Crystal River Nuclear Plant
15760 W. Power Line Street
Crystal River, FL 34428

Docket 50-302
Docket 72-1035
Operating License No. DPR-72

10 CFR 50.54(q)
10 CFR 50, Appendix E
10 CFR 50.90
10 CFR 72.44(f)

May 25, 2016
3F0516-02

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555-0001

Subject: Crystal River Unit 3 – License Amendment Request #322, Revision 0, Independent Spent Fuel Storage Installation (ISFSI)-Only Emergency Plan, and ISFSI-Only Emergency Action Level Bases Manual, for the CR-3 SAFSTOR Period with Spent Fuel on Site

References:
1. NRC to CR-3 letter dated March 13, 2013, "Crystal River Unit 3 Nuclear Generating Plant Certification of Permanent Cessation of Operation and Permanent Removal of Fuel From the Reactor (Adams Accession No. ML13058A380)
2. NRC to CR-3 letter dated March 30, 2015, "Crystal River Unit 3 – Exemptions From Certain Emergency Planning Requirements and Related Safety Evaluation (TAC No. MF2981)" (ADAMS Accession No. ML15058A906)

Dear Sir:

Pursuant to 10 CFR 50.54(q), 10 CFR 50.47(b), 10 CFR 50, Appendix E, and 10 CFR 50.90, Duke Energy Florida LLC., previously known as Duke Energy Florida Inc. (DEF), hereby provides License Amendment Request (LAR) #322 Revision 0, to replace the Permanently Defueled Emergency Plan (PDEP) and its associated Emergency Action Level Bases Manual with the Independent Spent Fuel Storage Installation (ISFSI)-Only Emergency Plan (IOEP) and its associated Emergency Action Level Bases Manual. This IOEP will be used at Crystal River Unit 3 Nuclear Plant (CR-3) during the period when all spent fuel will be stored in the CR-3 ISFSI. The proposed changes are being submitted to the NRC for approval prior to implementation, as required under 10 CFR 50.54(q)(4), 10 CFR 50, Appendix E, Section IV.B.2, and 10 CFR 72.44(f).

This change reflects the complete removal of all fuel from the spent fuel pools and permits specific reductions in the size and makeup of the Emergency Response Organization due to the elimination of the design basis accident related to the spent fuel (fuel handling accident). The supplement to the Post Shutdown Decommissioning Activities Report (PSDAR) dated November 16, 2015 (Adams Accession No. ML15322A117) documented that DEF expects to have all spent fuel transferred to the ISFSI by the end of February, 2018. To comport to the reduced scope of potential radiological accidents with spent fuel in dry cask storage within the ISFSI, DEF determined that replacement of the PDEP and Permanently Defueled Emergency

Action Level (PD EAL) Bases Manual with the IOEP and the ISFSI-Only Emergency Action Level Bases Manual (IO EAL Bases Manual) were warranted.

The proposed emergency plan continues to rely on previously granted exemptions from certain emergency planning requirements (Reference 2), as the basis for these exemptions has not changed and remains in effect. These proposed IOEP changes have been determined to represent changes in both the EAL scheme and the staffing level previously approved to implement the PDEP in accordance with the requirements of 10 CFR 50.54(q) and therefore, require NRC approval prior to implementation.

LAR #322, Revision 0, contains a description of proposed License Amendment Request, Proposed Changes, and Regulatory Analysis in Enclosure 1, IOEP Draft Revision A (Enclosure 2), and the ISFSI-Only Emergency Action Level (IO EAL) Bases Manual, Draft Revision A, revised scheme (Enclosure 3), and a comparison matrix of the Nuclear Energy Institute 99-01, "Development of Emergency Action Levels for Non-Passive Reactors, Revision 6," to the Proposed CR-3 Emergency Classification System and New Emergency Action Levels (Enclosure 4), reflecting the addition of the ISFSI, that has been reviewed and concurred upon with the State and local emergency management officials. Supporting Evaluations and calculations are included in Enclosure 5.

There are no new regulatory commitments made within this submittal.

The CR-3 Plant Nuclear Safety Committee has reviewed this LAR and recommended it for approval.

DEF requests approval of this IOEP LAR by December 31, 2017. Once approved, the Amendment will be implemented within 60 days following DEF's submittal of written notification to the NRC that the spent fuel has been transferred out of the pools.

If you have any questions regarding this submittal, please contact Mr. Phil Rose, Lead Licensing Engineer, Nuclear Regulatory Affairs, at (352) 563-4883.

I declare under penalty of perjury that the foregoing is true and correct. Executed on May 25, 2016.

Sincerely,

Ronald R. Reising, Senior Vice President
Operations Support

RRR/par

Enclosures: 1. Description of Proposed License Amendment Request, Proposed Changes, and Regulatory Analysis

2. ISFSI-Only Emergency Plan, Draft Revision A
3. ISFSI-Only Emergency Action Level Bases Manual, Draft Revision A
4. Comparison Matrix of Nuclear Energy Institute 99-01, “Development of Emergency Action Levels for Non-Passive Reactors, Revision 6,” to the Proposed CR-3 Emergency Classification System and New Emergency Action Levels
5. Supporting Evaluations and Calculations

xc: NMSS Project Manager
Regional Administrator, Region I
State of Florida

DUKE ENERGY FLORIDA, INC.

CRYSTAL RIVER UNIT 3

DOCKET NUMBERS 50 - 302 AND 72-1035/
LICENSE NUMBER DPR - 72

LICENSE AMENDMENT REQUEST #322, REVISION 0, ISFSI-ONLY EMERGENCY PLAN, DRAFT REVISION A, AND ISFSI-ONLY EMERGENCY ACTION LEVEL BASES MANUAL, DRAFT REVISION A

ENCLOSURE 1

DESCRIPTION OF PROPOSED LICENSE AMENDMENT REQUEST, PROPOSED CHANGES, AND REGULATORY ANALYSIS

LICENSE AMENDMENT REQUEST #322, REVISION 0– ISFSI-ONLY EMERGENCY PLAN, DRAFT REVISION A, AND ISFSI-ONLY EMERGENCY ACTION LEVEL BASES MANUAL, DRAFT REVISION A,

1.0 INTRODUCTION

By letter dated February 20, 2013, DEF submitted a certification of permanent cessation of power operation and permanent removal of fuel from the reactor vessel (Reference 1). Consequently, as specified in 10 CFR 50.82(a)(2), the 10 CFR Part 50 license no longer authorizes operation of the reactor or emplacement or retention of fuel in the reactor vessel.

The U.S. Nuclear Regulatory Commission (NRC) issued License Amendment No. 246 to Facility Operating License No. DPR-72 for the Crystal River Unit 3 Nuclear Generating Plant (CR-3) by letter dated March 31, 2015 (Reference 1). Since the issuance of License Amendment No. 246, where the CR-3 Permanently Defueled Emergency Plan (PDEP) with exemptions and Permanently Defueled Emergency Action Levels (PD EALs) were approved, additional changes to the CR-3 Emergency Plan and EAL Bases Manual are warranted to reflect the storage of all fuel in an Independent Spent Fuel Storage Installation (ISFSI) facility.

LAR #318 is currently under review by the NRC. That change revises the PDEP and PD EAL Bases Manual to add an ISFSI EAL to the PD EAL Bases Manual. There should not be any interaction between these LARs as LAR #318 is required to be implemented prior to placing spent fuel into the ISFSI, while LAR # 322 is to be implemented after all spent fuel is in dry storage within the ISFSI. Therefore, there is no need to disposition other license changes as they relate to this LAR.

As such, an intermediate step prior to removal of all fuel from the site is to store the fuel in an ISFSI on site. The supplement to the Post Shutdown Decommissioning Activities Report (PSDAR) dated November 16, 2015 (Reference 3) documented that DEF expects to have all spent fuel transferred to the ISFSI by the end of February, 2018. To comport to the reduced scope of potential radiological accidents with spent fuel in dry cask storage within the ISFSI, DEF determined that replacement of the PDEP and PD EAL Bases Manual with the ISFSI-Only Emergency Plan (IOEP) and the ISFSI-Only Emergency Action Level Bases Manual (IO EAL Bases Manual) were warranted.

The proposed emergency plan is for the operation of the ISFSI. The plan would only be implemented after all spent fuel has been removed from the spent fuel pools and placed in dry storage within the ISFSI. Implementation of the emergency plan would involve DEF establishing administrative controls for radiological source term accumulation limits and methods to control the accidental dispersal of the radiological source. The proposed emergency plan continues to rely on previously granted exemptions from certain emergency planning requirements (Reference 4) as the basis for these exemptions has not changed and remains in effect.

AREVA Inc. (AREVA) is the holder of the Certificate of Compliance (CoC) 1004 for the standardized NUHOMS® System, which will be used to store spent fuel at the CR-3 ISFSI. Currently, the Technical Specifications associated with the CoC require that under certain circumstances, the cask must be returned to the spent fuel pool for inspection. AREVA submitted an Application for Amendment 14, to the standardized NUHOMS CoC No. 1004 for

Spent Fuel Storage Casks, Revision 0, on April 16, 2015 (Reference 12). AREVA submitted a revision to the above referenced Application for Amendment 14 of this CoC on November 11, 2015 (Reference 13). This revision requests the deletion of the License Condition to require a return to the Spent Fuel Pool for inspection. AREVA has requested approval of the CoC amendment by October 2016. Once the CoC is revised, there will no longer be a requirement to return spent fuel to the spent fuel pools. This license amendment will not be implemented if the revision to the AREVA CoC, Amendment 14, is not approved.

Consistent with the condition that the proposed emergency plan may be implemented 60 days after all spent fuel has been certified removed from the spent fuel pools, CR-3 will be submitting a LAR to revise the CR-3 Facility Operating License to comport to the ISFSI-Only condition that there is no longer a requirement to return spent fuel to the spent fuel pools. This LAR is expected to be submitted by the end of July, 2016.

2.0 DESCRIPTION

The proposed amendment would modify the CR-3 license by revising the emergency plan and associated emergency action level (EAL) scheme. The proposed changes reduce the scope of onsite emergency planning requirements to reflect the reduced scope of potential radiological accidents with all spent fuel in dry cask storage within the ISFSI. After all spent fuel is in dry cask storage within the ISFSI, the number and severity of potential radiological accidents possible at CR-3 are substantially lower. There continues to be no need for offsite emergency response plans at CR-3 because no design basis accident or reasonably conceivable beyond design basis accident can result in a radioactive release that exceeds Environmental Protection Agency (EPA) Protective Action Guides (PAGs) beyond the site boundary.

The analysis of potential onsite and offsite consequences of accidental releases associated with the operation of an ISFSI is contained in NUREG-1140, “A Regulatory Analysis on Emergency Preparedness for Fuel Cycle and Other Radioactive Material Licensees.” NUREG-1140 concluded that the postulated worst-case accident involving an ISFSI has insignificant consequences to public health and safety. This evaluation shows that the maximum offsite dose to a member of the public due to an accidental release of radioactive materials would not exceed 1 rem Total Effective Dose Equivalent.

The robust nature and high integrity of the spent fuel storage system selected for use at the ISFSI is designed to prevent the release of radioactivity in the event of an accident, including environmental phenomena (e.g., earthquake and flooding). As a result of the high integrity dry shielded canister’s design and the substantial protection afforded the canisters by the horizontal storage modules (HSM), leakage of fission products from a canister is not considered to be a credible event.

The radioactive source term for an accidental release at the defueled reactor site is reduced by radioactive decay and spent fuel removal from the pools to the ISFSI. Potential offsite doses were calculated at CR-3 to verify that the necessary administrative radiological source term accumulation limits would be adequate during decontamination and dismantling of radioactive systems, structures, and components contained in the non-operational nuclear unit. These administrative radiological source term accumulation limits ensure that if a radiological release were to occur, it would not exceed two times the Offsite Dose Calculation Manual (ODCM) limits (2 times 1500 millirem/year) at the site boundary for 60 minutes (and therefore not result in

doses to the public above EPA PAGs beyond the controlled area boundary). In addition to administrative limits on radioactive source term accumulation, administrative controls will be in place to limit the dispersal of radioactive material. These administrative limits and dispersal controls are in addition to the requirements already specified in the ODCM for control of effluent releases.

The current EAL scheme was approved for use at CR-3 on March 31, 2015 and is based on NEI 99-01, Revision 6 (Reference 6). The proposed EAL scheme remains based on NEI 99-01, Revision 6, as appropriate for the ISFSI-Only condition at CR-3 (Reference 7). The proposed revisions constitute a change in the emergency planning function commensurate with the ongoing and anticipated reduction in radiological source term at CR-3.

3.0 PROPOSED CHANGES

The major changes to the CR-3 Emergency plan are:

- Removal of the various emergency actions related to the spent fuel pools.
- Removal of non-ISFSI related emergency event types.
- Replacement of the “Shift Manager” title for the “ISFSI Shift Supervisor (ISS)” title as the position that assumes the Emergency Coordinator responsibilities.
- Revision of the Emergency Response Organization.

The off-normal events and accidents addressed in the CR-3 ISFSI–Only Emergency Plan are related to the dry storage of spent nuclear fuel within the ISFSI and include only the off-normal, accident, natural phenomena, and hypothetical events and consequences presented in the NUHOMS Certificate of Compliance (CoC) 1004 (Amendment 14) Horizontal Modular Storage System Updated Final Safety Analysis Report (NUHOMS FSAR). After all fuel is removed from the CR-3 spent fuel pools, there will no longer be any potential for the accidents previously described in the CR-3 Emergency Plan that would increase risk to the health and safety of the public. These accidents included events specifically related to the storage of the spent fuel in the spent fuel pools. After the transfer of the spent fuel pools to the ISFSI, the spent fuel storage and handling systems will be removed from operation consistent with the PSDAR (Reference 2).

3.1 Elimination of Spent Fuel Pools Initiating Conditions and EALs

The initiating conditions (ICs) and EALs associated with emergency classification in the current emergency plan are based on NEI 99-01, Revision 6. Specifically, Appendix C of NEI 99-01 contains a set of ICs and EALs for permanently defueled nuclear power plants that had previously operated under a 10 CFR Part 50 license and have permanently ceased operations.

After all spent fuel has been removed from the spent fuel pools and placed in dry storage within the ISFSI, the NEI 99-01, Appendix C ICs and EALs that are associated with the spent fuel pools are no longer required to be in the emergency plan. Additionally, certain ICs and EALs whose primary function is not associated with the spent fuel pools are also no longer required to be in the emergency plan when administrative controls are established to limit source term accumulation and the offsite consequences of uncontrolled effluent releases.

Therefore, the ICs listed in Table 1 below are being deleted from the currently approved emergency plan for CR-3. The ICs being deleted are either associated only with spent fuel pool operation or are ICs for which administrative controls to limit possible effluent releases have been established.

Table 1 – Emergency Plan Initiating Conditions Being Deleted

ALERT	UNUSUAL EVENT
PD-AA1 (all) Release of gaseous or liquid radioactivity resulting in offsite dose greater than 10 mrem TEDE or 50 mrem CDE	PD-AU1 (all) Release of gaseous or liquid radioactivity greater than 2 times the ODCM limit for 60 minutes or longer.
PD-AA2 (all) UNPLANNED rise in plant radiation levels that impedes plant access required to maintain spent fuel integrity.	PD-AU2 (all) UNPLANNED rise in plant radiation levels.
ALERT	**UNUSUAL EVENT**
	PD-SU1 (all) UNPLANNED spent fuel pool temperature rise.
PD-HA1 HOSTILE ACTION ~~within the OWNER CONTROLLED AREA or airborne attack threat within 30 minutes.~~ is occurring or has occurred. * 1) A HOSTILE ACTION is occurring or has occurred ~~within the OWNER CONTROLLED AREA~~ as reported by the Security Shift Supervisor. ~~**OR**~~ * 2) ~~A validated notification from NRC providing information of an aircraft attack threat within 30 minutes of the site~~. *	PD-HU1 Confirmed SECURITY CONDITION or threat 1) A SECURITY CONDITION that does not involve a HOSTILE ACTION as reported by the Security Shift Supervisor. **OR** 2) Notification of a CREDIBLE SECURITY THREAT directed at the site. ~~**OR**~~ * 3) ~~A validated notification from the NRC providing information of an aircraft threat.~~ *
	PD-HU2 (all) ** Hazardous event affecting SAFETY SYSTEM equipment necessary for spent fuel cooling

* Only the strike through portion is being deleted.
** For an ISFSI–Only facility, the condition addressed by PD-HU2 remains fully addressed by IC E-HU1

The currently existing CR-3 ICs and EALs not listed in Table 1 above are being retained. The EAL ICs being deleted include all ICs associated with the categories of abnormal radioactive

release and system malfunction as well as SECURITY CONDITIONs associated with aircraft. These categories apply only to spent fuel pool operation and the minimized risk of having all spent fuel stored within the ISFSI.

The EAL ICs being retained in the emergency plan are appropriate to address the condition of an ISFSI-Only facility (no fuel stored in the spent fuel pools).

3.2 Emergency Response Organization Revision

A Resource Manager is provided to assist in assessing the event and obtaining needed resources. The Resource Manager is required to be in contact with the Emergency Coordinator within two (2) hours of classification of an Unusual Event or Alert. The Resource Manager augments the Emergency Coordinator by assisting in assessing the emergency condition and coordinating the required resources, including public information interface. Services provided to the Emergency Coordinator by the Resource Manager can be provided remotely and do not necessitate an onsite response of the Resource Manager. By responding remotely, the actual response time is decreased with no negative impact to services and functional responsibilities provided by the Resource Manager.

Events that require entry into the ISFSI-Only Emergency Plan would be an extreme natural phenomenon (beyond design basis) or a security condition, either of which would negatively impact or restrict access to the site.

Therefore, the Resource Manager's functional responsibilities could be performed in a timely manner either by reporting to the site or performing the function remotely in the specified timeframe.

4.0 TECHNICAL ANALYSIS

4.1 Radiological Consequences of Design Basis Events

CR-3 is situated on the Gulf of Mexico, approximately 75 miles north of St. Petersburg, FL. The land area within a 20 mile radius around the plant is primarily farmland or undeveloped land, with a low population density. The summer-time population of Citrus County, FL is approximately 140,000. Two small communities are within 10 miles of the plant, Crystal River (approximately 3000 people) and Inglis (approximately 1000 people). The entire 50-mile radius west of the plant is the Gulf of Mexico.

Chapter 14 of the CR-3 Final Safety Analysis Report (FSAR) previously described the design basis accident (DBA) scenarios and transient scenarios that were applicable to CR-3 with fuel stored in the spent fuel pools. However, after transfer of all irradiated fuel to dry storage within the ISFSI, those accident scenarios postulated in the FSAR are no longer possible. The ISFSI is a passive storage system that does not rely on electric power for heat transfer. After removal of the spent fuel from the spent fuel pools, there are no credible fuel related accidents for which Certified Fuel Handler, Shift Supervisor, or Non-Certified Operator actions are required to prevent occurrence or mitigate the consequences. There is no credible accident resulting in radioactive releases requiring offsite protective measures.

The robust design and construction of the spent fuel storage system selected for use at the ISFSI prevents the release of radioactivity in the event of an off-normal or accident event as described in the ISFSI Storage System UFSAR. Leakage of fission products from a canister confinement boundary breach is not considered to be a credible event, given the high integrity nature of the canister's design and the additional protection afforded by the storage casks.

DEF submitted a PSDAR on December 2, 2013 (Reference 2) which identified that CR-3 will decommission using a SAFSTOR method in which most plant fluid systems are drained and the plant is left in a stable condition until final decontamination and dismantlement activities begin. The PSDAR was updated by a supplemental letter dated November 16, 2015 that provided a realistic date that DEF expects to have all spent fuel transferred to the ISFSI at the end of February, 2018 (Reference 3).

After all the spent fuel has been removed from the spent fuel pools, the estimated radiological inventory (non-fuel) that remains at the reactor facility is primarily attributable to activated reactor components and structural materials. There are no credible accident scenarios that can mobilize a significant portion of this inventory for release. As a result, the potential accidents that could occur during decommissioning the reactor facility have negligible offsite and onsite radiological consequences.

With all spent nuclear fuel in dry storage within the ISFSI, the radiological status of the facility required for implementing this proposed ISFSI-Only Emergency Plan (IOEP) is summarized as follows:

- The remaining radiological source term at CR-3 will not create an unplanned/unanticipated increase in radiation or in liquid or airborne radioactivity levels outside of the site boundary that would result in doses to the public above EPA PAG limits at the site boundary.
- Source term accumulation from activities during decontamination and dismantlement of radioactive systems, structures, and components are administratively controlled at a level that would preclude declaring an Unusual Event. (UE).
- Necessary radiological support personnel will be administratively required to be onsite during active decontamination and dismantlement of radioactive systems, structures, and components.

The IOEP and certain ICs and EALs, for which administrative controls to limit possible effluent releases will be established, do not apply to decontamination and dismantlement of radioactive systems, structures, and components.

NUREG-0586 (Reference 8) supports this conclusion in the following statement:

> "The staff has reviewed activities associated with decommissioning and determined that many decommissioning activities not involving spent fuel that are likely to result in radiological accidents are similar to activities conducted during the period of reactor operations. The radiological releases from potential accidents associated with these activities may be detectible. However, work procedures are designed to minimize the likelihood of an accident and the consequences of an accident, should one occur, and procedures will remain in place to protect health and safety while the possibility of significant radiological accident exists."

NUREG-0586 also makes the following supportive statement:

> "The staff has considered available information, including comments received on the draft of Supplement 1 of NUREG-0586, concerning the potential impacts of non-spent fuel related radiological accidents resulting from decommissioning. This information indicates, that with the mitigation procedures in place, the impacts of radiological accidents are neither detectible nor destabilizing. Therefore, the staff makes the generic conclusion that impacts of non-spent fuel related radiological accidents are SMALL. The staff has considered mitigation and concludes that no additional measures are likely to be sufficiently beneficial to be warranted."

Accordingly, administrative controls that are designed to minimize the likelihood and consequence of an off-normal or accident event would be implemented when decontamination or dismantling activities of radioactive systems, structures, or components are being performed.

Implementation of the IOEP would involve DEF establishing administrative controls for radiological source term accumulation limits and methods to control the accidental dispersal of the radiological source.

Examples of radiological source term accumulation limits are based on:

- Radioactive materials collected on filter media and resins (dose rate limit).
- Contaminated materials collected in shipping containers (dose rate limit).
- Surface or fixed contamination on work areas that may create airborne radioactive material (activity limits).
- Radioactive liquid storage tank (activity concentration limits).

An example of a method to control accidental dispersal of the radiological source term is limitation on dispersal mechanisms that may cause a fire (e.g., limits on combustible material loading, use of fire watch to preclude fire, etc.) or placement of a berm around a radioactive liquid storage tank. If the dispersal control fails, the limits on source term would preclude exceeding the site boundary source term limit.

As discussed in the previously granted exemption from various emergency planning requirements contained in 10 CFR 50.47 and 10 CFR 50, Appendix E (Reference 4), an analysis of the potential radiological impact of a design basis accident at CR-3 in a permanently defueled condition indicates that any releases beyond the site boundary are below EPA PAG exposure levels, as detailed in Reference 5. The basis for these exemptions has not changed and remains in effect for the proposed emergency plan changes.

4.2 Radiological Consequences of Postulated Events

Although the limited scope of design basis accidents that remain applicable to the CR-3 facility justifies a reduction in the necessary scope of emergency response capabilities, DEF also assessed beyond design basis events using past industry precedence, including information contained in Appendix I, "Radiological Accidents," of NUREG-0586 (Reference 8).

Under the previous facility condition of fuel stored within the spent fuel pools, the most severe postulated beyond design basis event involved a highly unlikely sequence of events that causes heatup of the spent fuel, postulated to occur without any heat transfer, such that the zircaloy fuel

cladding reaches ignition temperature (adiabatic heat up). The resultant zircaloy fire could lead to the release of large quantities of fission products to the atmosphere. However, after removal of the spent fuel from the spent fuel pools, the configuration of the spent fuel stored in dry storage precludes the possibility of such a scenario.

With this previously limiting beyond design basis scenario no longer possible, DEF assessed the following beyond design basis events associated with performance of decommissioning activities with all irradiated fuel stored in the CR-3 ISFSI. A summary of the assessments is provided below.

1. Cask Drop Event (Fuel Related Accident)

   CR-3 is the holder of a general license for the storage of spent fuel in an ISFSI at power sites in accordance with the provisions of 10 CFR 72.210 and 10 CFR 72.212. The generally licensed ISFSI at CR-3 is used for interim onsite dry storage of spent nuclear fuel assemblies in the Trans-Nuclear Standardized NUHOMS® System (NUHOMS Certificate of Compliance (COC) 1004, Amendment 14).

   As documented in the storage system UFSAR, analysis of the normal events, including drop events, determined that canister drops can be sustained without breaching the confinement boundary, preventing removal of spent fuel assemblies, or creating a criticality accident. There are no evaluated normal conditions or off-normal or accident events that result in damage to the canister producing a breach in the confinement boundary. Neither normal conditions of operation or off-normal events preclude retrieval of the fuel for transport and ultimate disposal.

