SAFETY EVALUATION REPORT

RENEWAL OF LICENSE SNM-1107 FOR

WESTINGHOUSE ELECTRIC COMPANY LLC, HOPKINS, SOUTH CAROLINA

DOCKET NUMBER 70-1151

Enclosure 2

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LIST OF ACRONYMS AND ABBREVIATIONS

10 CFR	Title 10 of the *Code of Federal Regulations*
ADAMS	Agencywide Documents and Management System
ADU	ammonium diurinate
AIHA	American Industrial Hygiene Association
ALARA	as low as is reasonably achievable
ALI	annual limit on intake
Am	americium
ANI	area needing improvement
ANSI	American National Standards Institute
ANS	American Nuclear Society
ASTM	American Society for Testing and Materials
BAM	Brookfield Asset Management Inc.
BMP	best management practices
CA	consent agreement
CAA	controlled access area
CAAS	criticality accident alarm system
CAP	corrective actions program
CCA	contamination controlled area
CEDE	committed effective dose equivalent
CFFF	Columbia Fuel Fabrication Facility
CFR	Code of Federal Regulations
CM	configuration management
Cs	cesium
CSE	criticality safety evaluations
CSM	conceptual site model
DAC	derived air concentration
DCE	detailed cost estimate
DCP	double contingency principle
DDE	deep dose equivalent
DFP	decommissioning funding plan
DHEC	Department of Health and Environmental Control
DOE	U.S. Department of Energy
EA	enforcement action
EH&S	Environment, Health and Safety
EIS	environmental impact statement
EOC	Emergency Operations Center
ERO	emergency response organization
ERPGs	emergency response planning guidelines
ERT	emergency response team
ETAPS	electronic training and procedure system
F	fluorine
FHA	fire hazard analysis
FNMC	fundamental nuclear material control
FR	Federal Register
FWA	facility walkthrough assessment
GET	general employee training
HAZMAT	hazardous material

HAZOP	hazard and operability
HEPA	high-efficiency particulate air
HF	hydrofluoric acid
HOC	Headquarters Operations Center
HS&E	health, safety and the environment
ICRP	International Commission on Radiation Protection
ID	inventory difference
IFBA	integrated fuel burnable absorber
IFI	inspector follow-up ITEM
IROFS	item(s) relied on for safety
ISA	integrated safety analysis
k_{eff}	effective neutron multiplication factor
LEPC	Local Emergency Planning Committee
LEU	low-enriched uranium
LLRW	low-level radioactive waste
LPR	licensee performance review
LRA	license renewal application
LTL	lower tolerance limit
MC&A	material control and accounting
mrem	millirem
mSv	millisievert(s)
Na	sodium
NCS	nuclear criticality safety
NCSE	nuclear criticality safety evaluation
NCSIP-II	Nuclear Criticality Safety Improvement Project
NFPA	National Fire Protection Association
NMSS	Office of Nuclear Material Safety and Security
NNSA	National Nuclear Security Administration
NPDES	National Pollutant Discharge Elimination System
NPH	natural phenomena hazards
NRC	U.S. Nuclear Regulatory Commission
NVLAP	National Voluntary Laboratory Accreditation Program
O	oxygen
Pb	lead
pCi/g	picocuries per gram
PHA	process hazard analysis
PLC	programmatic logic controller
PM	preventive maintenance
ppm	parts per million
Pu	plutonium
QA	quality assurance
Ra	radium
RAI	request for additional information
RG	regulatory guide
RP	radiation protection
RPP	radiation protection program
RSP	radiation safety program
RWP	radiation work permit
SCDHEC	South Carolina Department of Health and Environmental Control
SCEMD	South Carolina Emergency Management Division
SEID	standard error of inventory difference

SEP	site emergency plan
SER	safety and safeguards evaluation report
SG	safeguards
SNM	special nuclear material
SPLs	single parameter limits
SUNSI	sensitive unclassified non-safeguards information
Tc	technetium
TEDE	total effective dose equivalent
Th	thorium
TLD	thermoluminescent dosimeter
U	uranium
UNBSS	uranyl nitrate bulk storage system
URRS	uranium recovery and recycling services
USL	upper subcritical limit
WEC	Westinghouse
wt%	weight percent
σ	standard deviation

EXECUTIVE SUMMARY

This report documents the U.S. Nuclear Regulatory Commission (NRC) staff's safety and security evaluation of the Westinghouse Electric Company LLC (WEC) application for renewal of a Title 10 of the *Code of Federal Regulations* (10 CFR), Part 70 license to possess and use special nuclear material (SNM) at its Columbia Fuel Fabrication Facility (CFFF) located in Hopkins, South Carolina. The facility is licensed to possess and process enriched uranium up to a maximum of 5 weight-percent uranium-235 for the manufacture of nuclear fuel assemblies for use in commercial nuclear power reactors. The license (SNM-1107) was first issued by the Atomic Energy Commission on September 3, 1969, and most recently renewed on September 28, 2007, for a 20-year period, expiring on September 30, 2027. WEC submitted a license renewal application on November 30, 2012 (WEC, 2012a), that requested extension of the license for a 40-year period. While the staff was conducting its review, since the CFFF license did not expire until September 2027, the facility continued to operate under the timely renewal provisions in 70.38(a).

By letter dated February 7, 2013, the NRC deferred its review of the license renewal until 2014 to allow the NRC staff to budget and plan for the review in fiscal years 2014 and 2015 (NRC, 2013). On July 31, 2014, WEC submitted supplemental information for the license renewal application (WEC, 2014b). During the acceptance review, NRC staff determined additional information was needed to undertake a detailed technical review. The NRC staff held meetings with WEC staff on September 23 and 26, 2014, to discuss the scope of the acceptance and technical reviews (NRC, 2014a). WEC supplemented its application on December 17, 2014 (WEC, 2014c). The NRC staff completed its acceptance review and informed the licensee by letter dated December 30, 2014, that the supplemented application had been accepted for a detailed technical review (NRC, 2014c). A notice of opportunity to request a hearing for the renewal application was published in the *Federal Register* (FR) on February 27, 2015 (80 FR 10727) (NRC, 2015). No requests for a hearing were received.

