Enclosure 6 to E-54257

SAR Changed Pages
(Public Version)

2.2 Nearby Industrial, Transportation and Military Facilities

The only industrial facilities located within *five* mile of the WCS CISF boundary are URENCO USA, Permian Basin Materials*, the Lea County landfill, a future travel stop* and Sundance Services, Inc. (Figure 2-3). URENCO USA is a uranium enrichment facility that uses centrifuge technology to provide uranium enrichment services. Waste Control Specialists operates several permitted and licensed facilities immediately south of the WCS CISF, including a RCRA landfill, a low-level radioactive waste facility and a byproduct materials landfill. *The WCS Facilities include several fuel (diesel, gasoline, and propane) tanks used for fueling heavy equipment and facility operations. Tanks range in size from 350 gallons to 8,000 gallons.*

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Permian Basin Materials operates a quarry and crushing operation, wherein caliche, sand and gravel are mined, crushed and screened for commercial sales and used in making concrete (Permian, 2016[2-29]). Sundance Services, Inc. provides oilfield waste disposal services. Sundance Services is authorized by the New Mexico Energy, Minerals and Natural Resources Department to operate the waste oil treating plant, and also manages produced water, solids and drilling muds. Sundance Services is also authorized to landfarm solids (Sundance, 2016[2-30]).

The Lea County (New Mexico) Municipal Landfill is located to the southwest and across New Mexico Highway 234 from WCS CISF. This landfill disposes of municipal solid waste for the Lea County Solid Waste Authority under New Mexico Environmental Department Permit Number SW-98-08(P). The landfill services Lea County and its municipalities. The Lea County Municipal Landfill does not generate or receive hazardous waste (Lea, 2016[2-16]).

Construction has started on a travel stop operated by Love's Travel Stops & Country Stores located at the intersection of New Mexico State Highway 18 and Hwy 176. This facility, which will provide fuel for highway vehicles, is located more than 3.5 miles from the WCS CISF.

DD Landfarm, a non-hazardous oilfield waste disposal facility that closed in August 2013 and is undergoing decommissioning and post-closure monitoring, is located approximately 4 km (2.5 miles) west of the proposed WCS CISF.

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There are no military facilities within a mile of the WCS CISF. The closest military facility is Cannon Air Force Base is the closest at a distance of approximately 135 miles.

The Texas & New Mexico Railway (TXN) is a railway consisting of 111 miles of track that generally run north-south between the Union Pacific lines in Monahans, Texas and its termination in Lovington, New Mexico. The railway is 4.8 miles from the WCS CISF at its closest point. The TXN railway is evaluated for potential explosions in Chapter 12 using guidance from Regulatory Guide 1.91, Evaluations of Explosions Postulated to Occur at Nearby Facilities and on Transportation Routes near Nuclear Power Plants, Revision 2. The evaluation considers the case of one rail car carrying an explosive cargo as well as a unit train of ten rail cars carrying explosive cargo. The existing Waste Control Specialists railroad *spur and loop exits the Texas & New Mexico Railway near Eunice, New Mexico as shown in Figure 2-3. This spur continues east until it reaches the existing Waste Control Specialists facility where it forms a loop around the facility. The rail side track to the WCS CISF will begin by connecting to the northwest side of the existing loop and terminate by re-connecting at the north side of the loop. The spur and rail loop are owned and controlled by ISP partner WCS. No potentially explosive cargo will be allowed on these railways.*

Texas State Highway 176 is a two-lane highway with 3.6 m (12 foot) wide driving lanes, 2.4 m (8 foot) wide shoulders and a 61m (200 foot) wide right-of-way easement on each side. Access to the site is directly off of Texas State Highway 176. *Texas State Highway 176 is approximately 1.5 miles from the WCS CISF. New Mexico Highway 18 is a four-lane highway approximately 3.5 miles from the WCS CISF. Texas State Highway 176 is evaluated for potential explosions in Chapter 12 using guidance from Regulatory Guide 1.91, Evaluations of Explosions Postulated to Occur at Nearby Facilities and on Transportation Routes near Nuclear Power Plants, Revision 2.*

A natural gas pipeline owned by Energy Transfer LP runs parallel to Texas State Highway 176 within an easement on Waste Control Specialists property. The pipeline is approximately 7,700 feet from the WCS CISF at its closest point. Directly adjacent to and parallel to the Energy Transfer LP natural gas pipeline is an additional buried 14 inch diameter pipeline which is in idle status. The pipeline is also owned by Energy Transfer LP and it has been idle for over 15 years. Finally, a 10-inch diameter buried CO_2 pipeline runs along the western and northern boundary of New Mexico Section 32. This pipeline is over 8,000 feet from the WCS CISF at its closes point.

All Indicated Changes are in response to RAI NP-2.2-2

In addition to industrial and transportation facilities, gas and oilfield operations are common in west Texas. Regionally, the WCS CISF is located in the Permian Basin of west Texas and southeast New Mexico, which is one of the most important petroleum-producing regions in the United States, containing several thousand oil and gas wells [2-56]. Significant petroleum storage, however, is not located within 5 miles of the WCS CISF. Locally within the Waste Control Specialists property boundaries, oil and gas activity also is very limited. There is no active oilfield activity within the WCS CISF footprint area and only one documented dry hole in the immediate area of the WCS CISF (Figure 2-36). That dry hole has been cemented to the surface and proper plugging and abandonment protocol was observed. There is no evidence of any undocumented or "orphan" wells in the vicinity of the WCS CISF. If any open boreholes indicative of orphan wells are discovered during the construction process, these will be properly assessed and remediated using proper plugging and abandonment procedures in accordance with Texas Regulations. ISP joint venture member Waste Control Specialists also holds 100% of the Operating Rights for producing oil, gas, and other minerals for the area of land where the storage pads for Phase I and the future phases of the WCS CISF would be located. These rights allow ISP joint venture member Waste Control Specialists to prevent any drilling (horizontal or vertical) under storage pads for oil, gas, and other minerals. Based on Figure 2-36, 10 out of 12 locations (83%) are dry or no longer producing, which indicates there is little economically viable oil and gas resources within 1 mile of the WCS CISF and chances of petroleum recovery activities in this area are unlikely. As explained in SAR Section 2.6.2 and in the Probabilistic Seismic Hazard Analysis in Attachment D to SAR Chapter 2, it was determined there is a relatively low seismic hazard at the Waste Control Specialists site even with petroleum recovery activities.

SAR Chapter 12 Section 12.2 provides evaluations of the potential hazards these facilities present to the WCS CISF.

2.2.1 Aircraft Hazard Evaluation

ISP performed an aircraft hazards evaluation for the WCS CISF to demonstrate adequate assurance that the risks from aircraft hazards are sufficiently low. NRC regulations pertaining to siting evaluation, 10 CFR 72.90, require that proposed spent fuel storage installations be examined with respect to the frequency and severity of external natural and man-induced events that could affect the safe operation of the facility. The NRC accepts that spent fuel storage installations do not need to be designed to withstand aircraft crashes if there is less than one-in-one-million ($1x10^{-6}$) annual probability of occurrence [2-42].

For the WCS CISF aircraft hazard evaluation, relevant guidance from Standard Review Plan NUREG 0800 (Section 3.5.1.6-Aircraft Hazards) [2-43] was followed. Although NUREG 0800 is intended for light-water reactor designs, the approach for estimating aircraft hazard is considered to be relevant guidance for the WCS CISF.

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This evaluation considers nearby airports, federal airways, holding and approach patterns, military airports, training routes, and training areas. Recorded flight data, taken from a 10 nautical mile (12 mile) radius of the WCS CISF, over a recent two-year period (2017-2018) was reviewed and used to obtain federal airway flight frequencies. Airport and airway locations were determined using flight map information available from the FAA [2-44]. All of the twelve airports within 50 miles of the WCS CISF in the three counties (Andrews County TX, Gaines County TX and Lea County NM) in Texas and New Mexico were identified. There is no military base or airport within 50 miles of the WCS CISF. Federal airway and military training route locations were determined using the FAA Instrument Flight Rules (IFR) Enroute Aeronautical Charts [2-45]. Finally, for this evaluation, the protected area boundary was conservatively increased from 36 acres (0.06 square miles) for phase 1 of this project to envelope the eventual 130 acres (0.21 square miles) of the protected area, effectively covering the additional 98 acres that will be added for the anticipated seven additional phases of the project.

NUREG 0800 Section 3.5.1.6 provides proximity screening criteria for evaluating whether the probability of aircraft crash is less than an order of magnitude to 10E-7 per year. However, as the WCS CISF site has two Federal airways that pass near enough to the site (V68 and Q20), the conservative NUREG 0800 screening criteria are not satisfied. In this case, NUREG 0800 states that a detailed review of aircraft hazards be performed. The review seeks a description of aviation uses in the airspace near the proposed site, including airports and approach paths, Federal airways, restricted airways, and military uses.

NUREG 0800 Section 3.5.1.6 also provides acceptable methods for calculating the probability per year of an aircraft crashing into the plant. The evaluation considers in-flight crash rate per mile, width of airway, number of flights per year along the airway, and effective area of the site. Similarly, the evaluation considers civilian and military airport locations. The details of the evaluation are described in the sections below.

2.2.1.1 Site Description

The WCS CISF has a protected area boundary of 36 acres (0.06 square miles) which contains the Security and Administration Building, the Cask Handling Building and the Storage Area where the cask shipments arrive, and the canisters are off loaded and placed into storage. As indicated above, for this evaluation, the protected area boundary was increased to 130 acres (0.21 square miles), effectively covering the future seven phases of the project. Therefore, this evaluation is conservative as the actual protected area boundary is only 28% of the effective plant area assumed in this evaluation. The concrete storage casks, which contain canisterized SNF, are positioned on concrete pads located within the protected area boundary. The robust designs of the dry cask storage systems that will be within the protected area boundary provide additional defense-in-depth against radiological release, as these systems are passive (air-cooled) and designed to provide physical protection and radiation shielding.

All Indicated Changes are in response to RAI NP-2.2-1

2.2.1.2 Nearby Federal Airways

NUREG 0800 Section 3.5.1.6 seeks a description of the aviation uses in the airspace near the site. Resources made available from the FAA were used to identify Federal airways within a 10 nautical mile (12 mile) radius of the site. Commercial aircraft flight plans are limited to the Federal Airways that make up the enroute airspace structure of the National Airspace System (NAS). The enroute airspace structure of the NAS consists of three strata. The first stratum low altitude airways in the United States can be navigated using Navigational Aids (NAVAIDs), have names that start with the letter V, and are called Victor Airways. They cover altitudes from approximately 1,200 feet above ground level (AGL) up to, but not including 18,000 feet above mean sea level (MSL). The second stratum high altitude airways in the United States all have names that start with the letter J and are called Jet Routes. These routes run from 18,000 ft to 45,000 ft. The third stratum allows random operations above flight level (FL) 450, i.e. 45,000 ft.

There are also area navigation (RNAV) routes, which provide users with an ability to fly direct routes between any two points. In conjunction with the high-altitude routing (HAR) program, area navigation (RNAV) routes have been established to provide for a systematic flow of air traffic in specific portions of the enroute flight environment. The designator for these RNAV routes begins with the letter Q. Low altitude RNAV only routes are identified by the letter "T" prefix, followed by a three-digit number (T-200 to T-500).

The search within a 10 nautical mile radius identified that there are multiple federal airways near the WCS CISF: V68, Q20, and J66 [2-45]. The low-altitude airway is V68 and the two high-altitude airways are Q20 and J66. These airways are described in more detail as follows:

Low Altitude Airways (Figure 2-38 and Figure 2-39) [2-45]

- *V68 is a low-altitude east-west route (113° out of Lea County Regional Airport N32°38.29' W103.16.16' toward Midland Airpark Airport N32°00.56' W102°11.42'). Its centerline passes approximately 4 miles from the plant site and has a width of 9.21 miles (8 nautical miles).*

High Altitude Airways (Figure 2-40) [2-45]

- *Q20 is a high-altitude northwest-southeast RNAV route (121° out of HONDS, NM N33°34"00', W104°51"12' toward FUSCO, TX N31°10"37' W101°19"45'). Its centerline passes approximately 4 miles from the plant site and has a width of 9.2 miles (8 nautical miles).*
- *J66 is a high-altitude east-west Jet route (254° out of Big Spring, TX N32°23.14' W101°29.02' toward Newman, TX N31°57.10' W106°16.34'). Its centerline passes approximately 12 miles from the plant site and has a width of 9.2 miles (8 nautical miles).*

All Indicated Changes are in response to RAI NP-2.2-1

2.2.1.3 Flight Path Movements

Flight movement data for commercial and general aviation flights was provided by FlightAware, LLC. The spatial extent of data was a 10 nautical mile radius from the site location and covered a two-year time period (from January 1, 2017 to December 3, 2018). The data included information pertaining to aircraft location (latitude/longitude), direction of travel, origin, destination, aircraft type, time, and ground speed.

Table 2-14 provides a summary of flight movements and indicates that there were [ ] flight movements in 2017 and 2018, respectively. Note that the data for December 2018 was incomplete so the flight movements of each airway were proportionally extrapolated based on the available data from December 1st to 3rd. Since the flight movements in the first eleven months of 2018 increased by 6.36% compared with those in 2017, the overall flight movements in December 2018 were judged to have the same increase over December 2017 (i.e., 6.36%). Flight movements were segregated into high altitude (>18,000 ft) and low altitude (<18,000 ft) flights. There were a small number of flights with no altitude information provided. These flights are designated as 'other' in Table 2-14.

2.2.1.4 Military Training Routes

Military aircraft would fly within designated Military Training Routes (MTRs), which may or may not be flown under air traffic control. Airspace above the United States from the surface to 10,000 feet above sea level is limited to 250 knots (indicated airspeed) by FAA regulations. There is a military exception to this requirement, the Military Training Route Program, a joint venture by the FAA and the Department of Defense (DOD), developed for use by military aircraft to gain and maintain proficiency in tactical "low-level" flying. These low-level training routes are generally established below 10,000 feet for speeds in excess of 250 knots.

The review of IFR enroute Aeronautical Charts from FAA identified that there is a MTR in the vicinity of the WCS CISF: IR-128 and its reciprocal IR-180 (referred to as IR-128/180) [2-45]. This airway is described as follows:

Military Training Routes (Figure 2-38 and Figure 2-39)

- IR 128/180 is a low-altitude east-west military training route. IR-180 is a clockwise route while IR-128 is the reciprocal counter clockwise route. One of its segments crosses the New Mexico/Texas state border. The centerline of this segment passes approximately 15 miles from the plant site and has a width of 8.1 miles (7 nautical miles, 4 nautical miles on plant side and 3 on the other).

There are other MTRs, IR-178 and IR-192/194, which are further away and not considered in this review. Additional information for IR 128/180, including their distances from the site, is included in Table 2-15.

Military operations were not included in the summary of flight path movements in Table 2-14. The WCS CISF is near the border of two Air Route Traffic Control Centers (ARTCC), ZAB (Albuquerque, NM) and ZFW (Ft. Worth, TX) [2-46]. The total number of flights handled by ZFW and ZAB is provided in Table 2-16. There are approximately 6.36% military operations. It is judged that the ratio of flight classes passing through the WCS CISF site within a 10 nautical mile diameter circle is the same as flight classes handled by ZFW and ZAB. Therefore, the military operations passing through the WCS CISF site 10 nautical mile diameter circle is calculated as 5142 for the year 2018.

2.2.1.5 Airports

In addition to airways, NUREG 0800 Section 3.5.1.6 seeks a description of airports in the vicinity of the site. There are twelve (12) local and regional airports close by the WCS CISF, which are located in Andrews County TX, Gaines County TX, and Lea County NM. These airports are within a 50 nautical mile (57.5 mile) radius of the CIS Facility site. Of these airports, only the Lea County Regional (HOB) airport has a Federal Aviation Administration (FAA) funded air traffic control tower [2-48].

A summary of the airplane operations at airports near the WCS CISF are provided in Table 2-17. Airport operation numbers have been gathered from 2 sources, first is the Air Traffic Activity Data System (ATADS), which contains the official NAS air traffic operations data available for public release [2-44]. The other is GRC Inc.'s AirportIQ 5010 [2-48], which is a compilation of FAA form 5010-5 Airport Master Records and Reports. ATADS gives data as far back as 1990, where AirportIQ gives only the past year's data. Additionally, ATADS only gives data for Airports that have an FAA certified Air traffic control tower, so data for some of the smaller airports has only been sourced from AirportIQ.

Table 2-17 indicates that the closest airport to the site is Lea County Regional Airport (HOB), which is located 4 miles west of Hobbs, NM [2-44] and approximately 18.7 miles northwest from the plant site of the WCS CISF. The Lea County Regional Airport is classified as a small aircraft airport, which primarily serves single engine general aircraft. Recent regional airport statistics (2017) indicate that HOB has approximately 35 flight operations per day [2-48].

As the closest airport to the WCS CISF is approximately 18.7 miles away, it is judged that accidental aircraft crashes, due to airport landing and take-off operations, are low risk. Further, it is noted that NUREG 0800 Section 3.5.1.6 indicates that the probability of general aviation aircraft crash is extremely-low for distances further than 5 miles from end-of-the-runway locations. This observation provides confidence that the risk of airport crash is low, especially for an airport (HOB) that is 18.7 miles from the WCS CISF.

All Indicated Changes are in response to RAI NP-2.2-1

2.2.1.6 Risk Assessment

NUREG 0800 Section 3.5.1.6 provides the approach for estimating the probability per year of an aircraft crashing into the WCSF.

$$P_{FA} = C \; x \; N \; x \; \frac{A}{w}$$

Where
P_{FA}= probability per year of an aircraft crashing into the plant
C= in-flight crash rate per mile for aircraft using airway
N= number of flights per year along the airway
A= effective area of the plant in square miles
w= width of airway (plus twice the distance from the airway edge to the site when the site is outside the airway) in miles

The commercial aircraft in-flight crash rate (per mile airway), 'C', is recommended to be 4.0E-10 in NUREG 0800. This crash rate was estimated based on a conservative assumption that a non-catastrophic failure will occur somewhere in the U.S. once per year. NUREG 0800 Section 3.5.1.6 states that if the number of flights on a specific corridor exceed 100 per day, then more detailed analysis may be required. It is noted that the busiest airway near the WSP CISF is high-altitude federal airway J66, which has a minimum distance of 7.6 miles from the WSP CISF. Airway J66 has approximately 157 flights per day. Further, as this airway is a high-altitude (>18,000 ft) east-west corridor, it is judged that most flights on this airway are commercial.

The technical basis supporting the NUREG 0800 crash rate value of 4.0E-10 was reviewed to ensure that this value was appropriate for the J66 airway. The NUREG 0800 estimate was based on a review of crash rate data for all U.S. air operations between 1965 and 1975 [2-46]. During this time period, the linear average of the aircraft miles flown per year is 2.396E9. Based on the conservative assumption of one non-catastrophic failure per year [2-46], the NUREG 0800 aircraft crash rate was derived as the reciprocal of 2.396E9, or approximately 4E-10.

Flight safety in the U.S. has improved considerably in the last 20 years. During this time period, the FAA reports that commercial aviation fatalities in the U.S. have decreased by 95 percent [2-49]. This improvement in safety is primarily due to technological advances in navigation, FAA regulatory/inspection enhancements, and improvements in the sharing of safety and reliability data.

In addition, the total number of flights in the U.S. has increased considerably. World Bank data indicates that the number of passengers carried on U.S. flights in 2015 is more than 5 times the number in 1970 [2-50]. Based on the significant improvements in flight safety and considerable increase in number of flights in the 20 years (or more), it is judged that the NUREG 0800 value for in-flight crash rate (per mile) of 4E-10 can be conservatively assumed for the J66 airway.

As a conservative assumption, the military flights were assumed to be 6.37% of the total flights within the 10 nm radius of the plant. However, it noted that these flights are more likely to be located on the military training routes IR-128/180, which are located at least 10.6 miles away from the WCS CISF (Figure 2-38 and Figure 2-39. In the unlikely event that a military aircraft, loaded with ordnance, crashed on these flight paths, the distance from the plant is such that damage from exploded ordnance would be negligible. On this basis, it is judged that military flights with ordnance are not a risk-significant consideration.

The results of the evaluation are shown in Table 2-18. Based on site-specific flight information and nearby airway locations, the annual probability of aircraft crash at the WCS CISF is approximately 3.81E-7. This is lower than the one-in-one-million (1x10-6) annual probability of occurrence required by the NRC [2-42].

To provide an additional conservative value of the aircraft impact crash probability, the hypothetical scenario of all airways passing directly over the site was considered. Table 2-19 provides results of the evaluation. The annual probability of aircraft crash at the WCS CISF is approximately 7.38E-7, which is also lower than the one-in-one-million ($1x10^{-6}$) annual probability of occurrence required by the NRC [2-42].

The evaluation results, based on site-specific flight information and nearby airport locations, indicate that the annual probability of aircraft crash at the WCS CISF is approximately 3.81E-7. Using a conservative approach (i.e., all flights pass over the site), the annual probability of occurrence is computed to be less than 7.38E-7. Both probabilities are below the NRC annual probability of occurrence threshold of 1.0E-6 for aircraft crash. An additional conservatism in both approaches is the assumption that the effective area is equivalent to the full size of the protected area (130 acres) versus the actual area size for Phase 1 (36 acres). On this basis, it is judged that aircraft crash presents low risk to public health and safety and is therefore not necessary to be included as a design basis consideration.

