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SUBJECT: Requests NRC review of unreviewed safety question that has been identified at HB Robinson Steam Electric Plant,re movement of spent fuel shipping cask.

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CP&L

10 CFR 50.59(c)
10 CFR 50.90

Carolina Power & Light Company
Robinson Nuclear Plant
3581 West Entrance Road
Hartsville SC 29550

AUG 2 8 1997

Robinson File No.: 13510
Serial: RNP-RA/97-0128

United States Nuclear Regulatory Commission
ATTENTION: Document Control Desk
Washington, DC 20555

H. B. ROBINSON STEAM ELECTRIC PLANT, UNIT NO. 2
DOCKET NO. 50-261/LICENSE NO. DPR-23
REQUEST FOR REVIEW OF UNREVIEWED SAFETY QUESTION

Gentlemen:

The purpose of this letter is to request NRC review of an unreviewed safety question that has been identified at the H. B. Robinson Steam Electric Plant (HBRSEP), Unit No. 2 concerning movement of a spent fuel shipping cask. Identification of this condition has caused Carolina Power & Light (CP&L) Company to suspend shipment of spent nuclear fuel from HBRSEP to the Shearon Harris Nuclear Power Plant.

This unreviewed safety question is being submitted for NRC review in accordance with the requirements of 10 CFR 50.59(c) and 10 CFR 50.90. CP&L's analysis does not support a conclusion of no significant hazards considerations for this request, nor does it support a conclusion that this request is eligible for a categorical exclusion from the requirement to perform an environmental assessment. CP&L requests NRC's review of this unreviewed safety question by February 1, 1998, to allow the resumption of shipment of spent nuclear fuel.

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Attachment I to this letter provides the affidavit required by 10 CFR 50.30(b).

Attachment II to this letter provides a description of the current condition, a description of the proposed change, a safety assessment, a discussion of significant hazards consideration, and environmental information.

Attachment III to this letter provides a markup of the proposed change to the Updated Final Safety Analysis Report (UFSAR).

In accordance with 10 CFR 50.91(b), CP&L is providing the State of South Carolina with a copy of this letter with the attachments.

If you have any questions concerning this matter, please contact me or Mr. H. K. Chernoff of my staff .

Very truly yours,

Terry M. Wilkerson

T. M. Wilkerson

JSK/jk

Attachments

I. Affidavit
II. Proposed Change to the Updated Final Safety Analysis Report
III. Proposed UFSAR Change (Markup)

c: Mr. M. K. Batavia, Chief, Bureau of Radiological Health (SC)
Mr. B. B. Desai, USNRC Senior Resident Inspector, HBRSEP
Ms. B. L. Mozafari, USNRC Project Manager, HBRSEP
Mr. L. A. Reyes, USNRC Regional Administrator, Region II
Attorney General (SC)

Affidavit

State of South Carolina
County of Darlington

J. S. Keenan, having been first duly sworn, did depose and say that the information contained in letter RNP-RA/97-0128 is true and correct to the best of his information, knowledge and belief; and the sources of his information are officers, employees, contractors, and agents of Carolina Power & Light Company.

John S. Keenan

Sworn to and subscribed before me

this 28TH day of AUGUST 1997

(Seal) David Cook

Notary Public for South Carolina

My commission expires: MARCH 21, 2005

H. B. ROBINSON STEAM ELECTRIC PLANT, UNIT NO. 2
PROPOSED CHANGE
TO UPDATED FINAL SAFETY ANALYSIS REPORT

Description of Current Condition

By letter dated December 24, 1996, the NRC requested additional information regarding the H. B. Robinson Steam Electric Plant (HBRSEP), Unit No. 2 response to NRC Bulletin 96-02, "Movement of Heavy Loads Over Spent Fuel, Over Fuel in the Reactor Core, or Over Safety-Related Equipment." The NRC stated they had found that some licensees without single-failure-proof cranes had analyzed, or were planning to analyze, postulated spent fuel storage cask and transportation cask drop accidents to establish design basis accidents for their facilities. The NRC letter described a potential cask drop scenario in which there is a possibility of the cask lid becoming dislodged or the cask lid becoming dislodged and ejecting some or all of the spent fuel elements onto the top of the spent fuel racks, the floor of the pool, or adjacent areas. The NRC requested additional information to support the staff evaluation of this potential cask drop scenario. As discussed in Carolina Power & Light (CP&L) Company letter dated April 2, 1997, the specific scenario described in the December 24, 1996, request for additional information is considered to be not credible at HBRSEP.