WEC supplemented its application with additional information by letters dated February 29, 2016 (WEC, 2016a), March 7, 2016 (WEC, 2013), March 23, 2016 (WEC, 2016b), September 15, 2017 (WEC, 2017d), March 28, 2018 (WEC, 2018c), June 21, 2018 (WEC, 2018e), July 11, 2019 (WEC, 2019c), July 25, 2019 (WEC, 2019d), August 22, 2019 (WEC, 2019e), April 6, 2021 (WEC, 2021a), February 21, 2022 (WEC, 2022b), March 15, 2022 (WEC, 2022c), and March 21, 2022 (WEC, 2022a and WEC, 2022d). WEC submitted a final version of its application incorporating earlier changes on August 22, 2019, to facilitate the NRC's review (WEC, 2019e). WEC submitted an update to this final application on September 20, 2021 (WEC, 2021b).

The NRC staff conducted its safety and safeguards review in accordance with 10 CFR Part 20, "Standards for Protection Against Radiation," 10 CFR Part 40, "Domestic Licensing of Source Material," 10 CFR Part 70, "Domestic Licensing of Special Nuclear Material," 10 CFR Part 73, "Physical Protection of Plants and Materials," and 10 CFR Part 74, "Material Control and Accounting of Special Nuclear Material." The NRC staff used guidance in NUREG-1520 Revision 1, "Standard Review Plan for the Review of a License Application for a Fuel Cycle Facility" (NRC, 2010a) and other applicable guidance documents to conduct its review. The NRC staff's safeguards review evaluated WEC's Fundamental Nuclear Material Control Plan (FNMCP) and Physical Security Plan (PSP). The NRC staff also reviewed WEC's Emergency Management Plan (EP).

WEC also submitted an environmental report (ER) (WEC, 2014c) which the staff evaluated in preparation for its environmental assessment (EA) and finding of no significant impact (FONSI) consistent with the regulatory requirements in 10 CFR Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions." WEC supplemented the ER with a letter dated March 28, 2019 (WEC, 2019b), a license application letter dated July 11, 2019 (WEC, 2019c), and August 22, 2019 (WEC, 2019e). The EA and FONSI were published in the *Federal Register* on June 15, 2018 (83 FR 28014) (NRC, 2018b, "Columbia Fuel Fabrication Facility, Environmental Assessment and Finding of No Significant Impact," Federal Register, Vol. 83, No. 116, June 15, 2018, pp. 28014-28015). However, shortly after this publication, CFFF had a leak of liquid containing uranyl nitrate and hydrofluoric acid onto the plant floor which subsequently seeped through a rubber and concrete barrier into the soil below the plant. Remediation efforts and subsequent soil and water sampling identified localized groundwater contamination due to a previous plant leak that occurred in 2011. Based on this new information and public concern about the releases, the NRC staff decided to reopen its environmental review. On October 28, 2019, the NRC concurrently withdrew its June 2018 EA and FONSI and published a new draft EA for public review and comment (84 FR 57777).

In May 2016, while the license renewal review was ongoing, an event occurred at the CFFF facility. Uranium bearing material accumulated in a wet scrubber, which is part of the ventilation system. There was sufficient SNM present that, if it had accumulated in a different geometry, the material could have resulted in a criticality accident. WEC suspended operations in the conversion area and the scrubber for several months while the ventilation system was cleaned, and modifications were implemented (NRC, 2016b). During this time, WEC focused its efforts on the safe restart of operations which delayed its responses to the staff's requests for additional information (RAIs) and the license renewal review.

On March 29, 2017, WEC notified the NRC, as required by 10 CFR 70.32(a)(9), of the filing of a voluntary petition for relief under Chapter 11 of Title 11 of the United States Code in the United States Bankruptcy Court for the Southern District of New York (WEC, 2017c). On March 29, 2011, WEC and its immediate parent company, TSB Nuclear Energy Services, filed petitions for bankruptcy protection in the United States Bankruptcy Court for the Southern District of New York. WEC applied for NRC's consent to an indirect transfer of control of certain materials and export licenses pursuant to an agreement providing for Brookfield WEC Holdings Inc. to acquire TSB Nuclear Energy Services as described in a Plan of Reorganization submitted to the Bankruptcy Court. The NRC approved the indirect transfer on June 28, 2018 (NRC. 2018d). The NRC's approval was based on findings that the transfer would not result in any changes that would be inimical to the common defense and security, or to the health and safety of the public.

On February 26, 2019, SCDHEC executed a Consent Agreement (CA) with the WEC (SCDHEC/WEC 2019) to conduct remedial investigations and address historical contamination at the CFFF site. Subsequently, on June 5, 2020, the NRC staff decided to prepare an EIS (NRC 2020) because new sampling and monitoring data from the remedial investigations conducted by the WEC (WEC 2020) under a CA with SCDHEC revealed uncertainty related to the source and extent of contamination onsite and the potential future migration pathways offsite (SCDHEC/WEC 2019) and precluded the NRC staff from making a FONSI through the EA.

In accordance with 10 CFR 51.26, the NRC published a Notice of Intent (NOI) in the *Federal Register* to prepare an EIS and conduct a scoping process on July 31, 2020 (85 FR 46193). The NRC staff published the draft EIS for public review and comment (NRC, 2021; 86 FR 43276) on August 6, 2021. The NRC staff conducted outreach to the public to obtain input for the EIS in multiple ways. The NRC staff communicated the availability of the draft EIS for public comment

via an NRC press release, NRC social media, NRC e-mail distribution, NRC listserv, local newspapers, and radio stations, including a flyer containing plain language information about the draft EIS. The staff made hard copies of the draft EIS available to the public at three area libraries and sent postcards via U.S. mail to residences in the immediate vicinity of the CFFF providing notification of the availability of the draft EIS and the public comment period. The communications included notice of an NRC public webinar that was held on August 26, 2021, to gather comments on the draft EIS. The NRC addressed public comments on the draft EIS and issued a Final EIS on July 29, 2022 (NRC, 2022d). The Final EIS was noticed in the *Federal Register* on August 5, 2022 (87 FR 48044).