   The dry spent fuel storage casks used at CR-3 are approved for storage of spent fuel per 10 CFR 72.214; and, as such, are in compliance with the requirements of 10 CFR 72.24 and 10 CFR 72.122 for off-normal and accident events to ensure that they will provide safe storage of spent fuel during all analyzed off-normal and accident events. Therefore, no radiological release would be expected to occur.

2. Radioactive Material Handling Accident (Non-Fuel Related)

   The limiting non-fuel related event involves the release of radioactive material from a concentrated source, such as filters, resins, and shipping containers (as discussed in NUREG-0586, Appendix 1). The initiator to these events could be a fire, explosion, or a handling event (cask drop). During the CR-3 SAFSTOR dormancy period, after all spent fuel has been moved to the ISFSI, there would be no concentrated source of radioactive material whose release to the environment could exceed two (2) times the ODCM limit at the site boundary (2 times 1500 millirem/year). During decontamination and dismantlement activities, administrative controls would limit the total amount of activity that can accumulate in a concentrated source. Calculation N16-0001, Source Term Curie to Unrestricted Area Dose Rate Conversion Methodology, (Enclosure 5) develops an activity accumulation limit methodology for decontamination and dismantlement of irradiated stainless steel (e.g., reactor vessel internals) and irradiated concrete (e.g., reactor coolant loop bio-shield walls) based on isotopic mixtures from NUREG/CR-3474, such that a release to the environment from concentrated sources of these radioactive materials would not exceed two times the ODCM at the site boundary.

It is expected that representative material samples will be taken and analyzed prior to actual decontamination/dismantlement work. Using the methodology consistent with this calculation, container/filter maximum radioactivity limits will be derived.

The results of the above assessment indicate that the projected radiological doses at the controlled area boundary are less than the EPA PAGs.

3. Accidents Initiated in External Events

The effects of external events, such as aircraft crashes, fires, floods, wind (including tornados), earthquakes, lightning, and physical security breaches on the ISFSI remain unchanged from the effects that were considered under the existing emergency plan. Externally initiated events are addressed by the proposed EALs.

In summary, there continues to be a low likelihood of any postulated event resulting in radiological releases requiring offsite protective measures, and there is no credible radioactive material event (non-fuel related) resulting in radiological releases requiring declaration of an emergency.

4.3 ISFSI–Only Emergency Plan

The CR-3 ISFSI–Only Emergency Plan (IOEP) is provided in Enclosure 2 to this submittal for NRC review and approval. This proposed emergency plan is associated with EALs for events related to the ISFSI. The IOEP addresses the applicable regulations stipulated in 10 CFR 50.47, “Emergency Plans” (as exempted), 10 CFR 50, Appendix E, “Emergency Planning and Preparedness for Production and Utilization Facilities” (as exempted), and 10 CFR 72.32, “Emergency Plan,” and is consistent with the applicable guidelines established in NUREG-0654/FEMA-REP-1, Revision 1, “Criteria for Preparation and Evaluation of Radiological Emergency Response Plans and Preparedness in Support of Nuclear Power Plants.”

The IOEP describes the station’s plan for responding to emergencies while all spent fuel is in dry storage within an ISFSI. Currently, irradiated fuel is stored only in the spent fuel pools. After all spent fuel at CR-3 is in dry storage within the ISFSI, the number and severity of potential radiological accidents is significantly less than when fuel was stored in the spent fuel pools.

The CR-3 ISFSI-Only Emergency Plan conservatively provides that the emergency planning zone for the ISFSI is the area within the site boundary. At CR-3, the site boundary completely encompasses the controlled area. The controlled area, as defined in 10 CFR 72.3, “Definitions,” means the area immediately surrounding an ISFSI for which DEF exercises authority over its use and within which ISFSI operations are performed.

The controlled area is established to limit dose to the public during normal operations and design basis accidents in accordance with the requirements of 10 CFR 72.104, “Criteria for Radioactive Materials in Effluents and Direct Radiation from an ISFSI or MRS,” and 10 CFR 72.106, “Controlled Area of an ISFSI or MRS.” DEF’s analysis of the radiological impact of potential accidents at the ISFSI conclude that any releases beyond the ISFSI controlled area are expected to be less than the EPA PAGs. The controlled area is completely enclosed within

the site boundary. Thus, any radiological releases beyond the site boundary will also be less than the EPA PAGs.

Based on the reduced number and consequences of potential radiological events at CR-3 with all spent fuel in dry storage within the ISFSI, there will continue to be no need for offsite emergency response plans for the protection of the public beyond the site boundary. Additionally, the scope of the onsite emergency preparedness organization and corresponding requirements in the emergency plan may be reduced without an undue risk to the public health and safety.

The analysis of the potential radiological impact of an accident in a condition with all irradiated fuel stored in the ISFSI indicates that any releases beyond the site boundary are below the EPA PAG exposure levels as detailed in Reference 5. Exposure levels, which warrant pre-planned response measures, are limited to onsite areas. For this reason, radiological emergency planning is focused onsite.

4.4 ISFSI-Only Emergency Action Levels

Enclosure 3 provides the site-specific EAL technical bases document, which contains the proposed CR-3 ISFSI-Only Emergency Action Level (IOEAL) scheme for NRC review and approval. The current CR-3 EAL Scheme was approved by the NRC on March 31, 2015 Reference 6). The new ISFSI EAL scheme is to be implemented by the CR-3 ISFSI-Only Emergency Plan (provided in Enclosure 2).

Deletions from the currently approved EAL scheme are listed in Section 3.1, “Elimination of Spent Fuel Pool Initiating Conditions and EALs,” Table 1, “Emergency Plan Initiating Conditions Being Deleted,” above.

Related Documents

Supporting Evaluations/calculations for establishing appropriate radioactive material administrative control limits are provided in Enclosure 5 to this submittal.

Operating Modes and Applicability

The proposed EALs are only applicable after the final spent nuclear fuel assembly has been transferred out of the spent fuel pools and placed in dry storage within the ISFSI. This license amendment will not be implemented if the revision to the AREVA CoC, Amendment 14, is not approved.

State and Local Government Review of Proposed Changes

State and local emergency management officials are advised of EAL changes that are implemented. Prior to submittal, CR-3 has provided an overview of the new classification scheme to State and local emergency management officials in accordance with 10 CFR 50, Appendix E, Section IV.B.1.

5.0 Summary

By letter dated February 20, 2013, DEF submitted a certification of permanent removal of fuel from the reactor vessel (Reference 1). Consequently, as specified in 10 CFR 50.82(a)(2), the 10 CFR Part 50 license for CR-3 no longer authorizes operation of the reactor or emplacement or retention of fuel into the reactor vessel. The PSDAR for CR-3 dated December 2, 2013, documented that DEF expects to have all spent fuel transferred to the ISFSI by the end of 2019 (Reference 2). This date was later revised in a supplement to the PSDAR dated November 16, 2015, to the end of February, 2018 (Reference 3). To comport to the reduced scope of potential radiological accidents with spent fuel in dry cask storage within the ISFSI, DEF proposes a new EAL scheme and corresponding emergency plan changes.

This proposed amendment would revise both the emergency plan and the EAL scheme appropriate for the condition of the station wherein all spent nuclear fuel is in dry storage within the ISFSI. The new emergency plan and EAL scheme are being submitted to the NRC for approval, as required under Section IV.B.2 of Appendix E to 10 CFR Part 50. Additionally, 10 CFR 50.54 (q)(4) and 10 CFR 72.44(f) require that proposed changes receive prior approval by the NRC because they are considered to reduce the effectiveness of the plan.

The proposed emergency plan does not meet all standards of 10 CFR 50.47(b) and requirements of 10 CFR 50, Appendix E. However, DEF was granted exemptions from portions of 10 CFR 50.47(b), 10 CFR 50.47(c)(2), and 10 CFR 50, Appendix E, Section IV, by letter dated March 31, 2015 (Reference 4). The basis for these exemptions has not changed and remains in effect for the proposed emergency plan changes. With the granted exemptions, the emergency plan, as revised, will continue to meet the remaining applicable requirements in 10 CFR 50, Appendix E, and the planning standards of 10 CFR 50.47(b).

6.0 REGULATORY ANALYSIS

6.1 No Significant Hazards Consideration

In accordance with 10 CFR 50.90, “Application for amendment of license, construction permit, or early site permit,” Duke Energy Florida LLC., previously known as Duke Energy Florida Inc. (DEF), requests NRC approval of a reduction in effectiveness of the site Emergency Plan by the removal of several Emergency Action Levels (EALs) and corresponding changes to the emergency plan, to be implemented after all spent fuel is removed from the spent fuel pools and moved into dry storage within the CR-3 ISFSI facility. The proposed site Independent Spent Fuel Storage Installation (ISFSI) - Only Emergency Plan (IOEP) and ISFSI-Only Emergency Action Level (IOEAL) Bases Manual revisions are commensurate with the reduction in radiological source term at the CR-3 site. The PSDAR for CR-3 dated December 2, 2013 (Reference 2), documented that DEF expects to have all spent fuel transferred to the ISFSI by the end of 2019. This date was later revised in a supplement to the PSDAR dated November 16, 2015, to the end of February, 2018 (Reference 3). To comport to the reduced scope of potential radiological accidents with spent fuel in dry cask storage within the ISFSI, DEF proposes a new EAL scheme and corresponding emergency plan changes. Also, based on the AREVA Certificate of Compliance 1004, Amendment 14, approval, CR-3 will no longer be required to place spent fuel in the spent fuel pools after all fuel has been transferred to the ISFSI

DEF has evaluated whether a significant hazards consideration is involved with the proposed amendment by focusing on the three conditions set forth in 10 CFR 50.92, "Issuance of amendment," discussed below:

1. Does the proposed amendment involve a significant increase in the probability or consequences of an accident previously evaluated?

The proposed amendment would modify the CR-3 facility operating license by revising the emergency plan and revising the EAL scheme. CR-3 has permanently ceased operation and is permanently defueled. The proposed amendment is conditioned on all spent nuclear fuel being removed from wet storage in the spent fuel pools and placed in dry storage within the ISFSI. Occurrence of postulated accidents associated with spent fuel stored in a spent fuel pool is no longer credible in a spent fuel pool devoid of such fuel. The proposed amendment has no effect on plant systems, structures, or components (SSC) and no effect on the capability of any plant SSC to perform its design function. The proposed amendment would not increase the likelihood of the malfunction of any plant SSC. The proposed amendment would have no effect on any of the previously evaluated accidents in the CR-3 Final Safety Analysis Report (FSAR).

Since CR-3 has permanently ceased operation, the generation of fission products has ceased and the remaining source term continues to decay. This continues to significantly reduce the consequences of previously evaluated postulated accidents. Therefore, the proposed amendment does not involve a significant increase in the consequences of a previously evaluated accident.

2 Does the proposed amendment create the possibility of a new or different kind of accident from any accident previously evaluated?

The proposed amendment constitutes a revision of the emergency planning function commensurate with the ongoing and anticipated reduction in radiological source term at CR-3.

The proposed amendment does not involve a physical alteration of the plant. No new or different types of equipment will be installed and there are no physical modifications to existing equipment as a result of the proposed amendment. Similarly, the proposed amendment would not physically change any SSC involved in the mitigation of any postulated accidents. Thus, no new initiators or precursors of a new or different kind of accident are created. Furthermore, the proposed amendment does not create the possibility of a new failure mode associated with any equipment or personnel failures. The credible events for the ISFSI remain unchanged.

Therefore, the proposed amendment does not create the possibility of a new or different kind of accident from any previously evaluated.

3. Does the proposed amendment involve a significant reduction in a margin of safety?

Because the 10 CFR Part 50 license for CR-3 no longer authorizes operation of the reactor or emplacement or retention of fuel into the reactor vessel, as specified in 10 CFR 50.82(a)(2), the occurrence of postulated accidents associated with reactor operation is no longer credible. With all spent nuclear fuel transferred out of wet storage from the spent fuel

pools and placed in dry storage within the ISFSI, a fuel handling accident is no longer credible. There are no longer credible events that would result in radiological releases beyond the site boundary exceeding the EPA PAG exposure levels, as detailed in the EPA's "Protective Action Guide and Planning Guidance for Radiological Incidents," Draft for Interim Use and Public Comment dated March 2013 (PAG Manual).

The proposed amendment does not involve a change in the plant's design, configuration, or operation. The proposed amendment does not affect either the way in which the plant structures, systems, and components perform their safety function or their design margins. Because there is no change to the physical design of the plant, there is no change to these margins.

Therefore, the proposed amendment does not involve a significant reduction in a margin of safety.

Based on the above, DEF concludes that the proposed amendment presents no significant hazards consideration under the standards set forth in 10 CFR 50.92(c), and accordingly a finding of "no significant hazards consideration" is justified.

6.2 Applicable Regulatory Requirements/Criteria

The regulatory requirements, as exempted, are discussed below:

Title 10 of the Code of Federal Regulations (10 CFR), Section 50.47, "Emergency Plans," set forth emergency plan requirements for nuclear power plant facilities. The regulations in 10 CFR 50.47(a)(1)(i) state, in part:'

> "No initial operating license for a nuclear power reactor will be issued unless a finding is made by the NRC that there is reasonable assurance that adequate protective measures can and will be taken in the event of a radiological emergency."

Section 50.47(b) establishes the standards that emergency response plans must meet for NRC staff to make a positive finding that there is reasonable assurance that the licensee can and will take adequate protective measures in the event of a radiological emergency.

- Planning Standard (1) if Section 50.47(b) states, in part: "[E}ach principal response organization has staff to respond and to augment its initial response on a continuous basis."

- Planning Standard (2) of Section 50.47(b) states, in part: "On-shift facility licensee responsibilities for emergency response are unambiguously defined, adequate staffing to provide initial facility accident response in key functional areas is maintained at all times, timely augmentation of response capabilities is available…."

- Planning Standard (4) of Section 50.47(b) requires that a licensee's emergency response plan contain the following: "A standard emergency classification and action level scheme, the bases of which include facility system and effluent parameters, is in use by the nuclear facility licensee."

- Planning Standard (8) of Section 50.47(b) states, in part: "Adequate emergency facilities and equipment to support the emergency response are provided and maintained."

10 CFR 50.54(q)(4) specifies the process for revising emergency plans where the change reduces the effectiveness of the plan. This regulation states the following:

> "The changes to a licensee's emergency plan that reduce the effectiveness of the plan as defined in paragraph (q)(1)(iv) of this section may not be implemented without prior approval by the NRC."

Section IV.A of Appendix E, "Emergency Planning and Preparedness for Production and Utilization Facilities," to 10 CFR Part 50, states, in part: The organization for coping with radiological emergencies shall be described, including definition of authorities, responsibilities, and duties of individuals assigned to the licensee's emergency organization…"

Section IV.C.1 of Appendix E requires that each emergency plan to define the emergency classification levels that determine the extent of participation of the emergency response organization.

Section IV.E of Appendix E states, in part: "Adequate provisions shall be made and described for emergency facilities and equipment…"

As identified in 10 CFR 72.13, "Applicability," the applicable emergency plan requirements for an Independent Spent Fuel Storage Installation associated with a general license are specified in 10 CFR 72.32(c) and (d).

The proposed emergency plan continues to rely on previously granted exemptions from certain emergency planning requirements (Reference 4) as the basis for these exemptions has not changed and remains in effect.

In November 2012, NEI published NEI 99-01, Revision 6 (Reference 7). The NRC endorsed NEI 99-01, Revision 6, by letter dated March 28, 2013 (Reference 9). The changes being requested herein are based on Revision 6 to NEI 99-01. The proposed changes are conservatively being considered as a change to the EAL scheme development methodology. Pursuant to 10 CFR Part 50, Appendix E, Section IV.B.2, a revision to an entire EAL scheme must be approved by the NRC before implementation.

6.3 Precedent

Similar changes to emergency plans and associated emergency action levels for plants that have transitioned to ISFSI-Only status were approved by the NRC for the La Crosse Boiling Water Reactor Facility on September 8, 2014 (Reference 10), and for the Zion Facility on May 14, 2015 (Reference 11).

6.4 Conclusion

Based on the considerations discussed above, (1) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, (2) such activities will be conducted in compliance with the Commission's regulations, and (3) the

issuance of the amendment will not be inimical to the common defense and security or to the health and safety of the public.

7.0 ENVIRONMENTAL CONSIDERATION

A review has determined that the proposed amendment would change a requirement with respect to installation or use of a facility component located within the restricted area, as defined in 10 CFR 20, or would change an inspection or surveillance requirement. However, the proposed amendment does not involve (i) a significant hazards consideration, (ii) a significant change in the types or significant increase in the amounts of any effluent that may be released offsite, or (iii) a significant increase in individual or cumulative occupational radiation exposure. Accordingly, the proposed amendment meets the eligibility criterion for categorical exclusion set forth in 10 CFR 52.22(c)(9). Therefore, pursuant to 10 CFR 51.22(b), no environmental impact statement or environmental assessment need be prepared in connection with the proposed amendment.

8.0 REFERENCES

1. Letter from Jon Franke (DEF) to NRC Document Control Desk, “Certification of Permanent Cessation of Power Operations and that Fuel has been Permanently Removed from the Reactor,” dated February 20, 2013. (ADAMS Accession No. ML13056A005)
2. Letter from John Elnitsky (DEF) to NRC Document Control Desk, “Post-Shutdown Decommissioning Activities Report,” dated December 2, 2013. (ADAMS Accession No. ML13340A009)
3. Letter from Ron Reising (DEF) to Document Control Desk, “Notification of Schedule Change for the Post-Shutdown Decommissioning Activities Report, dated November 16, 2015. (ADAMS Accession No. ML15322A117)
4. Letter from Michael Orenak (NRC) to Terry Hobbs (DEF), “Crystal River Unit 3 – Exemptions from Certain Emergency Planning Requirements and Related Safety Evaluation,” dated March 30, 2015. (ADAMS Accession No. ML15058A906)
5. U.S. Environmental Protection Agency, Protective Action Guide and Planning Guidance for Radiological Incidents,” Draft for interim use and Public comment, dated March 2013, (PAG Manual).
6. Letter from Michael Orenak (NRC) to Terry Hobbs (DEF), “Crystal River Unit 3 – Issuance of Amendment Regarding Changes to the Emergency Plan and Emergency Action Levels,” dated March 31, 2015. (ADAMS Accession No. ML15027A209)
7. Nuclear Energy Institute (NEI) 99-01, Revision 6, “Methodology for Development of Emergency Action Levels for Non Passive Reactors,” November 2012. (ADAMS Accession No. ML12326A805)
8. NUREG-0586, “Generic Environmental Impact Statement of Decommissioning of Nuclear Facilities, “ Supplement 1, Volume 1, November 2002.
9. Letter from Mark Thaggard (NRC) to Susan Perkins-Grew (NEI), “U.S. Nuclear Regulatory Commission Review and Endorsement of NEI 99-01, Revision 6, Dated November 2012,” dated March 28, 2013. (ADAMS Accession No. ML 12346A463)
10. Letter from U.S. Nuclear Regulatory Commission to Dairyland Power Cooperative (La Crosse Boiling Water Reactor) “Issuance of Amendment Relating to the Dairyland Power Cooperative La Crosse Boiling Water Reactor Request for Changes to the Emergency

Planning Requirements," dated September 8, 2014. (ADAMS Accession No. ML14155A112)

11. Letter from U.S. Nuclear Regulatory Commission to Zion Solutions LLC (Zion Nuclear Power Station), "Issuance of Amendments Relating to the Emergency Planning Requirements for Zion Nuclear Power Station, Units 1 and 2, dated May 14, 2015. (ADAMS Accession No.ML15092A423)
12. AREVA to NRC Application for Amendment 14 to Standardized NUHOMS® Certificate of Compliance No. 1004 for Spent Fuel Storage Casks, Revision 0, dated April 16, 2015 (ADAMS Accession No. ML15114A056)
13. AREVA to NRC Application for Amendment 14 to Standardized NUHOMS® Certificate of Compliance No. 1004 for Spent Fuel Storage Casks, Revision 1, Response to First Request for Additional Information, dated November 11, 2015 (ADAMS Accession Nos. ML15114A050, ML15114A051)

DUKE ENERGY FLORIDA, INC.

CRYSTAL RIVER UNIT 3

DOCKET NUMBERS 50 - 302 AND 72-1035/
LICENSE NUMBER DPR - 72

LICENSE AMENDMENT REQUEST #322, REVISION 0, ISFSI-ONLY EMERGENCY PLAN, DRAFT REVISION A, AND ISFSI-ONLY EMERGENCY ACTION LEVEL BASES MANUAL, DRAFT REVISION A

ENCLOSURE 2

ISFSI-ONLY EMERGENCY PLAN, DRAFT REVISION A

INDEPENDENT SPENT FUEL STORAGE INSTALLATION (ISFSI) ONLY

EMERGENCY PLAN

(IOEP)

Draft A

(Revision 0 when approved)

DUKE ENERGY FLORIDA, LLC

CRYSTAL RIVER UNIT 3

Emergency Planning Coordinator	**Date**
ISFSI Site Director	**Date**

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1.0 INTRODUCTION

Crystal River Unit 3 Nuclear Plant (CR-3) was safely shutdown on September 26, 2009. On February 20, 2013, by letter 3F0213-07, Duke Energy provided certification to the U.S. Nuclear Regulatory Commission (NRC) required by 10 CFR 50.82(a)(1)(i) and (ii) that CR-3 has permanently ceased operations and that all fuel has been permanently removed from the reactor vessel. Subsequently, all spent fuel has been transferred to the on-site INDEPENDENT SPENT FUEL STORAGE INSTALLATION (ISFSI) facility.

The CR-3 ISFSI Only Emergency Plan (IOEP) describes the plan for responding to emergencies that may arise at the station's ISFSI. In this condition, no reactor operations can take place and all irradiated fuel is removed from the Spent Fuel Pool. This IOEP adequately addresses the risks associated with CR-3's current conditions.

As provided in the ISFSI storage system UFSARs, the analyses of the potential radiological impacts of postulated off-normal, natural phenomenon, and accident events in an ISFSI-Only condition indicates that any releases would result in a dose to the public below the radiation limits established in 10 CFR 72.106(b). Exposure levels, which warrant pre-planned response measures, are generally limited to the ISFSI pad and nearby vicinity, and for this reason; radiological emergency planning is focused on this area.

1.1 PURPOSE

The purpose of the IOEP is to assure an adequate level of preparedness to cope with the spectrum of emergencies that could be postulated to occur. This Plan integrates the necessary elements to provide effective emergency response considering cooperation and coordination of organizations expected to respond to emergencies.

1.2 SCOPE

The IOEP is developed to respond to potential radiological emergencies at the CR-3 ISFSI. Because there are no postulated off-normal, natural phenomenon, or accident events that would result in offsite dose consequences large enough to require offsite emergency planning, the overall scope of this plan delineates the actions necessary to safeguard onsite personnel. The concepts presented in this plan address the applicable regulations stipulated in 10 CFR 50.47, “Emergency Plans,” and 10 CFR 50 Appendix E, “Emergency Planning and Preparedness for Production and Utilization Facilities”. The Plan is consistent with the applicable guidelines established in NUREG-0654/FEMA-REP-1, Revision 1, “Criteria for Preparation and Evaluation of Radiological Emergency Response Plans and Preparedness in Support of Nuclear Power Plants” and NEI 99-01, “Development of Emergency Action Levels for Non-Passive Reactors,” Rev. 6.

Exemptions from selected portions of 10 CFR 50.47 and 10 CFR 50 Appendix E for CR-3 were granted by the Nuclear Regulatory Commission (NRC) on March 30, 2015 (ADAMS Accession Number: ML15058A906).

The IOEP, Revision 0, was approved per NRC Safety Evaluation dated ***[insert date prior to issuing].***

2.0 DISCUSSION

2.1 OVERVIEW OF ISFSI-ONLY EMERGENCY PLAN (IOEP)

In the event of an emergency at the CR-3 ISFSI, actions are required to identify and assess the nature of the emergency and to bring it under control in a manner that protects the health and safety of onsite personnel. This Plan describes the organization and responsibilities of Duke Energy for implementing emergency measures. It describes interfaces with Federal, State of Florida, and Citrus County organizations, which may be notified in the event of an emergency, and may provide assistance. Emergency services are provided by local public and private entities. Fire, rescue and law enforcement services are provided by Citrus County. Ambulance service is provided by Nature Coast Emergency Medical Services. Medical services are provided by Seven Rivers Regional Medical Center (SRRMC).

CR-3 is licensed under the requirements of 10 CFR Part 50, “Domestic Licensing of Production and Utilization Facilities.” Consistent with the requirements of 10 CFR Part 50, this Plan is based on the requirements of 10 CFR Part 50, Section 50.47(b) and Appendix E, “Emergency Planning and Preparedness for Production and Utilization Facilities,” with approved exemptions. Sections 5.0 thru 20.0 of this Plan address the standards outlined in 10 CFR 50.47(b)(1) through (16). In addition, the Plan is also intended to meet appropriate State of Florida and U.S. NRC regulations in accordance with Duke Energy's Operating License (No. DPR 72). CR-3 is licensed to store spent fuel in the CR-3 ISFSI under the General License provisions of 10 CFR 72.210 and 10 CFR 72.212.

