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April 12, 1996

Document Control Desk
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Subject: McGuire Nuclear Station
Docket Nos: 50-369 and 370
Spent Fuel Pool
Full Core Offload - 10CFR50.59 Analysis
Revision #1

Dear Sir:

Pursuant to our telecon of April 4, 1996, attached is the subject 10CFR50.59 analysis to support the continuing practice of full core offloads at McGuire Nuclear Station. Note that the practice of full core offloads is an integral part of the original plant licensing basis. The practice at McGuire is to disassemble the reactor core and move all fuel assemblies to the spent fuel pool during refueling activities. McGuire FSAR sections 9.1.3.1 and 9.1.4.1 are clarified to reflect this practice. No change to plant systems or components is being made. The clarification is made to enhance understanding of the practice and the basis of full core discharge to the spent fuel pool during refueling activities. In addition to the subject 50.59 analysis, included are markups of the applicable FSAR pages associated with the 50.59 analysis and proposed revisions of FSAR Tables which will be included in the upcoming fall, 1996 McGuire FSAR upgrade.

McGuire Unit 2 is currently in a refueling outage. The core offload of McGuire Unit 2 is scheduled to begin 4/13/96 at approximately 0400.

If you require further information, please contact James E. Snyder at (704)875-4447.

Very truly yours,

T. C. McMeekin

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If the shock absorbing cover is not in place, cask lifts are limited to 12" above the operating deck to ensure the validity of the cask drop analysis.

At such time that another truck cask or a rail cask is contemplated for use, a similar analysis will be performed prior to using the cask to assure that it will not enter the spent fuel pool.

9.1.2.4 Storage of Oconee Spent Fuel

The interim spent fuel storage plans for Duke Power nuclear facilities call for storage of Oconee spent fuel assemblies in the McGuire Spent Fuel Pools. A detailed description of Oconee fuel assemblies is given in Final Safety Analysis Report, Oconee Units 1, 2, and 3. Oconee fuel storage will proceed within the system design bases listed in Section 9.1.2.1, "Design Bases" on page 9-6. The safety evaluation presented in Section 9.1.2.3, "Safety Evaluation" on page 9-11 for the two region poison racks also applies to the storage of Oconee spent fuel assemblies.

9.1.3 SPENT FUEL COOLING AND PURIFICATION

The Spent Fuel Pool Cooling System (KF) is designed to remove heat from the spent fuel pool and maintain the purity and optical clarity of the pool water during fuel handling operations. The purification loop provides an alternate means for removing impurities from either the refueling cavity/transfer canal water during refueling or the refueling water storage tank water following refueling.

9.1.3.1 Design Bases

KF System design parameters are given in Table 9-1.

9.1.3.1.1 Spent Fuel Pool Cooling

The existing Spent Fuel Cooling System is designed to maintain the spent fuel pool water temperature within acceptable limits under normal and ~~abnormal~~ maximum heat load conditions. The normal and ~~abnormal~~ maximum heat loads are defined as follow:

<u>Normal Heat Load</u>: Assumes one-third core has been placed in the pool seven (7) days after shutdown. The remainder of the pool, less 193 spaces, is filled with previous McGuire discharges from normal refueling operations. ~~and Oconee spent fuel which has decayed at least five (5) years.~~ The 193 empty spaces are reserved for a full core discharge. The Oconee fuel is conservatively removed and replaced with higher heat load McGuire fuel in this calculation. Oconee fuel stored at McGuire has decayed such that it no longer adds a significant heat load compared to McGuire discharged fuel.

maximum ~~Abnormal~~ <u>Heat Load</u>: Assumes one full core discharge consisting of three batches. The batches are irradiated for 23.5 days, one year, and two years respectively. In addition, one refueling batch has decayed 36 days. The remainder of the pool is filled with previous McGuire discharges from normal refueling operations. ~~and Oconee spent fuel which has decayed at least five (5) years.~~ This case establishes the maximum heat load for pool operation and analysis.

