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January 11, 2006

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

Subject: Duke Energy Corporation
McGuire Nuclear Station Unit 2
Docket Number 50-370 and 72-38
Independent Spent Fuel Storage Installation (ISFSI)

Special Report Number 2005-01 for Approved Contents and Design Features for the NAC-UMS System, Section B 2.1, "Fuel Specification and Loading Conditions", Certificate of Compliance 1015,
Problem Investigation Process Number M-05-05888

Attached is a copy of Special Report Number 2005-01. This report is being submitted in accordance with the Approved Contents and Design Features for the NAC-UMS System, Section B 2.1, "Fuel Specification and Loading Conditions." An incorrect spent fuel assembly was placed into the NAC-UMS Cask. Per the Certificate of Compliance, a Special Report is required due to this occurrence.

The attached Special Report provides details of the occurrence, the causes, and corrective actions. If further cause analysis identifies information significant to the understanding of this event or it results in substantial changes to the corrective action plan, a revised special report will be submitted providing this information.

This occurrence was determined to be of no significance to the health and safety of the public.

There are no regulatory commitments contained in this report. Inquiries on this matter should be directed to Reza Djali at 704-875-4228.

Sincerely,

G.R. Peterson

G.R. Peterson

Attachment

IE22
MMSS01

cc:

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Duke Energy Corporation
McGuire Nuclear Station
Special Report 2005-01

BACKGROUND

The NAC-UMS system (the cask) consists of the following components: (1) transportable storage canister (TSC), which contains the spent fuel; (2) vertical concrete cask (VCC), which contains the TSC during storage; and (3) a transfer cask, which contains the TSC during loading, unloading, and transfer operations. The cask can store 24 Pressurized Water Reactor (PWR) fuel assemblies, as specified in Appendix B to the NAC-UMS Certificate of Compliance (COC) Certificate Number 1015.

The TSC is the confinement system for the stored fuel. The TSC assembly consists of a right circular cylindrical shell with a welded bottom plate, a fuel basket, a shield lid, two penetration port covers, and a structural lid. The cylindrical shell, plus the bottom plate and lids, constitute the confinement boundary. The stainless steel fuel basket is a right circular cylinder configuration. The square fuel tubes include neutron absorber sheets on all four sides for criticality control. Aluminum heat transfer disks are spaced midway between the support disks and are the primary path for conducting heat from the spent fuel assemblies to the TSC wall. Fuel assemblies to be stored may include components associated with the assemblies, as specified in Appendix B to the COC.

The cask is designed for a maximum heat load of 23kW or 0.9583kW per assembly (includes decay heat from spent fuel and Burnable Poison Rod Assembly (BPRA) or Thermal Plug Assembly (TPA)). The fuel must be cooled a minimum of 5 years prior to storage. Known or suspected failed fuel assemblies (rods) with cladding defects greater than pin holes or hairline cracks are not to be stored in the NAC-UMS system. Along with the spent fuel assemblies, BPRAs and TPAs may be stored within the cask. The NAC-UMS system can store 24 PWR fuel assemblies. The criteria for determining which assemblies may be stored are contained in the Appendix B to Certificate of Compliance number 1015, (Approved Contents and Design Features) for the NAC-UMS system.

This System provides passive dry storage of spent fuel. The system requires few operating controls. The principal controls and limits for this cask storage system are satisfied by the selection of fuel for storage that meets the Approved Contents presented in Appendix B. Spent fuel to be stored within the cask system must meet all of the controls and limits specified in Appendix B, Section 2.0 of the COC for the NAC-UMS System. As stated in Section 2.1, if any Fuel Specification or Loading Conditions of this section are violated, the following actions shall be completed:

- The affected fuel assemblies shall be placed in a safe condition.
- Within 24 hours, notify the NRC Operations Center.
- Within 30 days, submit a special report that describes the cause of the violation and actions taken to restore or demonstrate compliance and prevent recurrence.

