAINING RING BOLT	ST. STL.	ASTM A193 Gr.B6		HHCS 1 1/2-6 UNC
			8	28	TRUNNION BOLT	ST. STL.	COML		HHCS 1/2-13 UNC
				27	(DELETED)				
			4	26	DOOR LOCK TAB, CASK	304 ST. STL.	ASTM A240/A276		PLATE/BAR
			1	25	NAME PLATE	ST. STL.	COML		11 - 16 GAUGE SHEET
			A/R	24	THREADED PLUG	304 ST. STL.	ASTM A276		BAR
			4	23	LOCK PIN	ST. STL.	COML		SEE NOTE 5
			2	22	TRUNNION BUSHING	17-4 PH ST. STL.	SEE NOTE 9		ROUND BAR/FORGING
			2	21	TRUNNION CAP	304 ST. STL.	ASTM A240/A276		PLATE/BAR
				20					
			1	19	RETAINING RING	304 ST. STL.	ASTM A240		PLATE
1				18	SEAL MASTER, OUTER	EPDM	COML		
1				17	SEAL MASTER, INNER	EPDM	COML		
				16	NIPPLE	ST. STL.	COML		QUICK DISCONNECT NIPPLE
1				15	SHIELD/SEAL INSERT RING	304/F304 ST. STL.	ASTM A240/A182		PLATE/FORGING
3				14	SHIELD/SEAL INSERT TAB	304 ST. STL.	ASTM A240		PLATE
			1	13	SHIELD/SEAL INSERT ASSEMBLY			71160-657-96	
	1			12	DOOR PLATE-B	F304 ST. STL.	ASTM A182		FORGING
			1	11	DOOR-B			71160-657-97	
	3	3		10	THREADED INSERT	ST. STL.	COML		
	2	2		9	VENT SHIELD-C	304 ST. STL.	ASTM A240/A276		PLATE/BAR
	2	2		8	VENT SHIELD-B	304 ST. STL.	ASTM A240		PLATE
	2	2		7	VENT SHIELD-A	304 ST. STL.	ASTM A240		PLATE
	2	2		6	DOOR LOCK TAB, DOOR	304 ST. STL.	ASTM A240/A276		PLATE/BAR
	2	2		5	STANDOFF	304 ST. STL.	ASTM A240/A276		PLATE/BAR
	1	1		4	CONNECTOR	304 ST. STL.	ASTM A240		PLATE
		1		3	DOOR PLATE-A	F304 ST. STL.	ASTM A182		FORGING
			1	2	DOOR-A			71160-657-98	
			1	1	CASK BODY WELDMENT			71160-656-99	

QUANTITY

NOTES:

1. ALL WELDING PROCEDURES AND QUALIFICATIONS TO BE IN ACCORDANCE WITH AWS D1.1 OR ASME SECTION IX.
2. VISUALLY INSPECT (VT) ALL WELDS. AFTER LOAD TESTING LIQUID PENETRANT INSPECT (PT) ALL ACCESSIBLE LOAD BEARING WELDS WITH ACCEPTANCE CRITERIA PER NF-5350.
3. STENCIL/ENGRAVE APPROXIMATELY AS SHOWN. WHERE "XXXXX-XXX" IS NAC SERIAL NUMBER, "NN" REPRESENTS A UNIQUE NUMBER FOR EACH CASK MANUFACTURED AND "YYY,YYY" IS ACTUAL WEIGHT OF THE CASK. FILL WITH BLACK WEATHER RESISTANT PAINT.
4. ITEM 24 (THREADED PLUG) AT USER'S OPTION.
5. SUBSTITUTION OF 304 ST. STL. ASTM A240 IS ACCEPTABLE.
6. SHIELD FLUID (ITEM 33) TO BE DEMINERALIZED WATER.
7. SHIELD TANK TO BE FILLED WITH SHIELD FLUID (ITEM 33) UNTIL FLUID FLOWS FROM THE FILL-TO PORT LOCATION. INSTALL PORT PLUGS (ITEMS 31 AND 32) TO COMPLETE FILL.
8.
9. ASTM A564, TYPE 630 OR ASTM A182, TYPE 630.