At HBRSEP, loaded spent fuel shipping casks are shipped by rail to CP&L's Shearon Harris Nuclear Power Plant (SHNPP), where the fuel is placed in long term storage in the SHNPP spent fuel pool. The cask is prepared for loading by removing the valve box covers while the cask is on the railcar. The cask is then moved into the Fuel Handling Building (FHB) decontamination facility, at which point the cask closure head sleeve nuts are detensioned, and the cask head is removed. The cask is moved into the spent fuel pool cask set down area, by use of a single failure proof crane. The empty cask is then loaded with spent fuel, the head is replaced, the cask raised to the top of the pool water level where four cask closure head sleeve nuts are replaced and hand tightened. The use of four sleeve nuts is a vendor recommendation described operationally in the Cask Operating Manual to prevent the head from coming off in a cask "tipping accident."

The cask is then moved with the crane in the single failure proof configuration to the cask decontamination area where the cask is decontaminated and the 32 cask closure sleeve nuts are reinstalled in accordance with the cask vendor's recommendations.

The cask is then moved from the cask decontamination area to the spent fuel shipping rail car and lowered onto the rail car where the cask valve covers are reinstalled. This final lift is accomplished with the crane not in the single failure proof configuration, and with the cask valve covers not yet reinstalled.

Updated Final Safety Analysis Report (UFSAR) Section 15.7.5 addresses spent fuel cask drop accidents. Specifically, UFSAR Section 15.7.5 states that, while moving the cask with the single failure proof crane, a cask drop is considered to be an incredible event. Further discussion states . . . "A postulated cask drop could occur while the cask is being lifted with the non-redundant yoke between the decontamination facility and the shipping rail car. Administrative controls described in Section 15.7.5.3 limit the cask lift height to less than 30 feet (per 10 CFR 71.36) which eliminated any risk to the public health and safety from this postulated accident."

The shipping cask has been analyzed by the cask vendor for a 30 foot drop with no consequences to the public. However, the analysis was performed assuming that the cask was in the shipping configuration with the valve covers installed. During the development of the response to the December 24, 1996, request for additional information, CP&L has determined that the postulated cask drop accident with the cask valve covers not installed constitutes an unreviewed safety question.

Description of Proposed Change

CP&L proposes to revise the UFSAR section 9.1.4 and section 15.7.5 to include the evaluation of a previously unanalyzed spent fuel cask drop scenario. This scenario involves the postulated drop of a loaded spent fuel cask as the cask is being moved from the decontamination facility to the shipping railcar with the valve box covers removed, and the spent fuel cask crane in the non-single failure proof configuration. The results of the analysis are discussed below. A markup of the proposed change to the UFSAR is provided in Attachment III

Safety Assessment

The current analysis in UFSAR Section 15.7.5 addresses a cask drop onto a flat surface. The current analysis, however, did not include an evaluation of radiological consequences, because the spent fuel cask is limited to an equivalent 30 foot drop onto a flat, essentially unyielding, horizontal surface, and the cask is designed to withstand such loads. This determination is based on the critical assumption that the spent fuel cask is in a shipping configuration in accordance with the cask Certificate of Compliance. However, the cask valve box covers are removed before moving the cask from the railcar to the decontamination facility. The valve box covers are not reinstalled until after the loaded shipping cask is moved from the decontamination facility back to the shipping rail car.

This condition has been determined to constitute an unreviewed safety condition in that the consequences of a previously analyzed accident are increased. That is, a cask drop with the cask not in the shipping configuration could result in an increase in consequences as a result

of possible damage to the valves and a subsequent release of radioactivity. Also, the possibility of a new or different accident is created in that lateral movement of the cask resulting in an impact on the uncovered valves could result in valve damage that could result in a release of radioactivity from the cask.