The NRC staff reviewed the descriptions, specifications, and analyses presented by WEC in its application. Based on its review, including independent analyses of the information provided by WEC, the NRC staff concluded that the information provides an adequate basis for the safety and safeguards of facility operations and meets the requirements of the CFR. As a result, the staff finds that the continued operation of the facility does not pose an undue risk to the worker or to public health and safety. The NRC staff has also implemented a number of license conditions. A description of each license condition is provided at the appropriate location in this report. Based on the NRC staff's review, as documented in this report, the NRC grants WEC's license renewal request for a 40-year period.

CHAPTER 1 GENERAL INFORMATION

1.1 PURPOSE OF THE REVIEW

The purpose of this portion of the staff's review was to determine whether the facility and process descriptions in the license renewal application (LRA) submitted by WEC meets the requirements of Title 10 of the *Code of Federal Regulations* (10 CFR) 70.22, "Contents of Applications," 70.23, "Requirements for the approval of applications," and 10 CFR 70.65, "Additional Content of Applications," subparagraphs 70.65(b)(1), (b)(2) and (b)(3). The staff's review included an evaluation of whether the LRA adequately presents an overview of the site layout and a summary description of WEC's manufacturing process. In addition, the staff reviewed institutional information to determine whether the application adequately described the geographic, demographic, meteorological, hydrologic, geologic, and seismologic characteristics of the site and surrounding area.

1.2 REGULATORY REQUIREMENTS

The regulations applicable for this portion of the review are 10 CFR 70.22, "Contents of applications," 10 CFR 70.65, "Additional content of applications," and 10 CFR 70.23, "Requirements for the approval of applications."

1.3 STAFF REVIEW AND ANALYSIS

The NRC staff evaluated WEC's LRA following the acceptance criteria outlined in Sections 1.1.4, 1.2.4, and 1.3.4 of NUREG-1520 Revision (Rev.) 1, "Standard Review Plan for the Review of a License Application for a Fuel Cycle Facility" (NRC, 2010a). The NRC staff reviewed the LRA (WEC, 2019c), (WEC, 2019e), as supplemented, and the ISA Summary (WEC, 2019), which included consideration of the following areas:

1. Facility Layout Description
2. Process Overview
3. Site Overview
4. Institutional Information
5. Descriptive Summary of Licensed Material
6. Authorized Uses
7. Characteristics of the Material
8. Site Description

The staff also reviewed WEC's responses to requests for additional information, audit reports, and inspection reports, to have a better understanding of the site and facility overview and information. The staff's evaluation is summarized in the following sections.

1.3.1 FACILITY AND PROCESS DESCRIPTION

As stated in the LRA, WEC manufactures nuclear fuel assemblies and components at the CFFF for commercial nuclear power reactors. The CFFF receives uranium hexafluoride (UF_6), which is converted into uranium dioxide (UO_2) powder via an ammonium diuranate conversion process. The LRA refers to the ISA Summary where a detailed discussion of the process, including chemical reactions, is provided. The manufacturing operations consist primarily of the facility receiving low-enriched UF_6 (less than 5 weight-percent uranium-235), converting the UF_6 to UO_2

powder, processing the UO_2 powder through pressing into pellets and sintering. These processes are followed by fuel rod loading, sealing the rods, and fuel assembly fabrication. The primary operations are supported by neutron absorber addition or coating, laboratory, scrap recovery, and waste disposal systems. The processes are described in detail in the ISA Summary (WEC, 2019).

1.3.1.1 Equipment and Facilities

In Chapter 1 of the LRA, WEC provided a summary description of the site and facility including equipment, and each process as required by 10 CFR Paragraphs 70.22(a)(7) and 70.65(b)(2)-(3). The staff concluded that the description of the site and facility was adequate for the staff's understanding of the site and facility and was consistent with the ISA Summary.

The information in the LRA is supported by reference to information in the ISA Summary which contains the details of the processes, equipment, and facilities. Although the ISA Summary is not part of the license application, it must be submitted with the application. The NRC staff determined that WEC provided the required information in the application in conjunction with the ISA Summary. Therefore, NRC staff finds that the licensee meets the requirements of 10 CFR 70.22(a)(7),10 CFR 70.65(b)(2), and 10 CFR 70.65(b)(3).

1.3.1.2 Site Overview

In the LRA, WEC described the location of the CFFF relative to the nearest major city, the total acreage of the site, and the acreage occupied by the CFFF itself. The LRA also described the physical address, the surrounding land, buildings, and population. The WEC application referred to the ISA and the environmental report for details on the surrounding population, land uses, weather, and geology.

The WEC application provides details on the CFFF site, the fuel manufacturing process, and supporting processes in the ISA Summary. The purpose of each process and the interrelationships between processes are discussed. The proximity of facility buildings to the site boundary and nearby population centers is given. The 2010 census data was used in the license application. The ISA Summary is incorporated into the license application by reference.

1.3.2 INSTITUTIONAL INFORMATION

1.3.2.1 Corporate Identity

Chapter 1 of the LRA provides the legal name of the company, the state where the company is incorporated, the address of the corporate office, the address of the CFFF, and citizenship of the principal officers. WEC is majority owned and controlled by Brookfield WEC Holdings Inc. (WEC Holdings). WEC Holdings is ultimately owned and controlled by Brookfield Asset Management Inc. (BAM), a Canadian global alternative asset manager.

The NRC staff reviewed the corporate identity information and determined that WEC provided the required information. Based on its review, NRC staff determined that the licensee provided all required identifying information. Therefore, NRC staff finds that the licensee meets the requirement of 10 CFR 70.22(a)(1).

1.3.2.2 Financial Qualifications

As part of the license renewal process, the NRC staff determines whether WEC appears to be financially qualified to manufacture nuclear fuel assemblies at the CFFF during the renewal period in accordance with the regulations in 10 CFR Part 70, specifically Paragraph 70.23(a)(5). On March 29, 2017, WEC notified the NRC, as required by 10 CFR 70.32(a)(9), of a voluntary petition for relief under Chapter 11 of Title 11 of the U. S. Code in the U.S. Bankruptcy Court for the Southern District of New York (WEC, 2017c). In a separate application, on March 28, 2018, WEC also applied for NRC's consent to an indirect transfer of control providing for Brookfield WEC Holdings Inc. to acquire TSB Nuclear Energy Services. The transfer of control was approved by an NRC Order on June 28, 2018 (NRC, 2018d). The NRC reviewed and approved the financial qualifications of WEC as part of the SER for the license transfer. This review and the financial information in the license renewal application were used to verify the financial qualifications, as summarized below.