In the spent fuel pool, fuel assemblies are moved about by the spent fuel pool manipulator crane. The spent fuel pool manipulator crane is a rectilinear bridge and trolley crane spanning the pool with a vertical mast extending down into the spent fuel pool water. The mast supports and guides the gripping and hoisting devices for handling fuel assemblies. The bridge and trolley motions are used to position the mast over the fuel assembly located within a cell of the spent fuel storage racks. Fuel assemblies are lifted using a long tube with a pneumatic gripper on the end which is lowered down out of the mast to grip the fuel assembly. A winch mounted on the trolley raises the gripper tube and fuel assembly up into the mast tube. The fuel is transported while inside the mast tube to its new position. All controls for the spent fuel pool manipulator crane are mounted on a console on the trolley. The bridge and trolley are positioned on a coordinate system defined by a scale laid out on one bridge rail and one trolley rail. A video monitor system on the console can be used to indicate the position of the bridge and trolley, or the scales can be read directly. The drives for the bridge, trolley, and winch are variable speed and include a separate inching control on the winch. Electrical interlocks and limit switches, plus a mechanical stop, prevent a fuel assembly from being raised above a safe shielding depth. In an emergency, the bridge, trolley, and winch can be operated manually using a hand wheel on the motor shaft.

In addition to the mast, a fuel assembly within the spent fuel pool can be moved using an auxiliary hoist located on the spent fuel pool manipulator crane. There are two auxiliary hoists located on the spent fuel pool manipulator crane. A long handling tool is placed onto the hook of the spent fuel pool manipulator crane auxiliary hoist. The long handling tool is then used to grip and lift a fuel assembly located within a cell of the spent fuel storage racks. Unlike the mast, there is only a defined scale laid out on one bridge rail when the auxiliary hoist is used for fuel movement. There are no indications of the trolley position for the auxiliary hoist when it is being used to move a fuel assembly. Since the mast interlocks are not set up for use in the deep end of the cask loading area of the spent fuel pool, the auxiliary hoist on the north side of the spent fuel pool manipulator crane is used.

An alphanumeric system is utilized to designate individual cell locations within the spent fuel pool. Letters are used to designate a particular row within the spent fuel pool, while columns are represented by numbers. The letters "I"; "O"; and "Q" are not used to designate a row. Markings indicating rows and columns positions within the spent fuel pool are not provided.

DESCRIPTION OF OCCURRENCE

On December 12, 2005, fuel handling personnel were loading a NAC-UMS transportable storage canister, (ID 0FCTKN011) with spent fuel assemblies from the McGuire Unit 2 fuel pool. The long handling tool on the north auxiliary hoist of the spent fuel pool manipulator crane was being used to load the cask. At approximately 1300 hours, as the fuel handling personnel were retrieving a fuel assembly from pool location PP-34, they inadvertently retrieved the assembly from the adjacent pool location, RR-34 (fuel assembly Z50). Independent verification of assembly location was performed prior to its retrieval. The assembly was then transferred to the TSC where it was lowered into its specified storage location. As the assembly was being lowered into the canister, a camera operator noticed that the fuel ID did not match the one specified in the loading procedure. Fuel movement was immediately stopped with the assembly partially inserted into the storage cell location. The temporary supervisor in charge was contacted, as well as the Reactor Engineering Group. The Operations Group was not contacted at this time. After a short discussion and confirmation of the events leading to this scenario, the assembly was moved back to its original storage location in RR-34. The assembly was never disengaged from the grappling tool used to move it to the canister. The remaining activities associated with the loading of the cask were performed without incident. Prior to this event, 7 fuel assemblies had been loaded into the TSC. The Operations Group became aware of this event during shift turnover that night at approximately 1830 hours as they reviewed the daily Problem Investigation Process (PIP) report.

On December 13, 2005, at approximately 1600 hours the decision was made that the COC fuel specification was violated when the wrong assembly was inserted in the canister. The NRC Operations Center was notified at 1806. (event notification number 42203). This notification was made within 24 hours from when the event was discovered by Operations rather than when the event occurred.