Both cases assume that fuel is discharged over a 50 hour period after a minimum cooling time of 100 hours in the reactor vessel. The heat released from the fuel stored in the pool is determined in accordance with Branch Technical Position APCSB 9-2 "Residual Decay Energy for Light Water Reactors for Long Term Cooling." The calculations assume ~~a 12 month refueling cycle for McGuire and~~ an 18 months ~~for Oconee.~~ refueling cycle for McGuire. Table 9-3 and Table 9-4 show the normal and abnormal maximum heat loads for the expanded pool.

→ Insert Supplement

Supplement to 9.1.3.3.1 Availability and Reliability

For the normal heat load case, the spent fuel cooling system is designed for a single failure for an indefinite period of time. Table 9-5 shows that temperatures remain within acceptable limits.

For the maximum heat load case, the spent fuel pool cooling system is not designed for a single failure for an indefinite period of time. For single failure conditions, Table 9-5 shows that temperatures remain below boiling.

McGuire has a design requirement for the spent fuel pool to be qualified as an assured source for the Standby Shutdown Facility. The design basis of the Standby Shutdown Facility includes a total loss of spent fuel pool cooling for a period of 72 hours. Analysis of this scenario has shown that all spent fuel pool structures, systems and components are qualified for the 72 hour period. This provides adequate time for recovery of spent fuel pool cooling. This Standby Shutdown Facility scenario bounds the loss of one train of spent fuel pool cooling under maximum heat loads for 72 hours.

In summary, the spent fuel pool is not indefinitely qualified for loss of a single train under maximum heat loads. Spent fuel pool structures, systems and components have been qualified for a period of 72 hours given a complete failure of the pool cooling system. This provides adequate time for restoration of pool cooling should a train be lost during maximum heat load conditions.

connections, piping, and supports are removed. The CRDM cable bridge and seismic struts are removed. The head vent line flanges are disassembled. The blind flange and gasket are installed to piping attached to the refueling canal wall. The vessel head indication tubing is removed. The vessel head studs are detensioned and studs, nuts, and washers are removed, cleaned, inspected, and stored. The NIS detectors cover O-rings are removed and replaced. The vessel canal seal is installed and then tested by inflation. The permanent vessel nozzle inspection port plugs are installed and sealed. The head lift rig is attached and the head is lifted about four inches and stopped. This position is held for at least ten minutes during which time the sling bolt lugs to the lifting block welds, and the spreader lugs to the spreader arm welds are visually inspected. The head is then lifted to an appropriate height and moved to the vessel head storage stand. The CRDM shafts are then disconnected and, with the
4 upper internals, are removed from the vessel. The manipulator cranes are checked for proper operation. The fuel assemblies and rod cluster control assemblies are then free from obstructions and the core is ready for refueling.

3. Phase III - Fuel Handling

4 The refueling sequence is started with the reactor manipulator crane. Spent fuel assemblies are removed from the core in the sequence presented in the refueling procedure which is prepared before each refueling. ~~The positions of partially spent assemblies are changed, and new assemblies are added to the core. Alternatively, the entire core may be offloaded to the spent fuel pool.~~ The fuel assemblies are offloaded to Region 1 of the spent fuel pool where control rods and fuel components are moved to the assemblies they will occupy for the next fuel cycle. If desired only the discharge assemblies maybe removed and the remaining assemblies moved to their new locations.

The general fuel handling sequence is:

4 a. The reactor manipulator crane is positioned over a fuel assembly.

b. The fuel assembly is lifted by the manipulator crane to a pre-determined height sufficient to clear the reactor vessel and still leave sufficient water covering to eliminate any radiation hazard to the operating personnel.

c. The fuel transfer car is moved into the refueling canal from the spent fuel pool.

d. The fuel assembly container is pivoted to the vertical position by the upender.

e. The manipulator crane is moved to line up the fuel assembly with the fuel transfer system.

f. The manipulator crane loads a fuel assembly into the fuel assembly container of the transfer car.

4 g. The container is pivoted to the horizontal position by the reactor side upender.

h. The fuel container is moved through the fuel transfer tube to the spent fuel pool by the transfer car.