Because the analyses of the credible design basis events and consequences indicate there are no postulated accidents that would result in off-site dose consequences that are large enough to require off-site emergency planning, emergencies are divided into two classifications: 1) Notification of UNUSUAL EVENT and 2) ALERT. This classification scheme has been discussed and agreed upon with responsible off-site organizations and is compatible with the State Plan.

2.1 OVERVIEW OF ISFSI-ONLY EMERGENCY PLAN (IOEP) (Continued)

Duke Energy is responsible for planning and implementing emergency measures associated with the CR-3 ISFSI. This Plan is provided to meet that responsibility. To carry out specific emergency measures discussed in this Plan, detailed implementing procedures are established and maintained. Appendix A provides a listing of the implementing procedures for this Plan.

In addition to the description of activities and steps that can be implemented during a potential emergency, this Plan also provides a general description of the steps taken to recover from an emergency. It also describes the training, drills, exercises, planning, and coordination appropriate to maintain an adequate level of emergency preparedness.

2.2 FACILITY DESCRIPTION

The CR-3 Plant is located at Red Level, Florida in Citrus County, about 5 miles south of Levy County. The site is 7.5 miles northwest of Crystal River, Florida and 90 miles north of St. Petersburg, Florida. CR-3 is situated on the Gulf of Mexico, within the Crystal River Energy Complex.

CR-3 formerly consisted of a single unit nominal 911 MWe / 2609 MWth Nuclear Power Plant, utilizing a Babcock & Wilcox (B&W) Company (currently AREVA) pressurized water reactor (PWR). The unit is certified to have ceased power operations and is permanently defueled in accordance with 10 CFR 50.82(a)(1)(i) and (ii). All spent fuel has been transferred to the CR-3 INDEPENDENT SPENT FUEL STORAGE INSTALLATION (ISFSI) which is located to the east of the CR-3 Plant. The CR-3 ISFSI is a robust and high integrity facility for the spent fuel storage system. This facility is designed to prevent the release of radioactivity in the event of accidents, including environmental phenomena (e.g., earthquake and flooding).

2.3 SUMMARY OF EMERGENCY ACTIONS

The IOEP is activated by the ISFSI Shift Supervisor (ISS) upon identification of an emergency situation based upon the EMERGENCY ACTION LEVEL (EAL) criteria. The ISS assumes the position of the EMERGENCY COORDINATOR (EC). The emergency measures described in the subsequent sections and implementing procedures are implemented in accordance with the classification and nature of the emergency at the direction of the EC. Regulatory authorities and off-site support organizations are notified in accordance with this Plan. The EC has authority and responsibility for control and mitigation of the emergency, including emergency response resources, coordination of radiological ASSESSMENT ACTIVITIES, RECOVERY implementation, and coordination of emergency response activities.

The following sections of this IOEP describe the detailed plans and actions of the CR-3 Emergency Response Organization (ERO), including interfaces with off-site support organizations.

3.0 REFERENCES

3.1 10 CFR 50.47, “Emergency Plans”

3.2 10 CFR Part 50, Appendix "E," "Emergency Planning and Preparedness for Production and Utilization Facilities"

3.3 10 CFR Part 20, "Standards for Protection Against Radiation"

3.4 NUREG-0578, "TMI-2 Lessons Learned Task Force Status Report and Short-Term Recommendations" (July 1979)

3.5 NUREG-0654/FEMA-REP-1, "Criteria for Preparation and Evaluation of Radiological Emergency Response Plans and Preparedness in Support of Nuclear Power Plants" (November 1980)

3.6 Regulatory Guide 1.101, "Emergency Planning and Preparedness for Nuclear Power Reactors"

3.7 Environmental Protection Agency, “Protective Action Guide and Planning Guidance for Radiological Incidents,” Draft for Interim Use and Public Comment (March 2013)

3.8 "State of Florida Radiological Emergency Management Plan" (herein referred to as State Plan)

3.9 State of Florida Statutes, Chapter 170J-1, "Control of Radiation Hazards"

3.10 CR-3 Final Safety Analysis Report (FSAR)

3.11 CR-3 Permanently Defueled Technical Specifications

3.12 Emergency Plan Implementing Procedures

3.13 Seven Rivers Regional Medical Center "Radioactive Material Contamination Response Plan"

3.14 NRC Bulletin 2005-02, “Emergency Preparedness and Response Actions for Security-Based Events”

3.15 NEI 99-01, “Development of Emergency Action Levels for Non-Passive Reactors,” Rev. 6

3.16 CR-3 Letter 3F0213-07 dated February 20, 2013. Crystal River Unit 3 – Certification of Permanent Cessation of Power Operations and that Fuel Has Been Permanently Removed from the Reactor. ML13056A005.

3.17 NRC Letter dated March 13, 2013. Crystal River Unit 3 Nuclear Generating Plant Certification of Permanent Cessation of Operation and Permanent Removal of Fuel From the Reactor.

3.18 NRC Letter dated March 30, 2015. Exemptions From Certain Emergency Planning Requirements And Related Safety Evaluation. ML15058A906.

3.19 ISFSI Storage System Certificates of Compliance, Updated Final Safety Analysis Reports and Technical Specifications.

3.20 10 CFR 72.106, Controlled area of an ISFSI or MRS.

4.0 DEFINITIONS AND ABBREVIATIONS

4.1 DEFINITIONS

This section provides definitions that are used in this document. Terms capitalized in the text of this document indicate that they are defined here.

1. **Accountability:** Discretionary protective action taken for all persons onsite (within the ISFSI PROTECTED AREA) that involves the gathering of personnel into pre-designated areas and subsequent verification that the location of all personnel is known.

2. **Annual**: Once per calendar year unless otherwise specifically stated.

3. **Assessment Activities**: Actions taken during or after an emergency for the purpose of obtaining and processing the information that will be used to make the decisions to implement specific emergency measures.

4. **Emergency Actions**: Assessment, corrective, and PROTECTIVE ACTIONS designed to achieve a safe, stable condition, and to immediately mitigate the effects of the emergency.

5. **Emergency Action Level (EAL)**: A pre-determined, observable threshold for conditions that places the CR-3 ISFSI in a given emergency classification.

6. **Emergency Classification System**: A system of classification in which emergency occurrences are categorized according to specific protective action levels. The two emergency classifications in order of significance are UNUSUAL EVENT and ALERT. These classifications are defined by NEI 99-01, Rev. 6 as follows:

    a. **Unusual Event**: Events are in progress or have occurred which indicate a potential degradation of the level of safety of the ISFSI or indicate a security threat to facility protection has been initiated. No releases of radioactive material requiring off-site response or monitoring are expected unless further degradation of safety systems occurs.

b. **Alert**: Events are in progress or have occurred which involve an actual or potential substantial degradation of the level of safety of the CR-3 ISFSI or a security event that involves probable life threatening risk to site personnel or damage to ISFSI equipment because of HOSTILE ACTION. Any releases are expected to be limited to small fractions of the EPA PAG exposure levels.

7. **Emergency Coordinator (EC)**: This position is the highest level of authority for the CR-3 ERO and on-site emergency activities. This position is held by the ISFSI Shift Supervisor or designated alternate.

8. **Fire**: Combustion characterized by heat and light. Sources of smoke such as slipping drive belts or overheated electrical equipment do not constitute fires. Observation of flame is preferred but is not required if large quantities of smoke and heat are observed.

9. **Frequency**: That unit of time specified (monthly, quarterly, etc.) plus or minus 25 percent unless otherwise specifically stated. This definition does not apply to "ANNUAL" when it is related to the conduct of the Biennial Exercise (NRC Evaluated). Biennial Exercises are performed within the calendar year.

10. **Hostile Action**: An act toward the CR-3 ISFSI or its personnel that includes the use of violent force to destroy equipment, take hostages, and/or intimidate the licensee to achieve an end. This includes attack by air, land, or water using guns, explosives, projectiles, vehicles, or other devices used to deliver destructive force. Other acts that satisfy the overall intent may be included.

    “HOSTILE ACTION” should not be construed to include acts of civil disobedience or felonious acts that are not part of a concerted attack on the CR-3 ISFSI. Non-terrorism-based EALs should be used to address such activities, (e.g., violent acts between individuals in the OWNER CONTROLLED AREA). (NEI 99-01, Rev. 6)

4.1 DEFINITIONS (Continued)

11. **Hostile Force**: One or more individuals who are engaged in a determined assault, overtly or by stealth and deception, equipped with suitable weapons capable of killing, maiming, or causing destruction. (NEI 99-01, Rev. 6)

12. **Independent Spent Fuel Storage Installation (ISFSI)**: A complex that is designed and constructed for the interim storage of spent nuclear fuel and other radioactive materials associated with spent fuel storage.

13. **Local Assembly Area:** A pre-designated area personnel report to for organization, roll-call, and supervision when CR-3 ISFSI ACCOUNTABILITY is initiated.

14. **Owner Controlled Area:** The area of land (approximately 4738 acres) that is owned, leased, or otherwise controlled by Duke Energy, situated between the mouths of the Withlacoochee and Crystal Rivers and bounded to the north by woodlands, to the east by Highway 19, to the south by medium to dense woodlands and to the west by marshlands and the Gulf of Mexico.

15. **Protected Area**: The area encompassed by physical barriers and to which access is controlled.

16. **Protective Actions**: Those emergency measures taken after an uncontrolled release of radioactive material has occurred for the purpose of preventing or minimizing radiological exposures to persons that would be likely to occur if the actions were not taken.

17. **Protective Action Guide (PAG)**: The projected dose to an individual, resulting from a radiological incident at which a specific PROTECTIVE ACTION to reduce or avoid that dose is warranted.

4.1 DEFINITIONS (Continued)

18. **Recovery**: The condition declared after the immediate hazards to life and safety due to the emergency have been removed and efforts are directed to returning affected areas to normal.

19. **Recovery Actions**: Those actions taken after the emergency to restore the CR-3 ISFSI as nearly as possible to its pre-emergency condition.

20. **Release (Radioactive)**: Any radioactive material beyond pre-emergency levels and not attributable to normal operations, either detected or suspected of migrating beyond the **PROTECTED AREA,** while in a declared emergency. (Florida Nuclear Plant Emergency Notification Form).

21. **Site Boundary**: That line beyond which the land is not owned, leased, or otherwise controlled by the licensee. This line establishes the perimeter of the OWNER CONTROLLED AREA (OCA).

4.2 ABBREVIATIONS

CCSO	Citrus County Sheriff's Office
CR-3	Crystal River Unit 3
DEM	State of Florida Department of Community Affairs, Division of Emergency Management
DHBRC	Department of Health, Bureau of Radiation Control (State of Florida)
EAL	Emergency Action Level
EC	Emergency Coordinator
ENS	Emergency Notification System
EPA	U.S. Environmental Protection Agency
ERO	Emergency Response Organization
FSAR	Final Safety Analysis Report
ISFSI	Independent Spent Fuel Storage Installation
NRC	U.S. Nuclear Regulatory Commission
ORO	Offsite Response Organization
PAG	Protective Action Guide
RCA	Radiation Controlled Area
REAC/TS	Radiation Emergency Assistance Center/Training Site
SHRD	State Hot Ringdown
SRRMC	Seven Rivers Regional Medical Center
SWO	State Watch Office

5.0 ASSIGNMENT OF RESPONSIBILITY (ORGANIZATION CONTROL)

The CR-3 ISFSI Organization has complete capability at all times to perform the detection, classification, initial response, and notification functions required during an emergency.

Primary responsibilities for emergency response have been assigned, the emergency responsibilities of the various supporting organizations have been specifically established, and each principal response organization has staff to respond and to augment its initial response on a continuous basis.

5.1 ISFSI ORGANIZATION

Duke Energy is responsible for the safe storage of spent fuel in accordance with the State of Florida and NRC regulations. Responsibility for planning and implementing all emergency measures rests with Duke Energy.

The CR-3 ISFSI Organization has an inherent emergency response/RECOVERY function in its overall management and operation. This function can be delineated by reviewing management structure and responsibilities as follows:

1. **ISFSI Site Director**

   The ISFSI Site Director is directly responsible for the operation of the CR-3 ISFSI and has ultimate responsibility for the overall effectiveness of the CR-3 IOEP.

2. **ISFSI Manager - Operations and Maintenance**

   The ISFSI Manager - Operations and Maintenance reports to the ISFSI Site Director and is responsible for the safe operation and maintenance of the CR-3 ISFSI facility.

3. **ISFSI Shift Supervisor (ISS)**

   The ISS reports to the ISFSI Manager - Operations and Maintenance and is at CR-3, 24-hours a day, and is the senior management position during off-hours. This position is responsible for monitoring conditions at the CR-3 ISFSI.

5.2 EMERGENCY RESPONSE AND RESPONSIBILITIES

The ISFSI Shift Supervisor (ISS) has the responsibility and authority to declare an emergency and initiate appropriate actions in accordance with written procedures to mitigate the consequences. When an off-normal, natural phenomenon, or accident event becomes apparent, the ISS shall assess the condition and declare an emergency if warranted. When an emergency is declared the ISS assumes the positon of the Emergency Coordinator (EC).

The EC is responsible for the direction of all activities at the ISFSI site during an emergency. Should evaluation indicate the need, the EC has the authority to direct any or all personnel to relocate from the ISFSI and surrounding area and to notify all applicable agencies of the ISFSI status. The EC ensures that appropriate actions are taken to mobilize emergency teams and to notify management and applicable off site supporting organizations and regulatory agencies as necessary.

The functions associated within the EC's scope of responsibilities are specified in Table 6-1. The EC does not have concurrent duties which conflict with these responsibilities. At the direction of the EC, additional personnel may be activated to support the on-shift staff.

A Resource Manager assists in assessing the event and obtaining needed resources.

5.3 OFFSITE RESPONSE ORGANIZATIONS (ORO)

Response organizations are available on a continuous basis and interrelate to receive notifications and communications and provide medical and law enforcement support to the CR-3 ISFSI.

5.3.1 FLORIDA STATE WATCH OFFICE (SWO)

The Florida State Watch Office (SWO) is the primary point of contact for the State of Florida for the purpose of notification of an emergency declaration. Notification of an emergency will be made to the SWO within 60 minutes after an emergency declaration or change in classification. The SWO will notify the Division of Emergency Management (DEM) and Citrus County officials of an emergency at the CR-3 ISFSI.

The SWO is available on a 24-hour basis to receive emergency communications from CR-3 ISFSI staff and, in turn, contact State and local emergency response organizations, as appropriate.

Emergency notification is received from the EC or designated alternate via the State Hot Ringdown Telephone System (SHRD), or other means necessary.
The Duty Officer notifies the Florida Division of Emergency Management (DEM) and Citrus County officials. The Duty Officer, with assistance from the DEM, then notifies appropriate State agencies.

5.3.2 FLORIDA DIVISION OF EMERGENCY MANAGEMENT

The State of Florida Department of Community Affairs' DEM is responsible for coordinating Federal, State and local radiological emergency response activities, and for preparing and maintaining the State Plan.

The Director, DEM is responsible for coordinating DEM emergency response. The DEM receives notification of an emergency at the CR-3 ISFSI via the SWO; verifies the information contained in the notification messages; and alerts key State, Local and Federal emergency response personnel, as appropriate.

5.3.3 CITRUS COUNTY SHERIFF'S OFFICE, DIVISION OF EMERGENCY OPERATIONS, EMERGENCY MANAGEMENT SECTION

Citrus County Sheriff's Emergency Management is responsible for coordinating law enforcement and fire support at the CR-3 ISFSI. Communications are maintained through the Citrus County 9-1-1 Dispatch Center.

The CCSO is responsible for coordinating emergency operations at the local level and for keeping local officials advised of law enforcement actions involving the CR-3 ISFSI.

The Citrus County EOC in Lecanto, Florida maintains 24 hour per day communications through the County's Fire Dispatch/EOC via commercial telephone.

5.3.4 SEVEN RIVERS REGIONAL MEDICAL CENTER

SRRMC in Crystal River, Florida serves as the hospital to treat injuries resulting from any non-radiological or radiological emergency situation at the CR-3 ISFSI. The hospital will acknowledge and respond to all emergency medical requests from the Emergency Response Organization and management at the CR-3 ISFSI. Treatment will be provided for non-radiological and radiological injuries. The hospital will maintain communications with the CR-3 ISFSI. The hospital will maintain communications with the Citrus County EOC on support needs or other agencies as appropriate.

The hospital will furnish the services of physicians to injured persons. The hospital will accept all patients dispatched from the CR-3 ISFSI. If necessary, the hospital will utilize radiological support provided by CR-3 ISFSI Staff.

5.3.5 LOCAL EMERGENCY MEDICAL SERVICES

Ambulance service is available 24 hours per day to provide assistance in the event of an emergency at the CR-3 ISFSI via the Citrus County 9-1-1 Dispatch Center.

Upon request, local ambulance services will provide emergency medical services. It will maintain communication with the CR-3 ISFSI, SRRMC and/or CCSO on support needs.

Upon request from the CR-3 ISFSI EC or designee, ambulance service will be provided, which includes emergency medical treatment and/or transportation to a designated hospital facility. The service shall accept all patients dispatched from CR-3 ISFSI and, where necessary, shall utilize the radiological support provided by CR-3 Staff.

5.3.6 NUCLEAR REGULATORY COMMISSION

The NRC is the primary Federal agency providing coordination and support to the licensee in the event of an emergency at the CR-3 ISFSI. NRC responsibilities are directed toward a coordination of Federal efforts to provide assistance to the licensee and State and local governments in their planning and implementation of emergency preparedness procedures.

The NRC response must be regarded primarily as supportive of, and not a substitute for, responsible action by Duke Energy and other key response organizations. The NRC must be continually informed of status and possible radiological consequences, and be frequently updated on plans for emergency and RECOVERY ACTIONS and needs for assistance.

In the event of an emergency at the CR-3 ISFSI, the NRC Operations Center in Rockville, Maryland will be notified immediately after notification of the SWO and not later than 60 minutes after declaration of an emergency classification or change in classification. Classification information and radiological information are communicated to this office over a dedicated telephone line from the CR-3 ISFSI Emergency Response Facility. Emergency notification, ISFSI status information and radiological information is communicated via the Emergency Notification System (ENS). Other information is communicated via normal telephone service.

5.4 WRITTEN AGREEMENTS FOR EMERGENCY RESPONSE

Discussions have been held and agreements reached and confirmed, in writing, with State, County and private sector organizations having responsibilities for coping with radiological emergencies. Appendix B contains a list of these agreements. A copy of each agreement is maintained on file.

6.0 EMERGENCY RESPONSE ORGANIZATION

Emergency Response Organization (ERO) responsibilities for emergency response are listed in Table 6-1.

6.1 ON-SHIFT POSITIONS

The personnel and resources of the CR-3 ISFSI organization maintain the capabilities necessary to respond to an emergency. All site activities are conducted under the direction and control of the ISFSI Manager - Operations and Maintenance. To provide support in required areas, the CR-3 ISFSI organization is broken down into functional areas headed by designated managers. As appropriate, these areas are further subdivided according to specific technical disciplines or support functions.

6.1.1 ISFSI SHIFT SUPERVISOR (ISS) / EMERGENCY COORDINATOR (EC)

The ISFSI Shift Supervisor (ISS) is at the CR-3 ISFSI on a 24-hour basis and is the senior management position during off-hours. This position is responsible for monitoring conditions at the CR-3 ISFSI. The ISS has the responsibility and authority to declare an emergency and to initiate appropriate actions in accordance with written procedures to mitigate the consequences of the emergency. The ISS will assume the position of EC upon declaration of an emergency and has the responsibility to notify the Resource Manager of an emergency at the CR-3 ISFSI.

The EC is responsible for the direction of all activities at the CR-3 ISFSI during any emergency. In accordance with site procedures, the EC shall evaluate the emergency and take necessary actions to mitigate the consequences. The EC has the authority to direct personnel to relocate or to direct activities on the Energy Complex as necessary to ensure personnel safety.

The EC is responsible for assuring that appropriate corrective and PROTECTIVE ACTIONS are taken to mobilize emergency response personnel and for notifying management and off site supporting organizations and regulatory agencies, as necessary.

6.1.1 ISFSI SHIFT SUPERVISOR (ISS) / EMERGENCY COORDINATOR (EC) (cont.)

Other responsibilities assumed by the EC associated with the functions listed in Table 6-1 include:

- Classification of the event (Cannot be delegated)
- Notification of Local, State and Federal agencies
- Authorization of radiation exposure in excess of 10 CFR 20 limits. (Cannot be delegated)
- Management of available station resources
- Initiation of mitigative actions
- Initiation of corrective actions
- Initiation of onsite protective actions
- Decision to request offsite police, fire, or ambulance assistance
- Augmentation of the emergency staff, as deemed necessary
- Coordination of Security activities
- Termination of the emergency condition when appropriate
- Performance of initial radiological assessment
- Maintaining a record of event activities
- Suspend security measures

6.1.2 SECURITY

Security staffing is maintained in accordance with the CR-3 ISFSI Security Plan.

6.2 CR-3 ISFSI AUGMENTED EMERGENCY RESPONSE ORGANIZATION

Duke Energy maintains the necessary personnel and resources to support the CR-3 ISFSI EC in responding to an emergency.

6.2.1 RESOURCE MANAGER

The Resource Manager will be in contact with the EC within two hours of classification. The Resource Manager will augment the EC by assisting in assessing the emergency condition (refer to Table 6-1) and coordinating required resources, including public information interface. The Resource Manager does not need to physically report to CR-3 to perform their responsibilities.

6.2.2 RADIOLOGICAL ASSESSMENT PERSONNEL

For a declared emergency involving radiological consequences (EU1), a minimum of one person trained in radiological monitoring and assessment will report to the CR-3 ISFSI within four hours of the emergency declaration to assist the EC.

6.2.3 MEDICAL RESPONSE PERSONNEL

The Crystal River Energy Complex "Emergency Response Coordinator" (ERC) is available 24 hours a day and will be called upon should a medical emergency arise. The responsibilities of the medical response personnel are to provide basic life support to injured persons and request transportation for injured persons to a medical facility, as required.

The medical response personnel are authorized to release to medical personnel only the required pertinent information necessary to treat the injured, and to deliver the injured to the appropriate medical facility. Emergency Response Coordinators provide search and rescue support as well as medical response.

6.2.4 FIRE RESPONSE

The Crystal River Energy Complex "Emergency Response Coordinator" (ERC) is available 24 hours a day and will be called upon should a fire occur at the CR-3 ISFSI. The ERC is fully trained in firefighting techniques and will maintain command and control of the FIRE scene.

6.2.5 CORPORATE ORGANIZATION

In the event of an emergency at the CR-3 ISFSI that requires personnel and other support resources beyond those available within the CR-3 ERO, support is available from other Duke Energy facilities and can be requested from various contractors. Additional support to CR-3 is available from off-site organizations, as previously discussed in Section 5.0 of this Plan.

6.2.6 OFFSITE RESPONSE ORGANIZATIONS (ORO)

Additional support is available from OROs, as previously discussed in section 5.3 of this IOEP.

TABLE 6.1

EMERGENCY RESPONSE ORGANIZATION STAFFING AND RESPONSIBILITIES

FUNCTIONAL AREA	LOCATION	ON-SHIFT STAFF	AUGMENTED OFFSITE RESPONSE
Assessment of Condition (Emergency Declaration)	Emergency Response Facility	EMERGENCY COORDINATOR	Resource Manager
Emergency Direction and Control	Emergency Response Facility	EMERGENCY COORDINATOR	------
Notification/Communication	Emergency Response Facility	EMERGENCY COORDINATOR	------
Radiological Accident Assessment and Protective Actions	Emergency Response Facility/ On Scene	EMERGENCY COORDINATOR	Resource Manager
			Augmentation Responder - **Note 1**
Corrective Actions	Emergency Response Facility/ On Scene	EMERGENCY COORDINATOR	-----
Firefighting	On Scene	Emergency Response Coordinator (ERC)	Offsite Response Organization
Rescue Operations/ First Aid	On Scene	Emergency Response Coordinator (ERC)	Offsite Response Organization
Security	Per ISFSI Security Plan	Per ISFSI Security Plan	N/A

Note 1: For a declared emergency involving radiological consequences (EU1), a minimum of one person trained in radiological monitoring and assessment will report to the CR-3 ISFSI within four hours of the emergency declaration.

7.0 EMERGENCY RESPONSE SUPPORT AND RESOURCES

Response support organizations from the local, State, Federal, and private sectors available to assist in an emergency at the CR-3 ISFSI are identified and described in Section 5.0.

CR-3 maintains agreements with organizations that can be relied upon in an emergency to provide assistance. The agreements are listed in Appendix B.