The CFFF is subject to the financial qualification requirements in 10 CFR 70.23(a)(5). The application states that WEC continues to be financially qualified to carry out licensed activities as part of the license transfer review application submitted by letter dated March 21, 2018 (WEC, 2018b); Appendix D provides WECs income statements including financial pro-forma statements extending from 2015 through 2022, and a balance sheet from WEC's emergence from bankruptcy dated December 31, 2017. These figures provide both Westinghouse's projected opening balance sheet upon emergence from bankruptcy, and the Columbia Fuel Consolidated Income Statement, which lists Westinghouse's actual income for FY 2016 and FY 2017, and projected income for FY 2018 to FY 2022. The documentation shows that Westinghouse's business activities at CFFF are net cash positive and are projected to generate an operating profit through 2022 (NRC, 2018d). The NRC staff reviewed these financial statements from WEC and concludes that the licensee will likely continue to be financially qualified with respect to CFFF. Thus, WEC appears to be financially qualified to meet its license obligations to maintain safety, security, and protection of the environment.

Staff review also confirmed that WEC's triennial update to the CFFF Decommissioning Funding Plan (WEC, 2019d, WEC, 2019c, and WEC 2021b) contains realistic cost estimates, and provides a method of assuring funds for decommissioning equal to the decommissioning cost estimate. The licensee will update the decommissioning cost estimate and funding at intervals not to exceed 3 years[1], consistent with requirements in 10 CFR 70.25(e)(2). Further review of the financial assurance for decommissioning is provided in Chapter 10 of this SER.

Based on the results of its review, the NRC staff determined that WEC appears to have sufficient resources to operate the safety and security programs, and to satisfy its decommissioning responsibilities. Based on the financial information provided by the licensee in its application as supplemented, the NRC staff finds that WEC appears to be financially qualified to engage in the proposed activities in accordance with 10 CFR 70.23(a)(5).

[1] A DFP triennial update was submitted to NRC for review on May 9, 2022 (WEC, 2022g). It will be reviewed on a separate schedule, independent of this license renewal.

1.3.2.3 Type, Quantity, and Form of Licensed Material

Paragraph 70.22(a)(4) of 10 CFR requires the name, amount, and specifications (including the chemical and physical form, and where applicable, isotopic content) of the SNM that the licensee proposes to use or produce.

The licensee requests to possess and use the following materials:

- [ ] grams of U-233 in any chemical or physical form, limited to laboratory use as individual 1 gram maximum quantities in ventilated hoods, glove boxes, or other enclosures
- [ ] grams of U-235, as uranium of any enrichment, in any chemical or physical form
- [ ] kilograms of U-235 enriched to no greater than 5 weight-percent, in any chemical or physical form except metal
- [ ] grams of Pu-238/239 as sealed sources
- transuranics and fission products, not to exceed 3,300 becqueral (Bq) alpha per KgU, or 440,000 Mev Bq gamma per KgU
- [ ] millicuries of any byproduct material in the form of contamination on nuclear fuel assemblies or contaminated rods or equipment
- [ ] kilograms of Uranium (natural or depleted) in any chemical or physical form
- [ ] pound depleted uranium flywheel

In the LRA, the licensee stated that administrative controls are in effect to assure that only authorized materials are packaged for disposal, and that the controls include routine checks to verify that the controls are effective.

The LRA describes the possession limits of the materials by name, amount, and chemical form, physical form, and enrichment level. The possession limits approved in the 2007 license renewal (NRC, 2007e), have been modified over time. In 2010, staff from NRC, the State of South Carolina Department of Health and Environmental Control, and WEC agreed that the source and byproduct material, previously licensed by the Agreement State, would be moved to the NRC license. Therefore, by Amendment 10 of license SNM-1107 dated February 25, 2011 (NRC, 2011a), the NRC staff approved a transfer of natural and depleted UF_6 and residual contamination on fuel assemblies from Agreement State License RM-94, issued by the State of South Carolina, to NRC license SNM-1107 (NRC, 2010b, "Transferring Natural Uranium Hexafluoride From The State License To The NRC License," July 27, 2010, ADAMS Accession No. ML101800306). This transfer was initiated by WEC in preparation for the NRC staff's development of a proposed rulemaking to require source and byproduct materials at fuel cycle facilities to be regulated solely by the NRC (see Staff Requirements Memorandum (SRM)-M070308B issued by the Commission on March 22, 2007 (NRC, 2007)). Although the rulemaking was subsequently terminated in 2013 (see SRM-12-0071 (NRC, 2013a)), the source and byproduct material had already been added to the NRC license by Amendment 10, which was supported by the South Carolina Agreement State. In addition, Amendment 18 (NRC, 2015d) also increased the possession limits of U-235 for storage purposes only.

The byproduct material includes residual radiological contamination that may occur when fresh fuel assemblies have been transferred to commercial nuclear power reactors where they are stored in the spent fuel pool, but returned to the fuel fabrication facility due to manufacturing or other defects. In that case, the fresh fuel assemblies can become contaminated by the trace

quantities of radiological impurities (i.e., byproduct material as defined in 10 CFR 30.4, “Definitions”) which are present in the spent fuel pool.

The NRC staff reviewed the description of the licensed material and determined that the licensee provided the names, amounts, physical forms, and quantities possessed under this license. Therefore, the NRC staff finds that the licensee meets the requirement of 10 CFR 70.22(a)(4).

1.3.2.4 Authorized Uses

Paragraph 70.22(a)(2) of 10 CFR requires the license application to describe the activity for which the SNM is requested, the place at which the activity is to be performed, and the general plan for carrying out the activity. Under a renewed license, WEC would continue to manufacture commercial nuclear fuel. Effective November 2, 2015, the licensee has also been authorized to store, without processing, UF_6 in 30B cylinders for customers (NRC, 2015d). The fuel manufacturing activities have been conducted since the license was last renewed on September 28, 2007 (NRC, 2007e).

WEC enumerated supporting activities, such as handling licensed materials including source, byproduct, and SNM in stated chemical and physical forms. The processes include chemical conversion, fuel fabrication, quality assurance, process development, health physics laboratory operations, scrap recovery operations, UF_6 cylinder processing, maintenance, decontamination, waste operations, non-radioactive component fabrication, and shipping.