An evaluation has been performed to determine the consequences of the postulated cask drop accident. This evaluation would bound any consequences of damage due to an impact during lateral movement. Assumptions used to calculate the bounding Low Population Zone (LPZ) and Site Boundary doses include: (1) fuel rod damage occurs and maximum available gap activity is released; (2) filtration is not credited, and the entire activity is assumed to be released to the environment; (3) releases are considered to be at ground level; (4) the atmospheric dispersion (X/Q) value used for UFSAR Chapter 15.7 analyses, i.e., 0.00087, is applied. Using these assumptions, the doses were determined to be a small fraction of the NRC acceptance criteria for Section 15.7.5 of NUREG - 0800, the Standard Review Plan. The evaluation demonstrates that the release would not be sufficient to initiate the Control Room radiation alarm or pressurization mode of the Control Room ventilation system.

Dose assessments were performed using maximum potential releases assuming failure of the spent fuel and radionuclide release from damage to the valves. Calculated doses at the Site Boundary and the Low Population Zone (LPZ) are as follows:

Comparison of Consequences

	Site Boundary 0 - 2 hrs.		Low Population Zone 0 - 8 hrs.	
	Whole-Body (rem)	Thyroid (rem)	Whole-Body (rem)	Thyroid (rem)
Dose Limits - 10 CFR 100	25	300	25	300
Standard Review Plan 15.7.5 Acceptance Limits	6	75	6	75
Calculated Radiological Dose from Cask Drop Event (Cask with Less Than Full Integrity)	0.0072	0.1233	0.0072	0.1233

Conclusion

The dose consequences resulting from an accident resulting in damage to spent fuel cask while being moved with the cask valve covers removed is a small fraction of the 10 CFR 100 limits and the acceptance criteria in the Standard Review Plan.

Significant Hazards Consideration

The NRC has provided standards in 10 CFR 50.92(c) for determining whether a significant hazards consideration exists. A change involves no significant hazards consideration if it would not: (1) involve a significant increase in the probability or consequences of an accident previously evaluated, (2) create the possibility of a new or different kind of accident from any accident previously evaluated, or (3) involve a significant reduction in a margin of safety. CP&L has reviewed this proposed change and concludes that it involves a significant hazards consideration. The basis for this determination follows.

Analysis

1. The proposed change does not involve a significant increase in the probability or consequences of an accident previously evaluated.

   The changes described do not impact the probability of occurrence of accidents previously analyzed. A cask drop with the cask valve box removed has no impact on accident initiators. Dose assessments using maximum potential releases assuming failure of the spent fuel and a radionuclide release due to an accident that results in damage to the valves show that an increase in consequences results. However, the increase is not significant and the accident results in a release of radioactivity that is only a small fraction of the 10 CFR 100 limits.

2. The proposed change creates the possibility of a new or different kind of accident from any accident previously evaluated.

   Since movement of the cask with the valve covers removed does not require a cask drop to produce an accident that results in consequences (e.g., lateral movement of the cask into plant equipment that results in damage to the valves), this condition creates the possibility of a new or different kind of accident from any accident previously evaluated.

3. The proposed change does not involve a significant reduction in the margin of safety.

   As described in the proposed change, even though complete cask integrity may not be preserved in the event of a loaded cask drop with the valve box covers removed the radiological consequences calculated using conservative assumptions were determined to be a small fraction of the 10 CFR 100 values, i.e., a whole body dose at the site boundary of 0.0072 Rem vs the 10 CFR 100 criterion of 25 Rem. Therefore, the proposed change does not involve a significant reduction in the margin of safety.

Environmental Considerations

10 CFR 51.22(c)(9) provides criterion for, and identification of, licensing and regulatory actions eligible for categorical exclusion from performing an environmental assessment. A change requires no environmental assessment if it would not: (1) involve a significant hazards consideration; (2) result in a significant change in the types or significant increase in the amounts of any effluents that may be released offsite; (3) result in a significant increase in individual or cumulative occupational radiation exposure. CP&L has reviewed this proposed change and determined that it does not meet the eligibility criteria for categorical exclusion set forth in 10 CFR 51.22(c)(9). The basis for this determination is as follows.

Analysis

The change does not meet the eligibility criteria for categorical exclusion set forth in 10 CFR 51.22(c)(9) for the following reasons:

1. As discussed previously, the proposed change involves a significant hazards consideration.

2. There is no significant increase in the amounts of any effluents that may be released offsite.

The proposed revision to the UFSAR will have no impact on the types of effluent that may be released offsite. The proposed change may involve a small increase in releases of radioactivity due to accidents; however, there is no change in the amount effluents released offsite.