All Indicated Changes are in response to RAI NP-2.2-1

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Tentative Changes for Future RAI Responses

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RAI P-2.2-2

Proprietary Information on This Page
Withheld Pursuant to 10 CFR 2.390

Table 2-15
Nearby Federal Airway and Military Training Route NUREG 0800 Screening

Airway or Pattern	Type	Travel Direction	Distance to Centerline	Width left of center [mi]	Width right of center [mi]	Site side	Distance to nearest edge [mi]
V68	Federal	Either	3.4	4.6	4.6	N/A	Over Site
Q20	Federal	Either	3.7	4.6	4.6	N/A	Over Site
J66	Federal	Either	12.2	4.6	4.6	N/A	7.6
IR-128/ IR-180	MTR	W to E	15.2	4.6	3.5	Left	10.6
	MTR	E to W	15.2	3.5	4.6	Right	

Table 2-16
Military Traffic Handled by ZFW and ZAB in from 1/1/2017 to 12/31/2018

Facility	Air Carrier	Air Taxi	General Aviation	Military	Total
ZFW	2,621,740	782,346	911,447	325,375	4,640,908
ZAB	2,099,849	444,067	485,773	173,764	3,203,453
Total:	4,721,589	1,226,413	1,397,220	499,139	7,844,361
	60.19%	15.63%	17.81%	6.36%	

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Table 2-17
Nearby Airport NUREG 0800 Screening

Airports	***City, State***	***Distance from site [mi]***	***Average Annual Operations***	***Airport IQ 5010 Operations for 12 months ending:***	***Operations***				***Based Aircraft***				
					General Aviation (local & itinerant)	***Air Taxi***	***Air Carrier***	***Military***	***SE***	***ME***	***J***	***Heli***	***Ultralight***
ANDREWS COUNTY (E11)	*Andrews, TX*	*32.0*	*6228*	*4/25/2018*	*100%*				*29*	*2*			*1*
TWO LEGGS (1TA5)	*Denver City, TX*	*34.0*	*N/A*						*3*				
SEAGRAVES (F97)	*Seagraves, TX*	*46.0*	*2100*	*6/20/2018*	*100%*				*7*				
GAINES COUNTY (GNC)	*Seminole, TX*	*28.3*	*12125*	*4/26/2018*	*99%*	*1%*			*16*	*3*			
HAMILTON AIRCRAFT, INC (5TA0)	*Seminole, TX*	*20.5*	*N/A*						*3*				
SEMINOLE SPRAYING SERVICE (39TE)	*Seminole, TX*	*26.2*	*2000*	*N/A*	*100%*				*6*				
INDUSTRIAL AIRPARK (NM83)	*Hobbs, NM*	*23.4*	*N/A*						*11*	*1*			*1*
LEA COUNTY RGNL (HOB)	*Hobbs, NM*	*18.7*	*12745*	*04/01/2017*	*68%*	*16%*	*9%*	*7%*	*41*	*6*	*5*	*1*	
LEA COUNTY/JAL/ (E26)	*Jal, NM*	*22.9*	*3000*	*04/04/2017*	*100%*				*7*	*1*	*1*		
LEA COUNTY-ZIP FRANKLIN MEMORIAL(E06)	*Lovington, NM*	*40.2*	*2200*	*04/03/2017*	*100%*				*11*	*1*			
NOR LEA COUNTY GENERAL HOSPITAL (NM94)	*Lovington, NM*	*39.2*	*0*	*12/30/2004*									
TATUM (18T)	*Tatum, NM*	*57.3*	*500*	*04/03/2017*	*100%*				*3*				

Table 2-18
Results of Aircraft Hazard Evaluation (Airways Considered Separately)

Variable Description	***Variable***	***Units***	***Low Altitude (V68 &other)***	***High Altitude***		***Military (6.36%)***	***Flight data w/o altitude#***	***Total***
				J66 (W-E)	***Q20 & Other***			
Inflight Crash Rate(NUREG-0800)	*C*	mi^{-1}	*4.00E-10*	*4.00E-10*	*4.00E-10*	*4.00E-10*	*4.00E-10*	
Aircraft Operations within 10 nautical miles of WSC CISF in 2018	*N*	yr^{-1}	**[ ]**	**[ ]**	**[ ]**	*5142*	**[ ]**	**[ ]**
Width of Airway	*w*	*mi*	*9.2*	*24.2*	*9.2*	*29.3*	*9.2*	
Area of WCS CISF	*A*	mi^2	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	
Probability of inflight aircraft impacting WSC CISF	P^{FA}	yr^{-1}	**[ ]**	**[ ]**	**[ ]**	*1.47E-08*	**[ ]**	***3.81E-07***

All Indicated Changes are in response to RAI NP-2.2-1

Table 2-19
Probability of Inflight Aircraft Impacting WCS CISF (All airways pass over the site)

Variable Description	*Variable*	*Units*	*Air Carrier*	*Air Taxi*	*General Aviation*	*Military*	*Total*
Inflight Crash Rate (NUREG-0800)	*C*	mi^{-1}	*4.00E-10*	*4.00E-10*	*4.00E-10*	*4.00E-10*	
Aircraft Class		-	*60.19%*	*15.63%*	*17.81%*	*6.36%*	
Aircraft Operations within 10 nautical miles of WCS CISF in 2018	*N*	yr^{-1}	[ ]	[ ]	[ ]	*5142*	
Width of Airway	*w*	*mi*	*9.2*	*9.2*	*9.2*	*9.2*	
Area of WCS CISF	*A*	mi^2	*0.21*	*0.21*	*0.21*	*0.21*	
Probability of inflight aircraft impacting WCS CISF	P^{FA}	yr^{-1}	[ ]	[ ]	[ ]	*4.69E-08*	***7.38E-07***

All Indicated Changes are in response to RAI NP-2.2-1

Figure 2-1
Waste Control Specialists Facility Site Plan

All Indicated Changes are in response to RAI NP-2.4-3

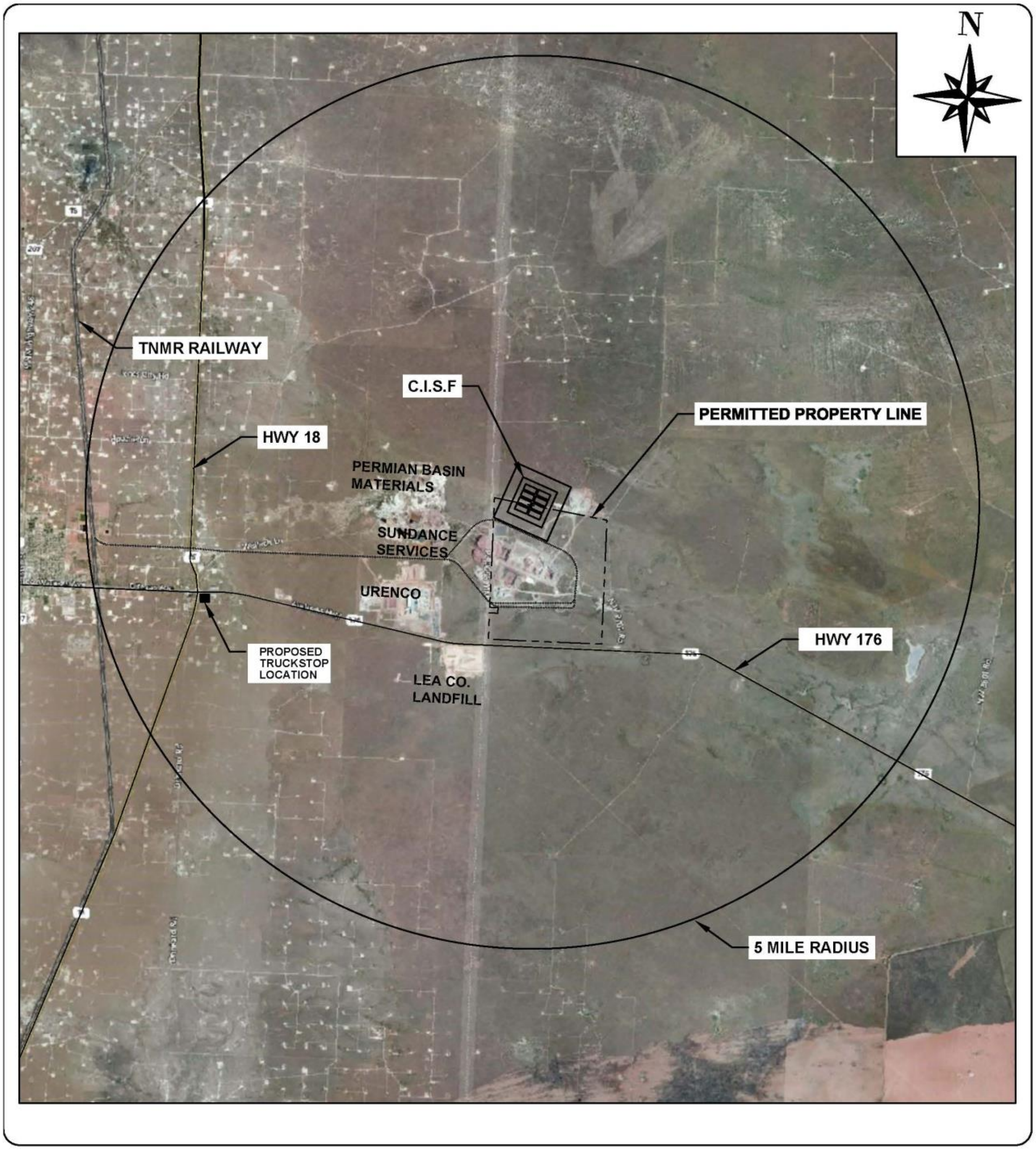


Figure 2-3
Proposed WCS CISF 5-mile Radius

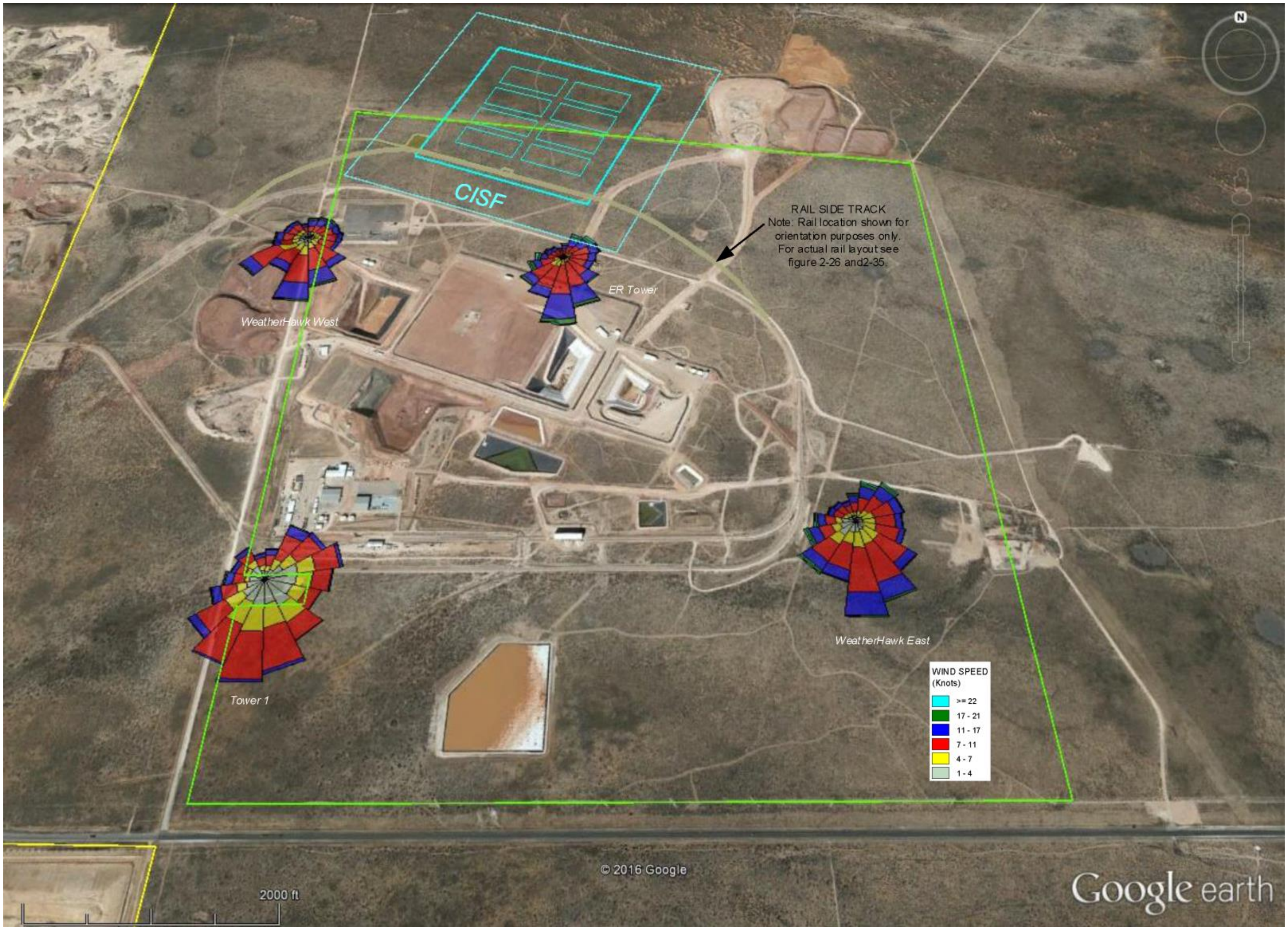
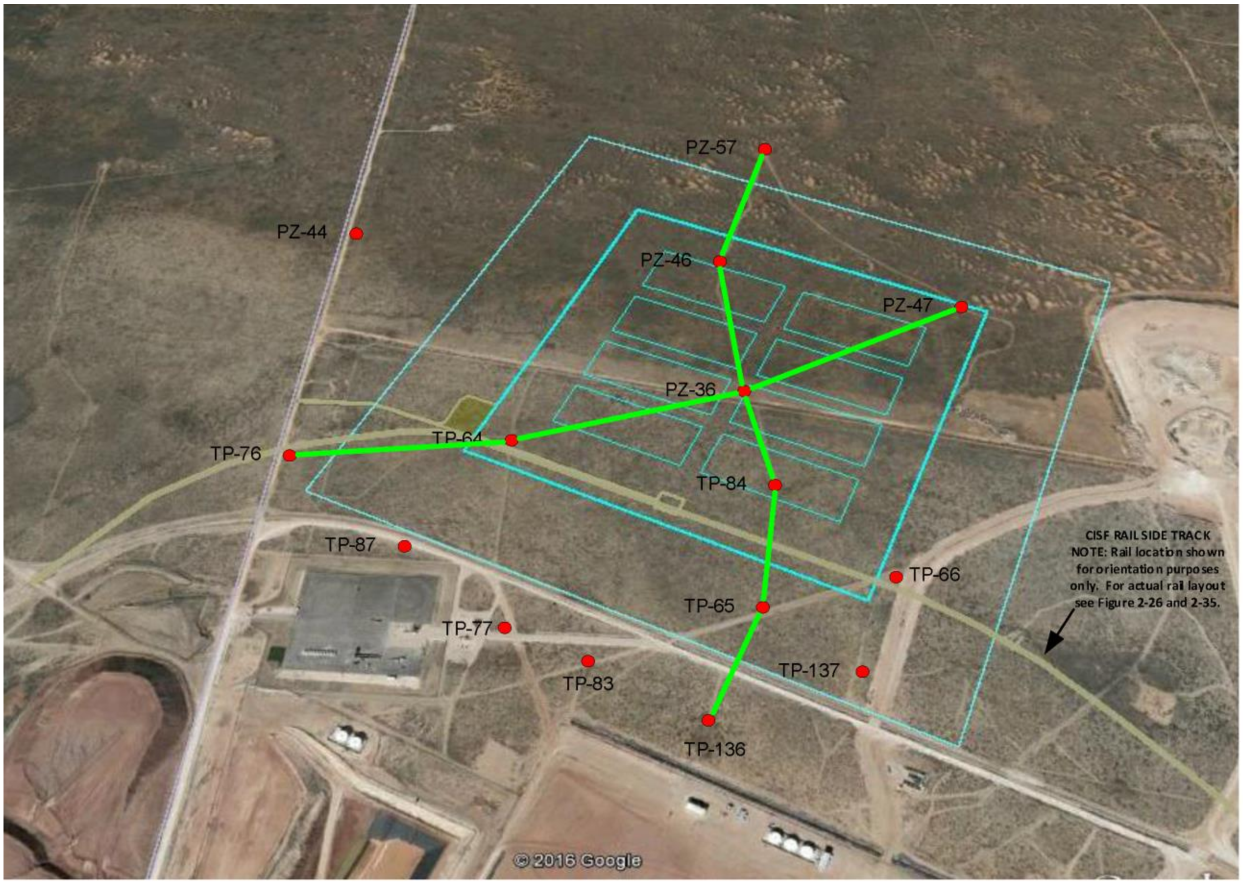


Figure 2-4
Wind Rose Location Map

All Indicated Changes are in response to RAI NP-2.4-3



Monitoring Well/ Piezometer Name	Date Drilled/ Completed	Total Depth Well (ft btoc)	Bottom of Well Elevation (ft msl)	Ground Elevation (ft msl)	Top of Casing Elevation (ft msl)	Depth to Red Bed Claystone (ft bgs)	Top of Red Bed Claystone (ft msl)
PZ-36	7/20/05	78.98	3419.51	3494.79	3498.49	75.0	3419.79
PZ-44	1/22/08	82.98	3416.90	3496.59	3499.88	77.1	3419.49
PZ-46	1/23/08	93.83	3412.04	3502.38	3505.87	87.4	3414.98
PZ-47	1/24/08	92.22	3411.56	3500.60	3503.78	87.0	3413.60
PZ-57	1/23/08	99.56	3415.44	3511.79	3515.00	93.5	3418.29
TP-64	1/11/08	70.81	3433.99	3502.08	3504.80	65.3	3436.78
TP-65	1/11/08	57.68	3436.07	3490.40	3493.75	52.5	3437.90
TP-66	1/10/08	57.78	3430.88	3485.45	3488.66	51.0	3434.45
TP-76	2/7/08	53.42	3436.78	3487.06	3490.20	47.1	3439.96
TP-77	2/7/08	51.30	3436.09	3484.19	3487.39	45.4	3438.79
TP-83	2/11/08	55.55	3435.60	3487.77	3491.15	49.8	3437.97
TP-84	2/12/08	65.24	3429.59	3491.56	3494.83	58.7	3432.86
TP-87	3/15/08	49.02	3438.47	3484.17	3487.49	43.3	3440.87
TP-136	3/20/09	55.21	3438.01	3490.17	3493.22	50.5	3439.67
TP-137	3/20/09	56.46	3434.68	3488.00	3491.14	51.5	3436.50