8.0 EMERGENCY CLASSIFICATION SYSTEM

8.1 STANDARD CLASSIFICATION OF EMERGENCIES

Duke Energy utilizes NEI 99-01, "Development of Emergency Action Levels for Non-Passive Reactors" Rev. 6, as its basis for classifying emergencies. The classification system referenced in NEI 99-01, Rev. 6 has been endorsed by the NRC and offers a standard method for classifying emergencies. EALs are addressed in site procedures and the ISFSI Only Emergency Plan EAL Basis Manual (IOEP EALBM).

This IOEP addresses two (2) classifications of emergencies (UNUSUAL EVENT and ALERT), which represent a hierarchy of emergencies based on potential accidents that could occur at the CR-3 ISFSI. Once indications are available that an EAL is met, the event is assessed and classified, and the corresponding emergency classification level is promptly declared as soon as possible.

8.1.1 Unusual Event

Events are in progress or have occurred which indicate a potential degradation of the level of safety of the CR-3 ISFSI or indicate a security threat to facility protection has been initiated. No release of radioactive material requiring off-site response or monitoring are expected. The State of Florida and the NRC are notified of an UNUSUAL EVENT.

The purpose of the UNUSUAL EVENT classification is to bring the on-shift staff to a state of readiness and to provide for systematic handling of event information and its related decision making.

8.1.2 Alert

Events are in progress or have occurred which involve an actual or potential substantial degradation of the level of safety of the CR-3 ISFSI or a security event that involves probable life threatening risk to site personnel or damage to ISFSI equipment because of HOSTILE ACTION. Any releases are expected to be limited to small fractions of the EPA PAG exposure levels.

As in the case of the UNUSUAL EVENT, the ALERT classification includes emergency situations which are not expected to threaten the public, but for which notification of the State of Florida and the NRC is required.

8.2 EMERGENCY ACTION LEVELS AND POSTULATED ACCIDENTS

Both emergency classifications are characterized by EALs consisting of specific instrument readings and/or observations which are used to tell the CR-3 ISS that an initiating condition has been met. These EALs are used to assure that the initial classification of emergencies can be accomplished rapidly, allowing for the prompt identification of the nature of mitigating activities needed.

EALs and Initiating Conditions are provided under the following categories for the CR-3 ISFSI:

- ISFSI Malfunction
- Hazards and Other Conditions

The ISFSI UFSAR describes the Design Basis Accidents (DBAs) applicable to the CR-3 ISFSI, along with the radiological dose calculation results. Specific guidance for classifying emergencies is found in site procedures and the ISFSI Only Emergency Plan EAL Basis Manual (IOEP EALBM).

EALs shall be reviewed with State of Florida and Citrus County government authorities on an ANNUAL basis.

9.0 NOTIFICATION METHODS AND PROCEDURES

To provide prompt notification of affected personnel and emergency response organizations in the event of an emergency at the CR-3 ISFSI, Duke Energy has established means for notification and dissemination of emergency messages.

9.1 BASIS FOR NOTIFICATION

The notification of personnel and emergency response organizations is commensurate with the hazard posed by the emergency. The EMERGENCY CLASSIFICATION SYSTEM described in Section 8.0 is the primary bases for notification and has been mutually agreed upon by applicable State and Federal response organizations.

The EC is responsible for identifying the appropriate emergency classification, declaring the emergency and initiating emergency notifications.

9.2 MEANS OF NOTIFICATION

Various communications systems, as described in Section 10.0 are available to perform emergency notifications. The EC is the primary individual for initiating notifications; however, the EC may designate an individual to carry out appropriate notifications. Implementing procedures and various directories identify organizations and individuals to be notified and contain appropriate listings of telephone numbers.

The following sections describe the means of notifying, alerting, and mobilizing the various emergency response organizations or individuals.

9.2.1 CR-3 ISFSI STAFF

Following declaration of an emergency, the EC will notify the Resource Manager. The Resource Manager will provide support to the EC as described in Section 6.0. Notifications to other management and key personnel will be made as in accordance with established procedures. These notifications will be completed via the on-site telephone system, or other commercial means which may include land line and/or wireless devices.

9.2.2 FOSSIL-HYDRO PERSONNEL

Upon declaration of an emergency, the EC or a delegate will notify the Fossil-Hydro facilities by telephone or other available means, and an appropriate response will be initiated. The EC or a delegate will provide further instructions, as required.

9.2.3 NUCLEAR REGULATORY COMMISSION

The NRC Operations Center will be notified of an emergency via the Event Notification System (ENS) telephone line. Upon contact with the NRC, a description of the emergency is provided, along with potential consequences. Commercial phone lines will be used as a backup means of notification in the event of failure of the ENS.

9.2.4 FLORIDA STATE WATCH OFFICE (SWO)

The Florida State Watch Office (SWO) will be notified of an emergency via the State Hot Ring Down (SHRD) telephone line. The commercial telephone systems serve as back-up communications systems. Upon contact, the content of the Florida Nuclear Plant Emergency Notification Form will be provided. The SWO will notify the Florida DEM and Citrus County officials of an emergency at the CR-3 ISFSI.

9.2.5 SUPPORT ORGANIZATIONS

Medical, local law enforcement agency, and firefighting support services are primarily notified for assistance via the public 9-1-1 process. Requests for support services are the responsibility of the EC.

9.3 EMERGENCY MESSAGES

Notification of an emergency is provided verbally to the SWO based on the content of the Florida Nuclear Plant Emergency Notification Form. The form may also be transmitted electronically. The content of the initial notification and follow-up message form has been established in conjunction with the State of Florida and includes the date and time of the incident, the class of emergency, and the EAL. Appropriate identification of the caller and time of the notification are also provided.

As additional information describing the emergency situation and local conditions becomes available, supplemental messages containing additional detail are provided.

10.0 EMERGENCY COMMUNICATIONS

Several modes of communication are available to transmit information at the CR-3 ISFSI; throughout the Crystal River Energy Complex; and to various locations off-site during normal and emergency conditions. In the event of an emergency at the CR-3 ISFSI, these communications systems provide the appropriate means for alerting or activating emergency personnel in each response organization and allow continued means for contact throughout the emergency.

The various communications systems provided for both on-site and off-site communications are used on a regular basis or tested periodically in accordance with established procedures. Periodic testing or frequent use of each system is conducted as follows:

System	Use/Testing
Commercial Telephones	Frequent Use
Portable UHF Radios	Frequent Use
SHRD	Tested Monthly
ENS	Tested Monthly

All systems are available at the CR-3 Emergency Response Facility on a 24-hour basis to allow prompt notification and activation of emergency response organizations.

11.0 PUBLIC INFORMATION

The EC or Resource Manager will notify Duke Energy Corporate Communications following an emergency declaration. The Corporate Communications will be notified at the company's Charlotte headquarters and a near-site response team may be established for the CR-3 ISFSI.

The near-site response team will be staffed with a company spokesperson and media communicators, who will provide local interaction with the media. If an event occurs at the CR-3 ISFSI, information will be disseminated to the public in a timely manner.

Briefings with media organizations will be coordinated between Duke Energy Corporate Communications and the near-site response team per Corporate Communications protocols.

12.0 EMERGENCY FACILITY AND EQUIPMENT

Adequate emergency facilities and equipment to support the emergency response are provided and maintained. This section of the IOEP identifies and describes the emergency response facility, assessment equipment, the first aid and medical facilities, and protective equipment and supplies that can be utilized during an emergency.

12.1 EMERGENCY RESPONSE FACILITY (ERF)

The emergency command and control functions are managed within the ERF. Within the ERF the EC (or other personnel as directed) can assess conditions; evaluate the magnitude and potential consequences of abnormal conditions; initiate preventative and corrective actions; and perform notifications. The ERF provides sufficient space to accommodate anticipated response personnel and provides availability of communication systems as specified in Section 10.0. Radiological conditions as a result of DBAs specified in the ISFSI storage system UFSARs do not inhibit staffing of the ERF.

12.2 EMERGENCY EQUIPMENT

This section describes the monitoring instruments used to initiate emergency measures and provide continuing assessment of conditions throughout the course of an emergency.

12.2.1 PORTABLE RADIATION AND CONTAMINATION MONITORING INSTRUMENTS

Duke Energy maintains portable radiation and contamination monitoring equipment necessary for monitoring the conditions of the CR-3 ISFSI. These instruments are normally utilized and maintained by the Radiation Protection Group and are available for emergency use.

12.2.2 COMMUNICATION SYSTEMS

Communication systems are identified and tested as described in Section 10.

12.3 EMERGENCY SUPPLIES

Emergency equipment and supplies necessary to carry out the provisions of the IOEP and support procedures are maintained at the Emergency Response Facility. Table 12.1 lists typical emergency equipment and supplies.

Emergency kit contents listed in Table 12.1 are inspected, inventoried, and operationally checked at least quarterly and anytime a kit is opened and used. Sufficient reserves of instruments/equipment are provided to replace those which are removed from emergency kits for calibration or repair. Calibration of instruments has been established at intervals recommended by instrument suppliers, or as required by Federal regulations.

12.4 FIRST AID FACILITIES

First aid supplies and equipment are located at the CR-3 ISFSI. Qualified personnel are available 24 hours per day to provide medical treatment as referenced in Section 16.0.

Radiological wound monitoring on-site is performed using an appropriate instrument. If the severity of the wound restricts decontamination efforts by radiation protection personnel, the injured personnel will be referred to off-site medical personnel or transported to an off-site medical facility for treatment and further decontamination.

TABLE 12.1

TYPICAL EMERGENCY EQUIPMENT/SUPPLIES

Kit Contents

Compass	Pens, Pencils
Protective Clothing	Calculator
Air Sampler Heads	Plant Survey Map
Tape, Barricade	Area Map
Thermoluminescent Dosimeter (TLD) Badges	Tape, Masking
Radiation Signs	HP Probes
Plastic Rain Gear	Check Source
Smears	Area Monitor (or Electronic Dosimeters)
Air Filters, Particulate	Batteries
Charcoal Cartridges	Flashlight
Felt Marker, Black	Labeled Envelopes
Shoe Covers	SH-4 Sample Mount and Holder
Gloves	Bottle, for water samples
Pad Paper	Electronic Dosimeters

13.0 ACCIDENT ASSESSMENT

Effective response to a potential emergency situation requires assessment to determine the nature of the emergency and its actual and potential consequences. Duke Energy has established various methods to evaluate and monitor the effects of a potential emergency at the CR-3 ISFSI and has the appropriate means to assure adequate assessment.

The ASSESSMENT ACTIVITIES required to evaluate a particular emergency depend on the specific nature and classification of the emergency. The ISS/EC is responsible for the initial measurement of ISFSI dose rates after an off-normal, natural phenomena, or accident event. The EALs identify the parameter value to determine the emergency condition. Classification of events is performed by the ISS/EC in accordance with the EAL scheme.

If the measured ISFSI dose rates exceed the EAL threshold, the ISS/EC then ensures a radioactive RELEASE assessment in the vicinity of the affected storage module or cask is performed. After completing the assessment, the EC will contact the Resource Manager for assistance in interpreting the radioactive RELEASE assessment results. Notification of the radiological RELEASE assessment is in accordance with Section 9.0.

14.0 PROTECTIVE ACTIONS

Protective actions for onsite personnel are provided for their health and safety. Implementation guidelines for onsite protective actions are provided in implementing procedures.

Additionally, implementing procedures provide for a range of protective actions (e.g. relocation of personnel and personnel take cover) to protect onsite personnel during HOSTILE ACTIONS.

14.1 CR-3 ISFSI ACCOUNTABILTY

The EC has the authority to initiate personnel ACCOUNTABILITY of the CR-3 ISFSI.

ACCOUNTABILTY should be considered and used as a protective action whenever a risk to health or safety exists and prudence dictates. If personnel ACCOUNTABILITY is required, at the direction of the EC, all individuals at the facility (including employees without emergency assignments, visitors and contractor personnel) shall be notified of the emergency.

When ACCOUNTABILTY is initiated, personnel will stop work, shut down potentially hazardous equipment, and proceed to the pre-designated LOCAL ASSEMBLY AREAS. ACCOUNTABILITY will take place and the results will be reported to the EC when requested.

ACOUNTABILITY of all personnel inside the ISFSI PROTECTED AREA should be accomplished within 60 minutes after event classification and maintained thereafter at the discretion of the EC. If personnel are unaccounted for, teams shall be dispatched to locate the personnel.

14.2 CRYSTAL RIVER ENERGY COMPLEX ASSEMBLY, SHELTERING, OR RELOCATION

Other areas of the Crystal River Energy Complex may be affected by the need to relocate personnel. If required, the EC will determine the specific areas that need to have personnel relocated. Personnel and visitors located outside of the ISFSI Protected Area but within the SITE BOUNDARY will be directed to report to an assembly area or exit the site as appropriate. Relocation of personnel in these areas of the Crystal River Energy Complex will be in accordance with established procedures. The EC is responsible for controlling access to the CR-3 ISFSI site when the IOEP is activated.

15.0 RADIOLOGICAL EXPOSURE CONTROL

CR-3 maintains a radiological exposure control program to assure that protection against radiological exposure, as set forth in 10 CFR Part 20 and Chapter 170J 1 of the State of Florida Statutes, is provided. This program is implemented through the "Radiological Protection Standard" which covers both normal and emergency radiation protection measures.

Means for controlling radiological exposures in an emergency are established for emergency workers. The means for controlling radiological exposures shall include exposure guidelines consistent with EPA Emergency Worker and Lifesaving Activity Protective Action Guides.

15.1 EXPOSURE GUIDELINES

During an emergency, doses above normal occupational radiation exposure limits may be authorized by the EC for activities such as saving a life, preservation of valuable equipment, or controlling exposure. Table 15.1 provides exposure guidelines for on-site emergency activities.

15.2 RADIATION PROTECTION

The purpose of a Radiation Protection Program is to assure that radiation doses received by personnel are kept as low as reasonably achievable and do not exceed the prescribed limits for both normal and emergency conditions. The established measures to provide this assurance include access control, personnel monitoring, and contamination control.

15.2.1 ACCESS CONTROL

During a declared emergency, radiological surveys of the ISFSI pad area will be performed to determine the actual extent of the radiological concern. As necessary, the EC will ensure RCAs and access controls are established to prevent personnel from entering the area. RECOVERY and corrective actions will be planned and executed in a manner that minimizes exposure to personnel.

15.2.2 PERSONNEL EXPOSURE MONITORING

Personal dosimeters are utilized to monitor the exposure of personnel during normal or emergency conditions. Adequate supplies of dosimeters are maintained for use during an emergency. Procedures describe in detail the types of personal dosimeter devices, the manner in which they are to be used, who is to wear them, and how they are to be cared for.

Emergency worker dose records are maintained in accordance with Radiation Protection procedures.

15.3 CONTAMINATION CONTROL

Various contamination control measures are utilized. These include access control measures and means for the decontamination of personnel, areas, and equipment. These activities are addressed in facility procedures and are briefly described below.

All personnel are monitored for radioactive contamination prior to leaving the site. During normal or emergency conditions, contamination should be removed from any part of a person's body prior to their leaving the RCA. All personnel decontamination, even during an emergency, will be performed under the supervision of the Radiation Protection Group and in accordance with established procedures.

Portable contamination monitoring instruments are available to frisk personnel for potential contamination.

Documentation of surveys, contamination, and decontamination activities shall be maintained in accordance with Radiation Protection procedures.

TABLE 15.1

GUIDELINES FOR EMERGENCY RESPONSE WORKER EXPOSURE

ACTIVITY	GUIDELINE	CONDITION
All occupational exposures	5 rem	All reasonably achievable actions have been taken to minimize dose.
Protecting valuable property necessary for public welfare.	10 rem [a]	Exceeding 5 rem unavoidable and all appropriate actions taken to reduce dose. Monitoring available to project or measure dose.
Lifesaving or protection of large populations	25 rem [b]	Exceeding 5 rem unavoidable and all appropriate actions taken to reduce dose. Monitoring available to project or measure dose.

Notes: a For potential doses >5 rem, medical monitoring programs should be considered.

b In the case of a very large incident, consider need to raise property and lifesaving response worker guidelines.

NOTE: Reference for this table is Table 2-2 in the EPA PAG Manual.

NOTE: The dose limits listed above are in addition to any annual occupational dose already received.

16.0 MEDICAL AND HEALTH SUPPORT

Medical assistance is available on-site and off-site for treatment of CR-3 ISFSI personnel. Various means of transportation are also available to transport individuals for radiological and non-radiological injuries.

The individuals and organizations providing emergency medical assistance as identified in this section either have the capability for evaluation of radiation exposure and uptake or they are provided this capability from Duke Energy in the form of personnel and/or equipment. Duke Energy assures that persons providing these services are adequately prepared to handle contaminated individuals through detailed training classes, drills and exercises. Letters of Agreement with off-site organizations and individuals for medical support are listed in Appendix B.

16.1 ON-SITE FIRST AID

First aid assistance at the CR-3 ISFSI is designed to handle a wide range of injuries. This task is accomplished by medical response personnel. The medical response personnel are on-site individuals trained in basic first aid procedures. Medical response personnel are trained to handle injured personnel, with or without radiological considerations.

16.2 MEDICAL TRANSPORTATION

Transportation of injured personnel is available via local emergency medical services, other Duke Energy vehicles, or private vehicles. When personnel are transported to Seven Rivers Regional Medical Center (SRRMC) while in a contaminated condition, a person trained in radiological monitoring will be dispatched to monitor and maintain radiological controls.

16.3 OFF-SITE MEDICAL SUPPORT

The Seven Rivers Regional Medical Center (SRRMC) in Crystal River, Florida has medical facilities capable of handling various types of injuries. SRRMC is capable of treating patients with injuries of a non-radiological or radiological nature.

SRRMC will provide for hospital treatment, medical examinations, and laboratory services for those Duke Energy employees, and other persons designated by Duke Energy. Medical records, including bioassay records, will be maintained permanently by the hospital.

When local facilities are considered inadequate because of the nature or severity of the injury sustained, the injured person may be referred to a trauma center in Florida or to Oak Ridge, Tennessee - REAC/TS for hospitalization. Oak Ridge Associated Universities (ORAU) operates a research hospital in Oak Ridge, Tennessee for the U.S. Department of Energy.

17.0 EMERGENCY TERMINATION AND RECOVERY

Duke Energy has established general plans described in the following sections to yield RECOVERY from potential emergencies at the CR-3 ISFSI. The recovery organization will be based on the normal Duke Energy organization and would function with the senior management position being responsible for site activities.

17.1 EMERGENCY TERMINATION AND NOTIFICATION

Termination of an emergency status is the responsibility of the EC. The EC is also responsible for providing notification of the emergency termination and initiation of RECOVERY operations to the NRC, State of Florida (SWO), the CR-3 ERO, and other organizations that may be providing on-site support.

17.2 RECOVERY OPERATIONS

RECOVERY operations begin immediately following emergency termination and will address the specific emergency circumstances.

RECOVERY planning includes equipment to be repaired or replaced, licensing implications, special training requirements, offsite support, and determination of causes and consequences. Site procedures addressing RECOVERY operations provide an outline for a short term RECOVERY plan.

The ISFSI Site Director shall be responsible for the development and implementation of the RECOVERY plan and shall provide for detailed monitoring of the implementation and status reporting. The ISFSI Site Director also has the authority to revise or halt activities as circumstances dictate.

The RECOVERY will be terminated by the Duke Energy senior management position after the ISFSI is returned to a stable condition.

18.0 EXERCISE AND DRILLS

Periodic exercises are conducted to evaluate major portions of emergency response capabilities. Periodic drills are conducted to develop and maintain key skills. Deficiencies as a result of exercises or drills are identified and corrected.

18.1 BIENNIAL EXERCISE AND DRILL

A Biennial Exercise is conducted and tests the capability and a major portion of the basic elements existing within emergency preparedness plans and organizations. The State of Florida, the Citrus County Sheriff's Office and local support organizations (firefighting, ambulance and medical services) will be invited to participate to verify this capability to respond to an emergency scenario requiring response.

Drills are conducted for the purpose of testing, developing, and maintaining the proficiency of emergency responders. Exercise and Drill scenarios will include, at a minimum, the following:

- Basic objective(s) of the exercise / drill.
- Date(s), time period, place(s), and participating organizations.
- A time schedule of real and simulated initiating events.
- A narrative summary describing the conduct of the drill to include such items as simulated casualties, offsite fire assistance, rescue of personnel, and use of protective clothing.

A remedial exercise will be conducted if it is determined that the emergency plan was not satisfactorily tested during the biennial exercise such that the NRC cannot find reasonable assurance that adequate protective measures can be taken in the event of a radiological emergency.

18.2 TRAINING DRILLS

Training drills serve as elements of training programs in which individuals demonstrate their ability to perform assigned emergency functions. During a training drill, on-the-spot correction of erroneous performance should be made and a demonstration of the proper performance should be offered. Problems should be noted for discussion as part of the training drill critique. Training drills shall be conducted at the FREQUENCY indicated below:

a. Communication Drills

- Monthly – Communication between the CR-3 ISFSI and the Florida State Watch Office (SWO) shall be demonstrated.

  These drills shall also include the aspect of understanding the content of messages.

b. Medical Emergency Drills

- ANNUAL - This drill will involve medical response personnel and include a simulated contaminated individual and may also allow provisions for participation by local support agencies (i.e., ambulance and off-site medical facilities). The off-site portions of the drill may be performed as part of the Biennial Exercise.

c. Radiological Monitoring

- ANNUAL - A drill involving radiation monitoring personnel to demonstrate ability to perform radiological survey and assessment.

d. Staff Augmentation Drills

- ANNUAL – An unannounced off-shift staff augmentation drill is conducted annually. This drill shall involve implementation of the ERO callout system procedure and documentation of the estimated response time for each responder. This drill shall serve to demonstrate the capability to augment the EC after an emergency classification.

Drill requirements may be satisfied as part of the Biennial Exercise. A critique shall be conducted as soon as practical after each drill or exercise. The critique shall evaluate the ability of the organization to respond to a simulated emergency situation.

18.3 CRITIQUES

A critique is performed as soon as practicable after training drills and exercises to evaluate the ability of the participating organizations to respond as indicated in this IOEP. Recommendations for revisions to the CR-3 IOEP, the implementing procedures and/or the upgrading of emergency equipment and supplies as a result of the drill or exercise should be forwarded to the Emergency Planning Coordinator who shall review, coordinate, and assure that appropriate changes are implemented to correct any deficiencies. A written evaluation shall result from the critique of the Biennial Exercise. The ISFSI Site Director shall assure that identified deficiencies are corrected.

19.0 EMERGENCY RESPONSE ORGANIZATION TRAINING

Radiological emergency response training is provided to those who may be called on to assist in an emergency. All personnel at the CR-3 ISFSI who fill required positions in the ERO will take part in a training program to assure adequate preparedness to assist in an emergency situation. Specific off-site support resources that may be called upon for emergency assistance will also be invited to participate in appropriate training programs. Emergency response personnel in the following categories receive initial training and ANNUAL retraining:

19.1 ISFSI SHIFT SUPERVISORS/EMERGENCY COORDINATORS AND RESOURCE MANAGERS

These following subjects shall be covered as a minimum on an ANNUAL basis:

- EMERGENCY ACTION LEVEL Classification.
- Federal, State and local government notification procedures.
- ERO Activation.
- Dose rate meter operation.
- Radioactive RELEASE assessment.
- Emergency exposure control.
- PROTECTIVE ACTIONS for onsite personnel.
- ISFSI Design Basis Accidents.
- Review of applicable drill identified deficiencies and Human Performance Concerns.

19.2 MEDICAL RESPONSE PERSONNEL

All medical response personnel are provided training. Training for personnel assigned to provide first aid support shall include courses equivalent to Red Cross Multi-Media.

19.3 RADIATION MONITORING PERSONNEL

Initial and ANNUAL retraining for radiation monitoring personnel consists of the following topics:

- Use of Radiation Protection procedures.
- Use of emergency survey equipment.
- Communications.
- Field surveys.
- The role of dose assessment in an emergency.
- Monitoring of radioactive releases.
- Review of applicable drill identified deficiencies and Human Performance Concerns.

19.4 MEDICAL SUPPORT PERSONNEL

Medical Support training is offered annually to SRRMC and local emergency medical services. The training will be structured to meet the needs of the respective organization with respect to the nature of their support.

20.0 RESPONSIBILITY FOR THE PLANNING EFFORT: DEVELOPMENT, PERIODIC REVIEW AND DISTRIBUTION OF EMERGENCY PLANS

20.1 EMERGENCY PLANNING COORDINATION

The ISFSI Site Director has overall authority and responsibility for emergency response planning. The CR-3 ISFSI Emergency Planning Coordinator develops and updates emergency plans and coordinates these plans with other response organizations. In the event that licensing actions by the NRC or changes in the State agencies or other off-site resources impact this Plan, the Emergency Planning Coordinator is responsible for identifying the particular impact and necessary revisions to the Plan. The Emergency Planning Coordinator reports to the ISFSI Manager-Operations and Maintenance.

The Emergency Planning Coordinator training will consist of periodic reviews of Federal emergency preparedness requirements and guidance documents and various site-specific documents related to emergency preparedness. Training is supplemented primarily by on-the-job activities and attendance of short courses, seminars, or executive conferences that relate specifically to emergency preparedness.