3. There is no significant increase in individual or cumulative occupational radiation exposure.

The on-site occupational dose consequences for workers in the immediate area have been evaluated to be less than 10 millirems. The personnel involved in a cleanup after a postulated accident would need to deal with a maximum of one cubic foot of material that may have a radiation level of 10 Rem at one meter based on the limit established for the maximum allowable water remaining in the cask after loading operations. This level could be effectively dealt with by use of temporary shielding and remote handling tools. The evaluation demonstrates that the release would not be sufficient to initiate the Control Room radiation alarm or pressurization mode of the Control Room ventilation system. Therefore, the proposed revision will not result in a significant increase in individual or cumulative occupational radiation exposure.

Environmental Discussion

The only environmental impacts resulting from the postulated accident would be the release of a small amount of radioactivity, as discussed above. CP&L has reviewed the Environmental Report for HBRSEP, Unit No. 2 and the Final Environmental Statement (i.e., NUREG-75/024) and determined that this constitutes a Class 7 event. A fuel mishandling accident outside containment was postulated as the Class 7 event in the Environmental Report, with consequences at the site boundary reported as 3.789 mrem thyroid and 0.763 mrem whole body. The consequences analyzed for the current spent fuel cask drop accident at the site boundary are 123.3 mrem thyroid and 7.2 mrem whole body. In both cases, the consequences are well within acceptance criteria. CP&L concludes that this condition does not change the overall conclusions of previous environmental analyses and there are no unacceptable impacts to the environment.

United States Nuclear Regulatory Commission
Attachment III to Serial: RNP-RA/97-0128
(8 Pages)

PROPOSED UFSAR CHANGE

During plant operation, the conveyor car is stored inside containment in the refueling canal. The gate valve is closed and a blind flange is bolted on the transfer tube to seal the reactor containment. A permanent davit arm is mounted on the fixed flange of the transfer tube for handling of the blind flange during refueling.

9.1.4.2.2.7 Rod cluster control (RCC) changing fixture. A fixture is mounted on the reactor cavity wall for removing RCC elements from spent fuel assemblies and inserting them into new fuel assemblies. The fixture consists of two main components: a guide tube mounted to the wall for containing and guiding the RCC element, and a wheel-mounted carriage for holding the fuel assemblies and positioning fuel assemblies under the guide tube. The guide tube contains a pneumatic gripper on a winch that grips the RCC element and lifts it out of the fuel assembly. By repositioning the carriage, a new fuel assembly is brought under the guide tube and the gripper lowers the RCC element and releases it.

9.1.4.2.2.8 Spent fuel cask handling crane. The Spent Fuel Cask Handling Crane is a Whiting 125/5 ton capacity crane. The Whiting Redundant Hoist System incorporates a dual load path through the hoist gear train, the reeving system, and the hoist load block along with restraints at critical points to provide load retention and minimize uncontrolled motions of the load upon failure of any single hoist component. The system includes two complete gear trains connecting the single hoist motor to the hoist drum.

9.1.4.2.2.9 Spent fuel cask redundant lifting yoke. The redundant lifting yoke supplied for the spent fuel shipping cask is furnished as part of a package which includes the shipping cask and its special transport vehicle. Specific details of the redundant lifting yoke conform to the following criteria; the design and fabrication of the shipping cask, transport vehicle, and handling equipment conform to all the applicable regulations of the NRC (10CFR71) and the DOT (49CFR170-178). The shipping cask redundant lifting yoke is of all steel construction. In addition to the above criteria, the redundant lifting yoke was designed for protection against single failure in that both the primary and secondary parts of the yoke will alone support 300 percent of the fully loaded cask weight without exceeding the yield strength of the material. The secondary yoke is connected to the sister hook of the crane and the primary yoke is independently attached to the lifting eye of the crane.

Before shipment, both the primary and secondary parts of the redundant yoke were proof-load tested (200 percent of the rated capacity) to assure compliance with the single failure criteria, and nondestructively tested i.e., magnetic particle or dye penetrant, and examined to ensure that no permanent deformations and/or other damage occurred. This design and testing eliminated the redundant lifting yoke as a factor contributing to a cask drop accident.