Figure 2-15
Boring Locations in the Vicinity of the WCS CISF

All Indicated Changes are in response to RAI NP-2.4-3

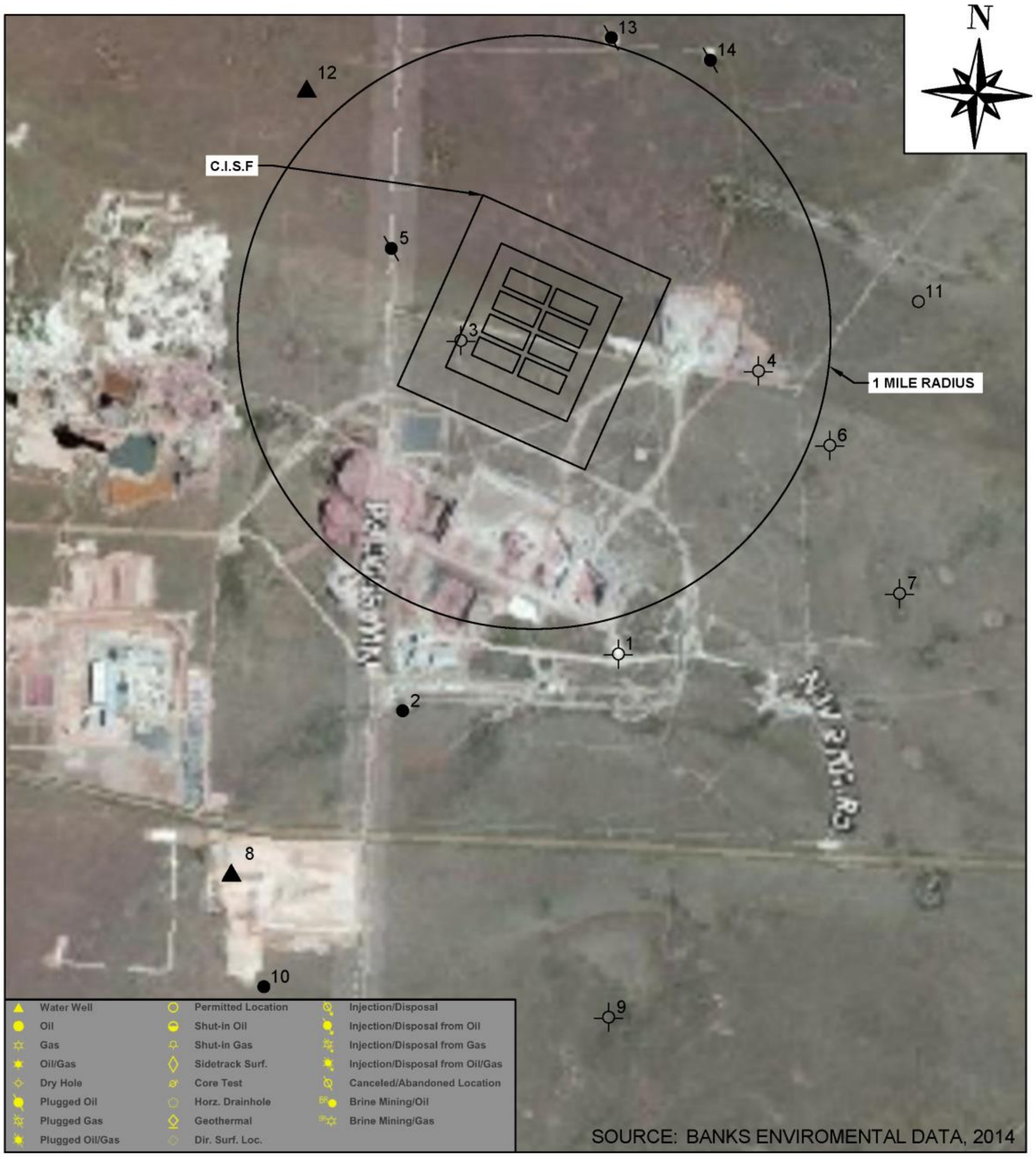


Figure 2-36
CISF 1-Mile Radius Oil and Gas Activity

All Indicated Changes are in response to RAI NP-2.2-2

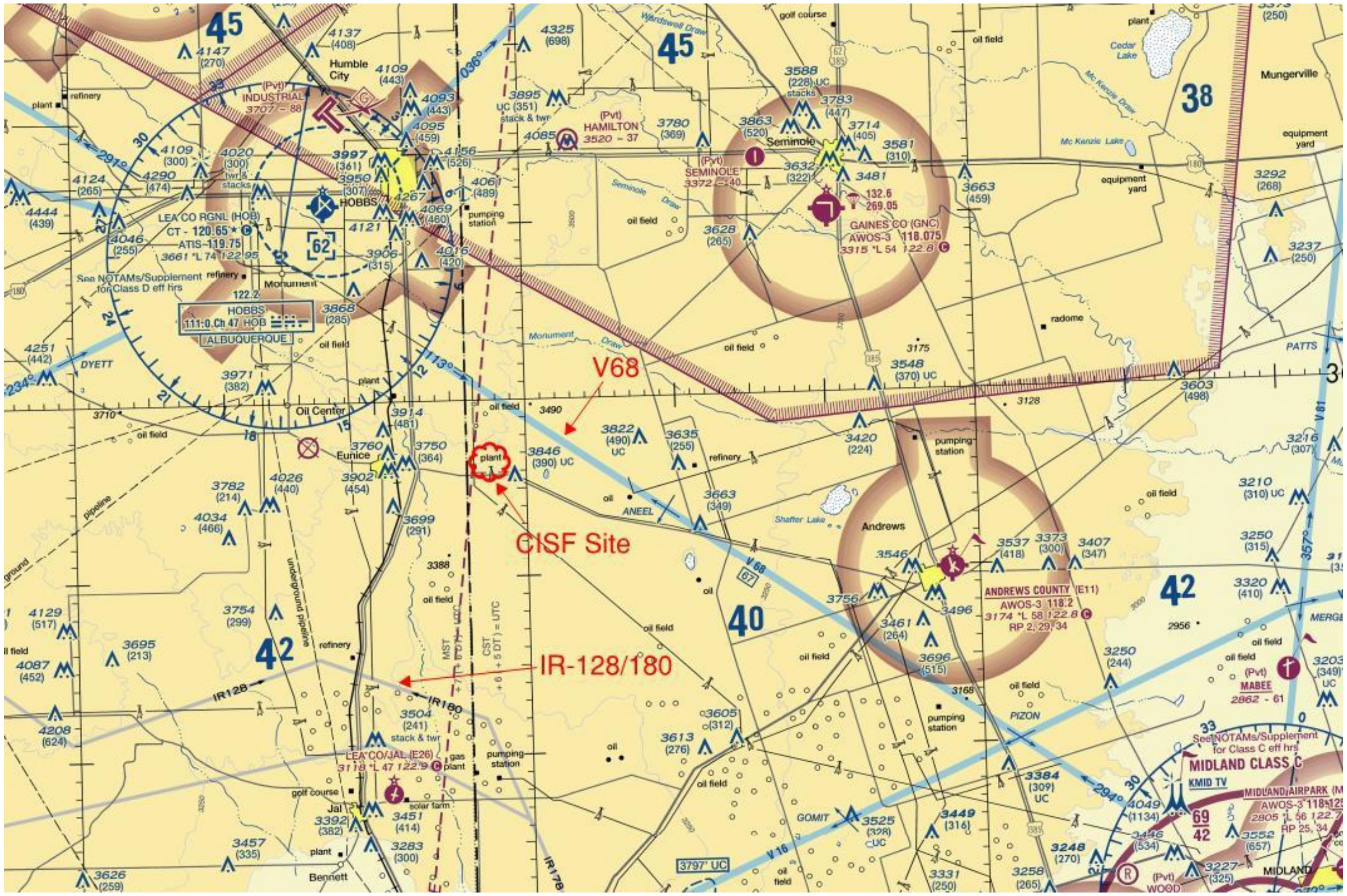


Figure 2-38
Low Altitude Air Routes Passing Near the Site

All Indicated Changes are in response to RAI NP-2.2-1

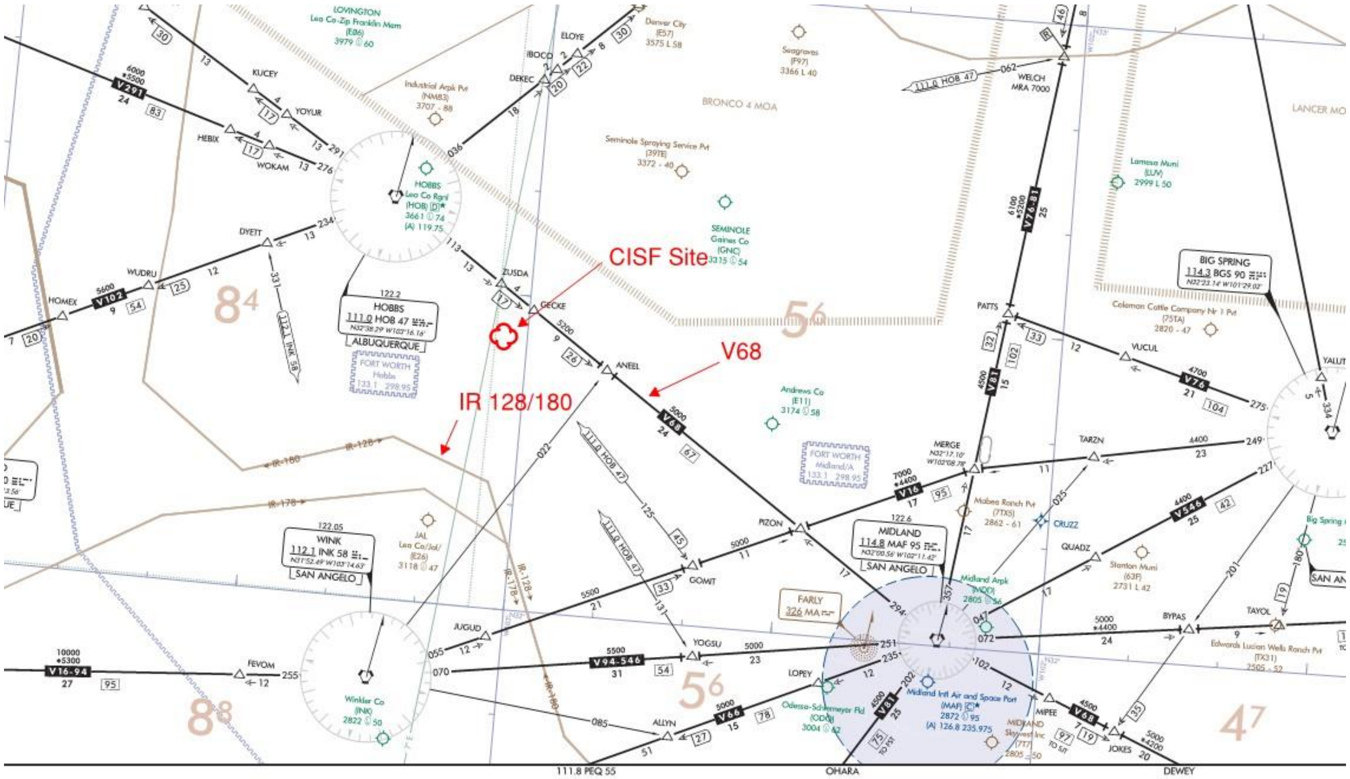


Figure 2-39
Low Altitude Air Routes Passing Near the Site

All Indicated Changes are in response to RAI NP-2.2-1

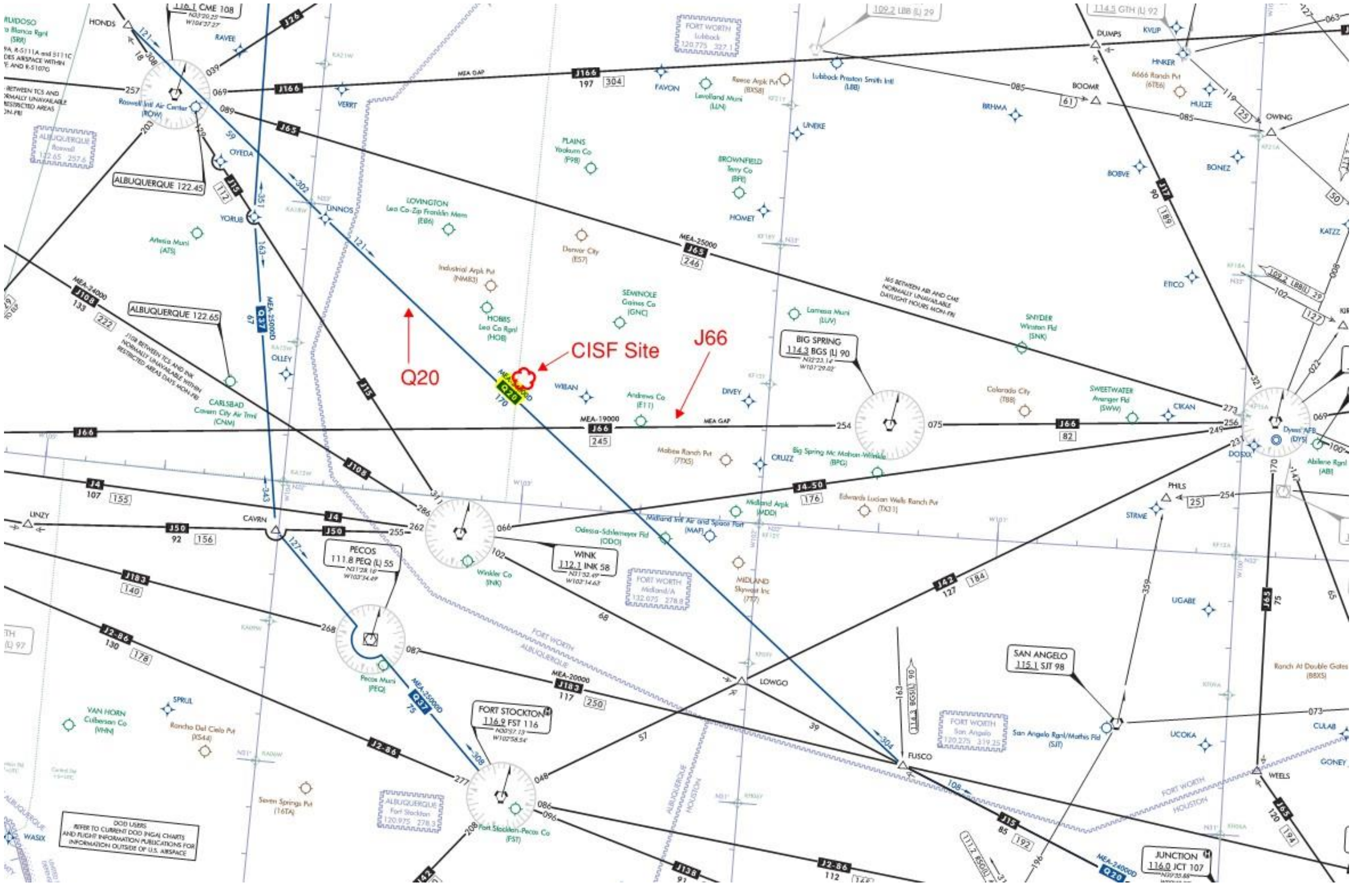


Figure 2-40
High Altitude Air Routes Passing Near the Site

All Indicated Changes are in response to RAI NP-2.2-1

Table 3-4
References for WCS CISF Storage System Components Important–to-Safety

Storage System	**Section in WCS CISF SAR**	**Section in Specific License or Certificate SAR**	**Drawings Containing ITS Items**
NUHOMS® - MP187 Cask System	Appendix A.3.1 *with* Table A.3-2*, Table A.3-3, Table A.3-4, Table A.3-5, and Table A.3-6*	Section 3.4 and Table 3-11 of Ref. [A.3-1]	Drawings listed in Appendix A.4.6
Standardized Advanced NUHOMS® System	Appendix B.3.1 Table B.3-2	Section 2.5 and Table 2.5-1 of Ref. [B.3-1]	Drawings listed in Appendix B.4.6 and Appendix A.4.6 numbers 14 and 15
Standardized NUHOMS®-61-BT System	Appendix C.3.1 Table C.3-2	Section K.2.3.1 and Table K.2-8 of Ref. [C.3-1] and the Quality Category Column of the parts lists on Drawing MP197-HB-71-1002, Rev.6 in Section A.1.4.10.1 of Ref. [C.3-2]	Drawings listed in Appendix C.4.6 and Appendix A.4.6 numbers 5 through 13 inclusive
Standardized NUHOMS®-61BTH Type 1 System	Appendix D.3.1 Table D.3-2	Section T.2.3 and Table T.2-15 of Ref. [D.3-1]	Drawings listed in Appendix D.4.6 and C.4.6 numbers 8 through 12 inclusive and Appendix A.4.6 numbers 5 through 13 inclusive
Yankee-MPC	Appendix E.3.1.2.1	Section 2.3.1 and Table 2.3-1 of Ref. [E.4-1]	Drawings listed in Appendix E.4.4
CY-MPC	Appendix E.3.1.2.1	Section 2.3.1 and Table 2.3-2 of Ref. [E.4-1]	Drawings listed in Appendix E.4.4
MPC-LACBWR	Appendix E.3.2.2.1	Section 2.A.3.1 and Table 2.A.3-1 of Ref. [E.4-1]	Drawings listed in Appendix E.4.4
NAC-UMS	Appendix F.3.1.2.1	Section 2.3.1 and Table 2.3-1 of Ref. [F.4-1]	Drawings listed in Appendix F.4.3
NAC-MAGNASTOR	Appendix G.3.1.2.1	Section 2.4.1 and Table 2.4-1 of Ref. [F.4.-1]	Drawings listed in Appendix G.4.3

All Indicated Changes are in response to RAI NP-15-2

7.5.2.2 VCT Operations

Personnel are trained to operate the VCT in accordance with approved procedures and all the controls used on the VCT are fail safe ('dead man') type controls.

7.5.2.3 VCT Inspections

VCT inspections are based on their associated Code requirements (ANSI N14.6 and ASME B30.1), as applicable, and good operating/engineering practices. Inspections are performed to ensure equipment is in good working order and that any postulated failures, which would result in equipment damage or personnel injury, do not occur.

VCT inspections are required IAW requirements specified in ASME B30.1. In summary, these inspections are based on type of inspection (Frequent or Periodic). Only Periodic inspections require formal documentation. Any rigging or other hardware is inspected per the appropriate ASME Chapter. Any deficiency identified that meets the Removal Criteria is corrected before allowing the VCT to return to service.

The VCT lift links, lifting pins and associated header beam are designed to the ANSI N14.6 design criteria for "Special lifting devices for Critical Loads", from ANSI N14.6. As such, annual inspections of these components are performed in accordance with the requirements specified in ANSI N14.6 (e.g. testing to verify continuing compliance, Maintenance & Repair, etc.). *Nil-ductility testing will be performed in accordance with ANSI N14.6-1993, Section 4.2.6 where "... ferritic materials for load-bearing members shall be subjected to a drop-weight test in accordance with ASTM E20884 or a Charpy impact test in accordance with ASTM A 370-77."*

7.5.2.4 Summary

The VCT is a uniquely designed on-site vehicle used to lift and move transportation casks and VCC overpacks containing canisters of SNF or GTCC waste inside and outside of the Cask Handling Building. Handling of the VCC's is not considered ITS, as the VCC has been evaluated for drops within the range of lift for placement onto the storage pads. Removing the transportation cask from the railcar within the Cask Handling Building is a lift considered ITS.

The 'haul path' is analyzed, and where necessary, enhancements to the travel path are implemented to ensure that any sensitive underground utilities.

The VCT is not an overhead hoisting system as defined by any ASME Standard, rather it is a mobile hydraulic gantry crane and adheres to applicable ASME B30.1 requirements. The lift links, lifting pins and header beam are designed, load tested and inspected in accordance with the requirements as specified in ANSI N14.6.

The neighboring facility to the west of the WCS CISF is a uranium enrichment facility, URENCO, and the distance is approximately 7,277 feet from the interior fence of the CISF to the closest building. The process used is a physical rather than a chemical process, and no chemical reactions are initiated although process hazards include possible chemical reactions in some accident scenarios. Some chemical reactions that may take place at URENCO are controlled by utility systems that decontaminate equipment and remove contaminants from effluent streams and lubricating oil [12-4]. Process Hazards identified by URENCO include radioactivity and toxicity of UF_6 release were found to be intermediate and high consequence. The potential accident sequences and consequences are discussed in greater detail in Section 3.7 of the Integrated Safety Analysis (ISA) Summary for the URENCO facility [12-4]. In the event of an accidental release, URENCO has calculated the 2-hour and 8-hour Total Effective Dose Equivalent (TEDE) doses at the site boundary and they are 3.1 mSv (310 mRem) and 8.0 mSv (800 mRem), respectively; these doses include the prompt gamma radiation and the released cloud contributions under accident meteorology (5th percentile). Figure 3.7-1 of the URENCO ISA shows corresponding doses as a function of distance from the criticality site, and since the WCS CISF is over 2,000 meters from the URENCO facility, the results indicate that the consequences of a postulated criticality event upon members of the public at or beyond the site boundary would be considerably below the threshold for an intermediate consequence event, as defined by 10 CFR 70.61 [12-4].

Regulatory Guide 1.91, Evaluations of Explosions Postulated to Occur at Nearby Facilities and on Transportation Routes near Nuclear Power Plants, Revision 2, was used to determine distances from nearby facilities or transportation routes beyond which any explosion that might occur is not likely to have an adverse effect on WCS CISF SSCs important to safety. The guidance in Regulatory Guide 1.91 is based on limiting the overpressure at SSCs to less than 1 psi from any explosion. The magnitude of explosions involving solid or liquid materials is calculated by converting the weight of potentially explosive materials to their TNT equivalence. Per Regulatory Guide 1.91, a more detailed review of transporting explosive materials on these transportation routes would not be required beyond demonstrating that the overpressures at the WCS CISF can be shown not to exceed 1 psi for any explosion. Using the methodology of Regulatory Guide 1.91, the nearest *truck* transportation routes are located much further from the CISF than the distances to exceed 1 psi overpressure. Based on the Regulatory Guide, the maximum probable hazardous solid cargo for a single highway truck is 50,000 lb, and detonation of this quantity of explosives could produce a 1 psi overpressure at a distance of approximately 1,660 ft (0.31 mile) from the detonation. Since Texas Highway 176 is approximately 8,000 feet (1.5 miles) from the southernmost edge of the storage pad for the canisters, explosions involving vehicles travelling on this road would not produce significant overpressures at these locations.

All Indicated Changes are in response to RAI NP-2.2-2

The Texas & New Mexico Railway at its closest point, is approximately 4.8 miles from the west OCA boundary of the WCS CISF. Using the methodology of Regulatory Guide 1.91, the maximum probable hazardous solid cargo for a single box car is 132,000 lbs, and detonation of this quantity of explosive could produce a 1 psi overpressure at a distance of approximately 2,300 ft (0.44 mile) from the detonation which does not approach the location of the WCS CISF.

The Waste Control Specialists rail spur and loop exits the Texas & New Mexico Railway near Eunice, New Mexico as shown in updated SAR Figure 2-3. This spur continues east until it reaches the existing Waste Control Specialists facility where it forms a loop around the facility. The rail side track to the WCS CISF will begin by connecting to the northwest side of the existing loop and terminate by re-connecting at the north side of the loop. This rail line is completely controlled by ISP joint venture member Waste Control Specialists and limited to approved Waste Control Specialists waste shipments and transport casks. Railcars carrying contents with the potential to adversely affect the CISF will not be permitted on the Waste Control Specialists rail spur and loop. Fire and explosion precautions for the WCS CISF rail side track are discussed in Section 3.3.6 of the SAR.

The effects of explosions on the storage systems are discussed in the SAR Appendices, Sections A.12.2.5, B.12.2.5, C.12.2.5, D.12.2.5, E.12.1.2, E.12.2.2, F.12.1.2 and G.12.1.2, and it is determined that the canisters are protected from the effects of explosions. Overpressures of substantially greater than 1 psi would be required to cause damage to the cask storage systems.

Permian Basin Materials LLC is a quarry located northwest of the facility. The quarry periodically employs blasting techniques for quarrying materials; however, this is outsourced to a third party and no explosives are stored onsite. The quarry is located beyond 1,660 feet from the proposed CISF and thus any accidental explosions would not produce overpressures greater than 1 psi to cause damage at the CISF.

Immediately south of the proposed WCS CISF is the currently operating Waste Control Specialists commercial waste disposal facility. The site has two propane tanks that are 2,600 gallons and 1,000 gallons and several smaller propane tanks. The explosion and vapor clouds of these propane tanks would not impact the CISF. Listed below are the distances of various gasoline and diesel storage locations that could be a potential explosion source; however, each location is over 1,660 feet (0.31 mile) from the CISF and none of the locations have quantities that would create overpressures in excess of 1 psi at the CISF.

Waste Control Specialists Gasoline and Diesel Locations, Quantities and Distance from proposed CISF:

- Mixed Waste Treatment Facility (MWTF) – Gas Storage Tank – 5,000 gallons – 4,732 feet from CISF
- MWTF – Diesel Storage Tank – 8,000 gallons – 4,732 feet from CISF
- MWTF – Diesel Storage Tank (Green Fuel) – 500 gallons – 4,732 feet from CISF

- Low Level Radioactive Waste Facility – Diesel Storage Tank – 3,384 gallons – 3,478 feet from CISF
- Fire Pump – 850 gallons Diesel – 3,205 feet from CISF
- 4 Generators – Diesel – 350 gallons each – 3,205 feet to 5,885 feet from CISF
- 3 Mobile Storage Tanks – Diesel – 475 gallons each – 3,483 feet to 7,777 feet from CISF

Oil industry pipelines are located near the facility. *A natural gas pipeline owned by Energy Transfer LP (previously owned by Sid Richardson Energy Services Company) runs parallel to Texas State Hwy 176 within an easement on Waste Control Specialists property. An evaluation assessing the hazards to the WCS CISF due to a pipeline leak and subsequent vapor cloud explosion following the guidance of Regulatory Guide 1.91 determined that the distance between the pipeline and the WCS CISF is sufficient to preclude any adverse impacts to the facility [12-7].*

Directly adjacent to (within 30 feet) and parallel to the Energy Transfer LP natural gas pipeline is an additional buried 14 inch diameter pipeline which is in idle status. This pipeline is also owned by Energy Transfer LP and it has been idle since before 2004.

There is a 10-inch diameter buried CO_2 pipeline which runs along the western and southern boundary of New Mexico Section 32. This pipeline does not present a hazard to the WCS CISF based on the nature of the pipeline product and its distance from the WCS CISF, which is more than 8,000 feet at its closest point.

Love's Travel Stops & Country Stores has started construction on a travel stop in New Mexico at the southeast corner of the intersection of New Mexico Highway 18 and Hwy 176. The Travel Stop will store up to 40,000 gallons of diesel fuel, 28,000 gallons of gasoline, and up to 12,000 gallons of non-flammable Diesel Exhaust Fluid (DEF) in underground tanks. Emergency Response Guide 128 [12-4] recommends a 0.5 mile safe distance for ignitable liquid tank fires which is much less than the 3.5 mile distance from the Travel Stop to the closest point at the WCS CISF boundary.

12.2.3 Adiabatic Heat Up/Blockage of Air Inlets/Outlets

The accident evaluated in the Appendices Chapter 12 (e.g., A.12, B.12, etc.) for each system that considers adiabatic heat up is the "Blockage of Air Inlets/Outlets." An accident scenario using the blockage of air inlets and outlets to analyze adiabatic heat up is consistent with the guidance given to NRC reviewers in NUREG 1567 [12-5].

For example, NUREG-1567, Section 6.5.1, "Decay Heat Removal Systems" describes "full blockage of ventilation passages" as a required thermal analysis for determining the performance of cask heat removal systems. Likewise, Section 15.5.2.8 of NUREG-1567, "Adiabatic Heatup," states that "the reviewer should verify that the configuration of the SSCs has been defined, (i.e., all inlets and outlets blocked (for casks) and cooling systems or pumps inoperable (for pools))."

All Indicated Changes are in response to RAI NP-2.2-2

12.3 References

12-1 NRC Regulatory Guide 3.48, "Standard Format and Content for the Safety Analysis Report for an Independent Spent Fuel Storage Installation or Monitored Retrievable Storage Installation (Dry Storage)," Rev. 1.