20.2 PLAN/PROCEDURES REVIEW AND UPDATE

The CR-3 IOEP should be reviewed and verified to be current on an ANNUAL basis by the Emergency Planning Coordinator. Revisions to the CR-3 IOEP and implementing procedures identified in Appendix A will be reviewed in accordance with 10 CFR 50.54(q) requirements.

Procedures listed in Appendix A shall be reviewed and verified to be current by the appropriate individual in accordance with established procedures. These procedures will be updated as appropriate and will consider improvements identified during drills and training.

20.2 PLAN/PROCEDURES REVIEW AND UPDATE (Continued)

In addition, there shall be a quarterly review and update of the notification rosters used to activate and implement the Plan.

Review of the CR-3 IOEP and the plans of support organizations shall consider applicable emergency planning criteria and regulations promulgated by the NRC, as applicable to the CR-3 ISFSI.

In addition to the above reviews and updates, the Emergency Planning Coordinator shall review and update appropriate support agreements (see Appendix B) as required. Support plans for other groups such as the fossil plant, procurement, and SRRMC may also be reviewed periodically.

20.3 TRAINING

The Emergency Planning Coordinator shall assist management in coordinating and/or providing emergency planning-related training. They shall assure that the training described in Section 19.0, is properly coordinated to assure adequate qualification, training, and retraining of personnel.

20.4 AUDITS

Duke Energy maintains a Corporate Nuclear Oversight Section (NOS) that will support audits of the CR-3 IOEP according to Corporate NOS audit practices and instructions, which meet the requirements of 10 CFR 50.54(t).

ISFSI ONLY EMERGENCY PLAN

APPENDIX A

CROSS REFERENCE IOEP SECTION TO PLANNING STANDARDS/REQUIREMENTS AND IMPLEMENTING PROCEDURES

APPENDIX A

CROSS REFERENCE IOEP SECTION TO PLANNING STANDARDS/REQUIREMENTS AND IMPLEMENTING PROCEDURES

Regulatory Requirement	Corresponding IOEP Section(s)	Procedure
10 CFR 50.47(b)(1)	5.0	To Be Determined (TBD)
10 CFR 50.47(b)(2)	6.0	TBD
10 CFR 50.47(b)(3)	5.0, 7.0, Appendix B	TBD
10 CFR 50.47(b)(4)	8.0	TBD
10 CFR 50.47(b)(5)	9.0	TBD
10 CFR 50.47(b)(6)	10.0	TBD
10 CFR 50.47(b)(7)	11.0	TBD
10 CFR 50.47(b)(8)	12.0	TBD
10 CFR 50.47(b)(9)	13.0	TBD
10 CFR 50.47(b)(10)	14.0	TBD
10 CFR 50.47(b)(11)	15.0	TBD
10 CFR 50.47(b)(12)	16.0	TBD
10 CFR 50.47(b)(13)	17.0	TBD
10 CFR 50.47(b)(14)	18.0	TBD
10 CFR 50.47(b)(15)	19.0	TBD
10 CFR 50.47(b)(16)	20.0	TBD
10 CFR 50.47(c)(2)	2.1	TBD
10 CFR Part 50, Appendix E IV		
10 CFR Part 50, Appendix E IV.A	5.0, 6.0, 7.0	TBD
10 CFR Part 50, Appendix E IV.B	8.0, 13.0	TBD
10 CFR Part 50, Appendix E IV.C	8.0, 9.0	TBD
10 CFR Part 50, Appendix E IV.D	9.0, 10.0	TBD
10 CFR Part 50, Appendix E IV.E	12.0	TBD
10 CFR Part 50, Appendix E IV.F	18.0, 19.0	TBD
10 CFR Part 50, Appendix E IV.G	20.0	TBD
10 CFR Part 50, Appendix E IV.H	17.0	TBD
10 CFR Part 50, Appendix E IV.I	14.0	TBD
10 CFR Part 50, Appendix E V	Appendix A	TBD
10 CFR Part 50, Appendix E VI	Not Applicable	Not Applicable

.

PERMANENTLY DEFUELED EMERGENCY PLAN

APPENDIX B

AGREEMENTS WITH SUPPORTING ORGANIZATIONS

AGREEMENTS WITH SUPPORTING ORGANIZATIONS

The following agreements are reviewed on an ANNUAL basis and updated as necessary. The documents are kept on file at CR-3 and maintained by the Emergency Planning Group.

1. Citrus County Sheriff's Office
2. Seven Rivers Regional Medical Center
3. Nature Coast EMS

SUMMARY OF CHANGES

DRR 752068

Page / Section	Change	Reason/References
Throughout	This is a major revision to the Emergency Plan which supports the transition to an Independent Spent Fuel Storage Installation (ISFSI) Only Emergency Plan (IOEP). The IOEP describes the station's plan for responding to emergencies that may arise at the CR-3 ISFSI facility. Major changes made throughout the Plan include the following: • Removal of terms/definitions/abbreviations and references that are no longer applicable • Adding new applicable references. • Changed the organizational titles to reflect the ISFSI organization titles. • Complete reorganization of the Emergency Response Organization including removal of the Emergency Mitigation Coordinator and Radiation Controls Coordinator position and adds the Recovery Manager position. • Deleted information that is no longer applicable based on the transfer of all spent fuel to the ISFSI facility.	Transition to an ISFSI Only Emergency Plan

DUKE ENERGY FLORIDA, INC.

CRYSTAL RIVER UNIT 3

DOCKET NUMBERS 50 - 302 AND 72-1035/
LICENSE NUMBER DPR - 72

LICENSE AMENDMENT REQUEST #322, REVISION 0, ISFSI-ONLY EMERGENCY PLAN, DRAFT REVISION A, AND ISFSI-ONLY EMERGENCY ACTION LEVEL BASES MANUAL, DRAFT REVISION A

ENCLOSURE 3

ISFSI-ONLY EMERGENCY ACTION LEVEL BASES MANUAL, DRAFT REVISION A

CRYSTAL RIVER UNIT 3

ISFSI ONLY EMERGENCY PLAN (IOEP)
EMERGENCY ACTION LEVEL (EAL)
BASES MANUAL

DRAFT A
(Revision 0 when approved)

Emergency Planning Coordinator	**Date**
ISFSI Site Director	**Date**

TABLE OF CONTENTS

1.0 PURPOSE

This manual provides an explanation and rationale for each EMERGENCY ACTION LEVEL (EAL) included in the Independent Spent Fuel Storage Installation (ISFSI) Only EAL scheme for the CR3 ISFSI facility. The information provided should be used to facilitate reviews of EALs and provide documentation for future reference. Decision-makers performing the duties of the Emergency Coordinator (EC) may use the information included in this document as a technical reference in support of an EAL interpretation. This information may assist the EC in making classifications, particularly those involving judgment or multiple events.

This manual is an Emergency Plan Implementing Procedure (EPIP). Any revisions must be carefully considered for Emergency Plan impact by evaluating changes in accordance with 10 CFR 50.54(q).

2.0 REFERENCES

2.1 NEI 99-01, Revision 6, November 2012, Development of Emergency Action Levels for Non-Passive Reactors, Appendix C, Permanently Defueled Station ICs/EALs and Section 8, Independent Spent Fuel Storage Installation (ISFSI) ICs/EALs.

2.2 Independent Spent Fuel Storage Installation (ISFSI) Only Emergency Plan (IOEP)

2.3 NUREG-1022, Event Reporting Guidelines: 10CFR50.72 and 50.73

2.4 NUREG-1536, Standard Review Plan for Spent Fuel Dry Storage Systems at a General License Facility

2.5 NSIR/DPR-ISG-01, Interim Staff Guidance, Emergency Planning for Nuclear Power Plants

2.6 NEI 03-12, Template for Security Plan, Training and Qualification, Safeguards Contingency Plan, and ISFSI Security Program.

2.7 10 CFR 2.390, Public inspections, exemptions, requests for withholding.

3.0 DEFINITIONS

Selected terms used in Initiating Condition (IC) and EAL statements are set in all capital letters (e.g., ALL CAPS). These words are defined terms that have specific meanings as used in this document. The definitions of these terms are provided below.

ALERT: Events are in progress or have occurred which involve an actual or potential substantial degradation of the level of safety of the CR3 ISFSI or a security event that involves probable life threatening risk to site personnel or damage to ISFSI equipment because of HOSTILE ACTION. Any releases are expected to be limited to small fractions of the Environmental Protection Agency (EPA) Protective Action Guide (PAG) exposure levels.

CONFINEMENT BOUNDARY: The barrier(s) between spent fuel and the environment once the spent fuel is processed for dry storage. As applied to the CR3 ISFSI, the CONFINEMENT BOUNDARY is the Dry Shielded Canister (DSC) consisting of the DSC shell, the inner top and inner bottom cover plates, the siphon and vent block, the siphon and vent port cover plates, and the associated welds.

CREDIBLE SECURITY THREAT: A threat to the CR3 ISFSI confirmed and validated by Security per procedures or received over the Emergency Notification System (ENS) from the NRC.

EMERGENCY ACTION LEVEL (EAL): A pre-determined, observable threshold for plant conditions that places the plant in a given emergency classification.

EMERGENCY CLASSIFICATION LEVEL (ECL): One of a set of names or titles established by the US Nuclear Regulatory Commission (NRC) for grouping off-normal events or conditions according to (1) potential or actual effects or consequences, and (2) resulting onsite and offsite response actions. The emergency classification levels, in ascending order of severity, are Notification of UNUSUAL EVENT (NOUE) and ALERT.

HOSTILE ACTION: An act toward the CR3 ISFSI or its personnel that includes the use of violent force to destroy equipment, take hostages, and/or intimidate the licensee to achieve an end. This includes attack by air, land, or water using guns, explosives, projectiles, vehicles, or other devices used to deliver destructive force. Other acts that satisfy the overall intent may be included. HOSTILE ACTION should not be construed to include acts of civil disobedience or felonious acts that are not part of a concerted attack on the CR3 ISFSI. Non-terrorism-based EALs should be used to address such activities (i.e., this may include violent acts between individuals in the owner controlled area).

HOSTILE FORCE: One or more individuals who are engaged in a determined assault, overtly or by stealth and deception, equipped with suitable weapons capable of killing, maiming, or causing destruction.

INDEPENDENT SPENT FUEL STORAGE INSTALLATION (ISFSI): A complex that is designed and constructed for the interim storage of spent nuclear fuel and other radioactive materials associated with spent fuel storage.

OWNER CONTROLLED AREA (OCA): The area of land (approximately 4738 acres) that is owned, leased, or otherwise controlled by Duke Energy, situated between the mouths of the Withlacoochee and Crystal Rivers and bounded to the north by woodlands, to the east by Highway 19, to the south by medium to dense woodlands and to the west by marshlands and the Gulf of Mexico. The OWNER CONTROLLED AREA is the area of land within the SITE BOUNDARY, as shown in Figure 2-3 of the FSAR. The PROTECTED AREA is located within the OWNER CONTROLLED AREA.

PROTECTED AREA: The area encompassed by physical barriers and to which access is controlled.

SECURITY CONDITION: Any security event as listed in the approved security contingency plan that constitutes a threat/compromise to site security, threat/risk to site personnel, or a potential degradation to the level of safety of the CR3 ISFSI. A SECURITY CONDITION does not involve a HOSTILE ACTION.

SITE BOUNDARY: That line beyond which the land is not owned, leased, or otherwise controlled by the licensee. This line establishes the perimeter of the OWNER CONTROLLED AREA (OCA).

UNUSUAL EVENT (UE): Events are in progress or have occurred which indicate a potential degradation of the level of safety of the ISFSI or indicate a security threat to facility protection has been initiated. No releases of radioactive material requiring off-site response or monitoring are expected unless further degradation of safety systems occur.

ATTACHMENT 1

EMERGENCY ACTION LEVEL

TECHNICAL BASES

Table A-1: Recognition Category "PD" and "E" Initiating Condition Matrix

UNUSUAL EVENT	ALERT
PD-HU1: Confirmed SECURITY CONDITION or threat. *(Attachment 1, Page 2)*	**PD-HA1:** HOSTILE ACTION is occurring or has occurred. *(Attachment 1, Page 4)*
PD-HU3: Other conditions exists which in the judgment of the Emergency Coordinator warrant declaration of an UNUSUAL EVENT (UE). *(Attachment 1, Page 6)*	**PD-HA3**: Other conditions exists which in the judgment of the Emergency Coordinator warrant declaration of an ALERT. *(Attachment 1, Page 7)*
E-HU1: Damage to a Dry Shielded Canister CONFINEMENT BOUNDARY *(Attachment 1, Page 8)*	

Hazards and Other Conditions

PD-HU1

ECL: Unusual Event

Initiating Condition: Confirmed SECURITY CONDITION or threat.

Emergency Action Levels: (1 or 2)

UNUSUAL EVENT
1. Confirmed SECURITY CONDITION or threat. 1) A SECURITY CONDITION that does not involve a HOSTILE ACTION as reported by the Security Shift Supervisor. **OR** 2) Notification of a CREDIBLE SECURITY THREAT directed at the site.

SECURITY CONDITION: Any security event as listed in the approved security contingency plan that constitutes a threat/compromise to site security, threat/risk to site personnel, or a potential degradation to the level of safety of the CR3 ISFSI. A SECURITY CONDITION does not involve a HOSTILE ACTION.

HOSTILE ACTION: An act toward the CR3 ISFSI or its personnel that includes the use of violent force to destroy equipment, take hostages, and/or intimidate the licensee to achieve an end. This includes attack by air, land, or water using guns, explosives, projectiles, vehicles, or other devices used to deliver destructive force. Other acts that satisfy the overall intent may be included. HOSTILE ACTION should not be construed to include acts of civil disobedience or felonious acts that are not part of a concerted attack on the CR3 ISFSI. Non-terrorism-based EALs should be used to address such activities (i.e., this may include violent acts between individuals in the owner controlled area).

Hazards and Other Conditions

PD-HU1

Basis:

This IC addresses events that pose a threat to plant personnel or spent fuel and thus represent a potential degradation in the level of plant safety. Security events which do not meet one of these EALs are adequately addressed by the requirements of 10 CFR § 73.71 or 10 CFR § 50.72. Security events assessed as HOSTILE ACTIONS are classifiable under IC PD-HA1.

Timely and accurate communications between Security Shift Supervision and the ISFSI Shift Supervisor/Emergency Coordinator are essential for proper classification of a security-related event. Classification of these events will initiate appropriate threat-related notifications to plant personnel and Off Site Response Organizations.

Security plans and terminology are based on the guidance provided by NEI 03-12, *Template for the Security Plan, Training and Qualification Plan, Safeguards Contingency Plan [and Independent Spent Fuel Storage Installation Security Program].*

EAL #1 references the Security Shift Supervisor because these are the individuals trained to confirm that a security event is occurring or has occurred. Training on security event confirmation and classification is controlled due to the nature of Safeguards and 10 CFR § 2.390 information.

EAL #2 addresses the receipt of a CREDIBLE SECURITY THREAT. The credibility of the threat is assessed in accordance with Security procedures.

Emergency plans and implementing procedures are public documents; therefore, EALs should not incorporate Security-sensitive information. This includes information that may be advantageous to a potential adversary, such as the particulars concerning a specific threat or threat location. Security-sensitive information should be contained in non-public documents such as the Security Plan.

Escalation of the emergency classification level would be via Initiating Condition PD-HA1.

Hazards and Other Conditions

PD-HA1

ECL: Alert

Initiating Condition: HOSTILE ACTION is occurring or has occurred.

Emergency Action Levels:

ALERT
1. HOSTILE ACTION is occurring or has occurred as reported by the Security Shift Supervisor.

HOSTILE ACTION: An act toward the CR3 ISFSI or its personnel that includes the use of violent force to destroy equipment, take hostages, and/or intimidate the licensee to achieve an end. This includes attack by air, land, or water using guns, explosives, projectiles, vehicles, or other devices used to deliver destructive force. Other acts that satisfy the overall intent may be included. HOSTILE ACTION should not be construed to include acts of civil disobedience or felonious acts that are not part of a concerted attack on the CR3 ISFSI. Non-terrorism-based EALs should be used to address such activities (i.e., this may include violent acts between individuals in the owner controlled area).

Hazards and Other Conditions

PD-HA1

Basis:

This IC addresses the occurrence of a HOSTILE ACTION.

Timely and accurate communications between Security Shift Supervision and the ISFSI Shift Supervisor/Emergency Coordinator are essential for proper classification of a security-related event.

As time and conditions allow, these events require a heightened state of readiness by the plant staff and implementation of onsite protective measures (e.g., evacuation or sheltering). The ALERT declaration will also heighten the awareness of Offsite Response Organizations, allowing them to be better prepared should it be necessary to consider further actions.

This IC does not apply to incidents that are accidental events, acts of civil disobedience, or otherwise are not a HOSTILE ACTION perpetrated by a HOSTILE FORCE. Examples include the crash of a small aircraft, shots from hunters, physical disputes between employees, etc. Reporting of these types of events is adequately addressed by other EALs, or the requirements of 10 CFR § 73.71 or 10 CFR § 50.72.

Emergency plans and implementing procedures are public documents; therefore, EALs should not incorporate Security-sensitive information. This includes information that may be advantageous to a potential adversary, such as the particulars concerning a specific threat or threat location. Security-sensitive information should be contained in non-public documents such as the Security Plan.

Hazards and Other Conditions

PD-HU3

ECL: Unusual Event

Initiating Condition: Other conditions exist which in the judgment of the Emergency Coordinator warrant declaration of an UNUSUAL EVENT (UE).

Emergency Action Levels:

UNUSUAL EVENT
1) Other conditions exist which in the judgment of the Emergency Coordinator indicate that events are in progress or have occurred which indicate a potential degradation of the level of safety of the ISFSI or indicate a security threat to facility protection has been initiated. No releases of radioactive material requiring offsite response or monitoring are expected unless further degradation of safety systems occurs.

Basis:

This IC addresses unanticipated conditions not addressed explicitly elsewhere but that warrant declaration of an emergency because conditions exist which are believed by the Emergency Coordinator to fall under the emergency classification level description for a UE.

Hazards and Other Conditions

PD-HA3

ECL: Alert

Initiating Condition: Other conditions exist which in the judgment of the Emergency Coordinator warrant declaration of an ALERT.

Emergency Action Levels:

ALERT
1) Other conditions exist which in the judgment of the Emergency Coordinator indicate that events are in progress or have occurred which involve an actual or potential substantial degradation of the level of safety of the ISFSI or a security event that involves probable life threatening risk to site personnel or damage to ISFSI equipment because of HOSTILE ACTION. Any releases are expected to be limited to small fractions of the EPA Protective Action Guideline exposure levels.

Basis:

This IC addresses unanticipated conditions not addressed explicitly elsewhere but that warrant declaration of an emergency because conditions exist which are believed by the Emergency Coordinator to fall under the emergency classification level description for an ALERT.

ISFSI Malfunction

E-HU1

ECL: Unusual Event

Initiating Condition: Damage to a Dry Shielded Canister **CONFINEMENT BOUNDARY.**

Emergency Action Levels: (1 or 2 or 3 or 4)

UNUSUAL EVENT
Damage to a Dry Shielded Canister CONFINEMENT BOUNDARY as indicated by radiation readings greater than or equal to the following: 1) 1300 mR/hr (gamma +neutron) on the radial surface of the fuel transfer cask while in transit to the ISFSI Horizontal Storage Module (HSM). OR 2) 1050 mR/hr (gamma + neutron) on the HSM Front Bird Screen while stored in the HSM. OR 3) 4 mR/hr (gamma + neutron) HSM Outside Door while stored in the HSM. OR 4) 40 mR/hr (gamma + neutron) HSM End Shield Wall Exterior while stored in the HSM. NOTE: Radiation readings are taken at the locations prescribed by the Technical Specifications for the Standardized NUHOMS Horizontal Storage System (Amendment Number 14 to COC 1004).

Mode Applicability: All

CONFINEMENT BOUNDARY: The barrier(s) between spent fuel and the environment once the spent fuel is processed for dry storage. As applied to the CR3 ISFSI, the **CONFINEMENT BOUNDARY** is the Dry Shielded Canister (DSC) consisting of the DSC shell, the inner top and inner bottom cover plates, the siphon and vent block, the siphon and vent port cover plates, and the associated welds.

ISFSI Malfunction

E-HU1

Basis:

This IC addresses an event that results in damage to the CONFINEMENT BOUNDARY of a dry shielded canister containing spent fuel. It applies to irradiated fuel that is licensed for dry storage beginning at the point that the loaded storage canister is sealed. The issues of concern are the creation of a potential or actual release path to the environment, degradation of one or more fuel assemblies due to environmental factors, and configuration changes which could cause challenges in removing the canister or fuel from storage.

The existence of "damage" is determined by radiological survey. NEI 99-01, Revision 6, November 2012, Development of Emergency Action Levels for Non-Passive Reactors, Section 8, Independent Spent Fuel Storage Installation (ISFSI) ICs/EALs recommends using "2 times" the site-specific cask specific technical specification allowable radiation level as the EAL. The technical specification multiple of "2 times" is used here to distinguish between non-emergency and emergency conditions. The emphasis for this classification is the degradation in the level of safety of the spent fuel dry shielded canister and not the magnitude of the associated dose or dose rate. It is recognized that in the case of extreme damage to a loaded canister, the fact that the "on-contact" dose rate limit is exceeded may be determined based on measurement of a dose rate at some distance from the canister.

Security-related events for ISFSIs are covered under ICs PD-HU1 and PD-HA1.

An UNUSUAL EVENT in this EAL is categorized on the basis of the occurrence of an event of sufficient magnitude that a loaded Dry Shielded Canister (DSC) CONFINEMENT BOUNDARY is damaged or violated while in transit or storage.

This EAL applies to emergency conditions affecting a spent fuel DSC caused by an accident or natural phenomena. This EAL would be applicable at all times in all modes for a loaded DSC from the time the lid is installed, during transport to the INDEPENDENT SPENT FUEL STORAGE INSTALLATION (ISFSI) and while stored in the Horizontal Storage Module (HSM).

As provided in the Transnuclear "Standardized NUHOMS System Technical Specifications" DRAFT Amendment 14 to COC 1004, Section 5.2.4 (Radiation Protection Program) and Section 5.4.2 (HSM or HSM-H Dose Rate Evaluation Program) contain radiation dose levels for the DSC that should not be exceeded based on whether the DSC is being transported inside the fuel transfer cask or while it is stored in the HSM. Keeping in line with NEI guidance that a UNUSAL EVENT warranted for radiation conditions at a level of twice the Technical Specification value, the values chosen for EAL E-HU1 represent these values. The "Note" in the EAL provides guidance on where the radiation readings are to be taken when evaluating this EAL.

ATTACHMENT 2

EMERGENCY CLASSIFICATION TABLES

EMERGENCY CLASSIFICATION TABLE INDEX

HAZARDS AND OTHER CONDITIONS		
CATEGORY (H)	**UNUSUAL EVENT (U)**	**ALERT (A)**
SECURITY *(Attachment 2, Page 2)*	**HU1**	**HA1**
Hazards and Other Conditions/ Emergency Coordinator Judgment *(Attachment 2, Page 3)*	**HU3**	**HA3**
ISFSI MALFUNCTION		
CATEGORY (E)	**UNUSUAL EVENT (U)**	**ALERT (A)**
ISFSI Malfunction *(Attachment 2, Page 4)*	**HU1**	Not Applicable

EMERGENCY CLASSIFICATION TABLE

PERMANENTLY DEFUELED **(PD)**

CATEGORY	UNUSUAL EVENT (HU1)	ALERT (HA1)
Hazards And Other Conditions **(H)**	**1**. Confirmed SECURITY CONDITION or threat. 1) A SECURITY CONDITION that does not involve a HOSTILE ACTION as reported by the Security Shift Supervisor. **OR** 2) Notification of a CREDIBLE SECURITY THREAT directed at the site.	**1.** HOSTILE ACTION is occurring or has occurred as reported by the Security Shift Supervisor.

EMERGENCY CLASSIFICATION TABLE

MODE: PERMANENTLY DEFUELED (PD)

CATEGORY	UNUSUAL EVENT (HU3)	ALERT (HA3)
Hazards And Other Conditions **(H)**	**1.** Other conditions exist which in the judgment of the Emergency Coordinator warrant declaration of a UE. 1) Other conditions exists which in the judgment of the Emergency Coordinator indicate that events are in progress or have occurred which indicate a potential degradation of the level of safety of the ISFSI or indicate a security threat to facility protection has been initiated. No releases of radioactive material requiring offsite response or monitoring are expected unless further degradation of safety systems occurs.	**1.** Other conditions exist which in the judgment of the Emergency Coordinator warrant declaration of an ALERT. 1) Other conditions exists which in the judgment of the Emergency Coordinator indicate that events are in progress or have occurred which involve an actual or potential substantial degradation of the level of safety of the ISFSI or a security event that involves probable life threatening risk to site personnel or damage to ISFSI equipment because of HOSTILE ACTION. Any releases are expected to be limited to small fractions of the EPA Protective Action Guideline exposure levels.