4 i. The container is pivoted to the vertical position by the pit side upender.

4 j. The fuel assembly is placed in the spent fuel storage rack by the fuel pool manipulator crane.

4 k. The new fuel assembly is brought from dry storage, lowered into the spent fuel pool with the new fuel elevator, and loaded into the spent fuel pool. Alternatively, the new fuel assembly may be already stored in the spent fuel racks.

4 l. Components are shuffled as necessary for next cycle.

4 m. The fuel assembly is loaded into the fuel assembly container by the fuel pool manipulator crane.

4 n. The fuel assembly container is pivoted to the horizontal position and the transfer car is moved back into the refueling canal.

4 o. The container is pivoted to the vertical position by the reactor side upender.

4 p. Fuel assemblies are located in the reactor core by the reactor manipulator crane.

4. Phase IV - Reactor Assembly

FSAR Table 9-3

~~Table A2-1~~

Normal ~~Maximum~~ Heat Load - 76 Feed Batch

Cooling (Days)	Enrichment	Burnup (MWd/MTU)	EFPD	Discharged Assemblies	Total Discharged	BTP 9-2 heatload (BTU/Hr)	ANS 5.1 heatload (BTU/Hr)
7	4.150	47277	1234.022	44	44	8.21E+06	8.27E+06
	4.400	42501	1109.359	32	76	5.95E+06	7.07E+06
579	4.150	47277	1234.022	44	120	5.49E+05	6.89E+05
	4.400	42501	1109.359	32	152	3.88E+05	4.71E+05
1121	4.150	47277	1234.022	44	196	3.19E+05	3.36E+05
	4.400	42501	1109.359	32	228	2.24E+05	2.26E+05
1664	4.150	47277	1234.022	44	272	2.58E+05	1.98E+05
	4.400	42501	1109.359	32	304	1.80E+05	1.32E+05
2207	4.150	47277	1234.022	44	348	2.37E+05	1.42E+05
	4.400	42501	1109.359	32	380	1.65E+05	9.45E+04
2749	4.150	47277	1234.022	44	424	2.26E+05	1.21E+05
	4.400	42501	1109.359	32	456	1.57E+05	8.02E+04
3292	4.150	47277	1234.022	44	500	2.17E+05	1.07E+05
	4.400	42501	1109.359	32	532	1.51E+05	7.11E+04
3834	4.150	47277	1234.022	44	576	2.09E+05	9.59E+04
	4.400	42501	1109.359	32	608	1.46E+05	6.38E+04
4377	4.150	47277	1234.022	44	652	2.02E+05	8.62E+04
	4.400	42501	1109.359	32	684	1.41E+05	5.73E+04
4920	4.150	47277	1234.022	44	728	1.95E+05	8.11E+04
	4.400	42501	1109.359	32	760	1.36E+05	5.39E+04
5462	4.150	47277	1234.022	44	804	1.88E+05	7.80E+04
	4.400	42501	1109.359	32	836	1.31E+05	5.19E+04
6005	4.150	47277	1234.022	44	880	1.81E+05	7.35E+04
	4.400	42501	1109.359	32	912	1.26E+05	4.89E+04
6548	4.150	47277	1234.022	44	956	1.75E+05	7.08E+04
	4.400	42501	1109.359	32	988	1.22E+05	4.71E+04
7090	4.150	47277	1234.022	44	1032	1.69E+05	6.76E+04
	4.400	42501	1109.359	32	1064	1.18E+05	4.50E+04
7633	4.150	47277	1234.022	44	1108	1.63E+05	6.52E+04
	4.400	42501	1109.359	32	1140	1.14E+05	4.34E+04
8175	4.150	47277	1234.022	44	1184	1.57E+05	6.29E+04
	4.400	42501	1109.359	32	1216	1.10E+05	4.18E+04
8718	4.150	47277	1234.022	44	1260	1.52E+05	6.07E+04
	4.400	42501	1109.359	32	1292	1.06E+05	4.03E+04
9261	4.150	47277	1234.022	44	1336	1.47E+05	5.85E+04
	4.400	42501	1109.359	32	1368	1.02E+05	3.89E+04
9804	4.150	47277	1234.022	44	1412	1.41E+05	5.62E+04
	4.400	42501	1109.359	32	1444	9.85E+04	3.73E+04
10347	4.150	47277	1234.022	19	1463	5.87E+04	2.34E+04