12-2 American National Standards Institute, American Nuclear Society, ANSI/ANS 57.9 1984, Design Criteria for an Independent Spent Fuel Storage Installation (Dry Storage Type).

12-3 Proposed SNM-1050, WCS Consolidated Interim Storage Facility Technical Specifications, Amendment 0.

12-4 *Emergency Response Guide 128, Emergency Response Guidebook (2016), U.S. Department of Transportation, Pipeline and Hazardous Materials Safety Administration.*

12-5 NUREG-1567, "Standard Review Plan for Spent Fuel Dry Storage Facilities," Revision 0, U.S. Nuclear Regulatory Commission, Office of Nuclear Material Safety and Safeguards, March 2000.

12-6 NUREG-1536, "Standard Review Plan for Spent Fuel Dry Storage Systems at a General License Facility," Revision 1, U.S. Nuclear Regulatory Commission, Office of Nuclear Material Safety and Safeguards, July 2010.

12-7 ISP Calculation "Hazard Analysis of Gas Pipeline for WCS CISF," WCS01-0211, Revision 0.

All Indicated Changes are in response to RAI NP-2.2-2

Yield Strength (ksi):	50.0
Modulus of Elasticity, E (× 10^6 psi):	*29.3*
Coefficient of Thermal Expansion, α (x 10^{-6} in/in/°F)	*6.5*
Density (lbm/in^3)	*0.284*

15.3.2.2 ASTM A514 - CTS Header Plate [15-4]

Ultimate Strength (ksi):	110.0
Yield Strength (ksi):	100.0

15.3.2.3 ASTM A693/564, Type 630 - Lift Pin [15-3]

Ultimate Strength (ksi):	135.0
Yield Strength (ksi):	105.0
Modulus of Elasticity, E (× 10^6 psi)	28.5
Coefficient of Thermal Expansion, α (x 10^{-6} in/in/°F)	5.9
Density (lbm/in^3)	0.29

15.3.2.4 ASTM A516, Gr 70 - Canister Adapter Plate [15-3]

Ultimate Strength (ksi):	70.0
Yield Strength (ksi):	38.0
Modulus of Elasticity, E (× 10^6 psi):	29.2
Coefficient of Thermal Expansion, α (x 10^{-6} in/in/°F)	6.4
Density (lbm/in^3)	0.284

15.3.2.5 ASTM A574, Gr 70 - Canister Adapter Plate Bolts [15-3]

Ultimate Strength (ksi):	170.0
Yield Strength (ksi):	135.0

15.3.2.6 ASTM A325 – Bolts [15-1]

Ultimate Strength (ksi):	120.0
Yield Strength (ksi):	92.0

15.3.2.7 ASTM A311, Class B – Pins [15-2]

Ultimate Strength (ksi):	170.0
Yield Strength (ksi):	135.0

15.3.2.8 ASTM A572, Grade 50 [*15-3*]

Ultimate Strength (ksi):	65.0

All Indicated Changes are in response to RAI NP-15-10

Yield Strength (ksi): 50.0

15.3.2.9 ASTM A36 [*15-3*]

Ultimate Strength (ksi): 58.0

Yield Strength (ksi): 36.0

15.3.2.10 ASTM A490 [15-1]

Ultimate Strength (ksi): 150.0

Yield Strength (ksi): 130.0

15.3.3 Vertical Cask Transporter

The VCT consists of two synchronized vertical hydraulic booms and is driven on steel tracks. The range of operations is areas between the Canister Transfer System and the Storage Area. Between the tops of the vertical hydraulic booms, across the width of the VCT is the lift beam, from which the lift links are hung. Lifting links are positioned in fixed locations on the beam and are interchangeable for different transportation cask and storage cask types. Loads are lifted by energizing the vertical hydraulic booms, in a synchronized motion, to raise and lower the lift beam of the VCT. The following materials are identified in the analysis of the VCT.

15.3.3.1 ASTM A572, Gr. 50 - VCT lift tower [15-3]

Values at Temperature (100°F)

Ultimate Strength (ksi): 65.0

Yield Strength (ksi): 50.0

Modulus of Elasticity, E (× 10^6 psi): *29.3*

Coefficient of Thermal Expansion, α (x 10^{-6} in/in/°F) *6.5*

Density (lbm/in^3) *0.284*

15.3.3.2 ASTM A514 - VCT Header/Lift Link [15-4]

Values at Temperature (100°F)

Ultimate Strength (ksi): 110.0

Yield Strength (ksi): 100.0

15.3.3.3 ASTM A693/564, Type 630 - Lift Pin [15-3]

Values at Temperature (70°F)

Ultimate Strength (ksi): 135.0

Yield Strength (ksi): 105.0

Modulus of Elasticity, E (× 10^6 psi): 28.5

All Indicated Changes are in response to RAI NP-15-10

15.4 References

15-1 ASME NOG-1-2010, "Rules for Construction of Overhead and Gantry Cranes (Top Running Bridge, Multiple Girder)," The American Society of Mechanical Engineers, 2010.

15-2 ASTM A311/A311M – 04 (Reapproved 2010), "Standard Specification for Cold-Drawn, Stress-Relieved Carbon Steel Bars Subject to Mechanical Property Requirements," ASTM International, West Conshohocken, Pennsylvania.

15-3 "Structural and Thermal Material Properties – MAGNASTOR/MAGNATRAN Cask System," NAC Calculation 71160-2101 Rev. *9*, NAC International, Atlanta, Georgia.

15-4 ASTM A514/A514M – 05 (Reapproved 2009) "Standard Specification for High-Yield-Strength, Quenched and Tempered Alloy Steel Plate, Suitable for Welding," West Conshohocken, PA, 2009.

15-5 ANSI N14.6-1993 American National Standard for Radioactive Materials – "Special Lifting Devices for Shipping Containers Weighing 10,000 Pounds (4500 kg) or More," 1993.

A.3.1 SSCs Important to Safety

The classifications of the NUHOMS®-MP187 Cask System systems, structures and components are discussed in Section 3.4 of Volume 1 and Section 3.2 of Appendix C of the "Rancho Seco Independent Spent Fuel Storage Installation Safety Analysis Report" [A.3-1]. These classifications are summarized in Table A.3-2 for convenience. Because the bill of materials (BOM) for the drawings incorporated by reference for the FO-, FC-, and FF-DSCs do not list the Quality Category for each item, this information is provided in Table A.3-3 and Table A.3-4. The item numbers listed in the tables correspond to the item number in the BOM of the applicable drawing incorporated by reference in Appendix A.4.6. Similarly, Table A.3-5 and Table A.3-6 provide the Quality Category for each of the items that make up the MP187 cask as listed on the BOM for the drawings incorporated by reference in Appendix A.4.6 for the MP187 cask.

A.3.1.1 FO-, FC-, FF-DSCs and GTCC Canister

The FO-, FC-, and FF-DSCs provide the fuel assembly (FA) support required to maintain the fuel geometry for criticality control. Accidental criticality inside a DSC could lead to off-site doses exceeding regulatory limits, which must be prevented. The DSCs, including the GTCC canister, also provide the confinement boundary for radioactive materials. Therefore, the DSCs, including the GTCC canister, are designed to maintain structural integrity under all accident conditions identified in Chapter 12 without losing their function to provide confinement of the spent fuel assemblies. The DSCs, including the GTCC canister, are important-to-safety (ITS).

A.3.1.2 Horizontal Storage Module

For the NUHOMS®-MP187 Cask System, the horizontal storage modules (HSM) used is the HSM Model 80, herein referred to as HSM. The HSMs are considered ITS since these provide physical protection and shielding for the DSC during storage. The reinforced concrete HSM is designed in accordance with American Concrete Institute (ACI) 349 [A.3-4] and constructed to the requirements of ACI-318 [A.3-5]. The level of testing, inspection, and documentation provided during construction and maintenance is in accordance with the quality assurance requirements defined in 10 CFR Part 72, Subpart G. Thermal instrumentation for monitoring HSM concrete temperatures is considered "not-important-to-safety" (NITS).

A.3.1.3 NUHOMS® Basemat and Approach Slab

The basemat and approach slabs for the HSMs are considered NITS and are designed, constructed, maintained, and tested to ACI-318 [A.3-5] as commercial-grade items.

All Indicated Changes are in response to RAI NP-15-2

A.3.4.6 Material Selection

Materials are selected based on their corrosion resistance, susceptibility to stress corrosion cracking, embrittlement properties, and the environment in which they operate during normal, off normal and accident conditions. The confinement boundary for the DSC materials meet the requirements of ASME Boiler and Pressure Vessel Code, Section III, Article NB-2000 and the specification requirements of Section II, Part D [A.3-7], with the listing of ASME Code exceptions for the DSCs and the cask provided in Appendix A “ASME Code Exceptions for the MP187 cask and FO, FC, and FF DSC's” of the “Rancho Seco Independent Spent Fuel Storage Installation Safety Analysis Report” [A.3-1]. The DSC and cask materials are resistant to corrosion and are not susceptible to other galvanic reactions. Studies under severe marine environments have demonstrated that the shell materials used in the DSC shells are expected to demonstrate minimal corrosion during an 80-year exposure. The DSC internals are enveloped in a dry, helium-inerted environment and are designed to withstand the loads from all normal, off-normal and accident conditions. The HSM is a reinforced concrete component with an internal DSC support structure that is fabricated to ACI and AISC Code requirements. Both have durability well beyond a design life of 80 years.

A.3.4.7 Operating Procedures

The sequence of operations are outlined for the NUHOMS®-MP187 Cask System in Chapter 5 and A.5 for receipt and transfer of the DSCs to the storage pad, insertion into the HSM, monitoring operations, and retrieval and shipping. Throughout Chapter 5, CAUTION statements are provided at the steps where special notice is needed to maintain ALARA, protect the contents of the DSC, or protect the public and/or ITS components of the NUHOMS®-MP187 Cask System.

Table A.3-3
Quality Classification for Items on Drawing NUH-05-4004 (FO- and FC-DSCs)

2 Pages

Item No.	Nomenclature Or Description	Quality Classification
52	Plate	B
51	Plate, Stiffening	B
50	Bottom Plug Side Casing	B
49	Bottom Plug Top Casing	B
48	Plate, .085 Thk	B
47	Stop Plate, .50 X 1.00 X .12 Thk	B
46	Plate 1/4" Thk Formed To 1.25" X 1.25" Angle	B
45	ANGLE, 1 1/4 X 1 1/4 X 1/4" Thk	B
44	Spacer Sleeve, 3.625 LG.	A
43	Spacer Sleeve, 4.25 LG.	A
42	Spacer Sleeve, 4.50 LG.	A
41	Spacer Sleeve, 4.75 LG.	A
40	Spacer Sleeve, 5.25 LG.	A
39	Spacer Sleeve, 5.50 LG.	A
38	Bottom End Spacer Sleeve	A
37	Top End Spacer Sleeve	A
36	Plate Stiffening	B
35	(Not Used)	
34	Top Plug Lifting Post	B
33	Top Plug Top Casing	B
32	Top Plug Side Casing	B
31	Top Plug Bottom Casing	B
30	Vent And Siphon Port Cover Plate	A
29	Outer Top Cover Plate, 1 1/4" Thk	A
28	Inner Top Cover Plate, 3/4" Thk	A
27	Bottom Shield Plug	B
26	Top Shield Plug	B
25	Support Ring	A
24	Lifting Lug	B
23	Quick Connect, 1/2" Male	NITS
22	Male Connector, 3/4" Tube X 3/4" MNTP	NITS

All Indicated Changes are in response to RAI NP-15-2

Table A.3-3
Quality Classification for Items on Drawing NUH-05-4004 (FO- and FC-DSCs)

2 Pages

21	Siphon Tubing, 3/4 OD X .05 Wall	NITS
20	Siphon & Vent Block	A
19	Key	B
18	Extension Plate	B
17	Shear Key	B
16	Support Rod	A
15	(Not Used)	
14	Neutron Absorber Sheet (BORALTM)	A
13	Spacer Disc – Type “B”	A
12	Oversleeve	A
11	Guide Sleeve	A
10	Spacer Disc – Type “A”	A
9	Spacer Disc – Type “C”	A
8	(Not Used)	
7	Bottom Plug Post	B
6	Inner Bottom Cover	A
5	Grapple Ring Support	B
4	Grapple Ring	B
3	Lead Shielding	B
2	Outer Bottom Cover	A
1	Cylindrical Shell	A

All Indicated Changes are in response to RAI NP-15-2

Table A.3-4
Quality Classification for Items on Drawing NUH-05-4005 (FF-DSC)
2 Pages

Item No.	Nomenclature Or Description	Quality Classification
44	Plate, Stiffening	B
43	Plate	B
42	Plate, Stiffening	B
41	Bottom Plug Side Casing	B
40	Bottom Plug Top Casing	B
39	Side lid Plate	A
38	Cover Plate, 11 GA (.12) Thk	B
37	Spacer Bar	B
36	Washer Plate	B
35	6 X 6 Mesh .047 Wire Dia. 2.50 Dia.	B
34	Top Lid Lifting Pintle	A
33	Bottom Lid Adapter Plate	A
32	Top Lid Cover Plate	A
31	Shear Key	B
30	Flange Plate	A
29	Liner, 1/4” Thk	A
28	(Not Used)	
27	Top Plug Post	B
26	Top Plug Side Casing	B
25	Top Plug Top Casing	B
24	Top Plug Bottom Casing	B
23	Vent & Siphon Port Cover Plate	A
22	Outer Top Cover Plate, 1 1/4" Thk	A
21	Inner Top Cover Plate, 3/4" Thk	A
20	Support Ring	B
19	Lifting Lug	B
18	Quick Connect, 1/2" Male	NITS
17	Male Connector 3/4" Tube X 3/4" MNPT	NITS
16	Siphon Tubing, 3/4" O.D. X .05 Wall	NITS
15	Siphon & Vent Block	A
14	(Not Used)	
13	(Not Used)	
12	Bottom Plug Post	B

All Indicated Changes are in response to RAI NP-15-2

Table A.3-4
Quality Classification for Items on Drawing NUH-05-4005 (FF-DSC)
2 Pages

11	Lead Shielding	B
10	Outer Support Plate	A
9	Inner Support Plate	A
8	Top Spacer Disc, 2.0 Thk	A
7	Spacer Disc, 2.0 Thk	A
6	Inner Bottom Cover	A
5	Grapple Ring Support	B
4	Grapple Ring	B
3	Key	B
2	Outer Bottom Cover	A
1	Cylindrical Shell	A

All Indicated Changes are in response to RAI NP-15-2

Table A.3-5
Quality Classification for Items on Drawing NUH-05-4001 (MP187 Cask)
2 Pages

Item No.	Nomenclature Or Description	Quality Classification
53	Tube I.D. Sized to Fit Items 33 & 34 (□1 1/2" Sched 40 of Similar)	NITS
52	10 GA Sheet	B
51	Screw Thread Insert 2-12UN-2B X 5.50 LG X (2.27) OD	A
50	Screw Thread Insert 1-8UNC-2B X 2.00 LG X (1.18) OD	A
49	NSP Support Angle, Inner	A
48	Space Washer	NITS
47	Screw Flat Hd Cap Screw 1/2-13UNC-2A X 1.0 LG	B
46	Lower Trunnion Plug Shielding Block	B
45	Lower Trunnion Plug Cover Plate	B
44	Tapered Pin	NITS
43	Test Port, Plug	B
42	Vent/Drain Port, Plug	B
41	Test/Vent/Drain Port, Threaded Insert	B
40	Test Port Seal	A
39	Vent/Drain Port Seal	A
38	Impact Limiter Attachment Block	A
37	O-Ring (2.0 ID) Vent/Drain/Test Plug	B for Transport C for Storage
36	Vent/Drain Port Screw, Cap Hex Hd 3/4-10UNC-2A X 1 3/4" LG	A
35	Test Port Screw, Cap Hex Hd 3/4-10UNC-2A X 1 3/4" LG	A
34	Screw, Cap Hd Soc, 1-8UNC-2A 5.0 LG	B
33	Hardened Washer, 1.5 OD X .177 Thk Max	A
32	Hardened Washer, 3.0 OD X .28 Thk Max	A
31	Filler Plate	A
30	Screw, Cap Hd Soc, 1-8UNC-2A 4.5 LG	A
29	O-Ring (17.5 ID); Ram Closure Plate: Cross-Section .425”	A
28	O-Ring (19.4 ID); Ram Closure Plate: Cross-Section .248”	C for Storage B for Transport
27	Screw, Cap Hd Soc, 2-12UN-2A X 8.16 LG	A
26	O-Ring (71.4 ID); Top Closure Plate: Cross-Section .425”	B
25	O-Ring (69.6 ID); Top Closure Plate: Cross-Section .425”	A
24	Top Closure Plate	A

All Indicated Changes are in response to RAI NP-15-2

Table A.3-5
Quality Classification for Items on Drawing NUH-05-4001 (MP187 Cask)
2 Pages

23	Ram Closure Plate	A
22	Castable Neutron Shielding Material	B
21	Rails, .120 Thk X 4.0 Wide	B
20	Upper Trunnion Plug Bottom Plate	B
19	Neutron Shield Shell	B
18	Plugs	B
17	Rupture Plug .036 (20 GA) Thk	B
16	NSP Support Angle, Outer	A
15	NSP Bottom Support Ring, Plate	A
14	NSP Top Support Ring, Plate	A
13	Tie Bar	A
12	Bearing Block	A
11	Pad Plate	A
10	Lower Trunnion Sleeve	A
9	Upper Trunnion Sleeve	A
8	Upper Trunnion Plug Side Plate	B
7	Upper Trunnion Plug Cover Plate	B
6	Gamma Shield (Lead)	B
5	Top Flange, Machined Ring Forging	A
4	Top Structural Shell, Rolled Plate	A
3	Bottom Structural Shell, Rolled Plate	A
2	Bottom End Closure, Machined Forging	A
1	Inner Shell, Rolled Plate	A

All Indicated Changes are in response to RAI NP-15-2

Table A.3-6
Quality Classification for Items on Drawing NUH-05-4003 (MP187 cask)

Item No.	Nomenclature Or Description	Quality Classification
21	Hardened Washer, 1.5 OD X .177 Thk	A
20	Key Plug Bottom Plate	NITS
19	Key Plug Side Plate	NITS
18	Trunnion Back, 1/4" Thk Plate	B
17	Upper Trunnion	A
16	Lower Trunnion	B
15	Screw, Socket Head Cap 1-8UNC-2A X 5.13 LG	A
14	Flat HD Hex Socket Cap Screw 1/2-13UNC-2A X 1.00 LG	B
13	Key Plug Cover Plate	NITS
12	Plate, 1/2" Thk X 3.25 Sq	NITS
11	Outer Plug Support Bracket L6 X 3 1/2 X 1/2 X 2.50 Wide	NITS
10	BOLT, 1-8UNC-2A X 9.75 LG With Std Washer	NITS
9	Lifting Eyes, Drop Forged	NITS
8	Pipe, 1" Sch 40	NITS
7	Inner Plug Inside Sleeve Rolled Plate 1/4" Thk	NITS
6	Inner Plug Sleeve Rolled Plate 1/4" Thk	NITS
5	Inner Plug Cover Plate 3/4" Thk	NITS
4	Nut, 1/2-13UNC-2B	NITS
3	Outer Plug Sleeve Rolled Plate 1/4" Thk	NITS
2	Outer Plug Cover Plate 3/4" Thk	NITS
1	Castable Neutron Shielding Material (NS-3)	B

A.4.2.2 Design Description

The FO-, FC- and FF-DSCs and GTCC waste canister are stainless steel flat head pressure vessels that provides confinement that is designed to withstand all normal condition loads as well as the off-normal and accident condition loads created by earthquakes, tornadoes, flooding, and other natural phenomena.

The HSM Model 80 is a low profile, reinforced concrete structure designed to withstand all normal condition loads as well as the off-normal and accident condition loads created by earthquakes, tornadoes, flooding, and other natural phenomena. The HSM is also designed to withstand off-normal and accident condition loadings postulated to occur during design basis accident conditions such as a complete loss of ventilation. The MP187 cask, in the transfer configuration, is used to transfer the canisters from the CHB to the storage pad where the cask is mated to the HSM Model 80. The cask is designed to withstand all normal condition loads as well as the off-normal and accident condition loads created by earthquakes, tornadoes, flooding, and other natural phenomena.

A.4.2.3 Safety Considerations

The FO-, FC- and FF- DSCs are important-to-safety (ITS), Quality Category A components. The GTCC waste canister is an ITS, Quality Category B component. The HSM Model 80 is an ITS, Quality Category B component. The MP-187 Cask is an ITS, Quality Category *A* component.

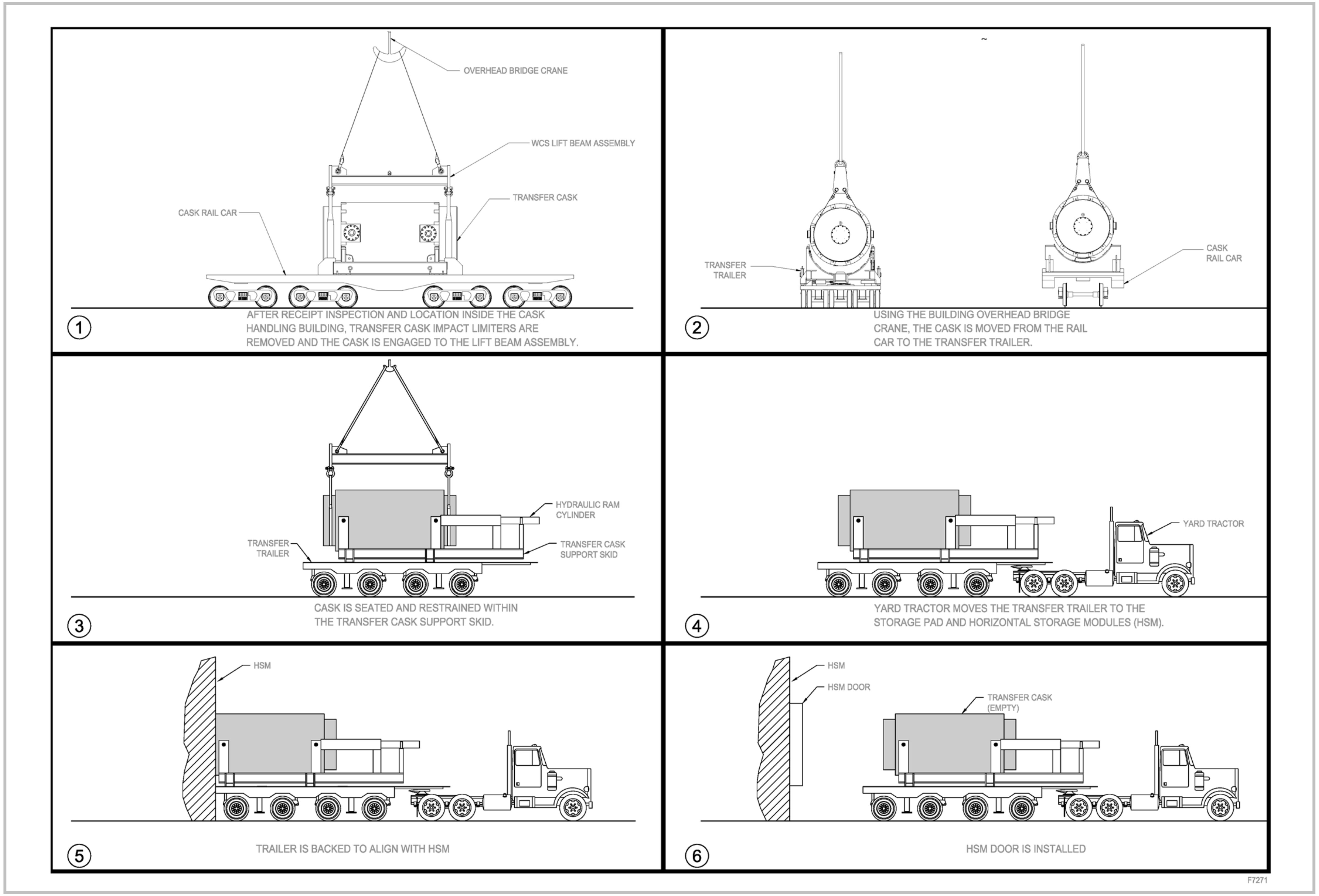


Figure A.5-1
NUHOMS®-MP187 System Operations

All Indicated Changes are in response to RAI NP-15-8

APPENDIX A.13
AGING MANAGEMENT PROGRAMS

Table of Contents

This section is newly added.