UNLESS OTHERWISE STATED	GROUP	NAME	DATE
DIMENSIONING AND TOLERANCING SHALL BE PER ASME Y14.5M-94.	PREPARER	[signature]	2-2-18
ALL THREAD DEPTH CALLOUTS ARE TO BE CONSIDERED AS A MIN. DEPTH OF PERFECT TREADS	CHECKER	[signature]	2-2-18
	PROJECT MANAGER	[signature]	2-2-18
ALL DIMENSIONS ARE IN INCHES	ENGINEERING	[signature]	2-2-18
MACHINED SURFACES SHALL BE ▽ OR BETTER	LICENSING	[signature]	2/2/18
NEXT ASSEMBLY: N/A			
DRAWING TYPE: LICENSE	QUALITY	[signature]	2/2/18

NAC INTERNATIONAL

PASSIVE TRANSFER CASK ASSEMBLY, MAGNASTOR

PROJECT 71160 | DRAWING 657 | REV 1NP

SCALE N. T. S. | WEIGHT N/A | SH 1 OF 1 | 12/28/2017

4.9.1 Water Phase Contingency Events for PWR Fuel

Water phase contingency events are applicable after closure lid installation through initiation of draining operations. This includes operations such as TSC removal from the spent fuel pool, TSC lid closure welding, and TSC hydrostatic testing. Time and temperature limitations are based on full heat load PWR decay heat (maximum of 35.5 kW) and are bounding of lower decay heat loads.

The following water phase contingency events have been analyzed:

[redacted]

4.9.2 Draining, Vacuum Drying and Helium Backfill Phase Contingency Events for PWR Fuel

Draining, vacuum drying and helium backfill/cooling phase contingency events are applicable from the start of TSC cavity water draining operations through completion of the final helium backfill and completion of Minimum Helium Backfill Time in accordance with Technical Specification LCO 3.1.1. Normal operations include continuous ACWS or equivalent cooling, throughout the draining, vacuum drying, and helium backfill phases to maintain TSC temperatures below normal allowable/operational limits. Cooling is confirmed during ACWS by monitoring the transfer cask (MTC) annulus outlet temperature and ensuring it is ≤ 113°F. For reverse ACWS flow, the inlet temperature and flow rate are monitored to ensure they meet the following approved operational limits for PWR heat loads ≤ 35.5 kW:

[redacted]

[redacted]

[redacted]

[redacted]

4.9.3 TSC Transfer Phase Contingencies for PWR Fuel

The TSC Transfer Phase contingency events are applicable during the period from the termination of ACWS cooling following completion of the required Minimum Helium Backfill Time (i.e. cooling time) per LCO 3.1.1 through completion of TSC transfer from the MTC into the VCC. The allowable TSC Transfer Times are as specified in Technical Specification LCO 3.1.1, as applicable to the decay heat load and Minimum Helium Backfill Time (i.e. cooling time) utilized.

[redacted]

[redacted]

6. Fill the TSC with clean or pool water. For PWR spent fuel contents, the soluble boron concentration in the TSC shall be verified and monitored in accordance with the LCO 3.2.1.
7. Attach the lift yoke to a crane suitable for handling the loaded TSC, MTC and yoke. Position the lift yoke over the transfer cask and engage it with the two transfer cask trunnions.

   Note: The temperature of the transfer cask (surrounding ambient air temperature) must be verified to be at or above the minimum operating temperature of 0°F, per Section 4.3.1.f. of the Technical Specifications (not applicable to the stainless steel MTC2 design).
8. Lift the MTC containing the empty TSC and move it to the spent fuel pool following the prescribed load path.

   Note: An optional protective cover, attached to the bottom of the MTC, may be used to prevent imbedding contaminated particles in the shield doors and door rails.
9. Connect the clean water lines to the lower annulus fill ports of the MTC. Ensure that the unused ports are closed or capped to prevent pool water in-leakage.
10. Lower the MTC to the pool surface and turn on the clean water supply lines to the lower annulus fill ports to fill the MTC/TSC annulus.

    Note: Sequence on connection and filling/draining MTC/TSC annulus is at the discretion of the user based on approved site-specific procedures.
11. Spray the transfer cask and lift yoke with clean water to wet the exposed surfaces.