From a fuel specification perspective, the initial enrichment for fuel assembly Z50 was 3.636 weight percent U-235, the final burn up was 40,254 MWD, and the discharge date was 2/22/2002 or < 4 years of cooling time. Using the NRC-approved Regulatory Guidance 3.54 methodology, the decay heat for assembly Z50 was calculated to be approximately 1.437 kW as of 12/12/2005. The allowed specification for storage of fuel that meets the Approved Content specified in the COC is that the decay heat per assembly be ≤ 958.3 watts. The minimum cooling time for a fuel assembly with an initial enrichment of 3.636 weight percent U-235, and a final burn up of 40,254 MWD is 7 years. Thus the inadvertent insertion of spent fuel assembly Z50 into the TSC is a violation of fuel specification as stated per COC 1015 Appendix B, section 2.1.

CAUSES

The apparent cause of this event is due to inadequate human factor considerations for fuel movement with the auxiliary hoist. No indicators were provided for trolley position when the auxiliary hoist was being used to move a fuel assembly.

The delay in the NRC Operations Center notification was due to the following:

- Failure to update appropriate administrative processes and procedures relating to dry cask special reporting criteria.
- Determination of whether any fuel specifications were actually violated. This stemmed from the lack of familiarity in Operations with the NAC-UMS Technical Specifications (TS) section containing fuel specifications and loading conditions.

CORRECTIVE ACTIONS

Immediate:

1. The Fuel Handling personnel stopped work, made supervisory notifications, evaluated the situation, and returned the fuel assembly to its correct location.

Subsequent:

1. The NRC Operations Center was notified.

2. A root cause team was formed to evaluate the event and to determine the Corrective Actions to Prevent Recurrence (CAPR).

3. The following corrective actions were taken to allow future cask loading:

   a. Stenciled pool storage location letter designations onto the crane bridge handrails to improve human factor considerations for fuel movement with the auxiliary hoist.

   b. The Fuel Handling procedures were revised to improve correct component verification and Operation's awareness:

      1. Changes to the methodology for performing independent verification of cell location,
      2. Verification of fuel assembly identification prior to loading into the cask,
      3. Prompt Operations notification should a similar event occur.
      4. Increase awareness of this event among Operations, Maintenance, and Reactor Engineering.

4. A standard Pre-job brief was developed. This pre-job brief discusses the planned activities with Operations' shift personnel prior to cask loading evolutions.

Planned:

1. Appropriate administrative procedures will be updated to incorporate special reporting requirements related to dry cask activities.

2. Appropriate training material will be updated to incorporate the lessons learned.

SAFETY ANALYSIS

The mishandled spent fuel assembly had an initial enrichment of 3.636 weight percent U-235, the final burnup was 40,254 MWD, and the discharge date was 2/22/2002. Using the NRC approved Regulatory Guide 3.54 methodology, the decay heat for assembly Z50 was calculated to be approximately 1.437 kW as of 12/12/2005.

At the time of the event, there were 7 spent fuel assemblies in the cask with both fuel pool cooling trains operable. The spent fuel pool boron concentration was at least 2773 ppm.

The misloading of a fuel assembly that does not comply with the requirements of Appendix B, Section 2.0, has been evaluated (Section 11.2.3 of the NAC-UMS Safety Analysis Report). The fuel selection process and a final verification process precludes inadvertent loading of a fuel assembly with a decay heat load greater than the 0.9583kW per assembly from going undetected, and ensures removal of the fuel assembly from the cask prior to placing the lid. The spent fuel pool cooling system provides adequate capacity to maintain an acceptable temperature range for the TC and TSC with the lid removed and a misloaded fuel assembly (newly discharged spent fuel). The large heat capacity of the fuel pool allows enough heat dissipation throughout fuel loading operations of the TSC (prior to closing the cask).

The inadvertent loading of a fuel assembly with a higher initial enrichment than the design basis fuel is also discussed in Section 11.2.3 of the SAR for the NAC-UMS system. The evaluation demonstrates that the cask remains subcritical under these conditions. The criticality analysis that was performed for the NAC-UMS system assumes the loading of 24 fresh, unburned fuel assemblies into the TSC with an initial enrichment of 5 wt % U-235. The criticality control features of the TSC ensure that K_{eff} of the fuel is less than 0.95 with a boron concentration of 1000 ppm.

Thus, Duke Power concluded that this event was of low safety significance and resulted in no adverse consequences to the health and safety of the public.