The NRC staff reviewed the information stating the activity for which the SNM will be used. Based on its review, the NRC staff has determined that the licensee has provided a description for each activity or process in which the licensee proposes to possess, use and store SNM. The authorized uses of SNM proposed for the facility are described, and are considered consistent with the Atomic Energy Act of 1954, as amended. Therefore, the NRC staff finds that the licensee meets the requirements of 10 CFR 70.22(a)(2).

1.3.2.5 Renewal Period

The initial SNM-1107 license was issued on September 3, 1969 (NRC, 1968). The license was renewed for 10 years in 1978, 1985 (NRC, 1985) and 1995 (NRC, 1995a, “Safety Evaluation Report and Renewal of SNM-1107 for the Westinghouse Electric Corporation,” November 3, 1995, ADAMS Accession No. ML060110462).

WEC submitted a 20-year renewal license application to the NRC on July 28, 2006. The staff granted a 20-year license extension on December 13, 2007 (NRC, 2007e), with an expiration date of September 30, 2027.

On December 4, 2006, the Commission published a new policy in the *Federal Register* (71 FR 70441), which approved a maximum license term of 40 years for license renewals and new applications, specific to licensees required to submit integrated safety analysis (ISA) summaries according to 10 CFR Part 70, Subpart H, requirements (NRC, 2006).

WEC’s LRA requests a license for a 40 year term (WEC, 2021b). The information to support this review was obtained from multiple submittals, including the original submittal of a license renewal application dated July 31, 2014 (WEC, 2014b). WEC supplemented its application with additional submittals dated December 17, 2014 (WEC, 2014d), August 31, 2016 (WEC, 2016f),

March 22, 2017 (WEC, 2017b), March 28, 2018 (WEC, 2018c), June 21, 2018 (WEC, 2018d), July 11, 2019 (WEC, 2019c), July 25, 2019 (WEC, 2019d), August 22, 2019 (WEC, 2019e), April 6, 2021 (WEC, 2021a), September 21, 2021 (WEC, 2021b), February 21, 2022 (WEC, 2022b), March 15, 2022 (WEC, 2022c), and March 21, 2022 (WEC, 2022a and WEC, 2022d). The NRC staff reviewed WEC's license renewal request and determined the licensee provided the required information in 10 CFR 70.22(a)(3).

1.3.3 SITE DESCRIPTION

In the LRA, WEC discussed the location of the CFFF, the acreage of the site, and the proximity of the site to the nearest major city. The LRA also describes the land surrounding the site, including its local uses and road access.

The LRA contained detailed drawings of the CFFF site (WEC, 2019e). The LRA also included information on the proximity of the CFFF to nearby populations and was taken from the most recent census data.

The ISA Summary included the 2010 census data, and details on the meteorology and seismology of the site. After the license application was accepted for technical review, the licensee submitted updates to the ISA Summary as required by 10 CFR 70.72(d)(2). During the review, the NRC staff evaluated the most recent version of the ISA Summary.

Diagrams of the site layout were submitted with the revised license application dated September 21, 2021 (WEC, 2021b). The WEC-detailed drawings of the site layouts can be found in WEC's Physical Security Plan Drawings, dated January 9, 2015 (WEC, 2015a), and in WEC's Integrated Safety Analysis Summary dated January 27, 2022 (WEC, 2022). These documents contain security-related information and are not available to the public.

1.3.3.1 Site Geography

The ISA Summary described the site location, major nearby highways, nearby bodies of water, and significant features such as the military installations and airports. The site is located near the City of Columbia in Richland County, South Carolina. The ISA Summary, "CFFF Sites and Structures," shows the site boundaries and controlled area boundaries.

1.3.3.2 Population Information

The ISA Summary presented demographic information, including the 2010 census results for the Columbia metropolitan area, which includes Richland County. The Summary also describes nearby population centers, public facilities, nearby historic and cultural landmarks, and describes land uses within 1 mile of the facility.

1.3.3.3 Meteorology

The ISA Summary described primary wind directions and average wind speeds. In addition, it describes normal monthly amounts and forms of precipitation, and severe weather conditions in Richland County.

1.3.3.4 Hydrology

The ISA Summary describes the characteristics of nearby bodies of water, depth to the water table, groundwater, surface water, and potential flooding events.

1.3.3.5 Geology

The ISA Summary describes the characteristics of soil, formations and bedrock, and seismology.

The staff's review of the site description for WEC CFFF found in the ISA Summary, "CFFF Sites and Structures" (WEC, 2019), Section 1.0, "Facility Site Location And Description," is based on the criteria in Section 1.3 of NUREG-1520. The staff determined that the LRA adequately described and summarized general information pertaining to: (1) the site geography, including its location relative to mountain, rivers, population centers, schools, and commercial and manufacturing facilities, (2) population information using the most current census data at the time of initial submittal, and (3) meteorology, hydrology, and geology for the site.

1.4 EVALUATION FINDINGS

The staff reviewed the site description for WEC's CFFF in accordance with Section 1.3 of the Standard Review Plan in NUREG-1520, Revision 1. The WEC adequately described and summarized general information pertaining to: (1) the site geography, including its location relative to prominent natural and manmade features such as mountains, rivers, airports, population centers, schools, and commercial and manufacturing facilities, (2) population information using the most current census data, (3) meteorology, hydrology, and geology for the site, and (4) applicable design-basis events.

The NRC staff verified that the site description is consistent with the information used as a basis for the environmental report, emergency management plan, and ISA Summary. The LRA cross-referenced its general description with more detailed descriptions elsewhere in the application and ISA Summary. The staff concluded that the LRA meets the general requirements of 10 CFR 70.22, and 10 CFR 70.65(b)(1) and (2).

CHAPTER 2 ORGANIZATION AND ADMINISTRATION

2.1 PURPOSE OF THE REVIEW

The purpose of this portion of the review was to determine whether the licensee's organization and administration are qualified by reason of training and experience to use the material for the purpose requested in accordance with 10 CFR 70.22(a)(6) and 70.23(a)(2). The review evaluated whether management policies provide reasonable assurance that WEC plans, implements, and controls site activities in a manner that ensures the safety of workers, the public, and the environment. The review also confirmed that the licensee identified and provided adequate qualification descriptions for key management positions.