    Note: Wetting the components that enter the spent fuel pool and spraying the components leaving the pool will reduce the effort required to decontaminate the components.
12. Lower the MTC as the annulus fills with clean water until the upper annulus fill ports are accessible. Hold this position and connect the clean water annulus fill lines to the upper fill ports. Ensure the unused ports are closed or capped to prevent pool water in-leakage.
13. Lower the transfer cask to the bottom of the pool in the cask loading area.
14. Disengage the lift yoke and visually verify that the lift yoke is fully disengaged. Remove the lift yoke from the spent fuel pool while spraying the yoke and crane cables with clean water.
15. Load the previously selected fuel assemblies into the TSC basket.

    Note: The fuel assemblies shall be selected in compliance with the requirements of the approved contents specified in Appendix B of the Technical Specifications and the boron concentration limits of the Technical Specifications, including limitations on fuel assembly positions within the basket. Specific fuel assembly positions for preferential and zoned loading patterns shall be in full compliance with the requirements of Appendix B of the Technical Specifications. Assembly selection, placement and compliance with preferential zone loading patterns within the basket shall be independently verified.

Note: Up to four DFCs containing authorized PWR contents may be loaded in a TSC with a DF Basket Assembly. A DFC spacer is required to be positioned in the Designated DF Basket Assembly corner locations for the shorter length DFCs. Independently, visually verify proper placement and correct orientation of each required DFC spacer.

Note: At the option of the user, install fuel assembly spacers for the axial positioning of the PWR fuel assembly types to be loaded. Verify spacer identification and install fuel spacers in each intended fuel loading location based on the fuel spacer plan prepared, which is based on the fuel assembly inventory and nonfuel hardware to be loaded. Independently, visually verify proper placement and correct orientation of each required fuel spacer.

16. Visually verify the fuel assembly (and DFC, as applicable) identifications to confirm the serial numbers match the approved fuel-loading pattern.
17. Install three swivel hoist rings hand tight in the three closure lid lifting holes or in three of the six TSC lift holes, and torque to the value specified in Table 9.1-2. Install a three-legged sling set to the hoist rings and connect the sling set to the crane hook or the attachment point on the lift yoke.

    Note: At the discretion of the user, the closure lid can be attached to the lift yoke and the lid installed during the lowering of the lift yoke.
18. Raise the closure lid. Adjust closure lid rigging to level the closure lid.
19. Move the closure lid over the spent fuel pool and align the lift yoke (if used) to the MTC trunnions and align the closure lid to the match marks of the TSC.
20. Lower the closure lid until it enters the TSC and seats in the top of the TSC. Visually verify closure lid alignment using the match marks (± ½ inch).

    Caution: Following closure lid installation of the PWR TSC, there is a thermal time limit of 19 hours to begin the Annulus Circulating Water System (ACWS), R-ACWS or approved alternative annulus flow system operation, and to begin temperature measurement of the MTC annulus outlet flow to verify MTC outlet temperature is maintained < 113°F. However, if the circulating water cooling system is not utilized, or becomes nonoperational, measure the cavity water temperature every 2 hours. If TSC preparation operations through draining are not completed prior to the cavity water temperature reaching 180°F (5 hr. corrective action time limit) or 200°F (2 hr. corrective action time limit), a cooling water flow will be established through the cavity to lower the water temperature, or the TSC shall be returned to the spent fuel pool for in-pool cooling within 5 hours for 180°F or 2 hours for 200°F. TSC in-pool cooling (seals deflated) will be continued until the ACWS operation is restored or initiated. Note that, for TSC assembly with a 2-inch diameter open vent port and a 1-inch or 2-inch diameter open drain port and the TSC lid has not been subjected to any

welding, the TSC cooling in the spent fuel pool is achieved by water flow through the lid periphery and the ports. Water flow in the annulus is not required.

Note: R-ACWS requires monitoring of inlet cooling water flow rates and maximum inlet water temperature, per Chapter 4, instead of monitoring outlet temperature.

21. Allow sling cables to go slack and move the lift yoke into position to engage the MTC trunnions. Engage the lift yoke to the trunnions, apply a slight tension, and visually verify engagement.
22. Raise the MTC until its top clears the pool surface. Visually verify that the closure lid is properly seated. If necessary, lower the transfer cask and reinstall the closure lid. Rinse the lift yoke and MTC with clean water as the equipment is removed from the pool.
23. Rinse and flush the top of the MTC and TSC with clean water as necessary to remove any radioactive particles. Survey the top of the TSC closure lid and the top of the MTC to check for radioactive particles.
24. As the MTC is removed from the spent fuel pool, terminate the annulus fill water supply, remove the annulus fill system hoses, and allow annulus water to drain into the spent fuel pool.
25. Following the prescribed load path, move the MTC to the designated workstation for TSC closure operations.