All Indicated Changes are in response to RAI NP-15-13

A.13. AGING MANAGEMENT PROGRAMS

The aging management programs (AMPs) described in Appendix C, Section C.13 are applicable to the SSCs of the MP187 Cask system.

This section is newly added.

All Indicated Changes are in response to RAI NP-15-13

For the DSCs, a combination of fixed poison in the basket and geometry are relied on to maintain criticality control. The structural analysis shows that there is no deformation of the basket under accident conditions that would increase reactivity.

B.3.4.6 Material Selection

RAI NP-15-6

Materials are selected based on their corrosion resistance, susceptibility to stress corrosion cracking, embrittlement properties, and the environment in which they operate during normal, off normal and accident conditions. The confinement boundary for the DSC materials meet the requirements of ASME Boiler and Pressure Vessel Code, Section III, Article NB-2000 and the specification requirements of Section II, Part D [B.3-8] *with the listing of ASME Code Alternatives for the DSCs provided in Table 3.1-14 of the "Advanced NUHOMS® Horizontal Modular Storage System Safety Analysis Report" [B.3-1]*. The DSC and cask materials are resistant to corrosion and are not susceptible to other galvanic reactions. Studies under severe marine environments have demonstrated that the shell materials used in the DSC shells are expected to demonstrate minimal corrosion during an 80-year exposure. The DSC internals are enveloped in a dry, helium-inerted environment and are designed *to withstand the loads from all normal, off-normal and accident conditions*. The AHSM is a reinforced concrete component with an internal DSC support structure that is fabricated to ACI and AISC Code requirements. Both have durability well beyond a design life of 80 years.

RAI NP-15-1

B.3.4.7 Operating Procedures

The sequence of operations are outlined for the Standardized Advanced NUHOMS® System in Chapter 5 and B.5 for receipt and transfer of the DSCs to the storage pad, insertion into the AHSM, monitoring operations, and retrieval and shipping. Throughout Chapter 5, CAUTION statements are provided at the steps where special notice is needed to maintain ALARA, protect the contents of the DSC, or protect the public and/or ITS components of the Standardized Advanced NUHOMS® System.

The MP187 cask, in the transfer configuration, is used to transfer the canisters from the CHB to the storage pad where the cask is mated to the AHSM. The cask is designed to withstand all normal condition loads as well as the off-normal and accident condition loads created by earthquakes, tornadoes, flooding, and other natural phenomena.

B.4.2.3 Safety Considerations

The NUHOMS®-24PT1 canisters are Important- to-Safety (ITS), Quality Category A components.

The AHSM is an important-to-safety (ITS), Quality Category B component. The MP187 cask is an ITS, Quality Category *A* component.

All Indicated Changes are in response to RAI NP-15-5

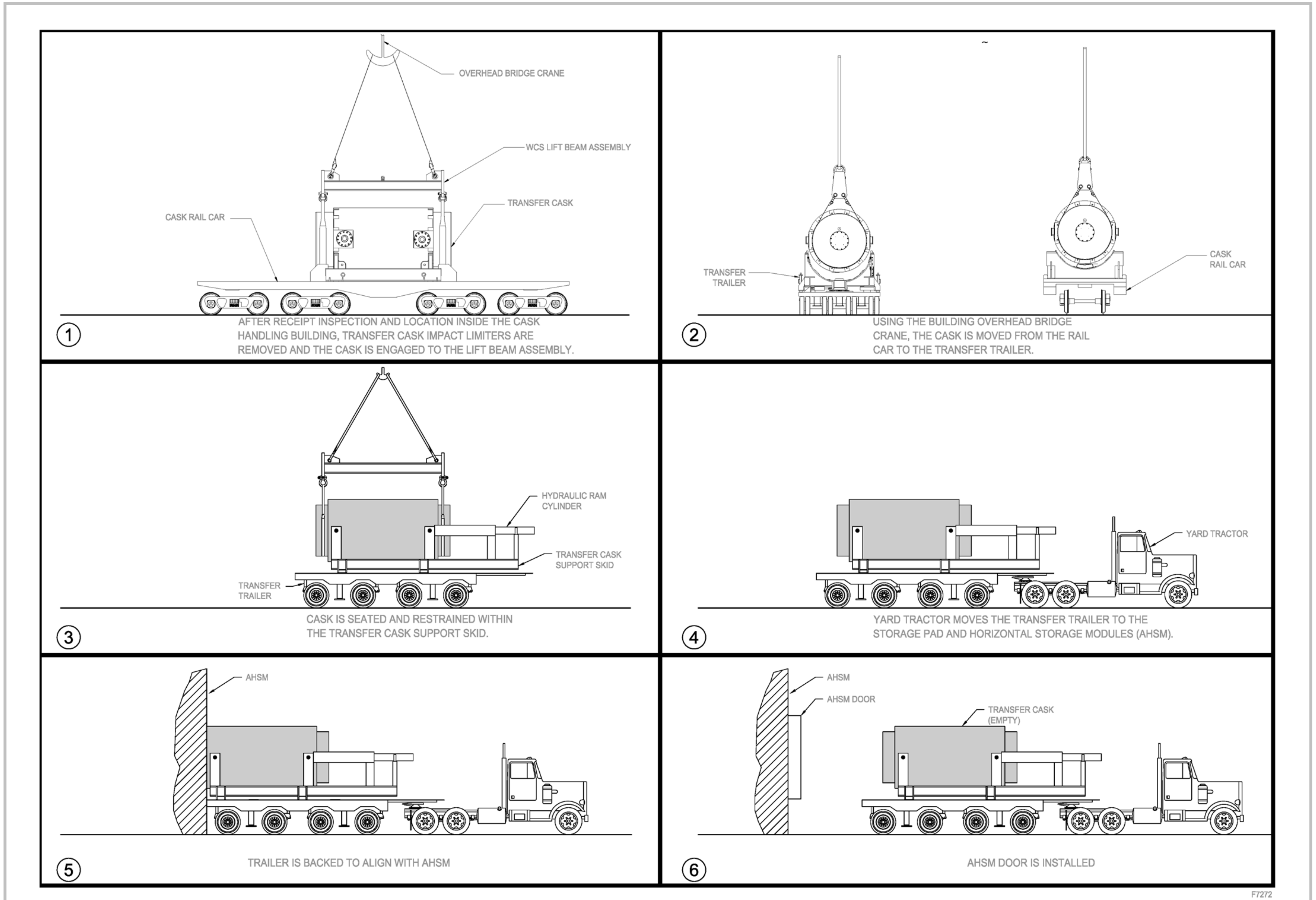


Figure B.5-1
Standardized Advanced NUHOMS® System Loading Operations

All Indicated Changes are in response to RAI NP-15-8

APPENDIX B.13
AGING MANAGEMENT PROGRAMS

Table of Contents

This section is newly added.

All Indicated Changes are in response to RAI NP-15-13

B.13. AGING MANAGEMENT PROGRAMS

The aging management programs (AMPs) described in Appendix C, Section C.13 are applicable to the SSCs of the Standardized Advanced NUHOMS® system.

This section is newly added.

All Indicated Changes are in response to RAI NP-15-13

C.3.4.6 Material Selection

Materials are selected based on their corrosion resistance, susceptibility to stress corrosion cracking, embrittlement properties, and the environment in which they operate during normal, off normal and accident conditions. The confinement boundary for the DSC materials meet the requirements of ASME Boiler and Pressure Vessel Code, Section III, Article NB-2000 and the specification requirements of Section II, Part D [C.3-7], with the listing of ASME Code alternatives for the DSCs provided in Tables K.3.1-2 and K.3.1-3 of the "Standardized NUHOMS® Horizontal Modular Storage System Safety Analysis Report" [C.3-1]. The code alternatives applicable to the MP197HB Cask are provided in Appendix A.2.13.13 of reference [C.3-10]. The DSC and cask materials are resistant to corrosion and are not susceptible to other galvanic reactions. Studies under severe marine environments have demonstrated that the shell materials used in the DSC shells are expected to demonstrate minimal corrosion during an 80-year exposure. The DSC internals are enveloped in a dry, helium-inerted environment and are designed *to withstand the loads from all normal, off-normal and accident conditions*. The HSM is a reinforced concrete component with an internal DSC support structure that is fabricated to ACI and AISC Code requirements. Both have durability well beyond a design life of 80 years.

C.3.4.7 Operating Procedures

The sequence of operations are outlined for the NUHOMS®-61BT System in Chapter 5 and C.5 for receipt and transfer of the DSCs to the storage pad, insertion into the HSM, monitoring operations, and retrieval and shipping. Throughout Chapter 5, CAUTION statements are provided at the steps where special notice is needed to maintain ALARA, protect the contents of the DSC, or protect the public and/or ITS components of the NUHOMS®-61BT System.

All Indicated Changes are in response to RAI NP-15-1

C.4.2.2 Design Description

The NUHOMS® 61BT DSCs are stainless steel flat head pressure vessels that provide confinement that is designed to withstand all normal condition loads as well as the off-normal and accident condition loads created by earthquakes, tornadoes, flooding, and other natural phenomena.

The HSM Model 102 is a low profile, reinforced concrete structure designed to withstand all normal condition loads as well as the off-normal and accident condition loads created by earthquakes, tornadoes, flooding, and other natural phenomena. The HSM is also designed to withstand off-normal and accident condition loadings postulated to occur during design basis accident conditions such as a complete loss of ventilation.

The MP197HB cask, in the transfer configuration, is used to transfer the canisters from the Cask Handling Building to the storage pad where the cask is mated to the HSM Model 102. The cask is designed to withstand all normal condition loads as well as the off-normal and accident condition loads created by earthquakes, tornadoes, flooding, and other natural phenomena.

C.4.2.3 Safety Considerations

The NUHOMS® 61BT DSCs are important-to-safety (ITS), Quality Category A components.

The HSM Model 102 is an important-to-safety (ITS), Quality Category B component. The MP197HB cask is an ITS, Quality Category *A* component.

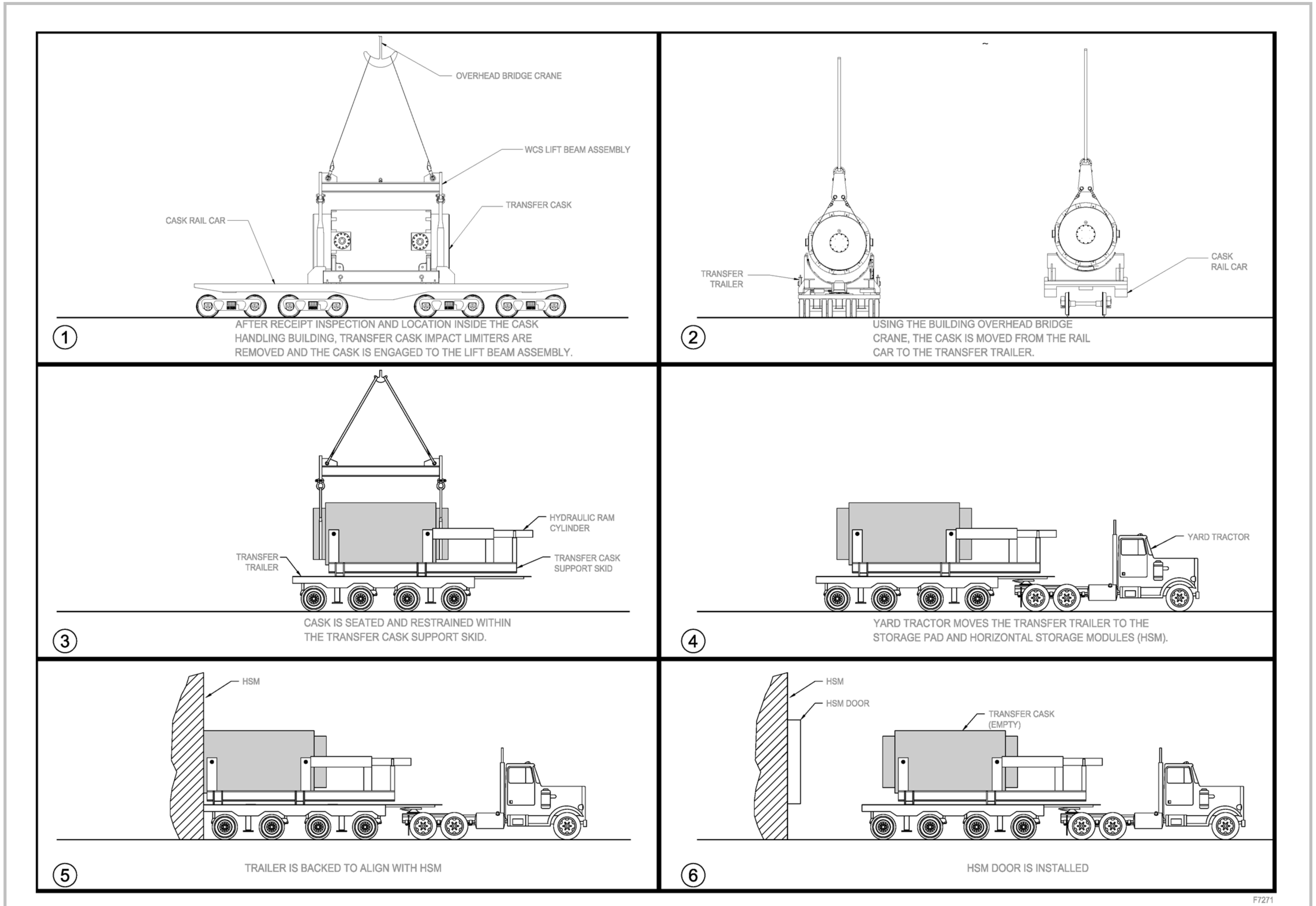


Figure C.5-1
Standardized NUHOMS®-61BT System Loading Operations

All Indicated Changes are in response to RAI NP-15-8

APPENDIX C.13
AGING MANAGEMENT PROGRAMS

Table of Contents

This section is newly added.

All Indicated Changes are in response to RAI NP-15-13

This section is newly added.

All Indicated Changes are in response to RAI NP-15-13

List of Tables

This section is newly added.

All Indicated Changes are in response to RAI NP-15-13

C.13. AGING MANAGEMENT PROGRAMS

C.13.1 Purpose

This chapter describes the aging management programs (AMPs) credited for managing each of the identified aging effects for the in-scope structures, systems, and components (SSCs) of the NUHOMS® related dry storage systems at the Waste Control Specialists (WCS) Consolidated Interim Storage Facility (CISF). The purpose of the AMPs is to ensure that aging effects do not result in a loss of intended function of the SSCs. The AMPs are based on the results of the aging management reviews (AMR) for the dry shielded canisters (DSCs), horizontal storage modules (HSMs), and concrete basemat presented in [C.13-29].

The AMPs developed to manage aging effects are:

- DSC External Surfaces Aging Management Program (applicable to DSC)
- DSC Aging Management Program for the Effects of Chloride-Induced Stress Corrosion Cracking (applicable to DSC)
- Horizontal Storage Module Aging Management Program for External and Internal Surfaces (applicable to HSM and DSC support structure)

In this chapter, the terms, DSC and HSM are used in a generic sense, and are intended to apply to the various types of DSCs, and HSMs used in the NUHOMS® related dry storage systems.

This section is newly added.

All Indicated Changes are in response to RAI NP-15-13

C.13.2 Methodology

The AMPs are based on the AMPs approved for the renewal of CoC 1004 [C.13-29 and C.13-30]. The structure of the AMPs is consistent with the 10 program elements described in NUREG-1927 [C.13-1], as follows:

1. Scope of the program: The scope of the program includes the specific SSCs and subcomponents subject to the AMP and the intended safety functions to be maintained. In addition, the element states the specific materials, environments, and aging mechanisms and effects to be managed.

2. Preventive actions: Preventive actions used to prevent aging or mitigate the rates of aging for SSCs.

3. Parameters monitored or inspected: This element identifies the specific parameters that will be monitored or inspected and describes how those parameters will be capable of identifying degradation or potential degradation before there is a loss of intended safety function.

4. Detection of aging effects: This element includes inspection and monitoring details, including method or technique (e.g., visual, volumetric, surface inspection), frequency, sample size, data collection, and timing of inspections to ensure timely detection of aging effects. In general, the information in this element describes the "when," "where," and "how" of the AMP (i.e., the specific aspects of the activities to collect data as part of the inspection or monitoring activities).

   "Accessible areas" are defined as surfaces of in-scope SSCs and subcomponents that can be visually inspected by direct means without disassembly, it also includes surfaces (or portions of surfaces) of in-scope SSCs and subcomponents that can be visually inspected by remote means without significant disassembly (such as removal of HSM door).

   "Inaccessible areas" are defined as surfaces of in-scope SSCs and subcomponents that cannot be visually inspected by direct or remote means.

5. Monitoring and trending: This element describes how the data collected will be evaluated. This includes an evaluation of the results against the acceptance criteria and an evaluation regarding the rate of degradation to ensure that the timing of the next scheduled inspection will occur before there is a loss of intended safety function.

6. Acceptance criteria: Acceptance criteria, against which the need for corrective action will be evaluated, ensures that the SSC intended safety functions and the approved design bases are maintained during the period of extended operations.

7. Corrective actions: Corrective actions are the measures taken when the acceptance criteria are not met. Timely corrective actions, including root cause determination and prevention of recurrence for significant conditions adverse to quality, are critical for maintaining the intended safety functions of the SSCs during the period of extended operations.

8. Confirmation process: This element verifies that preventive actions are adequate and that effective appropriate corrective actions have been completed. The confirmation process is commensurate with TN Americas 10 CFR Part 72, Subpart G Program. The QA Program ensures that the confirmation process includes provisions to preclude repetition of significant conditions adverse to quality.

9. Administrative controls: Administrative controls provide a formal review and approval process in accordance with an approved QA program.

10. Operating experience: The operating experience element of the program supports a determination that the effects of aging will be adequately managed so that the SSC intended safety functions will be maintained during the period of extended operations. Operating experience provides justification for the effectiveness of each AMP program element and critical feedback for enhancement.

Note: For the purpose of these AMPs, the phrase "period of extended operation" is defined as the period starting 20 years after the component was first placed in service, (i.e., at the original Independent Spent fuel Storage Installation (ISFSI), or nuclear power site, for the DSCs or at the CISF for the HSM and basemat).

C.13.3 DSC External Surfaces Aging Management Program

C.13.3.1 Scope of Program

This AMP applies to all DSCs except those where the AMP in Section C.13.4, aging management for the effects of chloride-induced stress corrosion cracking (CISCC), applies.

This program visually inspects and monitors the external surfaces of the DSC that may be subject to loss of material and cracking. The program scope includes external surfaces of the DSC shell assembly. The areas of DSC inspection are:

- Fabrication welds of the confinement boundary and the associated heat affected zone (HAZ), i.e., longitudinal and (if any) circumferential welds on the cylindrical shell,
- Crevice locations, e.g., where the shell sits on the support rail,
- The upper surface of the cylindrical shell, where atmospheric particulates would settle,
- The top and bottom ends of the cylinder, which are cooler than the center,
- Outer bottom cover plate, grapple assembly, their welds and HAZs, and
- Outer top cover plate, welds and HAZs.

The last two areas are not part of the confinement boundary, but their condition must be ascertained prior to retrieval and transport. As vertical surfaces out of the main path of air flow, they are the least susceptible to the effect of atmospheric deposits. Accessibility to the outer top cover plate may be limited during storage, but prior to transport, it can be inspected after the canister is pulled into a transport cask.

The materials, environments, and aging effects requiring management for the external surfaces of DSC shell assembly (to maintain confinement, shielding structural, heat transfer, and retrievability intended safety functions) are as follows:

Materials

DSC shell assembly components subject to AMR are constructed of the following material:

- Stainless Steel – shell assembly

Environments

DSC shell assembly components subject to AMR are exposed to the following environments:

- Sheltered

This section is newly added.

All Indicated Changes are in response to RAI NP-15-13

Aging Effects Requiring Management

The following aging effects associated with the DSC shell assembly components require management:

- Loss of material due to crevice and pitting corrosion for stainless steel components
- Loss of material due to galvanic corrosion for the DSC shell contacting graphite lubricant at the sliding rail surface
- Loss of material due to radiation-induced crevice corrosion, pitting corrosion, and stress corrosion cracking (SCC) for stainless steel DSC shell
- Cracking due to SCC for stainless steel components when exposed to moisture and aggressive chemicals in the environment

Interim Storage Partners (ISP) may use inspections results from other general or specific licensee inspections if it can be demonstrated that the other licensee inspections are bounding. Parameters to be considered in making a bounding determination include: similar or more benign environmental conditions, similar storage system design components, similar stored fuel parameters, heat load, and operational history. The criteria for DSC selection or the bounding determination shall be justified and documented. Justification of these bounding demonstrations needs to follow the same methodology used in the licensing and design basis calculations.

C.13.3.2 Preventive Actions

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

C.13.3.3 Parameters Monitored or Inspected

The DSC External Surfaces AMP consists of visual inspections to monitor for material degradation of the DSC shell assembly.

- DSC surfaces, welds and HAZs, and crevice locations near the DSC support rails are inspected for discontinuities and imperfections.