2.2 REGULATORY REQUIREMENTS

Title 10 of the *Code of Federal Regulations* (10 CFR) Paragraph 70.22(a)(6) requires the applicant to submit information on the technical qualifications, including training and experience of the applicant's staff who will engage in the proposed activities. The information provided by WEC must also comply with 10 CFR 70.23, "Requirements for the approval of applications."

Paragraph 70.22(a)(8) of 10 CFR requires WEC's proposed procedures to protect health and minimize danger to life or property.

2.3 STAFF REVIEW AND ANALYSIS

The U.S. Nuclear Regulatory Commission (NRC) staff evaluated Westinghouse Electric Company, LLC (WEC) license renewal application (LRA) for the Columbia Fuel Fabrication Facility (CFFF) (WEC, 2019c) against the acceptance criteria outlined in Section 2.4 of NUREG-1520, "Standard Review Plan for the Review of a License Application for a Fuel Cycle Facility" (NRC, 2010a).

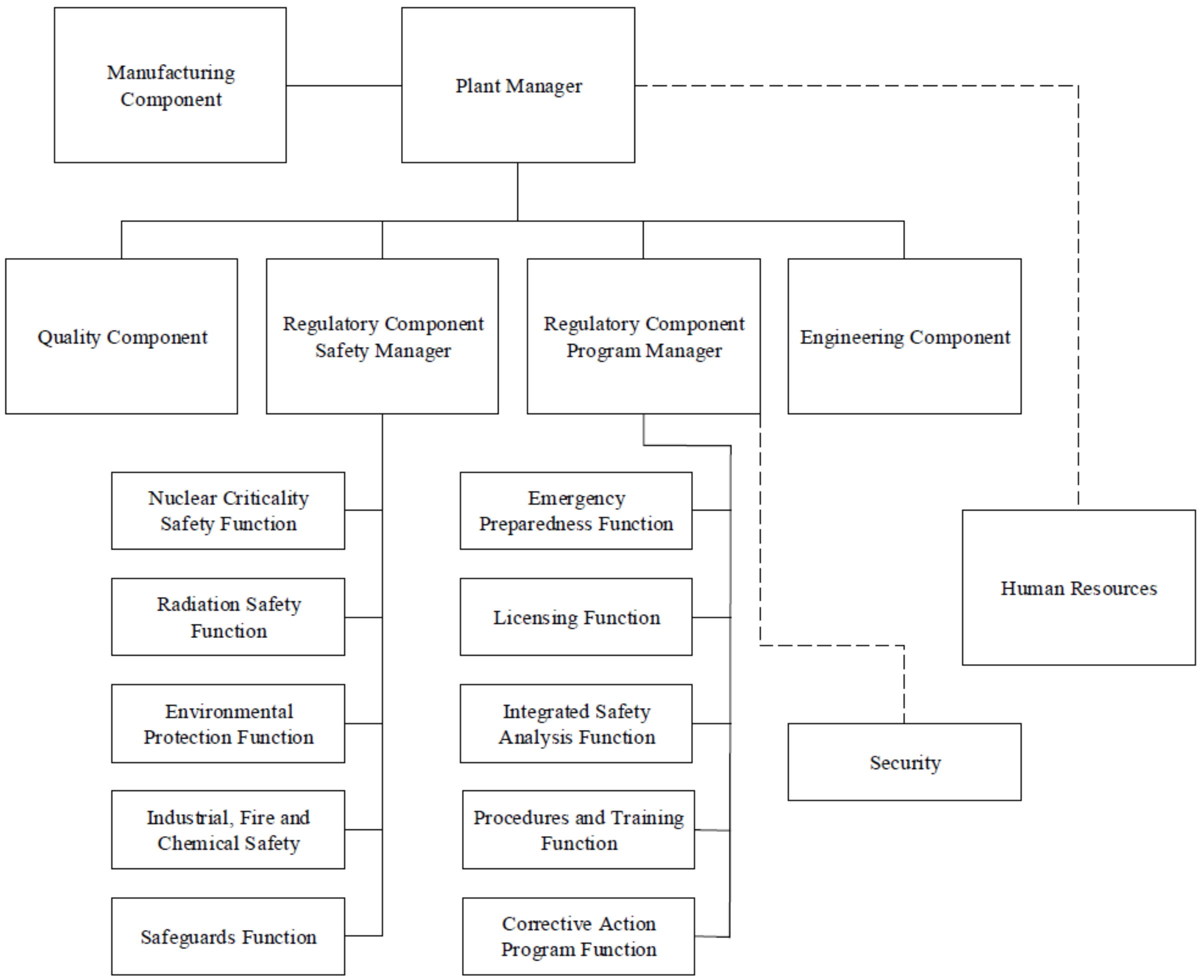
2.3.1 ORGANIZATIONAL GROUPS

Chapter 2, "Management Organization," of the LRA indicated that WEC manages several business interests including the CFFF. This facility is used for the design and manufacturing of nuclear fuel and components for commercial nuclear reactors worldwide.

In the LRA, WEC described specific organizational groups that are responsible for managing the design, construction, operations, and modifications of the facility or licensed activities. Figure 2.1 of the LRA (WEC, 2019e) provides an organizational chart illustrating the various generic responsibilities within the WEC CFFF organization.

LICENSE RENEWAL APPLICATION FIGURE 2.1

Figure 2.1 CFFF Organization



The plant manager has the ultimate responsibility for CFFF operations. This individual directs licensed activities and staff functions through subordinate managers responsible for the various manufacturing, quality, regulatory, and engineering components (i.e., WEC organizational groups with defined areas of responsibility). The plant manager works under the direction of corporate WEC. The minimum requirements for the plant manager include a baccalaureate degree or equivalent and five years of management experience in the nuclear business.

Each component has a defined area of responsibility, and at least three layers of management. The components are overseen by senior plant staff managers, mid-level area managers, and first-line supervisors. WEC's manufacturing component has overall accountability and responsibility for all nuclear fuel manufacturing activities at the CFFF. The quality component is responsible for assurance, inspection, and analytical services in support of the manufacturing and regulatory components. The regulatory component establishes requirements for safety, safeguards and licensed programs, and it evaluates the effectiveness and compliance with these programs. It is overseen by two senior plant staff managers. The safety manager is responsible for five functional areas—nuclear criticality safety, radiation safety, environmental

protection, and industrial, fire and chemical safety. The regulatory component program manager is responsible for five functional areas—emergency preparedness, licensing, integrated safety analysis, procedures and training, and the corrective action program.