    Note: At the option of the user, the TSC closure operations may be performed with the MTC partially submerged in the spent fuel pool, cask loading pit, or an equivalent structure. This operational alternative provides additional shielding for the cask operators.
26. Disengage the three-legged sling set from the closure lid and the lift yoke from the MTC trunnions. Place lift yoke and sling set in storage/lay-down area.
27. Inflate the MTC lower annulus seal with air or nitrogen. Disconnect the gas supply from the transfer cask.

    Note: The installation, use, and operational sequence of the lower annulus seal is at the discretion of the user based on approved site-specific procedures. At the option of the user, the gas supply can be maintained continuously to the annulus seals.
28. Install the ACWS, R-ACWS or alternative annulus flush/cooling system, to the lower and upper annulus fill lines. Unused fill lines are to be closed or capped.

    Note: For TSCs prepared with the MTC partially submerged on an in-pool shelf, partially drained cask loading pit or equivalent partial submerged condition, or in an ACWS catch basin, alternative ACWS operations (e.g., reverse flow ACWS [R-ACWS]) may be utilized to maintain TSC and fuel clad temperatures within normal operational limits.

Note: ACWS or R-ACWS operation allows the vacuum drying and TSC transfer times in LCO 3.1.1 to be utilized.

29. Initiate clean water flow into the MTC lower fill lines with annulus water discharging through the upper fill lines. Ensure water flow is maintained to keep the outlet water temperature ≤ 113°F.

    Note: Analysis of alternative reverse flow R-ACWS operations for PWR fuel are detailed in Chapter 4, demonstrating that the fuel clad and TSC temperatures are bounded by standard ACWS cooling operations for the following reverse flow limits for PWR heat loads ≤ 35.5 kW:

    - A maximum inlet water temperature of ≤ 100°F, which requires a minimum inlet flow rate of ≥ 60 GPM
    - A minimum inlet flow rate of ≥ 40 GPM, which limits the maximum inlet water temperature of ≤ 70°F

    Additionally, for PWR heat loads ≤ 25 kW the following alternate operational limits are approved for reverse ACWS:

    - A maximum inlet water temperature of ≤ 100°F, which requires a minimum inlet flow rate of ≥ 40 GPM

    Note: With the R-ACWS, or site-approved alternative ACWS, operating, there is no time limit through initiation of the draining of the PWR TSC. However, if the ACWS, R-ACWS, or site-approved alternative ACWS not utilized, or becomes nonoperational, measure the cavity water temperature measurements shall start within 19 hours of installation of the closure lid and repeated every 2 hours. If PWR TSC preparation operations through draining are not completed prior to the cavity water temperature reaching 180°F (5 hr. corrective action time limit) or 200°F (2 hr. corrective action time limit), ACWS or R-ACWS cooling shall be re-established, or a cooling water flow will be established through the cavity to lower the water temperature or the TSC shall be returned to the spent fuel pool within 5 hours for 180°F or 2 hours for 200°F. TSC in-pool cooling will be continued until the ACWS operation is restored or initiated. Note that, for TSC assembly with a 2-inch diameter open vent port and a 1-inch or 2-inch diameter open drain port quick disconnect valved nipples (QDVNs) and the TSC lid has not been subjected to any welding, the TSC cooling in the spent fuel pool is achieved by water flow through the lid periphery and the ports. Water flow in the annulus is not required.

30. Detorque and remove the lifting hoist rings from the closure lid.
31. Using a portable suction pump, remove any standing water from the closure lid weld groove, and the vent and drain ports.

51. Weld the closure ring to the TSC shell and to the closure lid. Perform visual and PT examinations of the final surfaces of the welds and record the results.

    Note: At the option of the user and in order to facilitate the Maximum Transfer Time of Technical Specification LCO 3.1.1 the installation, welding, and NDE of the closure ring may be performed immediately after helium backfill (Step 61) or after completion of the welding, testing, and NDE of the vent and drain inner or outer port covers (Step 63 or 66).