9.1.4.2.2.10 Spent fuel cask non-redundant lifting yoke. A non-redundant lifting yoke was also supplied with the spent fuel shipping cask for lifting the cask where the redundant yoke was not needed, or not possible to use because of the configuration of plant equipment or buildings. The design of the non-redundant lifting yoke meets the same criteria listed above for the redundant lifting yoke, except for the additional criteria describing redundancy.

Insert A

The physical configuration of the decontamination facility and the design of the railcar transportation system require that the non-redundant yoke be used to transfer the cask between the railcar and the decontamination facility. This load path does not suspend a heavy load over safety related structures, systems or components.

9.1.4.3 Refueling sequence of operation. The refueling is performed using detailed plant procedures. The general initial conditions and preparations before refueling are as follows:

1. Reactor is in cold shutdown condition and preparations made for head removal such as, removal of Control Rod Drive Mechanism (CRDM) missile shield, cables, and cooling ducts; RCS water level lowered below flange; vessel head insulation and instrument leads removal; and vessel head studs removed

2. The inflatable seal ring is installed, and the head is removed.

3. The fuel transfer tube blind flange is removed.

4. The fuel transfer tube isolation valve is open.

5. The refueling cavity is filled as the head is lifted off the reactor vessel and transferred to its storage pedestal.

6. The Control Rod Drive (CRD) shafts are unlatched.

7. The reactor vessel upper internals are lifted out using its lifting rig and stored on the underwater storage rack.

The refueling sequence is now started utilizing the manipulator crane. The sequence for fuel assemblies in positions where there are no RCC is as follows:

1. Spent fuel is removed from the core and placed into the fuel transfer system for removal to the spent fuel pit

2. Partially spent fuel is rearranged in the core

3. Replacement fuel assemblies are brought in from the spent fuel pit through the transfer system and loaded into the core

4. Whenever any fuel is added to the reactor core, a reciprocal curve of source neutron multiplication is recorded to verify the subcriticality of the core.

The refueling sequence is modified for fuel assemblies containing RCC elements, special maintenance or inspections requirements, surveillance capsule removal, or incore thimble replacement. If a transfer of the RCC elements between fuel assemblies is required, the assemblies are taken to the RCC change fixture to exchange the RCC elements from one assembly to another. Such an exchange is required whenever a fuel assembly containing RCC elements is removed from the core and whenever a fuel assembly is placed in or taken out of a control position during the refueling rearrangement.

Insert A

Section 15.7.5 describes the potential consequences of using the non-redundant yoke to lift the loaded IF-300 cask with less than full shipping integrity (i.e., with the cask drain/vent valve covers removed).

15.7.5 Spent Fuel Cask Drop Accidents

A postulated cask drop which could occur at the pool edge and result in the cask being deflected into spent fuel has been eliminated as a credible accident by design considerations. Redundancy has been incorporated in the design of the spent fuel cask lifting lugs, redundant lifting yoke, and the replacement 125-ton spent fuel cask handling crane to eliminate any risk to public health and safety from this postulated accident.

A postulated cask drop could occur while the cask is being lifted with the redundant yoke between the spent fuel building and the decontamination facility. Redundancy has been incorporated in the design of the spent fuel cask lifting lugs, the redundant yoke and the replacement 125 ton spent fuel cask handling crane to eliminate any risk to the public health and safety from this pstulated accident.

A postulated cask drop could occur while the cask is being lifted with the non-redundant yoke between the decontamination facility and the shipping railcar. Administrative controls described in Section 15.7.5.3 limit the cask lift height to less than 30 feet (per 10 CFR 71.36), ~~which eliminates any risk to the public health and safety from this postulated accident~~. The path of this lift does not go over any safety related structures, systems or components (SSC's).

Insert B

A detailed discussion of the safety features of each component is given below to demonstrate sufficient redundancy that dropping the spent fuel cask is not a credible accident.

15.7.5.1 Spent Fuel Cask Non-Redundant and Redundant Lifting Yoke. A non-redundant lifting yoke was supplied with the spent fuel shipping cask for lifting the cask where the redundant yoke was not needed, or not possible to use because of the configuration of HBRSEP equipment or buildings. The design of the non-redundant lifting yoke meets the same criteria listed below for the redundant lifting yoke, except for the additional criteria describing redundancy.