Total Heat load for Full Pool in storage mode BTU/hr 2.08E+07 1.95E+07

Table A2-2

Maximum Heat Load - 76 Feed Batch

Cooling	Enrichment	Burnup MWd/MTU	EFPD	Discharged Assemblies	Total Discharged	BTP 9-2 Heat Load (BTU/Hr)	ANS 5.1 Heat Load (BTU/Hr)
150 hrs.	4.150	1143	29.5	44	44	4.73E+06	4.33E+06
	4.400	978	25.24	32	76	3.26E+06	2.94E+06
	4.150	23158	597.72	44	120	7.95E+06	8.05E+06
	4.400	20015	516.6	32	152	5.72E+06	5.77E+06
	4.150	39263	1013.4	20	172	3.71E+06	3.83E+06
	4.400	37219	960.65	12	184	2.22E+06	2.28E+06
	4.400	43596	1125.24	8	192	1.49E+06	1.54E+06
	4.400	45115	1164.45	1	193	1.86E+05	1.93E+05
36 days	4.150	47277	1234.022	44	237	3.98E+06	3.96E+06
	4.400	42501	1109.359	32	269	2.88E+06	2.85E+06
579	4.150	47277	1234.022	44	313	5.49E+05	6.89E+05
	4.400	42501	1109.359	32	345	3.88E+05	4.71E+05
1121	4.150	47277	1234.022	44	389	3.19E+05	3.36E+05
	4.400	42501	1109.359	32	421	2.24E+05	2.26E+05
1664	4.150	47277	1234.022	44	465	2.58E+05	1.98E+05
	4.400	42501	1109.359	32	497	1.80E+05	1.32E+05
2207	4.150	47277	1234.022	44	541	2.37E+05	1.42E+05
	4.400	42501	1109.359	32	573	1.65E+05	9.45E+04
2749	4.150	47277	1234.022	44	617	2.26E+05	1.21E+05
	4.400	42501	1109.359	32	649	1.57E+05	8.02E+04
3292	4.150	47277	1234.022	44	693	2.17E+05	1.07E+05
	4.400	42501	1109.359	32	725	1.51E+05	7.11E+04
3834	4.150	47277	1234.022	44	769	2.09E+05	9.59E+04
	4.400	42501	1109.359	32	801	1.46E+05	6.38E+04
4377	4.150	47277	1234.022	44	845	2.02E+05	8.62E+04
	4.400	42501	1109.359	32	877	1.41E+05	5.73E+04
4920	4.150	47277	1234.022	44	921	1.95E+05	8.11E+04
	4.400	42501	1109.359	32	953	1.36E+05	5.39E+04
5462	4.150	47277	1234.022	44	997	1.88E+05	7.80E+04
	4.400	42501	1109.359	32	1029	1.31E+05	5.19E+04
6005	4.150	47277	1234.022	44	1073	1.81E+05	7.35E+04
	4.400	42501	1109.359	32	1105	1.26E+05	4.89E+04
6548	4.150	47277	1234.022	44	1149	1.75E+05	7.08E+04
	4.400	42501	1109.359	32	1181	1.22E+05	4.71E+04
7090	4.150	47277	1234.022	44	1225	1.69E+05	6.76E+04
	4.400	42501	1109.359	32	1257	1.18E+05	4.50E+04
7633	4.150	47277	1234.022	44	1301	1.63E+05	6.52E+04
	4.400	42501	1109.359	32	1333	1.14E+05	4.34E+04
8175	4.150	47277	1234.022	44	1377	1.57E+05	6.29E+04
	4.400	42501	1109.359	32	1409	1.10E+05	4.18E+04
8718	4.150	47277	1234.022	44	1453	1.52E+05	6.07E+04
	4.400	42501	1109.359	10	1463	3.31E+04	1.26E+04