52. Remove the water from the TSC using one of the following methods: drain down using a suction pump with a pressurized helium cover gas; or blow down using pressurized helium gas. Ensure the totalizer in the drain line is reset to zero prior to the start of draining.

    Note: Fuel rods shall not be exposed to air during canister draining operations. Record the start time of TSC draining operations. The maximum drying times of LCO 3.1.1 are based on the total time from start of the draining through completion of helium backfilling of the TSC cavity.

    Note: Vacuum drying and TSC transfer times of LCO 3.1.1, Tables 1.A and 1.B are based on the cavity water temperature of ≤ 130°F prior to draining. If ACWS cooling was not provided during welding and hydrostatic testing operations, measure TSC cavity water to confirm temperature is ≤ 130°F.

53. Connect a drain line with or without suction pump to the drain port connector.
54. Connect a regulated helium gas supply to the vent port connector.
55. Open gas supply valve and start suction pump, if used, and drain water from the TSC until water ceases to flow out of the drain line. Close gas supply valve and stop suction pump.

    Note: A total cumulative allowable time of 4.5 hours is available for loss of ACWS contingency events for PWR TSCs with decay heat loads of ≤ 25 kW and utilizing LCO 3.1.1, Items 1.A and 1.B, with an administrative time limit of 32 hours for Vacuum Drying Time, from the start of draining through completion of the minimum helium backfill/cooling time. Similarly, a total cumulative allowable time of 4.5 hours is available for loss of ACWS contingency events for PWR TSCs with decay heat load of ≤ 30 kW and utilizing LCO 3.1.1, Item 1.B with an LCO 3.1.1 limit of 32 hours for Vacuum Drying Time. Loss of ACWS time shall be monitored to ensure that the 4.5 hours is not exceeded. Licensees shall take appropriate corrective actions to ensure that contingency cooling is available (either in-pool cooling or backup ACWS or equivalent site-approved cooling system) and/or implemented to ensure that the total cumulative loss of ACWS time of 4.5 hours is not exceeded. For any loss of ACWS event during draining, vacuum drying or helium backfill cooling evolutions, the TSC shell is required to be cooled by using the Supplemental Annulus Cooling System (SACS) or equivalent site-approved system until steaming stops prior to re-initiating normal ACWS operations.

56. Record the time at the completion of the draining of the TSC. Record the volume of water drained from the TSC (V_{TSC}) as measured by the totalizer. At the option of the user, disconnect suction pump, close discharge line isolation valve, and open helium gas supply line. Pressurize TSC to approximately 25 psig and open discharge line isolation valve to blow down the TSC. Repeat blow down operations until no significant water flows out of the drain line. Note that time used for system draining and blow down is considered part of the vacuum drying time.
57. Disconnect the drain line and gas supply line from the drain and vent port quick-disconnects.
58. Dry the TSC cavity using vacuum drying methods as follows.

    Note: Ensure heat load dependent vacuum drying time limits are not exceeded so that fuel cladding temperatures are maintained below 752°F. Vacuum drying cycle time limits in LCO 3.1.1 are based on utilizing the ACWS, reverse flow ACWS or equivalent annulus cooling/flush system.

    a. Connect the vacuum drying system to the vent and drain port openings.
    b. Operate the vacuum pump until a vapor pressure of ≤ 10 torr is achieved in the TSC. The time durations of the first vacuum drying cycle shall be in accordance with the time limits of LCO 3.1.1.

       Isolate the vacuum pump from the TSC and turn off the vacuum pump. Observe the vacuum gauge connected to the TSC for an increase in pressure for a minimum period of 10 minutes. If the TSC pressure is ≤ 10 torr at the end of 10 minutes, the TSC is dry of free water in accordance with LCO 3.1.1.

    Note: [redacted] cooling period, subsequent drying cycle operations can continue for the times indicated in LCO 3.1.1, Table 2. Drying cycles and cooling periods may be continued until the TSC cavity passes the dryness verification per LCO 3.1.1. For fuel burnup greater than 45 GWd/MTU, the total number of cooling cycles is limited to ten, with cladding temperature variations more than 65 °C (117°F).