Lines of communication and authority among the manufacturing, quality, regulatory, and engineering components are specified in established policies and procedures maintained at the facility. Component managers are knowledgeable in the operating procedures applicable to their work areas, including safety programs. Managers in areas where uranium is present are knowledgeable of nuclear criticality safety controls and other controls identified in the Integrated Safety Analysis (ISA). Managers are also knowledgeable in occupational safety and health practices. At a minimum, a component manager must have a baccalaureate degree, or equivalent, with a science or engineering emphasis, and 2 years of experience in the nuclear business.

The description of WEC's organizational groups was provided in Section 2.1.1.3, "Position Accountability and Requirements," of the LRA which demonstrates a defined management structure. The organization components have distinct responsibilities, and their functions and role in CFFF operations are described. They are overseen by managers whose roles and responsibilities follow written procedures, and the managers have a required minimum qualification. The information provided is consistent with the regulatory acceptance criteria for organizational groups in NUREG–1520, Rev. 1, Section 2.4.3, and therefore meets 10 CFR 70.22, "Contents of applications," and 10 CFR 70.23. Based on its review, NRC staff finds WEC's organizational groups acceptable.

2.3.2 ORGANIZATIONAL HIERARCHY

The organizational hierarchy begins with the CFFF plant manager who has overall accountability and responsibility for the protection of the workers, the public, and the environment and compliance with the regulations. The component managers report to the plant manager, and are accountable and responsible to ensure their staff operate in accordance with WEC policies and management directives. Each component manager oversees multiple subordinates, including first-line supervisors who are responsible to conduct operations safely and according to all regulatory requirements.

The first-line supervisors are responsible for operations. The position has minimum qualification requirements which include a high school diploma, or equivalent, and 2 years of experience in the nuclear business. The role includes assuring that activities are conducted in accordance with operating procedures. They are also responsible to ensure their staff have the appropriate training and follow written procedures.

The regulatory component, which encompasses the safety manager and program manager, has broad responsibility for establishing safety, safeguards, and licensed programs. Its functions include: objective review and assessment of regulatory programs, administrative oversight of safety and safeguards procedures, and assurance of implementation of corrective actions as described in section 2.1.1.3(c), "Regulatory Component Managers and Engineering Functions" (WEC, 2019e). The regulatory component is kept administratively independent of the manufacturing, engineering, and quality components. The regulatory component has the responsibility and authority to prohibit, through the cognizant first-line supervisors, any situation that is believed to involve an imminent hazard. The regulatory component is responsible for evaluating licensed activities to assure the protection of CFFF employees, the public, and the environment.

The LRA provided a defined organization hierarchy which includes the plant manager, component managers, and the first-line supervisor. Each level of management has defined roles with specific areas of responsibility, as described in the LRA. In addition, the regulatory component provided the safety, safeguards, and regulatory functions which are maintained independently of the manufacturing function to avoid conflict of interest. The organizational hierarchy described in the LRA is consistent with the acceptance criteria provided in NUREG-1520, Rev. 1, Section 2.4.3, and therefore meets 10 CFR 70.22 and 10 CFR 70.23. Based on its review, the NRC staff finds WEC's organizational hierarchy acceptable.

2.3.3 SHUTDOWN AUTHORITY

In its LRA, WEC states that the regulatory component has the authority to shut down an operation when an undue imminent hazard is evident. Members of the regulatory component have the responsibility and authority to prohibit, through the cognizant first-level manager, any situation believed to involve undue imminent hazard. Such terminated operations remain in a safe-shutdown state until the situation is reviewed with appropriate management, and there is a consensus resolution of the situation.

In addition, personnel are encouraged to question the safety or security of any operating task or procedure, and may request a review of tasks or procedures at any time. Safety and security concerns are investigated, assessed, and resolved in a timely manner by the cognizant management. Facility personnel are also authorized to stop operations when a procedure cannot be followed safely as written. Based on its review, the NRC staff finds WEC's shutdown authority for CFFF staff to implement for employee-raised safety concerns to be acceptable because it is consistent with the acceptance criteria provided in NUREG–1520, Rev. 1, Section 2.4.3.

2.3.4 REPORTING UNSAFE CONDITIONS

As discussed in LRA Section 2.1.1.2, "Positions and Activities within Organizational Operating Units," (WEC, 2019e), CFFF personnel are encouraged to question and request a review of the safety or security of any operating task or procedure. Employee-raised concerns are investigated, assessed, and resolved through WEC's formal corrective action program (CAP). The CAP is discussed in LRA Section 3.8, "Corrective Action Program (CAP)."

As stated in Section 2.1.1.2, WEC personnel involved in operations at the facility have the right, and are actively encouraged to question, and/or request a review of the safety or security of any operating task or procedure. Concerns are given the proper priority based on their potential safety significance, and investigated, assessed and resolved in a timely manner. If there is any situation that is believed to involve an imminent hazard, such operation will be terminated and remain in safe shutdown until the situation is reviewed and agreed with the cognizant management. In addition, WEC has developed adequate mechanisms for identifying and reporting safety concerns as described in Section 3.7, "Incident Investigations" of the LRA. The program requires abnormal occurrences to be identified, tracked, investigated, and corrective actions implemented. The CAP is also implemented to address and resolve employee-identified concerns. The NRC staff reviewed the licensee's internal procedures RA-134, "Columbia Plant Safety Event Response Guideline," which are maintained onsite. These procedures were updated in 2016, as confirmed by NRC Inspection Report number 70-1151/2016-008 (NRC, 2016d), and are reviewed by inspection staff periodically on an as-needed basis. The internal reporting requirements described in the LRA are consistent with the acceptance criteria

provided in NUREG–1520, Revision 1, Section 2.4.3, and therefore meets 10 CFR 70.22 and 10 CFR 70.23. Based on its review, the NRC staff finds that WEC's formal process to implement, monitor, and resolve employee-raised safety concerns is acceptable.