Parameters Monitored or Inspected for Identified Aging Effects

Aging Effect	Aging Mechanism	Parameter(s) Monitored
Loss of Material	Crevice Corrosion	Surface Condition
Loss of Material	Pitting Corrosion	Surface Condition
Loss of Material	Galvanic Corrosion	Surface Condition
Cracking	Stress Corrosion Cracking	Surface Condition, Cracks

C.13.3.4 Detection of Aging Effects

A minimum of one DSC from each originating ISFSI, is selected for inspection. The DSC(s) selected for inspection is based on the following considerations/criteria which provide the basis for selection of a bounding DSC(s):

1. Time in service: Storage duration (time in service at originating ISFSI and WCS CISF) is related to surface temperature and deposition of contaminants. The DSC(s) selected for inspection is from the pool of DSCs with longest time in service.

2. Initial heat load: The DSC selected for inspection is from a pool of DSC(s) with low initial heat loading that result in low DSC shell surface temperatures, thus increasing relative humidity inside the HSM and promoting incubation of ambient contaminants.

3. DSC Fabrication and Design Considerations: A review of the design drawings and DSC fabrication package is performed to further screen-in the DSC(s) from the pool of candidates selected based on (1) and (2). Fabrication weld maps, if available, should be reviewed to identity locations of the circumferential and longitudinal welds, and external configurations of the inner bottom cover-to-shell weld (e.g., ASME Figure NB-4243-1(c)). These features are verified against the fabrication drawings for the specific DSC(s) under consideration for inspection.

4. HSM array configuration relative to climatological and geographical features: DSCs inside HSMs oriented such that the vent openings face the prevalent wind direction are to be considered for inspection, particularly if the wind direction is in the path of potential sources of contaminants (e.g., industrial plant, co-located coal power plant, if present).

Visual inspections are performed at intervals of 5 years ± 1 year. The ± 1 year is provided for inspection planning and potential limited availability of vendor remote non-destructive examination (NDE) equipment. The first examination will be performed on the selected DSC(s) prior to entering their period of extended operation. The same DSC(s) are used for each subsequent examination for trending.

Visual inspection can be conducted remotely by inserting high-resolution remote pan-tilt-zoom (PTZ) cameras or fiber optics through the HSM vents or through the annular gap between the DSC and HSM front door opening. Visual examinations follow procedures consistent with the ASME Code, Section XI, IWA-2200 [C.13-3].

Within the HSM cavity, certain surface areas of the DSC may be inaccessible for remote camera. This program addresses detection of aging affects for inaccessible areas by the inspection findings in accessible areas.

As much of the DSC surface as can be accessed is examined by VT-3 to ascertain its general condition, including evidence of water stains, discoloration, and surface deposits. [ ]

Areas subject to VT-1[1] examination are:

- the confinement boundary weld seams and their HAZ,
- the confinement boundary adjacent to the sliding rail surface that it rests upon,
- the confinement boundary surfaces with water staining or with discoloration indicative of corrosion products observed by the VT-3 inspection, and
- the outer top cover plate, welds, and HAZ, if accessible, or if the DSC needs to be completely withdrawn into the transfer cask.

Less than 100% coverage is acceptable if ISP can demonstrate that the areas sampled for inspection bound or are representative of the balance of the subject area.

Localized corrosion (e.g., pitting and crevice corrosion), cracking and stains (caused by leaking rainwater) or discolorations are documented, if any. Appearance and location of atmospheric deposits on the canister surfaces are recorded.

[

] The examination system shall be, as a minimum, capable of detecting flaws sizes meeting the allowable flaws in ASME B&PV Code Section XI IWB-3514.3 [C.13-3].

[1] According to ASME Section XI IWA-2211, the VT-1 visual examination is conducted to detect discontinuities and imperfections on the surface of components, including such conditions as cracks, wear, or corrosion. The VT-1 examination procedure is capable of resolving demonstration characters height of 1.1 mm in accordance with ASME Section XI Table IWA-2211-1 “Visual Examinations.” Remote inspection camera resolution capability shall meet VT-1 illumination, distance, and character height requirements for examination effectiveness.

Personnel performing visual examinations shall be qualified and certified in accordance with ASME XI, IWA-2300, including the requirements of ASME XI, Appendix VI.

Qualification of other NDE personnel shall be in accordance with ASME XI, IWA-2300. Personnel performing ultrasonic examinations shall also meet the additional certification requirements of ASME XI Appendix VII. In addition, they shall have a current certification for ASME XI, Appendix VIII, Supplement 2, for detection, depth sizing, and length sizing of intergranular stress corrosion cracking (IGSCC) in austenitic materials.

C.13.3.5 Monitoring and Trending

A baseline inspection is performed as part of the monitoring and trending activities so that the inspection results can be used for subsequent trending. Deficiencies are documented using approved processes and procedures, such that results can be trended and corrected. This monitoring is conducted in accordance with the provisions of the TN Americas 10 CFR Part 72, Subpart G Program.

C.13.3.6 Acceptance Criteria

The acceptance criteria are defined to ensure that the need for corrective actions will be identified before loss of intended functions. Visual examination via the use of remote digital camera is based on ASME VT-3 or VT-1 examination or equivalent (ASME Section XI Table IWA-2211-1) [C.13-3]. Any indications of relevant degradation detected are evaluated for continued service in TN America's corrective action program.

Inspection acceptance criteria for the VT-3 examination are no indications of pitting, rust, discoloration, or any indication of surface degradation.

Inspection acceptance criteria for the VT-1 examination are as follows:

- No indications of pitting or crevice corrosion
- No indications of galvanic corrosion as evidenced by red-orange corrosion products emanating from crevice locations (support rail plate-to-DSC shell interface)
- No indications of stress corrosion cracking
- No indications of corrosion products near crevices
- No indications of corrosion products on or adjacent to confinement boundary welds.

If, based on the results of the inspection, the DSC is determined to be free of any indications of corrosion or other degradation that could lead to the loss of intended function, no further actions are necessary until the next inspection.

If the DSC is determined to contain confirmed or suspected indications of corrosion or degradation, additional engineering evaluations are performed to demonstrate that the DSC will remain able to perform its design bases functions until the next inspection. ASME Code Section XI provides specific rules for evaluating flaw indications that may be detected during the inspections. If flaw indications are found, the flaw geometry is determined from the inspection results in accordance with Section XI, IWA-3300 [C.13-3]. The flaw dimensions are assessed and compared with the allowable flaw dimensions in Section XI, IWB-3514 [C.13-3] acceptance standards. If the flaw size is less than the allowable flaw size in the IWB-3514.1 acceptance standards, the flaw is acceptable with no need for further evaluation. If the flaw size exceeds the allowable flaw size in the IWB-3514.1 acceptance standards, the flaw must be evaluated using the acceptance criteria in IWB-3640. The procedures in ASME Section XI Appendix C [C.13-3] may be used for these evaluations.

When visual examination detects evidence of localized corrosion, the affected areas will be further examined to determine the extent and the depth of penetration. The additional information would be that required to evaluate defects, depending on the nature of the defects observed:

- Surface-connected crack length, for example by VT-1, or eddy current examination, for evaluation in accordance with ASME Code Section XI, IWB-3514.3.
- Surface-connected crack length and depth, for example by eddy current, UT, or both, for evaluation in accordance with IWB-3514.3 or IWB-3640.
- For macroscopic corrosion conditions such as crevice corrosion or concentrated pitting, the extent and depth of the corrosion would be determined by visual examination for evaluation of minimum shell thickness in accordance with ASME Code Section III, NB-3000.

If aging effects are identified in accessible locations, further evaluation of the aging effects in inaccessible locations is conducted via TN America’s corrective action program to ensure the aging effect is adequately managed and that the component’s intended function is maintained during the period of extended operation.

C.13.3.7 Corrective Actions

Site quality assurance (QA) procedures, review and approval processes, and administrative controls are implemented according to the requirements of TN Americas 10 CFR Part 72, Subpart G Program. TN America's corrective action program ensures that conditions adverse to quality are promptly identified and corrected, including root cause determinations and prevention of recurrence. Deficiencies are either corrected, or are evaluated as acceptable for continued service through engineering analysis, which provides reasonable assurance that the intended function is maintained consistent with current licensing basis conditions. Evaluations performed to assess conditions associated with aging need to follow the same methodology used in the licensing and design basis calculations. Extent of condition investigation may trigger additional inspections via a different method, increased inspection frequency or expanded inspection sample size, as described next.

Identification of localized corrosion or stress corrosion cracking requires an expansion of the sample size to determine the extent of condition at the site. Canisters with confirmed localized corrosion or stress corrosion cracking must be evaluated for continued service. Canisters with localized corrosion or stress corrosion cracking that do not meet the prescribed evaluation criteria must be repaired or replaced.

<u>Disposition of Canisters with Aging Effects</u>

Confirmation of localized corrosion or stress corrosion cracking requires inspection of additional canisters at the same location to determine the extent of condition. Priority for additional inspections should be to canisters with similar time in service and initial thermal loading.

Extent of condition disposition is commensurate with in-service inspection results:

- Canisters with no evidence of corrosion are permitted to remain in service and will continue to be evaluated at 5-year intervals with no expansion of sampling.
- Canisters with rust deposits that are determined to be a result of iron contamination but do not have evidence of localized corrosion or stress corrosion cracking are permitted to remain in service and will continue to be evaluated at 5-year intervals with no expansion of sampling.
- Canisters that show evidence of localized corrosion or stress corrosion cracking that does not exceed the acceptance standards in IWB-3514.1 are permitted to remain in service and will be evaluated at 5-year intervals. Sample size should be increased to assess candidate canisters with similar susceptibility assessments as determined from the selection criteria in Section C.13.3.4.

- Canisters that show evidence of localized corrosion or stress corrosion cracking that exceeds the acceptance standards in IWB-3514.1 but meet the acceptance criteria identified in IWB-3640 including the required evaluation per IWB-3641(a) using the prescribed evaluation procedures, are permitted to remain in service and should be evaluated at 3-year intervals. Sample size should be increased to assess candidate canisters with similar susceptibility assessments as determined from the selection criteria in Section C.13.3.4.
- Canisters that show evidence of localized corrosion or stress corrosion cracking that exceeds acceptance criteria identified in IWB-3640 are not permitted to remain in service. Sample size should be increased to assess candidate canisters with similar susceptibility assessments as determined from the selection criteria in Section C.13.3.4.

C.13.3.8 Confirmation Process

Confirmatory actions, as needed, are implemented as part of TN America's corrective action program. See also Section C.13.3.7.

C.13.3.9 Administrative Controls

Administrative controls under TN America's QA procedures and corrective action program provide a formal review and approval process. Administrative controls are implemented in accordance with the requirements of TN Americas 10 CFR Part 72, Subpart G Program, and will continue for the period of extended operation.
10 CFR Part 72 [C.13-26] regulatory requirements are used 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 industry as outlined in NEI 14-03 [C.13-2]. See also Section C.13.3.7.

C.13.3.10 Operating Experience

<u>Calvert Cliffs Nuclear Power Plant Experience</u>

The following discussion is extracted from Calvert Cliffs' response to NRC request for supplemental information letter (ML12212A216) [C.13-4].

This section is newly added.

All Indicated Changes are in response to RAI NP-15-13

In 2012, Calvert Cliffs performed an inspection of the interior of two NUHOMS® HSMs, and the exterior of the DSCs as part of their license renewal application. The first module examined was HSM-15, which was loaded in November 1996 and contained the "lead canister" to meet NUREG-1927 [C.13-28] Appendix E guidance. The second module inspected was HSM-1, which was loaded in November 1993 (the first loading) and represents one of the lowest heat load canisters ever loaded (estimated at 4.2 kW (as of the time of inspection)). The latter supplemental canister was added as part of the Electric Power Research Institute (EPRI) research efforts on evaluating stress corrosion cracking of stainless steel canisters used for dry storage. The EPRI research effort included salt concentration measurements on the upper shell of the DSC, collection of samples of the deposits on the upper shell of the DSC for offsite analysis, and surface temperature measurements via contact thermocouples for benchmarking best-estimate thermal models.

The visual inspection was conducted by remote and direct means with a remote controlled high definition PTZ camera system. The remote inspection was performed by lowering the camera through the rear outlet vent, which allowed for viewing of the majority portion of the DSC. The direct inspection was performed through the partially open door by mounting the camera on a pole.

On both DSCs selected for inspection (DSC-6 inside HSM-15 and DSC-11 inside HSM-1), the entire surface of the top cover plate and the top cover plate weld were examined and found to be in good condition with no signs of corrosion.

The shell of DSC-6 was observed to be in good general condition. The center circumferential weld and longitudinal welds were examined and no rust spots or signs of cracking were noted. The bottom shield plug circumferential weld could not be observed because it was obscured by the steel sleeve of the HSM doorway opening. A few small surface rust spots were noted on the DSC shell base metal. Calvert Cliffs believes that the few small spots of light rust on the shell were the result of contamination of the shell with free iron during fabrication or handling prior to being placed in service. Free iron contamination can occur when carbon or low-alloy steel tools come into contact with the surface or particles that are transferred to the stainless steel surface from grinding, welding, or cutting of carbon or low-alloy steel. Rusting of such free iron would be expected to have occurred fairly quickly once the outside surface of the DSC was exposed to water, which happens during the normal course of loading when the TC annulus is filled with demineralized water. The resulting light coating of surface rust would be cosmetic in nature, and would not result in degradation to the stainless steel shell of the DSC in the sheltered environment of the HSM, and is, therefore, not believed to be a current challenge to the confinement function of DSC-6. Calvert Cliffs has initiated a condition report to evaluate these locations in further detail to determine if additional and/or more frequent monitoring is required to conclusively ascertain their nature, and then take appropriate corrective action if their presence is determined to represent a potential challenge to the confinement function of the DSC.

The shell of DSC-11 (the lower heat load canister) was observed to be in good condition, and no signs of the rust were noted on the base metal or welds. A linear wear mark was noted running the length of the lower shell of DSC-11 near the inner side of the west rail. This mark is believed to be from the demonstration Independent Spent Fuel Storage Installation loading campaign that was conducted prior to the start of formal loading operations in 1993. During that demonstration, DSC-11 was loaded with dummy fuel assemblies (FAs) and inserted into an HSM, and then withdrawn. Verbal discussions with individuals who worked on the first loading campaign indicated that when the DSC-11 was used for an actual loading, it was rotated from the position used for the demonstration not to slide it along the rails in the same location twice. No signs of corrosion were noted on this wear mark. Since the wear occurred from sliding on the Nitronic 60 stainless steel surface of the rail, the lack of corrosion on this wear mark compared with that of the scratch on DSC-6, lends additional credence to the idea that the rust on the latter occurred through contact with carbon or low-alloy steel. The bottom end of both DSCs appeared polished, free of corrosion and in very good condition. Both grapple rings were examined and appeared to be in good condition.

Learning AMP

The “DSC External Surfaces Aging Management Program” is a “learning” AMP. This means that this AMP will be updated, as necessary, to incorporate new information on degradation due to aging effects identified from site-specific inspection findings, related industry OE, and related industry research. Site-specific and industry OE is captured through ISP’s OE review process.

The ongoing review of both site-specific and industry OE will continue through the period of extended operation to ensure that this AMP continues to be effective in managing the identified aging effects. Reviews of OE in the future may identify areas where this AMPs should be enhanced, updated, or if a new program should be developed.

ISP to maintain the effectiveness of this AMP under its QA program used to meet the criteria of 10 CFR Part 72, Subpart G [C.13-5 and C.13-26].

C.13.4 DSC Aging Management Program for the Effects of CISCC (Coastal Locations, Near Salted Roads, or in the Path of Effluent Downwind from the Cooling Tower(s))

C.13.4.1 Scope of Program

This AMP is applicable to DSCs from ISFSIs that may have sufficient atmospheric chlorides to initiate CISCC.

First, a site-specific applicability evaluation is performed to determine if this AMP is applicable to the DSC. This applicability evaluation is to be performed prior to entering the period of extended operation. The applicability evaluation determines if the site-specific environmental conditions could expose the DSCs to a chloride-containing atmosphere. This includes ISFSI sites located: (1) in a coastal environment, (2) near salted roads, and (3) in the path of effluent downwind from the cooling tower(s). The site-specific applicability evaluation shall be justified and documented.

This AMP is applicable to DSCs from ISFSIs that may have sufficient atmospheric chlorides to initiate CISCC within the period of extended operation. ISP may demonstrate that this AMP is not applicable by one of two methods:

[ ]

Air monitoring can be accomplished by using airborne particulate monitors or other monitoring stations specific to airborne chloride measurement. The airborne chloride concentration data should follow Environmental Protection Agency Clean Air Status and Trends Network (CASTNET) protocol. CASTNET measures weekly concentrations of chloride using a three-stage filter pack with a controlled flow rate, and chloride results are presented in $\mu g/m^3$.

The DSC AMP for the Effects of CISCC comprises three distinct processes:

- ISFSI specific applicability evaluation to determine if this AMP is applicable to the DSC
- DSC surface monitoring for chlorides, and

This section is newly added.

All Indicated Changes are in response to RAI NP-15-13

- Remote visual inspection for aging effects

This program visually inspects and monitors the external surfaces of the DSC shell assemblies that may be subject to loss of material or CISCC. The program scope includes the external surfaces of the DSC. The areas of DSC inspection are:

- Fabrication welds of the confinement boundary and the associated heat affected zone (HAZ), i.e., longitudinal and (if any) circumferential welds on the cylindrical shell,
- Crevice locations, e.g., where the shell sits on the support rail,
- The upper surface of the cylindrical shell, where atmospheric particulates would settle,
- The top and bottom ends of the cylinder, which are cooler than the center,
- Outer bottom cover plate, grapple assembly, their welds and HAZs, and
- Outer top cover plate, welds and HAZs.

The last two areas are not part of the confinement boundary, but their condition must be ascertained prior to retrieval and transport. As vertical surfaces out of the main path of air flow, they are the least susceptible to the effect of atmospheric deposits. Accessibility to the outer top cover plate may be limited during storage, but prior to transport, it can be inspected after the canister is pulled into a transport cask.

The materials, environments, and aging effects requiring management for the DSC shell stainless steel components in a coastal location, near salted roads, or in the path of effluent downwind from the cooling tower(s) (to maintain confinement, shielding, structural, heat transfer, and retrievability intended safety functions) are as follows:

Materials

DSC shell assembly components subject to AMR are constructed of the following material:

- Stainless steel –shell assembly

Environments

DSC shell assembly components subject to AMR are exposed to the following environments:

- Sheltered

This section is newly added.

All Indicated Changes are in response to RAI NP-15-13

Aging Effects Requiring Management

The following aging effects associated with the DSC shell assembly components require management:

- Loss of material due to crevice and pitting corrosion for stainless steel components,
- Loss of material due to galvanic corrosion for the DSC shell contacting graphite lubricant at the sliding rail surface,
- Cracking due to CISCC for stainless steel components when exposed to moisture and aggressive chemicals in a coastal location, near salted roads, or in the path of effluent downwind from the cooling tower(s),
- Loss of material due to radiation-induced crevice corrosion, pitting corrosion, and SCC for stainless steel DSC shell.

ISP may use inspections results from other general or specific licensee inspections if it can be demonstrated that the other licensee inspections are bounding. Parameters to be considered in making a bounding determination include: similar or more benign environmental conditions, similar storage system design components, similar stored fuel parameters, heat load, and operational history. The criteria for DSC selection or the bounding determination shall be justified and documented. Justification of these bounding demonstrations needs to follow the same methodology used in the licensing and design basis calculations.

C.13.4.2 Preventive Actions

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

C.13.4.3 Parameters Monitored or Inspected

The surface monitoring portion of the AMP consists of collection and measurements of chloride salts on the surfaces of selected DSC shell(s) on different positions of the DSC shell surface to get a representation of the spatial variation of the chloride concentration, if any. The surface chloride concentration data are monitored, correlated, and trended, and compared to NDE results to monitor for CISCC initiation threshold.

The visual inspection portion of the AMP consists of visual inspections to monitor for material degradation of the DSC shell assembly.

- DSC surfaces, welds and HAZs, and crevice locations near the DSC support rails are visually inspected for discontinuities and imperfections.

Parameters Monitored or Inspected for Identified Aging Effects

Aging Effect	Aging Mechanism	Parameter(s) Monitored
Loss of Material	Crevice Corrosion	Surface Condition
Loss of Material	Pitting Corrosion	Surface Condition
Loss of Material	Galvanic Corrosion	Surface Condition
Cracking	Stress Corrosion Cracking	Surface Condition, Cracks

C.13.4.4 Detection of Aging Effects

A minimum of one DSC from each originating ISFSI is selected for inspection. The DSC(s) selected for inspection is based on the following considerations/criteria, which provide the basis for the selection of a bounding DSC(s):

1. Time in service: Storage duration (time in service at originating ISFSI and WCS CISF) is related to surface temperature and deposition of contaminants. The DSC(s) selected for inspection is from the pool of DSCs with longest time in service.

2. Initial heat load: The DSC selected for inspection is from a pool of DSCs with low initial heat loading that result in low DSC shell surface temperatures, thus increasing relative humidity inside the HSM and promoting incubation of ambient contaminants.

3. DSC Fabrication and Design Considerations: A review of the design drawings and DSC fabrication package is performed to further screen-in the DSC(s) from the pool of candidates selected based on (1) and (2). Fabrication weld maps, if available, should be reviewed to identity locations of the circumferential and longitudinal welds, and external configurations of the inner bottom cover-to-shell weld (e.g., ASME Figure NB-4243-1(c)). These features are verified against the fabrication drawings for the specific DSC(s) under consideration for inspection.

4. HSM array configuration relative to climatological and geographical features: DSCs inside HSMs oriented such that the inlet vent openings face the prevalent wind direction are to be considered for inspection, particularly if the wind direction is in the path of potential sources of chloride aerosol contaminants (e.g., off-shore, salted roads, cooling towers, if present).

Visual inspections and surface sampling for chlorides are performed at intervals of 5 years ± 1 year. The ± 1 year is provided for inspection planning and potential limited availability of vendor remote non-destructive examination (NDE) equipment. The first examination will be performed on the selected DSC(s) prior to entering their period of extended operation. The same DSC(s) are used for each subsequent examination for trending.

Visual inspection, surface deposit sampling, and other NDE can be conducted remotely by inserting the inspection and/or sampling devices through the HSM vents or through the annular gap between the DSC and HSM front door opening. Visual examinations follow procedures consistent with the ASME Code, Section XI, IWA-2200 [C.13-3].

Within the HSM cavity, certain surface areas of the DSC may be inaccessible for inspection. This program addresses detection of aging affects for inaccessible areas by the inspection findings in accessible areas.