    Note: A total cumulative allowable time of 4 hours is available for loss of ACWS contingency events for PWR TSCs with decay heat loads of ≤ 30 kW from the start of helium evacuation through completion of the minimum helium backfill/cooling time for the second and subsequent vacuum drying cycles performed in accordance with LCO 3.1.1, Item 2. Loss of ACWS time shall be monitored to ensure that the 4 hour limit is not exceeded.

Licensees shall take appropriate corrective actions to ensure that contingency cooling is available (either in-pool cooling or backup ACWS or equivalent site-approved cooling system) and/or implemented to ensure that the total loss of ACWS time limit of 4 hours is not exceeded.

59. Upon satisfactory completion of the dryness verification, evacuate the TSC cavity to a pressure of ≤ 3 torr. Isolate and turn off the vacuum pump, and backfill and pressurize the TSC cavity with 99.995% (minimum) pure helium as follows:
    a. Determine the free volume of the TSC (V_{TSC}) per Step 56.
    b. Multiply the V_{TSC} free volume by the helium loading value per unit volume (L_{helium}) to determine required helium mass (M_{helium}) to be backfilled into the cavity.
    c. Set the helium bottle regulator to 90 (+5,-0) psig.
    d. Connect the helium backfill system to the vent port and reset the mass-flow meter to zero.
    e. Slowly open the helium supply valve and backfill the TSC with the required helium mass (M_{helium}) in accordance with LCO 3.1.1.
60. Disconnect the vacuum drying helium backfill system from the vent and drain openings. Note the time the helium backfill is completed.
61. Note: At the option of the user, Steps 50 and 51 can alternatively be performed at this point or immediately following Steps 63 or 67. The user to establish appropriate radiological controls to maintain operator dose ALARA. Install and weld the inner port cover on the drain port opening.
62. Install and weld the inner port cover on the vent port opening.
63. Perform visual and PT examinations of the final surface of the port cover welds and record the results.
64. Perform helium leak test on each of the inner port cover welds to verify the absence of helium leakage past the inner port cover welds.
65. Install and weld the outer port cover on the drain port opening. Perform visual and PT examinations of the final weld surface and record the results.
66. Install and weld the outer port cover on the vent port opening. Perform visual and PT examinations of the final weld surface and record the results.
67. Using an appropriate crane, remove the weld machine and supplemental shield.
68. The ACWS, R-ACWS or equivalent annulus cooling/flush system will be utilized throughout the TSC closing operations until the helium backfill time is satisfied (see LCO 3.1.1). Drain the TSC/MTC annulus by stopping ACWS flow to the annulus and connecting one or more drain lines to the lower annulus fill ports. Once the annulus is drained, deflate the top and bottom annulus seals. Note the time the MTC/TSC annulus cooling flow is terminated.

69. Remove the temporary plugs or ensure that a minimum of four annulus fill lines are open in the base of the transfer cask.

    Note: The time duration of the sequence of operations from stopping the MTC/TSC annulus cooling, or completing the helium backfill if the ACWS or R-ACWS is not used, through completion of TSC transfer into the concrete cask shall not exceed the transfer time limits in LCO 3.1.1. If the TSC transfer to the concrete cask cannot be completed in the defined time period, the transfer operation will be suspended and the TSC shall be cooled by the Supplemental Annulus Cooling System (SACS) or equivalent system until steaming stops and followed by continued cooling for a period of 30 hours using SACS and ACWS, R-ACWS or site-approved alternative cooling system prior to restarting TSC transfer operations. The second, and subsequent, minimum helium backfill time and maximum TSC transfer time shall be limited to the heat load specific cooling and specific transfer times in the maximum TSC transfer Tables 1.B and 1.D of LCO 3.1.1.

70. If using MTC1 or MTC2 with retaining blocks, remove the lock pins and move the MTC retaining blocks inward into their functional position, and reinstall the lock pins. If using MTC2 with retaining ring, install the transfer cask retaining ring and torque the retaining ring bolts to the value specified in Table 9.1-2.

71. Install the six swivel hoist rings into the six threaded holes in the closure lid if TSC transfer is to be performed by two sets of redundant slings. Torque the hoist rings to the manufacturer's recommended value.

    Note: Utilize high temperature-resistant slings (≤ 350°F).