EMERGENCY CLASSIFICATION TABLE

INDEPENDENT SPENT FUEL STORAGE INSTALLATION (ISFSI)

MODE: All (E)

CATEGORY	UNUSUAL EVENT (HU1)	ALERT (HA1)
ISFSI Malfunction **(E)**	Damage to a Dry Shielded Canister CONFINEMENT BOUNDARY as indicated by radiation readings greater than or equal to the following: 1300 mR/hr (gamma +neutron) on the radial surface of the fuel transfer cask while in transit to the ISFSI Horizontal Storage Module (HSM). OR 1050 mR/hr (gamma + neutron) on the HSM Front Bird Screen while stored in the HSM. OR 4 mR/hr (gamma + neutron) HSM Outside Door while stored in the HSM. OR 40 mR/hr (gamma + neutron) HSM End Shield Wall Exterior while stored in the HSM. NOTE: Radiation readings are taken at the locations prescribed by the Technical Specifications for the Standardized NUHOMS Horizontal Storage System (Amendment Number 14 to COC 1004).	**Not Applicable**

SUMMARY OF CHANGES

DRR 752065

PAGE / SECTION	CHANGE	REASON & REFERENCES
Throughout	Changed any reference to the CR-3 plant to the CR-3 ISFSI facility. Changed organizational titles to reflect ISFSI organization titles. Deleted emergency actions levels associated with the spent fuel pool and events no longer applicable based on an ISFSI Only emergency plan including EALs PD-AU1, PD-AA1, PD-AU2, PD-AA2, PD-HU2 and PD-SU1. Modified Security related EALS to make them specific to the CR-3 ISFSI facility and eliminate the parts that are not applicable to ISFSI facilities.	Support transition to an ISFSI Only facility.
Section 2.0	Deleted references that are no longer applicable due to the transition to an ISFSI Only emergency plan.	Support transition to an ISFSI Only facility
Section 3.0	Deleted definitions that are no longer applicable based on the removal of the EALs listed above.	Associated EALs deleted.

DUKE ENERGY FLORIDA, INC.

CRYSTAL RIVER UNIT 3

**DOCKET NUMBERS 50 - 302 AND 72-1035/
LICENSE NUMBER DPR - 72**

**LICENSE AMENDMENT REQUEST #322, REVISION 0,
ISFSI-ONLY EMERGENCY PLAN, DRAFT REVISION A, AND
ISFSI-ONLY EMERGENCY ACTION LEVEL BASES MANUAL,
DRAFT REVISION A**

ENCLOSURE 4

**COMPARISON MATRIX OF NUCLEAR ENERGY INSTITUTE
99-01, "DEVELOPMENT OF EMERGENCY ACTION LEVELS
FOR NON-PASSIVE REACTORS, REVISION 6," TO THE
PROPOSED CR-3 EMERGENCY CLASSIFICATION SYSTEM
AND NEW EMERGENCY ACTION LEVELS**

NEI 99-01, Rev 6, Appendix C/Section 8 ICs/EALs	Proposed EAL Matrix for CR-3	Comparison
PD-HU1 **ECL:** Notification of Unusual Event **Initiating Condition:** Confirmed SECURITY CONDITION or threat. **Operating Mode Applicability:** Not Applicable	**PD-HU1** **ECL:** Unusual Event **Initiating Condition:** Confirmed SECURITY CONDITION or threat.	• Use of Unusual Event instead of Notification of Unusual Event. Use is consistent with present EAL matrix and agrees in meaning and intent with NEI 99-01, Rev 6. • Deleted “Operating Mode Applicability” since it is not applicable to this EAL.
Example Emergency Action Levels: (1 or 2 or 3) (1) A SECURITY CONDITION that does not involve a HOSTILE ACTION as reported by the (site-specific security shift supervision). (2) Notification of a credible security threat directed at the site. (3) A validated notification from the NRC providing information of an aircraft threat.	**Emergency Action Levels:** (1 or 2) 1. Confirmed SECURITY CONDITION or threat. 1) A SECURITY CONDITION that does not involve a HOSTILE ACTION as reported by the Security Shift Supervisor. OR 2) Notification of a CREDIBLE SECURITY THREAT directed at the site.	• Removed "Example" from Emergency Action Levels and added applicable numbered EALs. • Deleted reference to aircraft threat.
Basis: This IC addresses events that pose a threat to plant personnel or the equipment necessary to maintain cooling of spent fuel, and thus represent a potential degradation in the level of plant safety. Security events which do not meet one of these EALs are adequately addressed by the requirements of 10 CFR § 73.71 or 10 CFR § 50.72. Security events assessed as HOSTILE ACTIONS are classifiable under IC PD-HA1. Timely and accurate communications between Security Shift Supervision and the Control Room is essential	**Basis:** This IC addresses events that pose a threat to plant personnel or spent fuel and thus represent a potential degradation in the level of plant safety. Security events which do not meet one of these EALs are adequately addressed by the requirements of 10 CFR § 73.71 or 10 CFR § 50.72. Security events assessed as HOSTILE ACTIONS are classifiable under IC PD-HA1. Timely and accurate communications between Security Shift Supervision and the ISFSI Shift Supervisor/Emergency Coordinator are essential for proper classification of a security-related event. Classification of these events will initiate appropriate threat-related notifications to plant personnel and Off Site Response	• Deleted reference to communicating with the Control Room and referenced communicating with the ISFSI Shift Supervisor/Emergency Coordinator. • Deleted wording associated with aircraft threats.

for proper classification of a security-related event. Classification of these events will initiate appropriate threat-related notifications to plant personnel and OROs. Security plans and terminology are based on the guidance provided by NEI 03-12, Template for the Security Plan, Training and Qualification Plan, Safeguards Contingency Plan [and Independent Spent Fuel Storage Installation Security Program]. EAL #1 references (site-specific security shift supervision) because these are the individuals trained to confirm that a security event is occurring or has occurred. Training on security event confirmation and classification is controlled due to the nature of Safeguards and 10 CFR § 2.39 information. EAL #2 addresses the receipt of a credible security threat. The credibility of the threat is assessed in accordance with (site-specific procedure). EAL #3 addresses the threat from the impact of an aircraft on the plant. The NRC Headquarters Operations Officer (HOO) will communicate to the licensee if the threat involves an aircraft. The status and size of the plane may also be provided by NORAD through the NRC. Validation of the threat is performed in accordance with (site-specific procedure). Emergency plans and implementing procedures are public documents; therefore, EALs should not incorporate Security-sensitive information. This includes information that may be advantageous to a potential adversary, such as the particulars concerning a specific threat or threat location. Security-sensitive information	Organizations. Security plans and terminology are based on the guidance provided by NEI 03-12, Template for the Security Plan, Training and Qualification Plan, Safeguards Contingency Plan [and Independent Spent Fuel Storage Installation Security Program]. EAL #1 references the Security Shift Supervisor because these are the individuals trained to confirm that a security event is occurring or has occurred. Training on security event confirmation and classification is controlled due to the nature of Safeguards and 10 CFR § 2.39 information. EAL #2 addresses the receipt of a CREDIBLE SECURITY THREAT. The credibility of the threat is assessed in accordance with Security procedures. Emergency plans and implementing procedures are public documents; therefore, EALs should not incorporate Security-sensitive information. This includes information that may be advantageous to a potential adversary, such as the particulars concerning a specific threat or threat location. Security-sensitive information should be contained in non-public documents such as the Security Plan. Escalation of the emergency classification level would be via Initiating Condition PD-HA1.	

should be contained in non-public documents such as the Security Plan. Escalation of the emergency classification level would be via IC PD-HA1.		
PD-HU3 **ECL:** Notification of Unusual Event **Initiating Condition:** Other conditions exist which in the judgment of the Emergency Director warrant declaration of a (NO)UE. **Operating Mode Applicability:** Not Applicable	**PD-HU3** **ECL:** Unusual Event **Initiating Condition:** Other conditions exist which in the judgment of the Emergency Coordinator warrant declaration of an UNUSUAL EVENT (UE).	• Use of Unusual Event instead of Notification of Unusual Event. Use is consistent with present EAL matrix and agrees in meaning and intent with NEI 99-01, Rev 6. • Used site specific title of Emergency Coordinator in lieu of Emergency Director. • Deleted “Operating Mode Applicability” since it is not applicable to this EAL.
Example Emergency Action Levels: (1) Other conditions exist which in the judgment of the Emergency Director indicate that events are in progress or have occurred which indicate a potential degradation of the level of safety of the plant or indicate a security threat to facility protection has been initiated. No releases of radioactive material requiring offsite response or monitoring are expected unless further degradation of safety systems occurs.	**Emergency Action Levels:** 1) Other conditions exist which in the judgment of the Emergency Coordinator indicate that events are in progress or have occurred which indicate a potential degradation of the level of safety of the ISFSI or indicate a security threat to facility protection has been initiated. No releases of radioactive material requiring offsite response or monitoring are expected unless further degradation of safety systems occurs.	• Removed "Example" from Emergency Action Levels. • Used site specific title of Emergency Coordinator in lieu of Emergency Director • Reworded to make EAL specific to CR-3 ISFSI facility.
Basis: This IC addresses unanticipated conditions not addressed explicitly elsewhere but that warrant declaration of an emergency because conditions exist which are believed by the Emergency Director to fall under the emergency classification level description for a NOUE.	**Basis:** This IC addresses unanticipated conditions not addressed explicitly elsewhere but that warrant declaration of an emergency because conditions exist which are believed by the Emergency Coordinator to fall under the emergency classification level description for a UE.	• Used site specific title of Emergency Coordinator in lieu of Emergency Director • Use of Unusual Event instead of Notification of Unusual Event. Use is consistent with present EAL matrix and agrees in meaning and intent with NEI 99-01, Rev 6.

PD-HA-1 **ECL:** Alert **Initiating Condition:** HOSTILE ACTION within the OWNER CONTROLLED AREA or airborne attack threat within 30 minutes. **Operating Mode Applicability:** Not Applicable	**PD-HA-1** **ECL:** Alert **Initiating Condition:** HOSTILE ACTION is occurring or has occurred.	• Changed Initiating Condition wording. • Deleted reference to airborne threat • Deleted “Operating Mode Applicability” since it is not applicable to this EAL.
Example Emergency Action Levels: (1 or 2) (1) A HOSTILE ACTION is occurring or has occurred within the OWNER CONTROLLED AREA as reported by the (site-specific security shift supervision). (2) A validated notification from NRC of an aircraft attack threat within 30 minutes of the site.	**Emergency Action Levels:** 1) HOSTILE ACTION is occurring or has occurred as reported by the Security Shift Supervisor.	• Removed "Example" from Emergency Action Levels. • Changed EAL wording to be specific for CR-3 ISFSI. • Deleted wording associated with aircraft threats.
Basis: This IC addresses the occurrence of a HOSTILE ACTION within the OWNER CONTROLLED AREA or notification of an aircraft attack threat. This event will require rapid response and assistance due to the possibility of the attack progressing to the PROTECTED AREA, or the need to prepare the plant and staff for a potential aircraft impact. Timely and accurate communications between Security Shift Supervision and the Control Room is essential for proper classification of a security-related event.	**Basis:** This IC addresses the occurrence of a HOSTILE ACTION. Timely and accurate communications between Security Shift Supervision and the ISFSI Shift Supervisor/Emergency Coordinator are essential for proper classification of a security-related event. As time and conditions allow, these events require a heightened state of readiness by the plant staff and implementation of onsite protective measures (e.g., evacuation or sheltering). The ALERT declaration will also heighten the awareness of Offsite Response Organizations, allowing them to be better prepared should it be necessary to consider further actions. This IC does not apply to incidents that are accidental events, acts of civil	• Changed wording to reflect CR-3 ISFSI EAL wording. • Deleted wording associated with aircraft threats. • Deleted reference to communicating with the Control Room and referenced communicating with the ISFSI Shift Supervisor/Emergency Coordinator. • Deleted example EALs.

As time and conditions allow, these events require a heightened state of readiness by the plant staff and implementation of onsite protective measures (e.g., evacuation, dispersal or sheltering). The Alert declaration will also heighten the awareness of Offsite Response Organizations, allowing them to be better prepared should it be necessary to consider further actions. This IC does not apply to incidents that are accidental events, acts of civil disobedience, or otherwise are not a HOSTILE ACTION perpetrated by a HOSTILE FORCE. Examples include the crash of a small aircraft, shots from hunters, physical disputes between employees, etc. Reporting of these types of events is adequately addressed by other EALs, or the requirements of 10 CFR § 73.71 or 10 CFR § 50.72. EAL #1 is applicable for any HOSTILE ACTION occurring, or that has occurred, in the OWNER CONTROLLED AREA. This includes any action directed against an ISFSI that is located within the OWNER CONTROLLED AREA. EAL #2 addresses the threat from the impact of an aircraft on the plant, and the anticipated arrival time is within 30 minutes. The intent of this EAL is to ensure that threat-related notifications are made in a timely manner so that plant personnel and OROs are in a heightened state of readiness. This EAL is met when the threat-related information has been validated in accordance with (site-specific procedure). The NRC Headquarters Operations Officer (HOO) will communicate to the licensee if the threat involves an aircraft. The status and size of the plane	disobedience, or otherwise are not a HOSTILE ACTION perpetrated by a HOSTILE FORCE. Examples include the crash of a small aircraft, shots from hunters, physical disputes between employees, etc. Reporting of these types of events is adequately addressed by other EALs, or the requirements of 10 CFR § 73.71 or 10 CFR § 50.72. Emergency plans and implementing procedures are public documents; therefore, EALs should not incorporate Security-sensitive information. This includes information that may be advantageous to a potential adversary, such as the particulars concerning a specific threat or threat location. Security sensitive information should be contained in non-public documents such as the Security Plan.	

may be provided by NORAD through the NRC. In some cases, it may not be readily apparent if an aircraft impact within the OWNER CONTROLLED AREA was intentional (i.e., a HOSTILE ACTION). It is expected, although not certain, that notification by an appropriate Federal agency to the site would clarify this point. In this case, the appropriate federal agency is intended to be NORAD, FBI, FAA or NRC. The emergency declaration, including one based on other ICs/EALs, should not be unduly delayed while awaiting notification by a Federal agency. Emergency plans and implementing procedures are public documents; therefore, EALs should not incorporate Security-sensitive information. This includes information that may be advantageous to a potential adversary, such as the particulars concerning a specific threat or threat location. Security-sensitive information should be contained in non-public documents such as the Security Plan.		

PD-HA-3 **ECL:** Alert **Initiating Condition:** Other conditions exist which in the judgment of the Emergency Director warrant declaration of an Alert. **Operating Mode Applicability:** Not Applicable	**PD-HA-3** **ECL:** Alert **Initiating Condition:** Other conditions exist which in the judgment of the Emergency Coordinator warrant declaration of an ALERT.	• Used site specific title of Emergency Coordinator in lieu of Emergency Director. • Deleted “Operating Mode Applicability” since it is not applicable to this EAL.
Example Emergency Action Levels: (1) Other conditions exist which in the judgment of the Emergency Director indicate that events are in progress or have occurred which involve an actual or potential substantial degradation of the level of safety of the plant or a security event that involves probable life threatening risk to site personnel or damage to site equipment because of HOSTILE ACTION. Any releases are expected to be limited to small fractions of the EPA Protective Action Guideline exposure levels.	**Emergency Action Levels:** 1) Other conditions exist which in the judgment of the Emergency Coordinator indicate that events are in progress or have occurred which involve an actual or potential substantial degradation of the level of safety of the ISFSI or a security event that involves probable life threatening risk to site personnel or damage to ISFSI equipment because of HOSTILE ACTION. Any releases are expected to be limited to small fractions of the EPA Protective Action Guideline exposure levels.	• Removed "Example" from Emergency Action Levels. • Used site specific title of Emergency Coordinator in lieu of Emergency Director • Reworded to make EAL specific to CR-3 ISFSI facility.
Basis: This IC addresses unanticipated conditions not addressed explicitly elsewhere but that warrant declaration of an emergency because conditions exist which are believed by the Emergency Director to fall under the emergency classification level description for an Alert.	**Basis:** This IC addresses unanticipated conditions not addressed explicitly elsewhere but that warrant declaration of an emergency because conditions exist which are believed by the Emergency Coordinator to fall under the emergency classification level description for an ALERT.	• Used site specific title of Emergency Coordinator in lieu of Emergency Director

E-HU1 **ECL:** Notification of Unusual Event **Initiating Condition**: Damage to a loaded cask CONFINEMENT BOUNDARY. **Operating Mode Applicability:** All	**E-HU1** **ECL:** Unusual Event **Initiating Condition:** Damage to a Dry Shielded Canister CONFINEMENT BOUNDARY. **Mode Applicability:** All	• Use of Unusual Event instead of Notification of Unusual Event. Use is consistent with present EAL matrix and agrees in meaning and intent with NEI 99-01, Rev 6. • Used “Dry Shielded Canister” in place of loaded cask as this is the specific component name used for the CR3 ISFSI. • Removed reference to “Operating” Mode as it does not apply to a CR-3 ISFSI condition.
Example Emergency Action Levels: (1) Damage to a loaded cask CONFINEMENT BOUNDARY as indicated by an on-contact radiation reading greater than (2 times the site-specific cask specific technical specification allowable radiation level) on the surface of the spent fuel cask.	**Emergency Action Levels:** (1 or 2 or 3 or 4) Damage to a Dry Shielded Canister CONFINEMENT BOUNDARY as indicated by radiation readings greater than or equal to the following: 1) 1300 mR/hr (gamma +neutron) on the radial surface of the fuel transfer cask while in transit to the ISFSI Horizontal Storage Module (HSM). <u>OR</u> 2) 1050 mR/hr (gamma + neutron) on the HSM Front Bird Screen while stored in the HSM. <u>OR</u> 3) 4 mR/hr (gamma + neutron) HSM Outside Door while stored in the HSM. <u>OR</u> 4) 40 mR/hr (gamma + neutron) HSM End Shield Wall Exterior while stored in the HSM. NOTE: Radiation readings are taken at the locations prescribed by the Technical Specifications for the Standardized NUHOMS Horizontal Storage System (Amendment Number 14 to COC 1004).	• Removed "Example" from Emergency Action Levels and added applicable numbered EALs. • Provided site-specific radiation levels which conform to the recommended “2 times” the site-specific dry shielded canister technical specification allowable radiation level • Included “NOTE” to identify that the radiation levels referenced in the EAL are taken at the locations prescribed by the Technical Specifications for the Standardized NUHOMS Horizontal Storage System.

Basis: This IC addresses an event that results in damage to the CONFINEMENT BOUNDARY of a storage cask containing spent fuel. It applies to irradiated fuel that is licensed for dry storage beginning at the point that the loaded storage cask is sealed. The issues of concern are the creation of a potential or actual release path to the environment, degradation of one or more fuel assemblies due to environmental factors, and configuration changes which could cause challenges in removing the cask or fuel from storage. The existence of "damage" is determined by radiological survey. The technical specification multiple of "2 times", which is also used in Recognition Category A IC AU1, is used here to distinguish between non-emergency and emergency conditions. The emphasis for this classification is the degradation in the level of safety of the spent fuel cask and not the magnitude of the associated dose or dose rate. It is recognized that in the case of extreme damage to a loaded cask, the fact that the “on-contact” dose rate limit is exceeded may be determined based on measurement of a dose rate at some distance from the cask. Security-related events for ISFSIs are covered under ICs HU1 and HA1.	**Basis:** This IC addresses an event that results in damage to the CONFINEMENT BOUNDARY of a dry shielded canister containing spent fuel. It applies to irradiated fuel that is licensed for dry storage beginning at the point that the loaded storage canister is sealed. The issues of concern are the creation of a potential or actual release path to the environment, degradation of one or more fuel assemblies due to environmental factors, and configuration changes which could cause challenges in removing the canister or fuel from storage. The existence of “damage” is determined by radiological survey. NEI 99-01, Revision 6, November 2012, Development of Emergency Action Levels for Non-Passive Reactors, Section 8, Independent Spent Fuel Storage Installation (ISFSI) ICs/EALs recommends using “2 times” the site-specific cask specific technical specification allowable radiation level as the EAL. The technical specification multiple of “2 times” is used here to distinguish between non-emergency and emergency conditions. The emphasis for this classification is the degradation in the level of safety of the spent fuel cask and not the magnitude of the associated dose or dose rate. It is recognized that in the case of extreme damage to a loaded cask, the fact that the “on-contact” dose rate limit is exceeded may be determined based on measurement of a dose rate at some distance from the cask. The radiation levels listed in the CR3 specific EAL represent the site-specific Technical Specification radiation levels and comply with this recommendation. Security-related events for ISFSIs are covered under ICs PD-HU1 and PD-HA1. An UNUSUAL EVENT in this EAL is categorized on the basis of the occurrence of an event of sufficient magnitude that a loaded Dry Shielded Canister (DSC) CONFINEMENT BOUNDARY is damaged or violated while in transit or storage.	• Provided site-specific amplifying information related to the development of the radiation levels for the EAL. • Added information that the EAL is applicable when the DSC is in transit or storage.

	This EAL applies to emergency conditions affecting a spent fuel cask caused by an accident or natural phenomena. This EAL would be applicable at all times in all modes for a loaded spent fuel storage cask from the time the lid is installed, as the cask leaves the Spent Fuel Handling Building and during transport to the INDEPENDENT SPENT FUEL STORAGE INSTALLATION (ISFSI). The Transnuclear "Standardized NUHOMS System Technical Specifications" DRAFT Amendment 14 to COC 1004, Section 5.2.4 (Radiation Protection Program) and Section 5.4.2 (HSM or HSM-H Dose Rate Evaluation Program) contains radiation values for the cask that should not be exceeded. Keeping in line with NEI guidance that an Unusual Event is warranted for radiation conditions at a level of twice the Technical Specification value, the values chosen for EAL E-HU1 represents these values. The "Note" in the EAL provides guidance on where the radiation readings are to be taken when evaluating this EAL.	

DUKE ENERGY FLORIDA, INC

CRYSTAL RIVER UNIT 3

DOCKET NUMBERS 50 - 302 AND 72-1035/ LICENSE NUMBER DPR - 72

LICENSE AMENDMENT REQUEST #322, REVISION 0, ISFSI-ONLY EMERGENCY PLAN, DRAFT REVISION A, AND ISFSI-ONLY EMERGENCY ACTION LEVEL BASES MANUAL, DRAFT REVISION A

ENCLOSURE 5

SUPPORTING EVALUATIONS AND CALCULATIONS

Systems	WD
Calc. Sub-Type	-
Priority Code	3
Quality Class	Non-Safety Related

NUCLEAR GENERATION GROUP

ANALYSIS / CALCULATION

N16-0001

(Calculation #)

Source Term Curie to Unrestricted Area Dose Rate Conversion Methodology

(Title including structures, systems, components)

☐ BNP UNIT _____

☒ CR3 ☐ HNP ☐ RNP ☐ NES ☐ ALL

APPROVAL ☒ Electronically Approved

Rev	Prepared By	Reviewed By	Supervisor
0	Signature *esign*	Signature *esign*	Signature *esign*
	Name Peter Ezzell	Name Tom Worthington	Name Craig Miller
	Date 5/12/16	Date 5/12/16	Date 5/12/16

(For Vendor Calculations)

Vendor N/A Vendor Document No. N/A

Owner's Review By N/A Date N/A

List Of Effective Pages

Page	Revision	Page	Revision
Cover	0		
i	0		
ii	0		
iii	0		
iv	0		
v	0		
vi	0		
1-6	0		

Attachments

Number	Revision	Number of Pages
1	0	4
2	0	4
3	0	1

Amendments

Letter	Revision	Number of Pages

Table of Contents

Revision Summary

Revision #	Revision Summary (Include brief description of revision and a list of EC's and other modifications incorporated into revision)
0	Revision 0 develops methods which can be used to determine curie limits for various source terms (filters, resins, waste containers) in order to assure that if the sources were dispersed that a predefined dose rate, or dose, is not exceeded.

Document Indexing Table

Document Type	Document Number	Function	Relationship to this Calculation	Action
e.g., CALC, DWG, PROCEDURE, TAG, SOFTWARE	e.g., calculation number, equipment tag number, procedure number, software name and version	IN for design inputs; OUT for affected documents	e.g., design input, assumption basis, reference, document affected by results	Specify if document index to be added or deleted by Document Services or Configuration Management (e.g., CM ADD, DS DELETE)

Record of Lead Review

Document N16-0001 **Revision** 0

The signature below of the Lead Reviewer records that:

- the review indicated below has been performed by the Lead Reviewer;
- appropriate reviews were performed and errors/deficiencies (for all reviews performed) have been resolved and these records are included in the design package;
- the review was performed in accordance with EGR0003.