As much of the DSC surface as can be accessed is examined by VT-3 to ascertain its general condition, including evidence of water stains, discoloration, and surface deposits. **[ ]**

Areas subject to VT-1[2] examination are

- the confinement boundary weld seams and their HAZ,
- the confinement boundary adjacent to the sliding rail surface that it rests upon,
- the confinement boundary surfaces with water staining or with discoloration indicative of corrosion products observed by the VT-3 inspection, and
- the outer top cover plate, welds, and HAZ, if accessible, or if the DSC needs to be completely withdrawn into the transfer cask.

Less than 100% coverage is acceptable if it can demonstrate that the areas sampled for inspection bound or are representative of the balance of the subject area.

Localized corrosion (e.g., pitting and crevice corrosion), stains, discolorations and stress corrosion cracks location and size are documented, if any. Appearance and location of atmospheric deposits on the canister surfaces are recorded.

When indications of aging degradation are detected via the visual NDE method, an NDE method more sensitive than VT-1 is recommended to quantify the degradation in order to evaluate for continued service and to ensure the DSC will continue to perform its intended function. The surface or volumetric NDE portion of the AMP consists of appropriate available NDE techniques.

[2] According to ASME Section XI IWA-2211, the VT-1 visual examination is conducted to detect discontinuities and imperfections on the surface of components, including such conditions as cracks, wear, or corrosion. The VT-1 examination procedure is capable of resolving demonstration characters height of 1.1 mm in accordance with ASME Section XI Table IWA-2211-1 “Visual Examinations.” Remote inspection camera resolution capability shall meet VT-1 illumination, distance, and character height requirements for examination effectiveness.

[

] The examination system shall be, as a minimum, capable of detecting flaws sizes meeting the allowable flaws in ASME B&PV Code Section XI IWB-3514.3 [C.13-3].

Personnel performing visual examinations shall be qualified and certified in accordance with ASME XI, IWA-2300, including the requirements of ASME XI, Appendix VI.

Qualification of other NDE personnel shall be in accordance with ASME XI, IWA-2300. Personnel performing ultrasonic examinations shall also meet the additional certification requirements of ASME XI Appendix VII. In addition, they shall have a current certification for ASME XI, Appendix VIII, Supplement 2, for detection, depth sizing, and length sizing of IGSCC in austenitic materials. Inspection procedures and personnel for surface sampling are qualified in accordance with site-controlled procedures and processes, as prescribed in the TN Americas 10 CFR Part 72, Subpart G Program.

C.13.4.5 Monitoring and Trending

A baseline inspection is performed as part of the monitoring and trending activities so that the inspection results can be used for subsequent trending. Deficiencies are documented using approved site processes and procedures, so that results can be trended and corrected. This monitoring should be conducted in accordance with the TN Americas 10 CFR Part 72, Subpart G Program.

C.13.4.6 Acceptance Criteria

The acceptance criteria are defined to ensure that the need for corrective actions will be identified before loss of intended functions. Visual examination via the use of remote digital camera is based on ASME VT-3 or VT-1 examination or equivalent (ASME Section XI Table IWA-2211-1) [C.13-3]. Any indications of relevant degradation detected are evaluated for continued service in TN America's corrective action program.

Inspection acceptance criteria for the VT-3 examination are no indications of pitting, rust, discoloration, or any indication of surface degradation.

Inspection acceptance criteria for the VT-1 examination are as follows:

- No indications of pitting or crevice corrosion,
- No indications of stress corrosion cracking,
- No indications of corrosion products near crevices,
- No indications of corrosion products on or adjacent to confinement boundary welds, and
- No indications of galvanic corrosion as evidenced by red-orange corrosion products emanating from crevice locations (support rail plate-to-DSC shell interface).

If, based on the results of the inspection, the DSC is determined to be free of any indications of corrosion or other degradation that could lead to the loss of intended function, no further actions are necessary until the next inspection.

If the DSC is determined to contain confirmed or suspected indications of corrosion or degradation, additional engineering evaluations are performed to demonstrate that the DSC will remain able to perform its design bases functions until the next inspection. ASME Code Section XI provides specific rules for evaluating flaw indications that may be detected during the inspections. If flaw indications are found, the flaw geometry is determined from the inspection results in accordance with Section XI, IWA-3300 [C.13-3]. The flaw dimensions are assessed and compared with the allowable flaw dimensions in Section XI, IWB-3514 [C.13-3] acceptance standards. If the flaw size is less than the allowable flaw size in the IWB-3514.1 acceptance standards, the flaw is acceptable with no need for further evaluation. If the flaw size exceeds the allowable flaw size in the IWB-3514.1 acceptance standards, the flaw must be evaluated using the acceptance criteria in IWB-3640. The procedures in ASME Section XI Appendix C [C.13-3] may be used for these evaluations.

When visual examination detects evidence of localized corrosion, the affected areas will be further examined to determine the extent and the depth of penetration. The additional information would be that required to evaluate defects, depending on the nature of the defects observed:

- Surface-connected crack length, for example by VT-1, or eddy current examination, for evaluation in accordance with ASME Code Section XI, IWB-3514.3.
- Surface-connected crack length and depth, for example by eddy current, UT, or both, for evaluation in accordance with IWB-3514.3 or IWB-3640.
- For macroscopic corrosion conditions such as crevice corrosion or concentrated pitting, the extent and depth of the corrosion would be determined by visual examination for evaluation of minimum shell thickness in accordance with ASME Code Section III, NB-3000.

If aging effects are identified in accessible locations, further evaluation of the aging effects in inaccessible locations is conducted via TN America’s corrective action program to ensure the aging effect is adequately managed and that the component’s intended function is maintained during the period of extended operation.

C.13.4.7 Corrective Actions

Site QA procedures, review and approval processes, and administrative controls are implemented according to the requirements of the TN Americas 10 CFR Part 72, Subpart G Program. TN America's corrective action program ensures that conditions adverse to quality are promptly identified and corrected, including root cause determinations 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 function is maintained consistent with current licensing basis conditions. Evaluations performed to assess conditions associated with aging need to follow the same methodology used in the licensing and design basis calculations. Extent of condition investigation may trigger additional inspections via a different method, increased inspection frequency and/or expanded inspection sample size, as described next.

Identification of localized corrosion or stress corrosion cracking requires an expansion of the sample size to determine the extent of condition at the site. Canisters with confirmed localized corrosion or stress corrosion cracking must be evaluated for continued service. Canisters with localized corrosion or stress corrosion cracking that do not meet the prescribed evaluation criteria must be repaired or replaced.

Disposition of Canisters with Aging Effects

Confirmation of localized corrosion or stress corrosion cracking requires inspection of additional canisters at the same location to determine the extent of condition. Priority for additional inspections should be to canisters with similar time in service and initial thermal loading.

Extent of condition disposition is commensurate with in-service inspection results:

- Canisters with no evidence of corrosion are permitted to remain in service and will continue to be evaluated at 5-year intervals with no expansion of sampling.
- Canisters with rust deposits that are determined to be a result of iron contamination but do not have evidence of localized corrosion or stress corrosion cracking are permitted to remain in service and will continue to be evaluated at 5-year intervals with no expansion of sampling.
- Canisters that show evidence of localized corrosion or stress corrosion cracking that does not exceed the acceptance standards in IWB-3514.1 are permitted to remain in service and will be evaluated at 5-year intervals. Sample size should be increased to assess candidate canisters with similar susceptibility assessments as determined from the selection criteria in Section C.13.4.4.

- Canisters that show evidence of localized corrosion or stress corrosion cracking that exceeds the acceptance standards in IWB-3514.1 but meet the acceptance criteria identified in IWB-3640, including the required evaluation per IWB-3641(a), using the prescribed evaluation procedures, are permitted to remain in service and should be evaluated at 3-year intervals. Sample size should be increased to assess candidate canisters with similar susceptibility assessments as determined from the selection criteria in Section C.13.4.4.
- Canisters that show evidence of localized corrosion or stress corrosion cracking that exceeds acceptance criteria identified in IWB-3640 are not permitted to remain in service. Sample size should be increased to assess candidate canisters with similar susceptibility assessments as determined from the selection criteria in Section C.13.4.4.

C.13.4.8 Confirmation Process

Confirmatory actions, as needed, are implemented as part of TN America's corrective action program. See also Section C.13.4.7.

C.13.4.9 Administrative Controls

Administrative controls under TN America's QA procedures and corrective action program provide a formal review and approval process. Administrative controls are implemented in accordance with the requirements of TN Americas 10 CFR Part 72, Subpart G Program, and will continue for the period of extended operation. 10 CFR Part 72 [C.13-26] regulatory requirements are used 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 industry as outlined in NEI 14-03 [C.13-2]. See also Section C.13.4.7.

C.13.4.10 Operating Experience

Information Notice 2012-20 [C.13-6]

NRC Information Notice 2012-20 "Potential Chloride-Induced Stress Corrosion Cracking of Austenitic Stainless Steel and Maintenance of Dry Cask Storage System Canisters" describes the potential for CISCC of austenitic stainless steel DCS canisters. CISCC could affect the ability of the spent fuel storage canisters to perform their confinement function during the period of extended operation. Several instances of CISCC have occurred in austenitic stainless steel components that were exposed to atmospheric conditions near saltwater bodies.

In the fall of 2009, three examples of CISCC, which extended through-wall, were discovered at a nuclear station in the weld HAZ of Type 304 stainless steel piping. The piping included 24-inch, Schedule 10 emergency core cooling system (ECCS) suction piping; 6-inch, schedule 10 alternate boration gravity feed to charging line piping; and an ECCS mini flow return to refueling water storage tank. While the through-wall failures were attributed to CISCC, surface pitting was also observed on the surface of the pipes, with a greater concentration in the weld HAZ. All three pipes were exposed to the outside ambient coastal atmosphere. Through-wall cracks developed after an estimated 25 years of service.

In 2005, at a nuclear station, a through-wall crack in a Type 304 stainless steel spent fuel pool cooling line was detected and attributed to CISCC. The 8-inch, Schedule 10S, seamless pipe was located in a room with a grating steel door that exposed the piping to atmospheric conditions. The crack initiated on the outer diameter at the base of a pit located on the bottom side of the pipe, approximately 0.5-inch downstream from a flange butt weld. The design temperature and pressure for this pipe was 100 °C (212 °F) and 1.03 MPag (150 psig), respectively.

Several failures in austenitic stainless steels have been attributed to CISCC. The components that have failed because of this failure mechanism at nuclear power plants, as discussed above, are made from the same types of austenitic stainless steels typically used to fabricate DCS system canisters. Empirical data have demonstrated that this failure mechanism is reproducible in Type 304 and 304L stainless steel as well as in Type 316L stainless steel. Accordingly, all types of austenitic stainless steels typically used to fabricate DCS system canisters (304, 304L, 316, and 316L) are susceptible to this failure mechanism.

Calvert Cliffs Nuclear Power Plant Experience

Data analysis for the deposited salt collected from the DSC surface has been conducted at Calvert Cliffs in 2012. The salt deposits collected on the actual canister surface in the field also contain other inorganic multiple species together with chloride [C.13-7, C.13-8, C.13-9]. The visual inspection on the DSC surfaces showed that the upper horizontal surface of the DSC canister was covered with dust layers of soil/clay and concrete constituents while the canister side and lower parts were visually metallic. The analysis of the deposits collected from the upper horizontal surface taken from the 11 o’clock position showed a relatively high concentration of sulfate, phosphate, and nitrate with little amount of chloride content (highest measured concentration was 5.2 mg/m^2). The major cations in the deposits were silicon, iron, and calcium, along with lower levels of magnesium, aluminum, potassium, titanium, and zinc. X-ray diffraction analysis revealed multiple crystal phases of the deposits including calcium carbonate, aluminum hydroxide, and silicon containing oxide or silicates complex. No visual indications of cracking were noted from the inspection.

As demonstrated from the inspection results at the Calvert Cliffs ISFSI, the deposits accumulated on the canister surfaces in particular for the upper horizontal surface area contained multiple other soluble and non-soluble species together with chloride content. These other types of anions and cations can affect chemistry of the deliquesced chloride salt solution. For example, the alkaline nature of the concrete constituents such as calcium carbonates and aluminum hydroxide can act to buffer the acidic deliquesced salt brine to be more benign. This is consistent with the buffering effect of carbonate and alumino-silicate that reduced the localized corrosion of Alloy 22 in brine in geologic depository studies. To some extent, inorganic ions such as nitrate and sulfate, and metal cations are also known as inhibitors of the pitting corrosion of stainless steel and aluminum. At this time, however, it is unknown how the presence of the other species would affect the susceptibility of the stainless steel canister to CISCC.

Learning AMP

The "DSC Aging Management Program for the Effects of CISCC" is a "learning" AMP. This means that this AMP will be updated, as necessary, to incorporate new information on degradation due to aging effects identified from site-specific inspection findings, related industry OE, and related industry research. Site-specific and industry OE is captured through ISPs OE review process.

The ongoing review of both site-specific and industry OE will continue through the period of extended operation to ensure that the program continues to be effective in managing the identified aging effects. Reviews of OE in the future may identify areas where AMPs should be enhanced or new programs developed.

ISP is to maintain the effectiveness of this AMP under its QA program used to meet the criteria of 10 CFR Part 72, Subpart G [C.13-5 and C.13-26].

In addition to the ongoing OE review, this AMP requires periodic written evaluations as described in Table C.13-1, of the aggregate impact of aging-related DSCs OE, research, monitoring, and inspections on the intended safety functions of the in-scope DSC's subcomponents (i.e., tollgates). While new information relevant to aging management is assessed, as it becomes available, in accordance with normal corrective action and OE programs, tollgates are an opportunity to seek other information that may be available and to perform an aggregate assessment. Tollgate assessments are not stopping points. No action, other than performing an assessment and addressing relevant findings in TN America's corrective action program, is required to continue operation. Tollgate assessment reports are not required to be submitted to the NRC, but are available for inspection. Appendix A of NEI 14-03 [C.13-2], provides guidance on the performance criteria for the tollgate assessments.

The tollgate schedule may be accelerated (i.e., the next tollgate is performed earlier) whenever sufficient new information has accumulated that could warrant a change in the AMP.

C.13.5 HSM Aging Management Program for External and Internal Surfaces

C.13.5.1 Scope of Program

The scope of the HSM AMP for external and internal surfaces program includes visual inspection of accessible concrete and steel components including HSM walls, roof, and floor slab (if applicable), HSM access door, DSC support structure and rail assembly, heat shields, air inlet and outlet vents, embedments and anchorages (i.e., structural connections including anchor bolts, cast-in-place bolts, through-bolts, and mounting hardware). This AMP also examines the ISFSI storage pad for evidence of concrete degradation.

The materials, environments, and aging effects requiring management for the HSM interior and exterior surfaces and structural components (to maintain shielding, structural, heat transfer, and retrievablity intended safety functions) are as follows:

Materials

HSM structural components subject to AMR are constructed of the following material:

- Reinforced concrete
- Carbon steel
- Stainless steel
- Aluminum

Environments

HSM structural components subject to AMR are exposed to the following environments:

- Sheltered
- Embedded
- External

Aging Effects Requiring Management

The following aging effects associated with the HSM structural components require management:

- Loss of material (spalling, scaling) and cracking due to freeze-thaw actions for reinforced concrete,
- Cracking; loss of bond; and loss of material (spalling, scaling) due to corrosion of embedded steel for reinforced concrete,
- Cracking due to expansion from reaction with aggregates (alkali-silica reaction (ASR)) for reinforced concrete,

- Increase in porosity and permeability; cracking; loss of material (spalling, scaling) due to aggressive chemical attack for reinforced concrete,
- Cracking due to increased stress levels from settlement for reinforced concrete,
- Loss of material due to general, pitting, and crevice corrosion for carbon steel components,
- Loss of material due to pitting and crevice corrosion for aluminum and stainless steel components, and
- Loss of material due to galvanic corrosion of Nitronic® DSC support rail plates.

For coated HSM carbon steel subcomponents, no credit is taken in the AMR for coating for the prevention of aging effect. However, this AMP will manage loss of coating integrity due to blistering, cracking, flaking, peeling, or physical damage.

C.13.5.2 Preventive Actions

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

C.13.5.3 Parameters Monitored or Inspected

For each material/aging effect combination, the specific parameters monitored or inspected depend on the particular HSM subcomponent. Parameters monitored or inspected are commensurate with industry codes, standards, and guidelines and consider industry and site-specific OE. ACI 349.3R [C.13-11] and ANSI/ASCE 11 [C.13-14] provide an acceptable basis for selection of parameters to be monitored or inspected for concrete and steel structural elements.

For concrete structures, parameters monitored include: (1) cracking, loss of bond, and loss of material (spalling and scaling) due to corrosion of embedded steel, freeze-thaw, or aggressive chemical attack; (2) cracking due to expansion from reaction with aggregates ASR; (3) increase in porosity and permeability due to leaching of calcium hydroxide and carbonation or aggressive chemical attack; (4) reduction of concrete anchorage capacity due to local concrete degradation; (5) cracking and distortion due to settlement.

The condition of below-grade concrete is monitored by groundwater chemistry sampling of the following parameters:

- pH
- sulfate concentration
- chloride concentration

This section is newly added.
All Indicated Changes are in response to RAI NP-15-13

Carbon steel, stainless steel, and aluminum components are monitored for loss of material due to general, pitting, galvanic corrosion, and crevice corrosion. Other conditions such as loose or missing anchors, and missing or degraded grout are also part of the inspection.

For coated HSM carbon steel subcomponents, this AMP manages loss of coating integrity due to blistering, cracking, flaking, peeling, or physical damage.

C.13.5.4 Detection of Aging Effects

Visual inspections of the exterior and interior surfaces of HSM structures and structural components and the accessible portions of the storage pad are conducted prior to entering the period of extended operation and at least once every 5 years ± 1 year thereafter, consistent with industry standards (ACI 349.3R) [C.13-11]. The groundwater chemistry sampling is performed prior to entering the period of extended operation and every 5 years ± 1 year thereafter, in order to trend the potential for corrosive environment existing in the area of the ISFSI. The ± 1 year is provided for inspection planning and potential limited availability of vendor remote NDE equipment. The same HSM(s) shall be used for each subsequent examination for the purpose of trending.

Inspection of the interior surfaces of concrete structures and structural components may be performed using a video camera, or fiber-optic scope or borescope technology through the openings of the storage system (e.g., air inlets, air outlets, and access door). Remote inspection system is qualified and demonstrated to have sufficient resolution capability and enhanced lighting to resolve the acceptance criteria in Section C.13.5.6.

The program consists of periodic visual inspections by personnel qualified to monitor structures and components for applicable aging effects, such as those described in the ACI 349.3R [C.13-11], ACI 201.1R [C.13-13], and ANSI/ASCE 11 [C.13-14]. Groundwater chemistry sampling is used to monitor the condition of the below-grade inaccessible portions of the storage pad.

Inspector qualifications should be consistent with industry guidelines and standards. Qualifications of inspection and evaluation personnel specified in ACI 349.3R [C.13-11] are acceptable for license renewal, as prescribed in 10 CFR 72.158.

Within the HSM cavity, certain surface areas are inaccessible for remote camera inspection (e.g., concrete surfaces behind heat shields, portion of the interior rear shield wall). This program addresses detection of aging affects for inaccessible areas by the inspection findings in accessible areas.

Potential degradation of the below-grade portion of the concrete pad is assessed by results of groundwater sampling at a minimum of three locations in the area of the ISFSI at a frequency of five years.

This section is newly added.
All Indicated Changes are in response to RAI NP-15-13

C.13.5.5 Monitoring and Trending

The first (baseline) inspection ascertains the condition of the HSMs at the beginning of the period of extended operation. The conditions of the HSMs observed in subsequent inspections are compared with the baseline conditions of the HSMs for trending purposes.

ACI 349.3R [C.13-11] prescribes that crack maps should be developed, monitored, and trended as a means of identifying progressive growth of defects that may indicate degradation due to specific aging effects such as ASR-induced expansion, freeze-thaw, or corrosion of rebar. Crack maps should be compared with those from previous inspections to identify accelerated degradation of the structure during the period of extended operation.

Deficiencies are documented using approved processes and procedures, so that results can be trended and corrected. This monitoring is conducted in accordance with the provisions of TN Americas 10 CFR Part 72, Subpart G Program.

C.13.5.6 Acceptance Criteria

The HSM AMP for external and internal surfaces calls for inspection results to be evaluated by qualified engineering personnel based on acceptance criteria selected for each structure and aging effect to ensure that the need for corrective actions is identified before loss of intended function occurs. The criteria are derived from design basis codes and standards and are to include ACI 349.3R [C.13-11], ACI 318 [C.13-15], ANSI/ASCE 11 [C.13-14], ASME Code [C.13-3], or the relevant AISC specifications, as applicable, and consider industry and facility OE. The criteria are directed at the identification and evaluation of degradation that may affect the ability of the HSM to perform its intended function. Loose bolts and nuts and cracked bolts are not acceptable unless approved by engineering evaluation.

Metallic Components

Inspection parameters for metallic components include the following:

For metallic surfaces, any of the following indications of relevant degradation detected are evaluated.

- Corrosion and material wastage (loss of material),
- Crevice, pitting, and galvanic corrosion (loss of material),
- Worn, flaking, or oxide-coated surfaces (loss of material),
- Corrosion stains on adjacent components and structures (loss of material),
- Surface cracks (cracking), or
- Stains caused by leaking rainwater

This section is newly added.

All Indicated Changes are in response to RAI NP-15-13

For carbon steel surfaces, one acceptable method for characterizing and quantifying the amount of corrosion (rust) present on a painted steel surface is ASTM D610-08 [C.13-16]. This test method covers the evaluation of the degree of rusting (spot rusting, general rusting, pinpoint rusting, and hybrid rusting) using visual standards and descriptions of 11 rust grades. In this method, Rust Grade 10 corresponds to no rust or less than 0.01% of surface rusted, Rust Grade 4 corresponds to rusting greater than 3% to the extent of 10% of surface rusted, and Rust Grade 0 corresponds to approximately 100% of surface rusted. In addition to determining the source of the corrosion, noted degradation shall be trended and evaluated under TN America's corrective action program.

For stainless steel and aluminum HSM subcomponents (e.g., stainless steel DSC support structure (HSM Model 152 only) heat shields, vent screens, and frames), a characterization method similar to ASTM D610 can be utilized to document, evaluate and trend crevice and pitting corrosion, if found.

<u>Concrete Components</u>

Inspection parameters for concrete components include the following:

Concrete acceptance criteria from ACI 349.3R [C.13-11] represent acceptable conditions for observed degradation that has been determined to be inactive. These criteria are termed second-tier for structures possessing 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 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 without requiring any further evaluation:

- Absence of leaching and chemical attack, including microbiological chemical attack,
- Absence of signs of corrosion in the steel reinforcement,
- Absence of drummy areas (poorly consolidated concrete, air void with paste deficiencies per ACI 201.1R),
- [ ]
- Scaling less than [ ]
- Spalling less than [ ]
- Absence of corrosion staining of undefined source on concrete surfaces,

[ ]

- Passive settlements or deflections within the original design limits.