Maximum Pool Heat Load Btu/Hr 4.22E+07 3.96E+07

FSAR Table 9-5

~~Table A2-3.~~

Maximum Pool Temperatures

Heat Load (*1E+6 BTU/Hr)	Cooling Trains Operating	Peak Temperature (degrees F)	Design Basis
20.8	2	116	120
20.8	1	136	140
42.2	2	137	140
42.2	1	180	<212

~~Table A2-4~~

FSAR Table 9-6

Pool Heat-up for Loss of Cooling Transient Summary

Heat Load (*1E+6 BTU/Hr)	Initial Temp. Assumed (F)	Time to Boiling (Hrs)	Heat-up Rate (F/hr)
20.8	120	11.94	7.70
20.8	140	9.35	7.70
42.2	140	4.61	15.63

Note: Thermal hydraulic analysis assumes a more conservative maximum of 150°F when the cooling system is operational, structural calculations use a 140°F.

Purpose

The purpose of this evaluation is to consider changes to the McGuire FSAR to clarify the wording regarding McGuire practice for fuel offload during refueling. The criteria of 10CFR50.59(a)(2) are used to determine if these clarifications constitute a USQ concern. This calculation is QA-1.

Description of Modification

The practice at McGuire is to disassemble the reactor core and move all fuel assemblies to the spent fuel pool during refueling outages. Fuel inserts are moved to their required location during this period and the assemblies are then ready for reassembly of the core. McGuire FSAR sections 9.1.3.1, 9.1.3.3.1, and 9.1.4.1 are clarified to more clearly reflect this practice. No changes to plant systems or components are being made. The clarification of the FSAR is made to enhance understanding of the practice and the basis of full core discharge to the spent fuel pool during refueling activities.

Safety Evaluation

The spent fuel cooling system is designed to maintain acceptable pool temperatures at all times when fuel is stored in the spent fuel pool. The safety function of the spent fuel cooling system is to ensure that spent fuel stored in the pool is cooled and remains covered with water during all storage conditions. The system is analyzed for the most adverse conditions of cooling water temperature and decay heat load to assure that all storage conditions are bounded. The components are QA-1 and active components are located and powered such that no single active failure will cause loss of cooling from both trains. The fuel storage conditions specifically considered in this review occur during refueling operation when the full core is offloaded into the spent fuel pool. A cooling period of 150 hours is assumed prior to discharge into the pool. Technical Specification 3/4.9.3 requires that no fuel movement occur prior to 100 hours after reactor shutdown. Fuel handling process and procedures utilized for unloading the core assure that the core offload is not complete until at least 150 hours after shutdown and that spent fuel pool temperatures remain within design limits. Decay Heat Loads are conservatively calculated using the BTP 9-2 or ANSI/ANS 5.1 methodology assuming a full pool of discharged assemblies. Although the Oconee fuel stored at McGuire combined with previously discharged McGuire fuel has decay heat loads lower than calculated for discharges from 18 month fuel cycles, the pool is conservatively considered to be filled with only 18 month cycle McGuire discharges.

For the normal heat load case, the spent fuel cooling system is designed for a single failure for an indefinite period of time. Table 9-5 shows that temperatures remain within acceptable limits.

For the maximum heat load case, the spent fuel pool cooling system is not designed for a single failure for an indefinite period of time. For single failure conditions, Table 9-5 shows that temperatures remain below boiling.

McGuire has a design requirement the spent fuel pool be qualified as an assured source for the Standby Shutdown Facility. The design basis of the Standby Shutdown Facility includes a total loss of spent fuel pool cooling for a period of 72 hours. Analysis of this scenario has shown that all spent fuel pool structures, systems and components are qualified for the 72 hour period. This provides adequate time for recovery of spent fuel pool cooling. This Standby Shutdown Facility scenario bounds the loss of one train of spent fuel pool cooling under maximum heat loads for 72 hours.