☒ **Design Verification Review** ☐ **Engineering Review** ☐ **Owner's Review**

☒ Design Review
☐ Alternate Calculation
☐ Qualification Testing

☐ **Special Engineering Review**_____

☐ YES ☐ N/A **Other Records are attached.**

Tom Worthington	Design Engineering	**5/10/16**
Lead Reviewer (print/sign)	**Discipline**	**Date**

Item No.	Deficiency	Resolution
1	Attachment 2, Page 2: Pm-145 Dose Factor should be 8.23e-9, not 8.28e-9	Corrected
2	Three typos as indicated on markup in "Body of Calculation"	Corrected
3	Attachment 3, ODCM Critical Organ Method. Cannot derive organ dose with information provided in table. A time unit is missing.	Clarified. Added a column to include 3.17e-8 years/s, and added an explanation of the calculation under the table.
4	Attachment 3, discussion about using 1 mrem TEDE should show how this affects the Source curies.	Added text to explain how the source curies would be scaled up by the ratio of the 1/0.015.

Record of Interdisciplinary Reviews

PART I — DESIGN ASSUMPTION / INPUT REVIEW: APPLICABLE ☐ Yes ☒ No

The following organizations have reviewed and concur with the design assumptions and inputs used in this calculation:

Systems Engineering

Name	Signature	Date

Operations

Name	Signature	Date

Other
Radiation Protection and Chemistry

Name	Signature	Date

PART II — RESULTS REVIEW:

The following organizations are aware of the impact of the results of this calculation (on designs, programs and procedures):

Systems Engineering
☐ Yes ☒ NO

Name	Signature	Date

Comments:

Operations
☐ Yes ☒ NO

Name	Signature	Date

Comments:

Other **Emergency Preparedness**

Name	Signature	Date
Bryan Ferguson	*esign*	

Comments: Liquid releases were not included in calculation even though the UE initiating condition for radiological events includes liquids. Resolved by noting that liquids are not within the scope of the calculation, but to be covered in the LAR.

Other

Name	Signature	Date

Comments: None

Purpose

The purpose of this calculation is to develop a method for establishing curie limits for waste containers, or other sources of collected radioactive materials, which have the potential to be atmospherically dispersed, given a specific site boundary dose rate or dose limit.

Body Of Calculation

1. Considerations in Developing a Methodology

Emergency and design basis accident dose assessment methods generally employ dose factors and dose terminology consistent with or taken from Federal Guidance Reports 11 and 12 (FGR11 & FGR12, Ref. R1 and R2), and 10 CFR 20 (Ref. R3). These documents and standards, issued in the late 1980s and early 1990s, are based on recommendations of the International Commission on Radiological Protection (ICRP) and replace the much older total body and critical organ approach (ICRP 2, 1959) with the effective dose equivalent, which uses a weighted sum of doses to irradiated organs and tissues.

The Offsite Dose Calculation Manual (ODCM, Ref. R7), which dictates the methods used for calculating dose and dose rate for non-emergency conditions (normal operational plant effluents), still uses the older total body and critical organ approach. The key regulation upon which the ODCM is based, 10 CFR 50, Appendix I, has not been revised to align its dosimetry basis with the radiation protection regulations in 10 CFR 20.

> Note: The NRC recognizes there would be benefit in better aligning the regulations (e.g 10 CFR 50, Appendix I) which govern effluent dose assessments for radioactive effluents with 10 CFR 20 and the most recent terminology and dose methodology (e.g. ICRP 103), and has issued an advance notice of proposed rulemaking (Ref. R13) on this subject.

Emergency classification levels (ECL) Alert, Site Area Emergency, and General Emergency all have dose based initiating conditions (ICs), starting at 10 mrem TEDE for Alert and going up by a factor of 10 for each subsequent emergency classification (Ref. R5). The Unusual Event (UE) radiological initiating condition for gaseous releases is not based on a dose threshold, but on a dose *rate* which is in turn based on the limits of the ODCM - a release of gaseous activity greater than 2 times the ODCM limit for 60 minutes or longer. The basis for this has been a count rate or vent concentration alarm set-point on the effluent monitor which correlated to a dose rate equal to the ODCM noble gas dose rate limit of 500 mrem/y total body (Ref. ODCM Specification 2.7.a).

By using a limit which was implemented in a way to cause an alarm, rather than a dose limit which would be consistent with the other emergency classification EALs, it makes it possible to receive early warning that conditions in the plant are such that a more serious event is potentially imminent or that there has been a loss of radioactive material control, both of which are important considerations for an operating plant, and to track the release so that a Unusual Event could be determined real time, instead of after the fact.

When all of the spent fuel has been moved from the pools to dry storage this ODCM dose rate limit will not be a useful basis for the UE initiating condition, as there will be no source of noble gases remaining within the plant. Industry guidance (Ref. R5) does not explicitly address an emergency classification scheme for this plant condition, only the use of an Unusual Event and Alert for a permanently defueled plant with spent fuel in the pools.

For a permanently defueled plant with no fuel in the pools, it is very unlikely that the initiating conditions for Unusual Event or Alert would occur given the programmatic controls (radiation protection, fire protection, safety, chemical control, etc) which will continue until license termination.

Nevertheless, if it is desirable to impose additional administrative controls to further reduce the potential release of radioactive materials, then one way to do this is to limit the amount of dispersible radioactive material in one location so that it is not reasonably possible to reach the UE and Alert initiating conditions should this material become atmospherically dispersed.

As the noble gas effluent monitor and its alarm set-point can no longer be used as a basis for entering a UE, consideration has been given to another ODCM dose rate limit (Ref. ODCM Specification 2.7.b), which covers the releases of other types of radionuclides, tritium and particulates, as a threshold for controlling quantities of radioactive materials.

By imposing a waste accumulation curie limit which equates to 2 times the dose rate limit for tritium and particulates (i.e. 2 times the limit of ODCM Specification 2.b, or 3000 mrem/y to any organ) it can be concluded that the radiological conditions for an Unusual Event will not occur and that the more important dose threshold of 10 mrem TEDE for an Alert cannot be reached.

2. Methodology

To develop the curie limit, samples of the more highly activated plant components should be obtained and analyzed so that the relative concentrations of the major radionuclides can be used in the curie limit calculation. Analysis should consider beta and alpha emitters as well as gamma emitters, as it is expected that the beta emitter, Ni-63, will dominate in later years in activated steel components, and some alpha emitters in activated concrete, such as Pu-239, may also become significant in later years.

In the absence of plant specific data, this calculation will rely on the isotopic distributions given in NUREG/CR-3474 (Ref. R4). Those radionuclides which are shown having "<" values were included using the value listed as if measured. The distributions given in NUREG/CR-3474 are expected to be biased towards longer-lived radionuclides as they were based on 30 effective full power years (EFPYs), while CR3's run time was approximately 23 EFPYs (Ref. R15).

Release fractions by isotope were used in this calculation with no regard for packaging and form as discussed in NUREG-1140 (Ref. 10). In practice, packaging and form should be considered.

The long term atmospheric dispersion factor, X/Q, for normal effluent releases was used because the Unusual Event initiating condition was defined in terms of ODCM limits and calculations used to assess compliance with those limits use a non-accident dispersion factor. If instead, a dose limit is used which is a fraction of the 10 mrem TEDE Alert threshold and 15 mrem ODCM organ dose limit, it would also be appropriate to use the long term X/Q.

One calculation is done using the PWR shroud data as representative of highly activated steel and one calculation was done using PWR bioshield data (10 cm depth) as representative of activated concrete as the activation concentrations and distributions in these two materials are markedly different.

> NOTE: In each case, steel or concrete, the relative values of the radionuclides are generally consistent, i.e. the relative concentrations are similar whether using 10 cm or 24 cm for concrete, or whether using the shroud or vessel wall for steel. The variation shown in the NUREG/CR-3474 tables may be less than the variability between the values in the tables and CR3's actual component data because of differences in impurity concentration, EFPY, and reactor design.

A screening calculation using the inhalation dose conversion factors of Federal Guidance Report 11 (FGR11) and the isotopic mixes from NUREG/CR-3474 is performed to determine the dose significant radionuclides. FGR11 provides a comprehensive list of radionuclide dose factors which includes all (except noble gases & Nb-92m/Nb-92) of the radionuclides identified in NUREG-/CR-3474, that Regulatory Guide 1.109 (Ref. R12, used by the ODCM) and NUREG-0172 (Ref. R9) do not.

The significant radionuclides from the screened list will then be used in a dose rate calculation consistent with the methods of the ODCM to arrive at organ dose rates (mrem/y) for a given source strength (curies/second).

The ratio of source strength (in curies) to maximum organ dose rate is used to arrive at curie limits which equates to 3000 mrem/y for 60 minutes.

A similar method can be used to determine a curie limit if it is determined that a dose based criteria, such as 1 mrem TEDE, is preferred over the dose rate criteria. In this case the critical organ dose method of the ODCM would not be used - dose (not dose rate) would be calculated using dose factors consistent with FGR11.

3. Design Inputs

The values given in Table 3.1 represent plant specific values used in this calculation, or standard values taken from accepted references.

Table 3.1

No.	Parameters	Value(s)	Source & Notes
1	Isotopic mix and relative concentration for activated steel.	Ref. R4	Ref R4 Table 5.1, Shroud except for Eu-152 which is taken from Table 5.1, Thermal Pad
2	Isotopic mix and relative concentration for activated Concrete	Ref. R4	Ref R4 Table 5.4 Bioshield (10 cm)
3	Site Boundary X/Q	2.5E-6 sec/m^3	Ref. R7
4	Breathing Rate	3700 m^3/y	Ref. R7
5	Release Fractions	Ref R10, R13, & R6.	Ref. R10, Table 13 is the primary source. Ref. R13 and R6 also provide release fractions.
6	Inhalation Dose Factors	Ref. R12 & R9	Ref. R12, Table E-9 or Ref. R9, Table 6
7	Internal Exposure dose factors	Ref. R1	Ref. R1, Table 2.1, *Effective* column
8	Half-Lives	Ref. R2	Ref. R2, Table A.1

4. Assumptions

Radioactive materials which are combustible or flammable, or otherwise considered dispersible offsite, will have an isotopic mix which is similar to one of the major activated components.

Release fractions are assumed on an isotope by isotope basis with no regard for packaging and form. In actual practice, lower release fractions may be more applicable (e.g. Mixed corrosion products or irradiated solid noncombustible as discussed in NUREG-1140).

Most of the activity will come from activated components although there will be significant surface contamination on many primary components. Source term characterization at the time of dismantlement should encompass both types of activity.

The hypothetical release will instantaneously go from zero to a rate which equates to 3000 mrem/y, stay at that rate for 60 minutes, then go to zero instantly. This yields conservative curie limits as any release would likely take some finite amount of time to reach 3000 mrem/y, then for the period of 60 minutes the release rate would likely be greater than 3000 mrem/y in order to be strong enough to last for this duration, then take some finite period of time to subside.

5. Detailed Calculation

5.1 Screening calculations are performed by spreadsheet (Attachments 1, Step I) and use the values given in Design Inputs in order to identify the dose significant radionuclides.

5.2 Inhalation dose rate (mrem/y) is calculated using a relationship consistent with ODCM pre-release dose rate calculation 1.3-1 (Ref. R7), which is based on formulas from NUREG-0133, Section 5.2.11 (Ref. 8). This is detailed in Attachment 1.

5.3 Dose factors for the screening calculation are taken from FGR11 (Ref. R1) as they are more current and complete.

5.4 Key radionuclides at 30 years are identified for use in the organ dose rate calculation. The key radionuclides are those, which when totaled, contribute to more than 90% of the dose rate.

Note: 30 years was used in order to illustrate a calculation having more than one key radionuclide identified, as Ni-63 was the sole dominating radionuclide at 60 years for the shroud. 60 years is consistent with the current scheduled time frame for dismantlement. In a real scenario, sample results obtained when the site is reactivated would be used in the screening calculation.

5.5 The key radionuclides identified in the screening calculation are used to perform the organ dose rate calculation. The organ dose rate calculations, based on the methods of the ODCM, are detailed in Attachment 2, Step II section of spreadsheet.

Note: If dose factors are not listed in Regulatory Guide 1.109, Table E-9, then use NUREG-0172, Table 6, which contains a more complete listing.

5.6 The highest organ dose rate is used to derive the source curie limit. This is done by determining the curies which would be released over 60 minutes at the dose rate limit, then adjusting the curies for each radionuclide by the release fraction to obtain the source curie. See Attachment 2, Step III section of spreadsheet.

Conclusions/Results

There are no binding curie limits derived in this calculation - curie limits are example results. Actual curie limits will be establish at the time work is planned or started at which point samples can be obtained and analyzed in order to identify the radionuclides (alpha, beta, and gamma emitters) which should be screened.

Although the source terms used in this calculation are based on activation of major steel and concrete components that is not to imply that bulk steel or concrete components or waste containers containing only concrete or steel are subject to have their activity dispersed to the site boundary as neither is combustible in solid form. The decision as to which type of waste to apply the curie limits is not within the scope of this calculation, although it expected that limits would likely be applied to consumable materials which come into contact with debris or fine particles which results from the dismantlement of the more highly activated components, or removal of surface contamination from primary components, and which have some potential to combust or be dispersed. Therefore, judgment must also be exercised in the application of release fractions for different types of materials and radionuclide forms when performing calculations of this nature.

The screening spreadsheet (Attachment 1) which uses the shroud radionuclide distribution shows that at 60 years, the decay period which coincides with the current schedule for dismantlement, Ni-63 overwhelmingly dominates for highly activated steel components. For activated concrete, Eu-152, H-3, and Pu-239 are key contributors.

The curie limits derived using a dose rate of 3000 mrem/y for 60 minutes are conservative with respect to off-site dose. As the curie limits assure that 3000 mrem/y for 60 minutes cannot be exceeded, the actual organ dose would only be a fraction of a millirem and the total body dose (or TEDE) would be a fraction of the organ dose (Attachment 3).

The results of this calculation were compared to calculation N13-0003, Public Dose from a Radioactive Waste Event. The total activity modeled in N13-0003 was ~115 Ci, which is ~20% of the 612 curie limit based on 30 year decay of the shroud. The major dose and curie contributors in the radwaste calculation included Cs-134, Cs-137, Co-60 and Ni-63, although Cs-134 can now be neglected due to decay (2.1 y half-life). For the shroud, most of the dose rate was due to Ni-63. As the limiting organ dose factor for Cs-137 in the radwaste event is similar to the limiting organ dose factor for Ni-63 in the shroud calculation (2.5e-4 vs 2.2e-4 mrem/pCi), and the total activity is much lower in the radwaste event, it can be concluded that the dose *rate* from the radwaste event would be below the Unusual Event threshold, if determined using the methods of this calculation.

References

R1 EPA Federal Guidance Report No 11, "Limiting Values of Radionuclide Intake and Air Concentration and Dose Conversion Factors for Inhalation, Submersion, and Ingestion" (September 1988)

R2 EPA Federal Guidance Report No. 12, "External Exposure to Radionuclides in Air, Water, and Soil" (1993)

R3 10 CFR 20, "Standards for Protection Against Radiation"

R4 NUREG/CR-3474, "Long-Lived Activation Products in Reactor Materials" (August 1984)

R5 NEI-99-01,"Development of Emergency Action Levels for Non-Passive Reactors" (Nov. 2012)

R6 NUREG-1940, "RASCAL 4: Description of Models and Methods" (December 2012)

R7 CR3 Offsite Dose Calculation Manual, Rev 36 (September 2015)

R8 NUREG-0133, "Preparation of Radiological Effluent Technical Specifications for Nuclear Power Plants" (October 1987)

R9 NUREG-0172, "Age Specific Radiation Dose Commitment Factors for One-Year Chronic Intake" (Nov. 1977)

R10 NUREG-1140, "A Regulatory Analysis on Emergency Preparedness for Fuel Cycle and Other Radioactive Material Licensees" (August 1991)

R11 NUREG/BR-0150, "RTM-96, Response Technical Manual", Vol. 1, Rev. 4 (March 1996)

R12 Regulatory Guide 1.109, "Calculation of Annual Doses to Man From Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR 50, Appendix I" Revision 1 (October 1977)

R13 10 CFR 30, "Rules of General Applicability to Domestic Licensing of Byproduct Material," sections 30.32 and 30.72, Schedule C.

R14 Federal Register, Vol. 80, No. 85. Monday, May 4, 2015. Nuclear Regulatory Commission. Proposed Rules, Reactor Effluents, 25237-25247

R15 Crystal River Unit 3 Cycle 17 Fuel Cycle Design Report (86-9104802-000), Rev. 13 (2/18/2009)

Screening Calculation

This screening calculation identifies dose significant radionuclides. The model data which was used represents concentrations and distribution of radionuclides in two markedly different activated materials at shutdown. The starting list was decayed for various time periods in order to identify likely dominant radionuclides at various future times. If this screening approach is used at time of dismantlement, decay correction will likely not be needed as the time between sampling and analysis of various components and start of work should be negligible compared to time between shutdown and site reactivation.

The spreadsheet results demonstrate there is negligible contribution to dose rate (or dose) from most of the candidate radionuclides at any given time period. It also shows how some radionuclides become more dominant with time (e.g. Ni-63 in steel), or greatly diminish over time (e.g. Co-60)

These spreadsheets go out to 60 years which is approximately the time from shutdown to the time of dismantlement.

The screening spreadsheet which uses the PWR shroud radionuclide distribution shows that Co-60 and Ni-63 dominate at 30 years. The 9 year results are for 2018, the year in which all spent fuel is expected to be in dry storage, shows that Co-60 dominates.

Noble gases (Ar-39, Kr-81, Kr-85) were omitted from the screening spreadsheets because noble gas inhalation dose factors are not listed in Table 2.1 of FGR11 (noble gases contribute relatively little to inhalation dose). Although Ar-39 and Kr-85 are listed in NUREG-0172 (which supports the old critical organ approach of the ODCM) their maximum organ dose factors are approximately 5 orders of magnitude lower than dose factors for more dominant radionuclides, such as Ni-63, making them inconsequential. Neither Nb-92 or Nb-92m have an inhalation dose factor listed in FGR-11, Regulatory Guide 1.109, or NUREG-0172, which is why neither were included in the spreadsheet. The screening calculation used PWR shroud data as representative of activated steel, but Eu-152 had no listed activity for the shroud. Therefore, the Eu-152 activity for the Thermal Pad was used.

A column by column description of the calculation details are given in page 4 of this attachment.

STEP I - Screening Dose Rate for Key Radionuclides

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
Major	Shroud	Release	Half-Life			Breathing	Conversion	DCF	Inhalation	%	Inhalation	%	Inhalation	%	Inhalation	%
Activation	Shutdown	Fraction	Years	X/Q		Rate	mrem/Sv	Sv/Bq	mrem/y		mrem/y		mrem/y		mrem/y	
Nuclides	Ci/gm	gm/s		s/m3	uCi/Ci	m3/y	x Bq/uCi		No Decay		9y Decay		30y Decay		60y Decay	
H-3	1.00E-05	0.5	1.235E+01	2.5E-06	1.E+06	3700	3.7E+09	1.73E-11	2.96E-03	0.00	1.79E-03	0.00	5.50E-04	0.00	1.02E-04	0.00
C-14	2.50E-05	0.01	5.730E+03	2.5E-06	1.E+06	3700	3.7E+09	5.64E-10	4.83E-03	0.00	4.82E-03	0.01	4.81E-03	0.03	4.79E-03	0.07
Cl-36	5.10E-07	0.5	3.010E+05	2.5E-06	1.E+06	3700	3.7E+09	5.93E-09	5.18E-02	0.02	5.18E-02	0.05	5.17E-02	0.37	5.17E-02	0.73
Ca-41	4.70E-09	0.01	1.400E+05	2.5E-06	1.E+06	3700	3.7E+09	3.64E-10	5.86E-07	0.00	5.85E-07	0.00	5.85E-07	0.00	5.85E-07	0.00
Mn-53	3.20E-09	0.01	3.700E+06	2.5E-06	1.E+06	3700	3.7E+09	1.35E-10	1.48E-07	0.00	1.48E-07	0.00	1.48E-07	0.00	1.48E-07	0.00
Mn-54	6.50E-03	0.01	8.560E-01	2.5E-06	1.E+06	3700	3.7E+09	1.81E-09	4.03E+00	1.22	2.75E-03	0.00	1.13E-10	0.00	3.20E-21	0.00
Fe-55	**2.10E-01**	**0.01**	**2.700E+00**	**2.5E-06**	**1.E+06**	**3700**	**3.7E+09**	**7.26E-10**	**5.22E+01**	**15.75**	**5.18E+00**	**5.40**	2.36E-02	0.17	1.07E-05	0.00
Ni-59	1.10E-04	0.01	7.500E+04	2.5E-06	1.E+06	3700	3.7E+09	7.31E-10	2.75E-02	0.01	2.75E-02	0.03	2.75E-02	0.20	2.75E-02	0.39
Co-60	**1.30E-01**	**0.001**	**5.271E+00**	**2.5E-06**	**1.E+06**	**3700**	**3.7E+09**	**5.91E-08**	**2.63E+02**	**79.37**	**8.05E+01**	**83.98**	**5.09E+00**	**36.82**	9.85E-02	1.39
Ni-63	**1.80E-02**	**0.01**	**9.600E+01**	**2.5E-06**	**1.E+06**	**3700**	**3.7E+09**	**1.70E-09**	**1.05E+01**	**3.16**	**9.81E+00**	**10.24**	**8.43E+00**	**61.03**	**6.79E+00**	**95.73**
Zn-65	6.40E-04	0.01	6.680E-01	2.5E-06	1.E+06	3700	3.7E+09	5.51E-09	1.21E+00	0.36	1.06E-04	0.00	3.65E-14	0.00	1.10E-27	0.00
Se-79	6.10E-10	0.01	6.500E+04	2.5E-06	1.E+06	3700	3.7E+09	2.66E-09	5.55E-07	0.00	5.55E-07	0.00	5.55E-07	0.00	5.55E-07	0.00
Sr-90	2.00E-06	0.01	2.912E+01	2.5E-06	1.E+06	3700	3.7E+09	3.51E-07	2.40E-01	0.07	1.94E-01	0.20	1.18E-01	0.85	5.76E-02	0.81
Zr-93	1.10E-10	0.01	1.530E+06	2.5E-06	1.E+06	3700	3.7E+09	8.67E-08	3.26E-06	0.00	3.26E-06	0.00	3.26E-06	0.00	3.26E-06	0.00
Mo-93	9.40E-07	0.01	3.500E+03	2.5E-06	1.E+06	3700	3.7E+09	7.68E-09	2.47E-03	0.00	2.47E-03	0.00	2.46E-03	0.02	2.44E-03	0.03
Nb-94	4.00E-07	0.01	2.030E+04	2.5E-06	1.E+06	3700	3.7E+09	1.12E-07	1.53E-02	0.00	1.53E-02	0.02	1.53E-02	0.11	1.53E-02	0.22
Tc-99	1.30E-07	0.01	2.130E+05	2.5E-06	1.E+06	3700	3.7E+09	2.25E-09	1.00E-04	0.00	1.00E-04	0.00	1.00E-04	0.00	1.00E-04	0.00
Ag-108m	1.00E-07	0.01	1.270E+02	2.5E-06	1.E+06	3700	3.7E+09	7.66E-08	2.62E-03	0.00	2.50E-03	0.00	2.23E-03	0.02	1.89E-03	0.03
Sn-121m	4.80E-09	0.01	5.500E+01	2.5E-06	1.E+06	3700	3.7E+09	3.11E-09	5.11E-06	0.00	4.56E-06	0.00	3.50E-06	0.00	2.40E-06	0.00
I-129	6.00E-13	0.5	1.570E+07	2.5E-06	1.E+06	3700	3.7E+09	4.69E-08	4.82E-07	0.00	4.82E-07	0.00	4.82E-07	0.00	4.82E-07	0.00
Ba-133	3.00E-06	0.01	1.074E+01	2.5E-06	1.E+06	3700	3.7E+09	2.11E-09	2.17E-03	0.00	1.21E-03	0.00	3.13E-04	0.00	4.51E-05	0.00
Cs-134	7.00E-06	0.01	2.062E+00	2.5E-06	1.E+06	3700	3.7E+09	1.25E-08	2.99E-02	0.01	1.45E-03	0.00	1.25E-06	0.00	5.21E-11	0.00
Cs-135	4.00E-11	0.01	2.300E+06	2.5E-06	1.E+06	3700	3.7E+09	1.23E-09	1.68E-08	0.00	1.68E-08	0.00	1.68E-08	0.00	1.68E-08	0.00
Cs-137	2.00E-06	0.01	3.000E+01	2.5E-06	1.E+06	3700	3.7E+09	8.63E-09	5.91E-03	0.00	4.80E-03	0.01	2.95E-03	0.02	1.48E-03	0.02
Pm-145	8.90E-10	0.01	1.770E+01	2.5E-06	1.E+06	3700	3.7E+09	8.23E-09	2.51E-06	0.00	1.76E-06	0.00	7.74E-07	0.00	2.39E-07	0.00
Sm-146	1.00E-16	0.01	1.030E+08	2.5E-06	1.E+06	3700	3.7E+09	2.23E-05	7.63E-10	0.00	7.63E-10	0.00	7.63E-10	0.00	7.63E-10	0.00
Sm-151	4.60E-09	0.01	9.000E+01	2.5E-06	1.E+06	3700	3.7E+09	8.10E-09	1.28E-05	0.00	1.19E-05	0.00	1.01E-05	0.00	8.03E-06	0.00
Eu-152	1.70E-07	0.01	1.333E+01	2.5E-06	1.E+06	3700	3.7E+09	5.97E-08	3.47E-03	0.00	2.18E-03	0.00	7.30E-04	0.01	1.53E-04	0.00
Eu-154	5.60E-07	0.01	8.800E+00	2.5E-06	1.E+06	3700	3.7E+09	7.73E-08	1.48E-02	0.00	7.29E-03	0.01	1.39E-03	0.01	1.31E-04	0.00
Eu-155	4.10E-07	0.01	4.960E+00	2.5E-06	1.E+06	3700	3.7E+09	1.12E-08	1.57E-03	0.00	4.47E-04	0.00	2.37E-05	0.00	3.59E-07	0.00
Tb-158	1.90E-09	0.01	1.500E+02	2.5E-06	1.E+06	3700	3.7E+09	6.91E-08	4.49E-05	0.00	4.31E-05	0.00	3.91E-05	0.00	3.41E-05	0.00
Ho-166m	1.60E-07	0.01	1.200E+03	2.5E-06	1.E+06	3700	3.7E+09	2.09E-07	1.14E-02	0.00	1.14E-02	0.01	1.12E-02	0.08	1.11E-02	0.16
Hf-178m	4.30E-08	0.01	3.100E+01	2.5E-06	1.E+06	3700	3.7E+09	6.65E-07	9.79E-03	0.00	8.00E-03	0.01	5.00E-03	0.04	2.56E-03	0.04
Pb-205	1.80E-12	0.01	1.430E+07	2.5E-06	1.E+06	3700	3.7E+09	1.06E-09	6.53E-10	0.00	6.53E-10	0.00	6.53E-10	0.00	6.53E-10	0.00
U-233	3.60E-10	0.001	1.585E+05	2.5E-06	1.E+06	3700	3.7E+09	3.66E-05	4.51E-04	0.00	4.51E-04	0.00	4.51E-04	0.00	4.51E-04	0.01
Pu-239	7.00E-09	0.001	2.407E+04	2.5E-06	1.E+06	3700	3.7E+09	1.16E-04	2.78E-02	0.01	2.78E-02	0.03	2.78E-02	0.20	2.77E-02	0.39
Totals >	0.365								331.29	100.0	95.874	100.0	13.817	100.0	7.094	100.0