The redundant lifting yoke supplied for the spent fuel shipping cask is furnished as part of a package which includes the shipping cask and its special transport vehicle. Specific details of the redundant lifting yoke conform to the following criteria. The design and fabrication of the shipping cask, transport vehicle, and handling equipment conform to all the applicable regulations of the NRC (10 CFR 71) and the DOT (49 CFR 170-178). The shipping cask redundant lifting yoke is of all steel construction and composed entirely of structural members. In addition to the above criteria the redundant lifting yoke was designed for protection against single failure in that both the primary and secondary parts of the yoke will alone support 300 percent of the fully loaded cask weight without exceeding the yield strength of the material. The secondary yoke is connected to the sister hook of the crane and the primary yoke is independently attached to the lifting eye of the crane.

Before using for shipments, both the primary and secondary parts of the redundant yoke were proof-load tested (200 percent of rated capacity) to assure compliance with the single failure criteria, and non-destructively

Insert B

In accordance with the operating instructions supplied by the IF-300 cask vendor, the lift of the loaded cask from the decontamination facility to the railcar is performed with the head bolts fully tensioned, drain/vent valves closed, and the cask tested for leakage. The drain/vent valve covers are not installed, however, so the 30 foot drop analysis performed per 10 CFR 71.36 does not bound this situation. An evaluation of the 30 foot drop during movement from the decontamination facility to the railcar was performed and indicated that, while fuel components would be retained in the cask, the IF-300 cask vent/drain valves may be damaged, and thus not gas tight. A release of noble gas and iodine gap activity to the environment could occur. Using the maximum activity loading for the IF-300 cask, this type of release has been evaluated (Reference 15.7.5-1) and the whole body and thyroid doses which could result are a small fraction of those previously analyzed for the fuel handling accident in Section 17.7.4.

The auxiliary hoist has one electric stopping and holding brake (Whiting Type 13 in. SESA) mounted on a shaft extended from the first pinion shaft and one mechanical control brake which is built into the auxiliary hoist reduction gear (Whiting Type #10). These brakes operate in the same manner as described above for the main hoist brakes.

The trolley has one electric stopping and holding brake (Whiting Type 6 in. SESA). Operation of the brake is the same as described above for the electric brake for the main hoist. The solenoid for this brake is connected across two phases of the trolley drive motor.

The bridge has one hydraulic drum type brake mounted on the bridge drive shaft with an automatic electric parking brake feature (Wagner Type 10 in. HM). For stopping duty it operates by pressing on a foot pedal in the cab which transmits hydraulic pressure to the brake unit which closes the brake shoes onto the brake drum thereby bringing the crane to a stop. Whenever electric power to the crane is broken, whether due to power failure, or opening of the main line switch, the brake automatically sets, bringing the crane to an emergency stop. The brake remains set until electric power is restored.

15.7.5.3 Administrative Considerations. The spent fuel cask cannot be handled over critical safety systems or equipment within the coverage provided by the 125 ton spent fuel cask handling crane.

The spent fuel cask can be positioned during handling operations so that the vertical distance between it and a flat essentially unyielding horizontal surface exceeds the hypothetical accident condition of a 30 ft drop (per 10CFR71.36). This will occur when the cask is moved between the cask decontamination room and the entrance to the spent fuel building. The cask decontamination room floor is approximately 50 ft below the entrance to spent fuel building. As explained above, the cask drop during this move has been eliminated as a credible accident due to redundant safety features designed into the crane, cask lifting lugs, and redundant lifting yoke.

The spent fuel cask is lifted with the non-redundant lifting yoke between the decontamination facility and the shipping railcar. Administrative controls are implemented in plant procedures to limit the vertical distance between the cask and a flat essentially unyielding horizontal surface to less than 30 feet (per 10CFR71.36). The path of this lift does not go over any safety related structures, systems or components (SSC's). ~~Therefore, any risk to the public health and safety due to a cask drop during this non redundant lift has been eliminated.~~

Insert C

Insert C

An evaluation of the 30 foot drop during movement from the decontamination facility to the railcar was performed and indicated that, while fuel components would be retained in the cask, the IF-300 cask vent/drain valves may be damaged, and thus not gas tight. A release of noble gas and iodine gap activity to the environment could occur. Using the maximum activity loading for the IF-300 cask, this type of release has been evaluated (Reference 15.7.5-1) and the whole body and thyroid doses which could result are a small fraction of those previously analyzed for the fuel handling accident in Section 15.7.4.