In summary, the spent fuel pool is not indefinitely qualified for loss of a single train under maximum heat loads. Spent fuel pool structures, systems and components have been qualified for a period of 72 hours given a complete failure of the pool cooling system. This provides adequate time for restoration of pool cooling should a train be lost during maximum heat load conditions.

USQ Evaluation

Could the activity increase the probability of an accident evaluated in the SAR?

No. This is only a clarification of McGuire practices and associated design bases regarding fuel handling during refueling activities. There are no changes to refueling activities. All activities are within the bounds of previously approved methods as outlined in the SAR. No activities are changed such that any analyzed accident is more probable. The spent fuel cooling system is not considered as an initiator of any accident evaluated in the SAR. The fuel handling accident analyzed in the SAR is not dependent on the spent fuel cooling system operation. Tornado Missile events affecting fuel in the spent fuel pool do not consider pool cooling but do require storage configurations during refueling to limit consequence. These conditions are met during full core discharge.

Could the activity increase the consequences of an accident evaluated in the SAR?

No. The clarification does not affect assumptions in the fuel handling accident analysis or analysis for tornado generated missiles. SSF events do not require consideration of full core discharge since there is no need for SSF supplied makeup during full core discharge. LOCA response, which automatically terminates spent fuel pool cooling, is not applicable during a full core discharge. The loss of cooling to the spent fuel pool is not considered an accident with radiological consequence in SAR analysis since there is time to take action to mitigate the consequence of failure of the cooling system. There are makeup systems available to assure makeup water to the pool. Pool temperatures are within the bounds of analyzed conditions for all pool loading conditions.

Could the activity create the possibility for an accident of a different type than any evaluated in the SAR?

No. There are no functional changes made by this clarification to the SAR. All systems and components will continue to operate as they have previously and will continue to be operated within the same design constraints. Therefore, no different accident is made credible by this clarification of the pool heat load and storage condition.

Could the activity increase the probability of a malfunction of equipment important to safety evaluated in the SAR?

No. This activity is a clarification of the SAR. There is no change to components or component operation as a result of this clarification. There is no change to the analysis of active components for all credible conditions and modes of operation. All components are designed to operate under the conditions previously described in the SAR.

Could the activity increase the consequences of a malfunction of equipment important to safety evaluated in the SAR?

No. This is a clarification of an acceptable practice described in the SAR. The full core discharge practice is bounded by existing SAR analysis. All equipment operates within the component design limits. No component functions are changed. Failure of a train of cooling is not directly considered as part of the design basis during full core discharge but the condition is analyzed for SSF design basis scenarios and no significant consequence is postulated. No radiological release or degradation of fission product barriers is made more likely by full core discharge.

Could the activity create the possibility for a malfunction of a different type than any evaluated in the SAR?

No. There are no added components or functions. No equipment or system is operated in a different manner or under conditions that are outside the design of the component or system. Failure of one or both trains of spent fuel cooling is considered in the FSAR in determination of peak pool temperatures. The clarification enhances the description of the amount of fuel discharged to the pool but not the manner that it is discharged or the operation systems or components.

Could the activity reduce the margin of safety as defined in the basis for any technical specification?

No. Technical Specifications cover pool criticality design and parameters important to fuel handling accidents. The revision to the SAR does not impact any parameters associated with these specifications. The fission product barriers considered in this area

of the SAR are the fuel, fuel clad and depth of water over the fuel. None of these parameters are changed.

Conclusions

This change of the FSAR to clarify wording concerning full core discharge during refueling activities does not constitute an Unreviewed Safety Question. No changes to Technical Specifications are needed.

References

1. McGuire FSAR section 9.1.3, 9.1.4, chapter 15 as updated through January, 1995 and changes related to Technical Specification Amendments 159/141.

2. McGuire Technical Specifications 3/4.9.3, 3/4.9.10, 3/4.9.12, 3/4.9.13 as amended through 165/147.

3. MCC-1201.30-00-0009 rev 2, Two Region Storage Rack Expanded Heat Load.

4. MCC-1139.01-00-0218 Thermal Analysis of Fuel Pool.