    Note: Alternative site-specific TSC lifting systems and equipment may be used for lowering and lifting the TSC in the MTC. The lifting system design must comply with the user's heavy load program and the applicable requirements of ANSI N14.6, NUREG-0612, and/or ASME/ANSI B30.9, as appropriate.

72. Complete final decontamination of the MTC exterior surfaces. Final TSC contamination surveys may be performed after TSC transfer following Step 21 in Section 9.1.2 when TSC surfaces are more accessible.

73. Proceed to Section 9.1.2.

9.1.2 Transferring the TSC to the Concrete Cask Using a Standard MTC

This section describes the sequence of operations required to complete the transfer of a loaded TSC from the MTC into a concrete cask, and preparation of the concrete cask for movement to the ISFSI pad.

12.1 Off-Normal Events

This section evaluates postulated off-normal events that might occur once during any calendar year of operations. The actual occurrence of any of these events is, therefore, infrequent.

12.1.1 Severe Ambient Temperature Events (106°F and -40°F)

This section provides the results of the evaluation of MAGNASTOR for the steady-state effects of severe ambient temperature events (106°F and -40°F).

12.1.1.1 Cause of Severe Ambient Temperature Event

Large geographical areas of the United States are subjected to sustained summer temperatures in the 90°F to 100°F range and winter temperatures that are significantly below zero. To bound the expected steady-state temperatures of the TSC and storage cask during severe ambient temperature events, analyses are performed to calculate the steady-state concrete cask, TSC, fuel basket, and fuel cladding temperatures for a 106°F ambient temperature and solar loads. Similarly, winter weather analyses are performed for a -40°F ambient temperature with no solar load. Neither ambient temperature event is expected to last longer than several days.

12.1.1.2 Detection of Severe Ambient Temperature Event

Detection of off-normal ambient temperatures would occur during measurement of ambient temperature.

12.1.1.3 Analysis of Severe Ambient Temperature Event

The analysis for the off-normal temperature events is presented in Chapter 4. Two-dimensional axisymmetric models are used to determine the temperatures of the concrete, the TSC, fuel basket, and fuel cladding. Steady-state conditions are considered in all analyses. Based on the analysis, the calculated principal component temperatures for each of the ambient temperature conditions and the allowable temperatures are summarized in Section 4.5.1. The calculated component temperatures are less than the allowable temperatures.

Table Deleted via 10 CFR 72.48

As shown in Section 4.4.1 and Section 4.4.3, the thermal analysis temperature results for the standard PWR basket bound the temperature results for the damaged fuel basket for normal operating conditions due to the higher thermal conductivity of the damaged fuel basket. For the same reasons, the temperature results for the severe ambient temperature events are also bounded.

The thermal stress evaluations for the concrete cask for these off-normal events are bounded by those for the accident event of "Maximum Anticipated Heat Load (133°F Ambient Temperature)" as presented in Section 12.2.7. Thermal stress analyses for the TSC and the basket components are performed using ANSYS finite element models as described in Section 3.6. A bounding thermal gradient is applied to the TSC and fuel baskets to bound the severe ambient temperature conditions. Factors of safety for off-normal events are presented in Section 3.6.

12.1.1.4 Corrective Actions

No corrective actions are required for these off-normal events.

12.1.1.5 Radiological Impact

There is no radiological impact due to these off-normal events.

12.1.2 Blockage of One-Half of the Air Inlets

This section provides the results of the evaluation of MAGNASTOR for the steady-state effects of a blockage of one-half of the air inlets at the normal ambient temperature (76°F).

12.1.2.1 Cause of Blockage of One-Half of the Air Inlets Event

Although unlikely, blockage of one-half of the air inlets may occur due to blowing debris, snow, intrusion of a burrowing animal, etc. The screens over the inlets are expected to minimize any blockage of the inlet channels and expedite recovery by restricting the blockage to the exterior of the concrete cask.

12.1.2.2 Detection of One-Half of the Air Inlets Blockage Event

The blockage of one-half of the air inlet screens would be detected visually by persons performing a daily surveillance of the ISFSI or observing an increase in the concrete cask outlet temperature if measured, which would result from the reduced airflow caused by the blockage. The air inlet screens blockage event may also be detected by security forces, or other operations personnel, engaged in other routine activities such as fence inspection or grounds maintenance.