The acceptance criteria for the groundwater chemistry sampling program are:

- pH ≥ 5.5
- Chlorides ≤ 500 ppm
- Sulfates ≤ 1500 ppm

These criteria are consistent with guidance provided in NUREG-1801 [C.13-12] and would demonstrate that the ISFSI concrete pad is not exposed to an aggressive soil and groundwater environment. For sites that exceed the above criteria (i.e., ISFSI sites with an aggressive soil and groundwater environment) a site-specific ISFSI concrete pad AMP is to be implemented as part of corrective action program.

If aging effects are identified in accessible locations, further evaluation of the aging effects in inaccessible locations is conducted via TN America's corrective action program to ensure the aging effect is adequately managed and that the component's intended function is maintained during the period of extended operation.

<u>Coatings</u>

Inspection parameters for coatings include the following:

Coating acceptance criteria are established in accordance with ASTM D7167-12 [C.13-17]. Acceptable coatings are free of peeling or delamination. Blistering, cracking, flaking, rusting, and physical damage are evaluated by a nuclear coatings specialist to determine acceptability.

Standard definitions of degradation mechanisms, in accordance with ASTM D4538-05 [C.13-18] and EPRI 1019157 [C.13-19], are as follows:

- Blistering - formation of bubbles in a coating (paint) film
- Cracking - formation of breaks in a coating film that extend through to the underlying surface
- Flaking - detachment of pieces of the film itself either from its substrate or from coating (paint) previously applied
- Peeling - separation of one or more coats or layers of a coating from the substrate
- Delamination - separation of one coat or layer from another coat or layer or from the substrate
- Rusting - corrosion that occurs when the applied coating thickness is insufficient to completely or adequately cover steel surfaces

- Physical Damage - removal or reduction of thickness of coating by mechanical damage

Repair, rehabilitation, or corrective action of an unacceptable condition should be performed in accordance with an applicable rehabilitation standard such as ACI 224.1R [C.13-20], ACI 364.1R [C.13-21] or ACI 562-13 [C.13-22].

C.13.5.7 Corrective Actions

Site QA procedures, review and approval processes, and administrative controls are implemented according to the requirements of TN Americas 10 CFR Part 72, Subpart G Program. TN America's corrective action program ensures that conditions adverse to quality are promptly identified and corrected, including root cause determinations 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 function is maintained consistent with current licensing basis conditions. Evaluations performed to assess conditions associated with aging need to follow the same methodology used in the licensing and design basis calculations. Extent of condition investigation per TN America's corrective action program may trigger additional inspections via a different method, increased inspection frequency and/or expanded inspection sample size.

C.13.5.8 Confirmation Process

Confirmatory actions, as needed, are implemented as part of TN America's corrective action program. See also Section C.13.5.7.

C.13.5.9 Administrative Controls

Administrative controls under TN America's QA procedures and corrective action program provide a formal review and approval process. Administrative controls are implemented in accordance with the requirements of TN Americas 10 CFR Part 72, Subpart G Program, and will continue for the period of extended operation. 10 CFR 72 regulatory requirements are used 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 industry as outlined in NEI 14-03 [C.13-2]. See also Section C.13.5.7.

C.13.5.10 Operating Experience

The HSM AMP for external and internal surfaces is modeled after the regulatory philosophy of 10 CFR 50.65 [C.13-10] structures monitoring program. Structures monitoring programs have been implemented for managing aging effects during the extended period of license renewal of the operating reactor plants. NUREG-1522 [C.13-23] documents the results of a survey in 1992 to obtain information on the types of distress in the concrete and steel structures and components, the type of repairs performed, and the durability of the repairs. Licensees who responded to the survey reported cracking, scaling, and leaching of concrete structures. The degradation was attributed to drying shrinkage, freeze-thaw, and abrasion. The degradation also includes corrosion of component support members and anchor bolts, cracks and other deterioration of masonry walls, and groundwater leakage and seepage into underground structures. The degradations at coastal sites were more severe than those observed at inland sites because of exposure to brackish water or seawater.

Information Notice IN 2013-07 "Premature Degradation of Spent Fuel Storage Cask Structures and Components from Environmental Moisture" describes OE on NUHOMS® HSMs installed at the TMI-2 INL site where water contributed to an accelerated aging process of concrete structures of the spent fuel storage system. Water entered cracks and crevices around the anchor bolt blockout through holes in the concrete roof structure, and when subjected to freezing temperatures, generated mechanical forces that produced cracks in the concrete. These cracks provided additional and larger pathways for water to enter the interior of the concrete, which resulted in larger cracks from subsequent freezing temperatures and promoted efflorescence. If remedial actions had not been taken, this accelerated aging process could have inhibited the ability of the concrete structure to perform its design function of protecting the canister system containing the radioactive material, as well as protecting personnel from ionizing radiation during normal and accident conditions. This example shows the importance of periodically monitoring the physical condition of a spent nuclear fuel storage system. By obtaining baseline measurements and performing periodic evaluations, accelerated degradation can be detected before the structures and components of a storage system become unable to perform their intended function, and corrective actions can be implemented.

<u>NUHOMS® Operating Experience</u>

Chapter 3, Section 3 of reference [C.13-29] provides a detailed description of NUHOMS® CoC 1004 OE.

<u>Calvert Cliffs' Operating Experience</u>

In 2012, Calvert Cliffs performed an inspection of the interior of two NUHOMS® HSMs, and the exterior of the DSCs as part of their license renewal application [C.13-4]. The visual inspection was conducted by remote and direct means with a remote controlled high definition PTZ camera system.

This section is newly added.

All Indicated Changes are in response to RAI NP-15-13

The accessible surfaces of the HSM concrete walls, roof, and floor all appeared to be in good condition with little to no signs of spalling or cracking. There was additional evidence of localized water intrusion to the interior of the module in the form of a few concrete stalactites. These stalactites were seen only near the rear outlet vent, which suggests that the source of the water intrusion is the outlet vent stack. Broken stalactite debris was observed on the surface of the heat shields beneath the ceiling. Stalactites are formed when water leaches calcium hydroxide out of the concrete ceiling, which precipitates as calcium carbonate on contact with carbon dioxide in the air. Water was observed to flow inward along concrete surface cracks, though water had not penetrated to the rebar, and the pure white color of the stalactites was present on the concrete surface. Therefore, concrete leaching could also occur in these surface cracks.

A condition report was initiated to evaluate whether their presence could have implications for performance of the intended functions of the HSM prior to the next aging management inspection. A coating of dirt and dust was present on the floor of both HSMs, but no debris or standing water was noted. In both HSM-15 and HSM-1, the DSC structural support beams and rails were in good condition, with the coating intact in most areas. There was a large buildup of dust on the transverse support beams horizontal surfaces particularly on the beams at the back end of the module. There were no signs of loose or missing bolting or fasteners. General corrosion of the carbon steel surface and bolting hardware was observed. The small areas of general surface corrosion observed do not represent a current challenge to the function of the DSC structural supports.

TMI-2 at Idaho National Laboratory Experience

The Three Mile Island Nuclear Generating Station, Unit 2 ISFSI uses NUHOMS-12T HSMs. In 2000, the licensee Department of Energy Idaho National Laboratory (INL), noted cracks in the HSMs and concluded they were cosmetic and insignificant. However, in 2007, the licensee observed continued cracking, crazing and spalling, as well as increased efflorescence on the HSM surfaces. The efflorescence was a solid, whitish crystalline material that was determined through sampling and analysis to be calcium carbonate. The licensee performed an evaluation in 2007, during which it determined that the HSMs were capable of performing their design basis functions. In 2008, the licensee noted that 28 of the 30 HSMs had cracks, mostly emanating from the anchor bolt blockout holes with widths up to 0.95 cm (0.38 in.). At that time, the licensee determined that the HSMs appeared to be prematurely deteriorating and that continued crack growth could affect the ability of the HSMs to fulfill their originally planned 50-year design service life. Subsequent evaluations by the licensee initiated the development of an annual inspection plan for the HSMs and base mat, as well as an examination of the inside of the HSMs. The evaluation included a field investigation and laboratory analysis to evaluate the concrete material quality, strength, and long-term durability potential. The conclusion reached was that water had entered the anchor bolt blockout holes on the roof of the HSMs. Subsequent freeze-thaw cycles initiated the crack formation. Repetition of the process resulted in both continued crack growth and the efflorescence growth identified in 2007 [C.13-24].

The licensee performed an extensive effort to correct the degrading concrete of their HSMs since 2011. Despite the observed cracking, the HSMs continued to fulfill fully their safety functions. The licensee committed to perform follow-up concrete inspections. This included: (1) an annual visual inspection of the repaired areas for any signs of additional cracking from freeze/thaw action; (2) that the personnel performing the inspection or evaluations would meet the requirements of American Concrete Institute (ACI) 349.3R-02, Chapter 11, "Qualifications of Evaluation Team;" (3) that visual inspections of accessible HSM concrete surfaces for aging effects would be performed per instructions contained in ACI 349.3R-02, Section 3.5.1, Visual Inspections and ACI 201.IR-08, "Guide for Conducting a Visual Inspection of Concrete in Service." Based on completion of the HSM concrete repairs, combined with licensee plans to implement a baseline inspection and an aging monitoring program on the HSM's, the NRC inspector follow-up item (IFI) has been closed [C.13-25].

Learning AMP

The "HSM Aging Management Program for External and Internal Surfaces" is a "learning" AMP. This means that this AMP will be updated, as necessary, to incorporate new information on degradation due to aging effects identified from site-specific inspection findings, related industry OE, and related industry research. Site-specific and industry OE is captured through ISP's OE review process.

The ongoing review of both site-specific and industry OE will continue through the period of extended operation to ensure that the program continues to be effective in managing the identified aging effects. Reviews of OE by the licensee in the future may identify areas where AMPs should be enhanced or new programs developed.

ISP is to maintain the effectiveness of this AMP under its QA program used to meet the criteria of 10 CFR Part 72, Subpart G [C.13-5 and C.13-26].

C.13.6 References

C.13-1 NUREG-1927, "Standard Review Plan for Renewal of Spent Fuel Dry Cask Storage System Licenses and Certificates of Compliance," U.S. Nuclear Regulatory Commission, Revision 1, June 2016.

C.13-2 NEI 14-03, "Format, Content, and Implementation Guidance for Cask Storage Operations-Based Aging Management," Revision 1, September 2015.

C.13-3 ASME B&PV Code, Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components." The ASME Boiler and Pressure Vessel Code, 2010, The American Society of Mechanical Engineers.

C.13-4 Calvert Cliffs Nuclear Power Plant, Independent Spent Fuel Storage Installation, Material License No. SNM-2505, Docket No. 72-8, "Response to Request for Supplemental Information, RE: Calvert Cliffs Independent Spent Fuel Storage Installation License Renewal Application," (TAC No- L24475), July 27, 2012 [ML12212A216].

C.13-5 NRC Regulatory Issue Summary 2014-09, "Maintaining the Effectiveness of License Renewal Aging Management Programs," August 6, 2014.

C.13-6 NRC Information Notice 2012-20, "Potential Chloride-Induced Stress Corrosion Cracking of Austenitic Stainless Steel and Maintenance of Dry Cask Storage System Canister," U.S. Nuclear Regulatory Commission, Office of Nuclear Material Safety and Safeguards.

C.13-7 J. Massari, "Calvert Cliffs ISFSI License Renewal and Expansion," Presentation at the NEI Used Fuel Management Conference, St. Petersburg, FL, May 7-9, 2013.

C.13-8 Letter from M.D. Flaherty to U.S. NRC, "Response to Request for Additional Information, 1799 RE: Calvert Cliffs Independent Spent Fuel Storage Installation License Renewal Application 1800 (TAC No. L24475)," June 14, 2013 [ML13170A574].

C.13-9 EPRI Letter (2013), "CCNPP Canister Inspection Chemical Analysis Results of Samples Collected," March 25, 2013.

C.13-10 10 CFR 50.65, "Requirements for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants," U.S. Nuclear Regulatory Commission, Office of the Federal Register.

C.13-11 ACI 349.3R, "Evaluation of Existing Nuclear Safety-Related Concrete Structures, American Concrete Institute," 2002.

C.13-12 NUREG-1801, Revision 2, "Generic Aging Lessons Learned (GALL) Report-Final Report," December 2010.

C.13-13 ACI 201.1R, "Guide for Making a Condition Survey of Concrete in Service," American Concrete Institute, 2008.

C.13-14 ANSI/ASCE 11-90, 99, "Guideline for Structural Condition Assessment of Existing Buildings," American Society of Civil Engineers.

This section is newly added.

All Indicated Changes are in response to RAI NP-15-13

C.13-15 American Concrete Institute, "Building Code Requirements for Reinforced Concrete," (ACI 318-83, 95) ACI, Detroit, MI (1983, 1995).

C.13-16 ASTM D610-08, "Standard Practice for Evaluating Degree of Rusting on Painted Steel Surfaces," American Society for Testing and Materials, November 2012.

C.13-17 ASTM D7167-12, "Standard Guide for Establishing Procedures to Monitor the Performance of Safety-Related Coating Service Level III Lining Systems in an Operating Nuclear Power Plant, ASTM International," West Conshohocken, PA, 2012.

C.13-18 ASTM D4538-05, "Standard Terminology Relating to Protective Coating and Lining Work for Power Generation Facilities," ASTM International, West Conshohocken, PA, 2005.

C.13-19 EPRI Report 1019157, "Guideline on Nuclear Safety-Related Coatings," Revision 2, (Formerly TR-109937 and 1003102), Electric Power Research Institute, December 2009.

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C.13-30 Letter from Meraj Rahimi (NRC) to Jayant Bondre (TN Americas LLC), "Renewal of Initial Certificate and Amendments Nos. 1 through 11and 13 Revision 1 and Amendment No. 14 of Certificate of Compliance No. 1004 for the Standardized NUHOMS® Horizontal Modular Storage System," December 4, 2017, (ADAMS Accession Number ML17338A092).

Table C.13-1
DSC AMP for the Effects of CISCC Tollgates

Tollgate	Year	Assessment
1	prior to T_o	Perform initial inspection of selected DSCs as specified in Section C.13.4.4 and as updated at the time that planning for the inspection begins.
2	$T_o + 5$ (note 1)	Evaluate information from the following sources and perform a written assessment of the aggregate impact of the information, including but not limited to corrective actions required and the effectiveness of the CISCC AMP: • Results of research and development programs focused specifically on initiation, propagation, inspection, and mitigation of atmospheric CISCC, such as those conducted by Electric Power Research Institute (EPRI), Central Research Institute of Electric Power Industry (CRIEPI), the Department of Energy (DOE), and DOE/University programs • Results of tollgate 1 inspections, including trending of chloride surface concentration, temperature, and humidity conditions compared to the latest research on CISCC initiation. • Relevant results of other domestic and international nuclear and non-nuclear research. • Relevant domestic and international nuclear and non-nuclear OE. • Relevant results of domestic and international performance monitoring for welded canister dry storage systems. • Relevant results of domestic and international inspections of welded canister dry storage systems. • Availability of improved technologies to inspect DSCs for stress corrosion cracking and for chemistry of surface deposits.
3	T_o+10	Evaluate additional information gained from the sources listed in tollgate 2 along with any new relevant sources and perform a written assessment of the aggregate impact of the information, including results of tollgate 2. The age-related degradation mechanisms evaluated at this tollgate and the time at which it is conducted may be adjusted based on the results of the tollgate 2 assessment.
4	T_o+20	Same as tollgate 2 as informed by the results of tollgates 2 and 3
5	T_o+30	Same as tollgate 3 as informed by the results of tollgates 2, 3, and 4

Notes:
(1) T_o is twenty years after the first DSC at the ISFSI was loaded.

D.3.4.6 Material Selection

Materials are selected based on their corrosion resistance, susceptibility to stress corrosion cracking, embrittlement properties, and the environment in which they operate during normal, off normal and accident conditions. The confinement boundary for the DSC materials meet the requirements of ASME Boiler and Pressure Vessel Code, Section III, Article NB-2000 and the specification requirements of Section II, Part D [D.3-7], with the listing of ASME Code alternatives for the DSCs provided in Tables T.3.1-2 and T.3.1-3 of the "Standardized NUHOMS® Horizontal Modular Storage System Safety Analysis Report" [D.3-1]. The code alternatives applicable to the MP197HB Cask are provided in Appendix A.2.13.13 of reference [D.3-10]. The DSC and cask materials are resistant to corrosion and are not susceptible to other galvanic reactions. Studies under severe marine environments have demonstrated that the shell materials used in the DSC shells are expected to demonstrate minimal corrosion during an 80-year exposure. The DSC internals are enveloped in a dry, helium-inerted environment and are designed *to withstand the loads from all normal, off-normal and accident conditions*. The HSM is a reinforced concrete component with an internal DSC support structure that is fabricated to ACI and AISC Code requirements. Both have durability well beyond a design life of 80 years.

D.3.4.7 Operating Procedures

The sequence of operations are outlined for the NUHOMS®-61BTH Type 1 System in Chapter 5 and C.5 for receipt and transfer of the DSCs to the storage pad, insertion into the HSM, monitoring operations, and retrieval and shipping. Throughout Chapter 5, CAUTION statements are provided at the steps where special notice is needed to maintain ALARA, protect the contents of the DSC, or protect the public and/or ITS components of the NUHOMS®-61BTH Type 1 System.

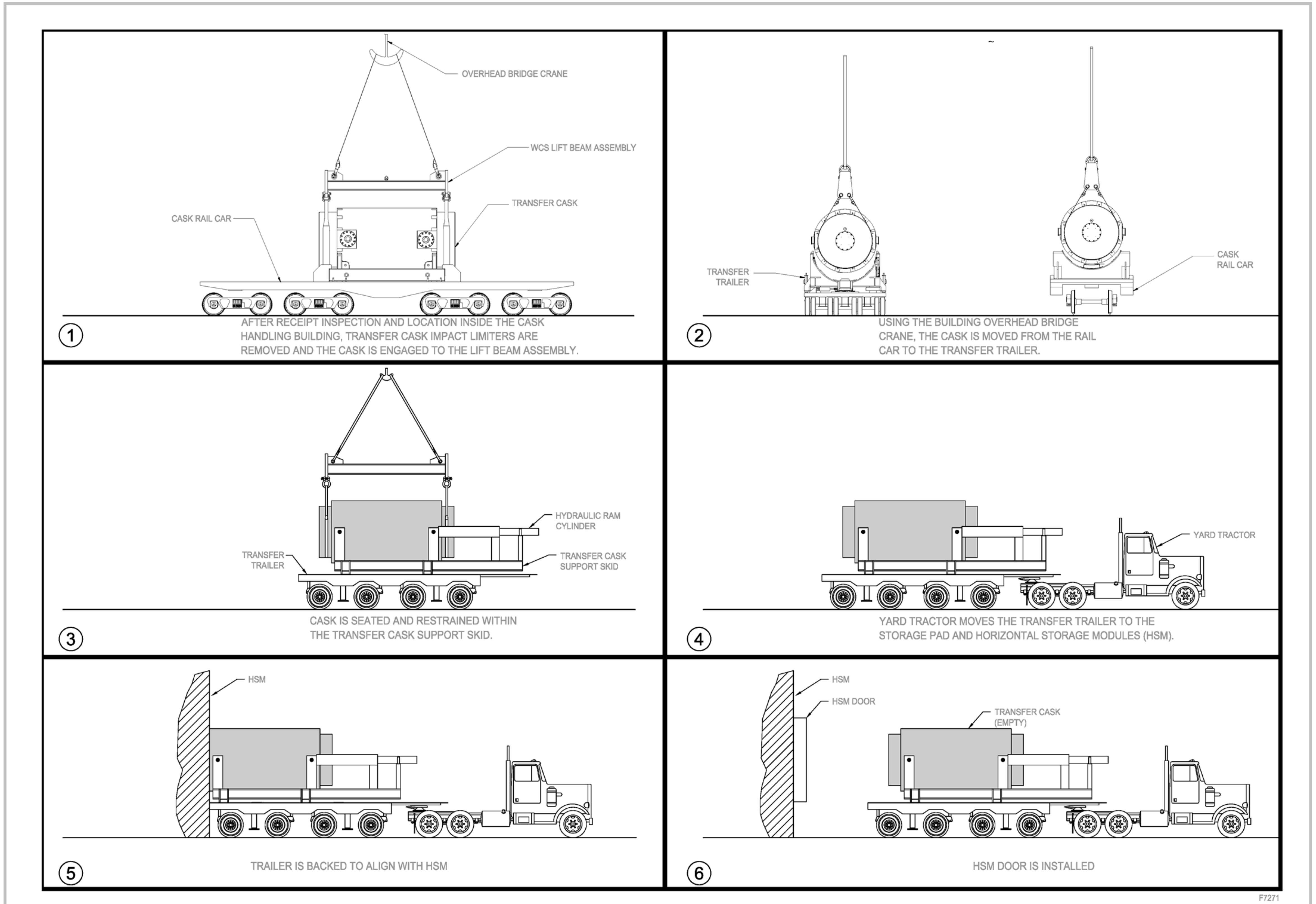

Figure D.5-1
Standardized NUHOMS®-61BTH Type 1 System Loading Operations

APPENDIX D.13
AGING MANAGEMENT PROGRAMS

Table of Contents

This section is newly added.

All Indicated Changes are in response to RAI NP-15-13

D.13. AGING MANAGEMENT PROGRAMS

The aging management programs (AMPs) described in Appendix C, Section C.13 are applicable to the SSCs of the 61BTH system.

This section is newly added.

All Indicated Changes are in response to RAI NP-15-13

H.3 PRINCIPAL DESIGN CRITERIA

RAI NP-15-4

This section describes the principal design criteria, which are unique to the canisterized GTCC waste storage program at the WCS CISF. *All GTCC canisters will be stored in the same storage overpacks used to store SNF canisters for each of the storage systems used at WCS CISF (Table 1-1). In addition, the GTCC canisters used for each storage system have external characteristics that are similar, and in most cases identical, to the canisters used for SNF. The drawings describing the GTCC containers, internal basket designs, and applicable design codes are listed for each of the storage systems in Section H.4.8. Additional descriptions of the GTCC canisters and internals can be found in the references listed in Section H.3.1.1.*

The design criteria used for WCS CISF are summarized in Table 1-2 and discussed in Chapter 3 of this SAR. A comparison of the design criteria for each of the storage systems with the WCS CISF design criteria is given in Appendices A–F (specifically in Tables A.3-1, B.3-1, C.3-1, D.3-1, E.3-1, F.3-1, and G.3-1). These comparisons demonstrate that the design criteria used for the storage systems are bounded by the WCS CISF design criteria.

Since the design criteria for the GTCC canisters at WCS CISF are the same as the design criteria used for storage systems listed in Table 1-1, a comparison of the design criteria for each of GTCC storage systems with WCS CISF conditions would be the same as the comparisons already shown for the storage systems in Appendices A and E through G and are not repeated in this chapter.

RAI NP-15-9