STEP I - Screening Dose Rate for Key Radionuclides

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
Major	BioShield	Release	Half-Life			Breathing	Conversion	DCF	Inhalation	%	Inhalation	%	Inhalation	%	Inhalation	%
Activation	Shutdown	Fraction	Years	X/Q		Rate	mrem/Sv	Sv/Bq	mrem/y		mrem/y		mrem/y		mrem/y	
Nuclides	Ci/gm	gm/s		s/m3	uCi/Ci	m3/y	x Bq/uCi		No Decay		9y Decay		30y Decay		60y Decay	
H-3	**8.30E-06**	**0.5**	**1.235E+01**	**2.5E-06**	**1.E+06**	**3700**	**3.7E+09**	**1.730E-11**	**2.46E-03**	**17.75**	**1.48E-03**	**19.53**	**4.56E-04**	**19.02**	**8.47E-05**	**14.91**
C-14	2.80E-09	0.01	5.730E+03	2.5E-06	1.E+06	3700	3.7E+09	5.640E-10	5.40E-07	0.00	5.40E-07	0.01	5.39E-07	0.02	5.37E-07	0.09
Cl-36	**1.50E-10**	**0.5**	**3.010E+05**	**2.5E-06**	**1.E+06**	**3700**	**3.7E+09**	**5.930E-09**	**1.52E-05**	**0.11**	**1.52E-05**	**0.20**	**1.52E-05**	**0.63**	**1.52E-05**	**2.68**
Ca-41	1.90E-08	0.01	1.400E+05	2.5E-06	1.E+06	3700	3.7E+09	3.640E-10	2.37E-06	0.02	2.37E-06	0.03	2.37E-06	0.10	2.37E-06	0.42
Mn-53	7.40E-15	0.01	3.700E+06	2.5E-06	1.E+06	3700	3.7E+09	1.350E-10	3.42E-13	0.00	3.42E-13	0.00	3.42E-13	0.00	3.42E-13	0.00
Mn-54	1.20E-08	0.01	8.560E-01	2.5E-06	1.E+06	3700	3.7E+09	1.810E-09	7.43E-06	0.05	5.08E-09	0.00	2.09E-16	0.00	5.90E-27	0.00
Fe-55	**4.70E-06**	**0.01**	**2.700E+00**	**2.5E-06**	**1.E+06**	**3700**	**3.7E+09**	**7.260E-10**	**1.17E-03**	**8.44**	**1.16E-04**	**1.53**	5.28E-07	0.02	2.39E-10	0.00
Ni-59	2.60E-11	0.01	7.500E+04	2.5E-06	1.E+06	3700	3.7E+09	7.310E-10	6.50E-09	0.00	6.50E-09	0.00	6.50E-09	0.00	6.50E-09	0.00
Co-60	**3.60E-07**	**0.001**	**5.271E+00**	**2.5E-06**	**1.E+06**	**3700**	**3.7E+09**	**5.910E-08**	**7.28E-04**	**5.26**	**2.23E-04**	**2.94**	1.41E-05	0.59	2.73E-07	0.05
Ni-63	3.30E-09	0.01	9.600E+01	2.5E-06	1.E+06	3700	3.7E+09	1.700E-09	1.92E-06	0.01	1.80E-06	0.02	1.55E-06	0.06	1.24E-06	0.22
Zn-65	2.50E-09	0.01	6.680E-01	2.5E-06	1.E+06	3700	3.7E+09	5.510E-09	4.71E-06	0.03	4.15E-10	0.00	1.43E-19	0.00	4.31E-33	0.00
Se-79	2.80E-15	0.01	6.500E+04	2.5E-06	1.E+06	3700	3.7E+09	2.660E-09	2.55E-12	0.00	2.55E-12	0.00	2.55E-12	0.00	2.55E-12	0.00
Sr-90	7.30E-11	0.01	2.912E+01	2.5E-06	1.E+06	3700	3.7E+09	3.510E-07	8.77E-06	0.06	7.08E-06	0.09	4.29E-06	0.18	2.10E-06	0.37
Zr-93	2.90E-14	0.01	1.530E+06	2.5E-06	1.E+06	3700	3.7E+09	8.670E-08	8.61E-10	0.00	8.61E-10	0.00	8.61E-10	0.00	8.60E-10	0.00
Mo-93	5.60E-13	0.01	3.500E+03	2.5E-06	1.E+06	3700	3.7E+09	7.680E-09	1.47E-09	0.00	1.47E-09	0.00	1.46E-09	0.00	1.45E-09	0.00
Nb-94	5.30E-12	0.01	2.030E+04	2.5E-06	1.E+06	3700	3.7E+09	1.120E-07	2.03E-07	0.00	2.03E-07	0.00	2.03E-07	0.01	2.03E-07	0.04
Tc-99	1.40E-13	0.01	2.130E+05	2.5E-06	1.E+06	3700	3.7E+09	2.250E-09	1.08E-10	0.00	1.08E-10	0.00	1.08E-10	0.00	1.08E-10	0.00
Ag-108m	3.20E-12	0.01	1.270E+02	2.5E-06	1.E+06	3700	3.7E+09	7.660E-08	8.39E-08	0.00	7.99E-08	0.00	7.12E-08	0.00	6.05E-08	0.01
Sn-121m	5.20E-13	0.01	5.500E+01	2.5E-06	1.E+06	3700	3.7E+09	3.110E-09	5.53E-10	0.00	4.94E-10	0.00	3.79E-10	0.00	2.60E-10	0.00
I-129	2.20E-17	0.5	1.570E+07	2.5E-06	1.E+06	3700	3.7E+09	4.690E-08	1.77E-11	0.00	1.77E-11	0.00	1.77E-11	0.00	1.77E-11	0.00
Ba-133	2.00E-09	0.01	1.074E+01	2.5E-06	1.E+06	3700	3.7E+09	2.110E-09	1.44E-06	0.01	8.08E-07	0.01	2.08E-07	0.01	3.01E-08	0.01
Cs-134	1.60E-08	0.01	2.062E+00	2.5E-06	1.E+06	3700	3.7E+09	1.250E-08	6.85E-05	0.49	3.32E-06	0.04	2.86E-09	0.00	1.19E-13	0.00
Cs-135	1.40E-15	0.01	2.300E+06	2.5E-06	1.E+06	3700	3.7E+09	1.230E-09	5.89E-13	0.00	5.89E-13	0.00	5.89E-13	0.00	5.89E-13	0.00
Cs-137	7.60E-11	0.01	3.000E+01	2.5E-06	1.E+06	3700	3.7E+09	8.630E-09	2.24E-07	0.00	1.82E-07	0.00	1.12E-07	0.00	5.61E-08	0.01
Pm-145	9.80E-12	0.01	1.770E+01	2.5E-06	1.E+06	3700	3.7E+09	8.230E-09	2.76E-08	0.00	1.94E-08	0.00	8.53E-09	0.00	2.63E-09	0.00
Sm-146	1.70E-19	0.01	1.030E+08	2.5E-06	1.E+06	3700	3.7E+09	2.230E-05	1.30E-12	0.00	1.30E-12	0.00	1.30E-12	0.00	1.30E-12	0.00
Sm-151	1.40E-09	0.01	9.000E+01	2.5E-06	1.E+06	3700	3.7E+09	8.100E-09	3.88E-06	0.03	3.62E-06	0.05	3.08E-06	0.13	2.44E-06	0.43
Eu-152	**3.90E-07**	**0.01**	**1.333E+01**	**2.5E-06**	**1.E+06**	**3700**	**3.7E+09**	**5.970E-08**	**7.97E-03**	**57.58**	**4.99E-03**	**65.73**	**1.67E-03**	**69.81**	**3.52E-04**	**61.95**
Eu-154	**4.80E-08**	**0.01**	**8.800E+00**	**2.5E-06**	**1.E+06**	**3700**	**3.7E+09**	**7.730E-08**	**1.27E-03**	**9.18**	**6.25E-04**	**8.23**	**1.20E-04**	**4.98**	**1.13E-05**	**1.98**
Eu-155	1.30E-09	0.01	4.960E+00	2.5E-06	1.E+06	3700	3.7E+09	1.120E-08	4.98E-06	0.04	1.42E-06	0.02	7.53E-08	0.00	1.14E-09	0.00
Tb-158	9.60E-14	0.01	1.500E+02	2.5E-06	1.E+06	3700	3.7E+09	6.910E-08	2.27E-09	0.00	2.18E-09	0.00	1.98E-09	0.00	1.72E-09	0.00
Ho-166m	3.90E-11	0.01	1.200E+03	2.5E-06	1.E+06	3700	3.7E+09	2.090E-07	2.79E-06	0.02	2.78E-06	0.04	2.74E-06	0.11	2.69E-06	0.47
Hf-178m	**1.80E-10**	**0.01**	**3.100E+01**	**2.5E-06**	**1.E+06**	**3700**	**3.7E+09**	**6.650E-07**	**4.10E-05**	**0.30**	**3.35E-05**	**0.44**	**2.09E-05**	**0.87**	**1.07E-05**	**1.89**
Pb-205	2.70E-17	0.01	1.430E+07	2.5E-06	1.E+06	3700	3.7E+09	1.060E-09	9.80E-15	0.00	9.80E-15	0.00	9.80E-15	0.00	9.80E-15	0.00
U-233	**1.20E-11**	**0.001**	**1.585E+05**	**2.5E-06**	**1.E+06**	**3700**	**3.7E+09**	**3.660E-05**	**1.50E-05**	**0.11**	**1.50E-05**	**0.20**	**1.50E-05**	**0.63**	**1.50E-05**	**2.65**
Pu-239	**1.70E-11**	**0.001**	**2.407E+04**	**2.5E-06**	**1.E+06**	**3700**	**3.7E+09**	**1.160E-04**	**6.75E-05**	**0.49**	**6.75E-05**	**0.89**	**6.74E-05**	**2.81**	**6.74E-05**	**11.86**
Totals >	1.4E-05								0.01384	100.0	7.592E-03	100.0	2.399E-03	100.0	5.682E-04	100.0

Screening Calculation Notes

Columns A & B: Major Nuclides and concentrations from NUREG/CR-3474. Shroud from Table 5.1, Bioshield from Table 5.4 (10cm depth)
Column C: Release Fractions available from several sources - NUREG-1140 (Table 13), NUREG-1940 (Tables 3.11 & 3.12), and 10CFR3.72 (Schedule C).
Note: Release fraction is unitless, however, it was given units of gm/second so that the product of the concentration (Curies per gram) in column A multiplied by release fraction (grams per second) in column B yields a release rate in Curies/second
Column D: Half-Life in years from FGR12 (Table A.1)
Column E: Dispersion factor, X/Q. Worst case of 16 site boundary values (Ref. ODCM, and FSAR Chapter 2)
Column F: Activity conversion factor, uCi/Ci
Column G: Breathing rate for child, m3/y. (ref. ODCM)
Column H: Conversion factor which converts Sv/Bq (Sieverts per Becquerel) inhaled to mrem/uCi inhaled. (Ref. FGR11, page 1 of Table 2.1)
Column I: Dose conversion factor in Sv/Bq. Use highest value in "Effective" column (Ref. FGR11, Table 2.1)
Column J: Inhalation dose rate (mrem/y) = Concentration (Ci/gm) x release fraction (grams/sec) x Atm. Dispersion factor (s/m3) x conversion factor (uCi/Ci) x breathing rate (m3/y) x conversion factor: Sv/Bq to to mrem/uCi (mrem/Sv x Bq/uCi) x Dose Conversion Factor (Sv/Bq)
= B x C x E x F x G x H x I
Column K: % of total dose per radionuclide in Column J
Column L: Inhalation dose rate decayed for 9 years (2018), the approximate time when all fuel is in dry storage
= dose rate (column J)/EXP(0.69315)*9/Half-Life (Column D))
Column M: % of total dose per radionuclide in Column L
Column N: Inhalation dose rate decayed for 30 years
= dose rate (column J) /EXP(0.69315*30/Half-Life (Column D))
Column O: % of total dose per radionuclide in Column N
Column P: Inhalation dose rate decayed for 60 years, the approximate time when dormancy is scheduled to end and dismantlement begin
= dose rate (column J) /EXP(0.69315*60/Half-Life (Column D))
Column Q: % of total dose per radionuclide in Column P

Dose Rate and Curie Limit Calculation

The key radionuclides identified in the screening calculation (Attachment 1, 30 y decay) are used to perform the organ dose rate calculation. The dose rate calculations, based on the methods of the ODCM (i.e. inhalation dose to a hypothetical child at the site boundary) are performed in Step II below. Dose factors were obtained from Regulatory Guide 1.109, Table E-9, or NUREG-0172, Table 6.

The highest organ dose rate (total) from Step II is used to derive the source curie limit, shown in Step III below. This is done by determining the curies which would be released over 60 minutes at the dose rate limit, then adjusting (dividing) the curies for each radionuclide by the release fraction to obtain the source curie.

Additional details about the spreadsheet calculations are given in the spreadsheet notes on page 4 of this attachment

STEP II - Organ Dose Rate

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
	Major Activation Nuclides	Shroud Ci/gm shutdow n	Release Fraction gm/s	Half-Life Years	X/Q s/m3	pCi/Ci	Breathing Rate m3/y	Bone	Liver	Total Body	Thyroid mrem/pCi	Kidney	Lung	GI-LLI
1	Co-60							0.00E+00	3.55E-06	6.12E-06	0.00E+00	0.00E+00	1.91E-03	2.60E-05
2	Ni-63							2.24E-04	1.25E-05	7.56E-06	0.00E+00	0.00E+00	7.43E-05	1.71E-06
3	Co-60	0.13	0.001	5.271	2.5E-06	1.E+12	3700	0.000E+00	8.260E-02	1.424E-01	0.000E+00	0.000E+00	4.444E+01	6.050E-01
4	Ni-63	0.018	0.01	96	2.5E-06	1.E+12	3700	3.003E+02	1.676E+01	1.014E+01	0.000E+00	0.000E+00	9.962E+01	2.293E+00
5							mrem/y >	**3.003E+02**	1.684E+01	1.028E+01	0.000E+00	0.000E+00	1.441E+02	2.898E+00

STEP III - Curie Limit

A	B	C	D	E	F	G	H	I
		Decay Factor	30 y Decay Ci/gm	Release Fraction gm/s	Release Ci/s	Release Ci/h	Adjusted Release Ci/h	Source Ci
Co-60	0.13	0.01935	0.00252	0.001	2.52E-06	9.06E-03	9.05E-02	**90.5**
Ni-63	0.018	0.80524	0.01449	0.01	1.45E-04	5.22E-01	5.21E+00	**521.3**
		Total >	0.01701		1.47E-04	5.31E-01	5.30E+00	**611.7**

The decayed Ci/s yields a dose rate of 300 mrem/y to the bone

The Adjusted total Ci/h release is the curies released in 1 hour at a rate of 3000 mrem/y

STEP II - Organ Dose Rate

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
	Major Activation Nuclides	Bioshield Ci/gm shutdown	Release Fraction gm/s	Half-Life Years	X/Q s/m3		Breathing Rate pCi/Ci m3/y	Bone	Liver	Total Body	Thyroid mrem/pCi	Kidney	Lung	GI-LLI
1	H-3							0.00E+00	3.04E-07	3.04E-07	3.04E-07	3.04E-07	3.04E-07	3.04E-07
2	Eu-152							7.42E-04	1.37E-04	1.61E-04	0.00E+00	5.73E-04	9.00E-04	1.14E-05
3	Eu-154							2.74E-03	2.49E-04	2.27E-04	0.00E+00	1.09E-03	1.66E-03	2.98E-05
4	H-3	8.30E-06	0.5	12.35	2.5E-06	1.E+12	3700	0.000E+00	2.167E-03	2.167E-03	2.167E-03	2.167E-03	2.167E-03	2.167E-03
5	Eu-152	3.90E-07	0.01	13.33	2.5E-06	1.E+12	3700	5.625E-03	1.039E-03	1.221E-03	0.000E+00	4.344E-03	6.823E-03	8.642E-05
6	Eu-154	4.80E-08	0.01	8.8	2.5E-06	1.E+12	3700	1.145E-03	1.041E-04	9.488E-05	0.000E+00	4.556E-04	6.938E-04	1.246E-05
7							mrem/y >	6.770E-03	3.309E-03	3.482E-03	2.167E-03	6.966E-03	**9.683E-03**	2.266E-03

STEP III - Curie Limit

A	B	C	D	E	F	G	H	I
	Bioshield Ci/gm shutdown	Decay Factor	30 y Decay Ci/gm	Release Fraction gm/s	Release Ci/s	Release Ci/h	Adjusted Release Ci/h	Source Ci
H-3	8.30E-06	0.185674	1.5E-06	0.5	7.71E-07	2.77E-03	8.59E+02	**1.719E+03**
Eu-152	3.90E-07	0.210141	8.2E-08	0.01	8.20E-10	2.95E-06	9.14E-01	**9.141E+01**
Eu-154	4.80E-08	0.094136	4.5E-09	0.01	4.52E-11	1.63E-07	5.04E-02	**5.040E+00**
		Total >	1.6E-06		7.71E-07	2.78E-03	8.60E+02	**1.815E+03**

The decayed Ci/s yields a dose rate of 9.683e-3 mrem/y to the lung

The adjusted total Ci/h release is the curies released in 1 hour at a rate of 3000 mrem/y

Dose Rate and Curie Limit Calculation Notes

STEP II - Organ Dose Rate

Rows 1 - 2 for Shroud and Rows 1 -3 for Bioshield:

Columns H thru N: Organ Inhalation dose factors (Reg. Guide 1.109, Table E-9 and NUREG-0172 Table 6)

Rows 3 - 4 for Shroud and Rows 4 - 6 for Bioshield:

Columns A thru E: same as Attachment 1 except for key radionuclides only

Column F: Converts curie to picocurie

Column G: Breathing rate for child, m3/y. (ref. ODCM)

Column H thru N: Inhalation dose rate (mrem/y) = Concentration (Ci/gm) x release fraction (grams/sec) x Atm. Dispersion factor (s/m3) x conversion factor (pCi/Ci)

x breathing rate (m3/y) x dose factor (mrem/pCi) /EXP(0.69315*30 years/Half-Life in (years))

= B x C x E x F x G x (H thru N dose factors)/EXP(0.69315*30/Half-Life (Column D))

Row 5 for Shroud and Row 7 for Bioshield

Columns H thru N: Total dose rate

STEP III - Curie Limit

Column C: Decay factor to account for 30 years of decay: = 1/EXP(0.69315*30 years/Half-Life (years))

Column D: Shutdown concentration adjusted for decay = B x C

Column F: Release rate in Ci/s which was used in Step II to obtain the maximum organ dose rate: = D x E

Column G: Release converted from Ci/s to Ci/h: = F x 3600

Column H: Adjusted Ci/h is the release rate which yields maximum organ dose rate of 3000 mrem/y: = G x 3000/(maximum organ dose rate from Step II - total)

Column I: Source curies represent the amount of activity of the source to yield the given release rate.

Therefore, release fractions are applied to the curie/h to obtain the limiting dose rate: = Adjusted release (Ci/h) / Release fraction = H / E

In this case release fraction is unitless

Dose

To put the curie limits derived from the dose rate limit in context, dose calculations were done using the critical organ method (as used by the ODCM) and the more current method which calculates effective dose equivalent and these results were compared against acceptable dose limits for members of the public in the unrestricted area (beyond the site boundary).

Source curies were taken from the shroud calculations in Attachment 2 (Page 2 of 4).

As expected from the dose rate results, the maximum organ dose due is < 1 mrem and the total body dose is very low, at ~ 0.01 mrem. The committed effective dose equivalent (CEDE), which is the total internal dose the body receives, is similar to the total body dose calculation using the critical organ approach.

These doses are orders of magnitude lower than the 10 CFR 20 limit of 100 mrem for members of the public, and far lower than the ODCM member of the public ALARA limit of 15 mrem to any organ and the emergency plan Alert threshold of 10 mrem TEDE.

If 10% of the Alert threshold (1 mrem TEDE) is used as a limit for back-calculating source curie limit it would assure that public dose remains very low in the unlikely event that an offsite release occurred, but would also allow for proportionately higher source curie limits. For example, if TEDE is comprised primarily of inhalation dose, then from the FGR 11 example below, the source limits of ~90 Ci Co-60 and ~ 520 Ci Ni-63 would be scaled up by 1/0.015, a factor of ~66, to ~6000 Ci Co-60 and ~35000 Curies Ni-63.

Dose - ODCM Critical Organ Method							Bone	Liver	**Total Body**	Thyroid	Kidney	Lung	GI-LLI
									Dose factors - mrem/pCi inhaled				
						Co-60	0.000E+00	3.550E-06	6.120E-06	0.000E+00	0.000E+00	1.910E-03	2.600E-05
						Ni-63	2.240E-04	1.250E-05	7.560E-06	0.000E+00	0.000E+00	7.430E-05	1.710E-06
	Source	Release				Breathing							
	Ci	Fraction	X/Q			Rate	Bone	Liver	**Total Body**	Thyroid	Kidney	Lung	GI-LLI
			s/m3	pCi/Ci	years/s	m3/y			Dose in mrem				
Co-60	90.5	0.001	2.50E-06	1E+12	3.17E-08	3700	0.000E+00	9.421E-05	1.624E-04	0.000E+00	0.000E+00	5.069E-02	6.900E-04
Ni-63	521.3	0.01	2.50E-06	1E+12	3.17E-08	3700	3.424E-01	1.911E-02	1.156E-02	0.000E+00	0.000E+00	1.136E-01	2.614E-03
					Total	mrem >	**0.3424**	0.0192	**0.012**	0.0000	0.0000	0.1643	0.0033

Dose = Source Ci x Release Fraction x X/Q x pCi/Ci x year/s x Breathing Rate x Dose Factor

Dose - Committed Effective Dose Equivalent (FGR11 Dose Factors)									
	Source	Release	X/Q	uCi/Ci		Breathing	Conversion	DCF	Inhalation
	Ci	Fraction	s/m3		years/s	Rate	mrem/Sv	Sv/Bq	mrem
						m3/y	x Bq/uCi		
Co-60	90.5	0.001	2.5E-06	1.E+06	3.17E-08	3700	3.7E+09	5.91E-08	5.80E-03
Ni-63	521.3	0.01	2.5E-06	1.E+06	3.17E-08	3700	3.7E+09	1.70E-09	9.61E-03
							Total	mrem >	**0.015**

Dose = Source Ci x Release Fraction x X/Q x uCi/Ci x year/s x Breathing Rate x Conversion x DCF