2.3.5 WRITTEN PROCEDURES

The WEC has formal procedures for conducting operations at the CFFF, changing equipment, changing procedures, and revising the CFFF organization. Written procedures, manuals, postings or other documents are prepared, and are the basis for performing specific operations. A first-level manager cannot make unilateral changes to these documents without formal review and approval of facility management. Changes to procedures are reviewed and approved in accordance with the requirements in Section 3.4.1, "Procedures," of the LRA, to assure that relevant technical and safety disciplines review and approve changes.

Organizational changes made at CFFF that have the potential to impact managers and engineers, or that have regulatory relevancy (e.g., may impact safety, safeguards, and/or other regulatory activities) are assessed for approval by the regulatory component in advance, when feasible. The level of assessment is increased based on the risk of adverse impacts on regulatory activities. The CAP is used to closely monitor implementation and minimize potential impacts. The assessment by the regulatory component and level of oversight by the CAP program is determined prior to implementation, whenever possible.

The WEC has a formal change process that requires any proposed change to the CFFF or to procedures be reviewed by all safety disciplines. These established policies and procedures prevent ad hoc changes to safety practices, safety equipment, and manufacturing operations.

The use of written procedures as described in the LRA is consistent with the acceptance criteria provided in NUREG-1520, Rev. 1, Section 2.4.3, and therefore meets 10 CFR 70.22, and 10 CFR 70.23. Based on its review, the NRC staff finds that WEC has effectively implemented the activities essential for the health, safety, and the environment functions, which are documented in formally approved, written procedures, and prepared in compliance with a formal document control program.

2.3.6 COMMUNICATION AND AUTHORITY

As discussed in Section 2.1.1.3, "Position Accountability and Requirements," of the LRA (WEC, 2019e), the CFFF has a formal organization with clearly delineated lines of authority, see Figure 2.1.

WEC has a formal review process for changes proposed to plant systems, procedures, and maintenance activities. A multidisciplinary safety review consistent with the scope and complexity of the change is performed. Changes are made in accordance with Section 3.1, "Configuration Management," and Section 3.4, "Procedures, Training and Qualification," in the LRA. Staff from the regulatory component are assigned to participate in the review to evaluate the effects a proposed change could have on safety or safeguards functions. This review also ensured proposed changes meet licensing requirements, and do not adversely affect safety or security. The review was documented in accordance with CFFF procedures.

The change process is established to incorporate input from key internal stakeholders, including individuals responsible for the operations of the system. For example, when a change is performed for a specific system, an individual involved in the operation of that system is

required to be a member of the design team. The licensee states in Section 2.1.1.2, "Positions and Activities within Organizational Operating Units," that CFFF staff are encouraged to have a questioning attitude, and differing internal viewpoints are generally taken into consideration and given the proper priority based on their potential safety significance, before a final approach is determined for implementation. However, the regulatory component is responsible for reviewing all changes that could impact safety, safeguard, and/or other regulatory activities. If a matter cannot be resolved, and the regulatory component works through the first-line supervisor to resolve concerns by involving input from other components (e.g., manufacturing, quality, regulatory).

Interactions between component personnel vary with the scope and complexity of the proposed change. For large or complex changes, the staff proposing a change to a system or procedure meets with the regulatory component staff in person, prior to formally submitting the proposed change for review. As the proposed change progresses through the stages of design, additional interactions with the regulatory component staff may occur.

The NRC staff determined that the interactions among the relevant safety disciplines ensure that changes made at the request of one discipline do not adversely affect safety or security of another discipline. The communications and authority described in the LRA is consistent with the acceptance criteria provided in NUREG-1520, Rev. 1, Section 2.4.3. Based on its review, the NRC staff finds WEC has established clear lines of communications and authority among the organizational units involved in the engineering, health and environmental safety, and operations functions of the facility to provide adequate safety for workers, the public, and the environment.

2.3.7 QUALIFICATION AND RESPONSIBILITIES

Section 2.1.1.3, "Position Accountability and Requirements" of the LRA stated that the minimum requirements for the position of a regulatory component manager or engineer are a baccalaureate degree (or equivalent (i.e., 8 years of applicable experience) with a science or engineering emphasis, and at least 2 years of experience in positions involving regulatory activities in the nuclear business. A component manager-in-training that does not meet these minimum requirements has an individual, formally designated by the next highest level of management, to provide direct advice and consultation until the minimum requirements are fully met. The regulatory component engineers receive training and documented qualifications specific to their regulatory activities, as stated in Section 3.4.2.2, "Job Specific Training and Qualification," of the LRA. A detailed description of the requirements for these and other technical positions, including management positions are provided in LRA Sections 2.1.1.3 and 3.4.2, "Training and Qualification."

New employees are trained in regulatory policies, safety and safeguards. General employee training (GET) is required for individuals who perform work at the CFFF. Job-specific training is required for specific positions to assure activities relied on for safety are properly performed. Refresher training and/or requalification is performed on a periodic frequency. WEC has established a training program to ensure all personnel on site are trained to work safely, and possess the knowledge of appropriate actions to take during an emergency, as discussed in Section 3.4.2.1, "General Employee Training (GET)," of the LRA.

Refresher training is required periodically, and provides continuing training in safety hazards and proper radiation protection procedures through annual radiation safety presentations. Section 3.4.2, "Training and Qualification," of the LRA describes further detail on the training

program, to include the selection of instructors, testing and feedback, retraining requirements, and records.

Based on the review discussed above, the NRC staff finds that WEC has adequately defined the qualifications, responsibilities and authorities of key supervisory and management positions responsible for the protection at the CFFF. Therefore, the staff finds that the application is consistent with the acceptance criteria for describing qualifications, responsibilities and authorities as provided in Section 2.4.3 of NUREG-1520, and therefore meets 10 CFR 70.22, and 10 CFR 70.23.

2.3.8 OFF-SITE ORGANIZATIONS

The emergency plan approved by the NRC (NRC, 2019d), as referenced in the license renewal application, provides a description of the off-site response organizations for firefighting, police, ambulance, and medical services. The NRC's detailed review of WEC's emergency plan is documented in Chapter 8 of this safety evaluation report (SER).

2.3.9 MANAGEMENT MEASURES

WEC identified management measures that ensure the availability and reliability of items relied on for safety in Chapter 3, "Management Measures," of the LRA. The NRC's detailed review of WEC's management measures is documented in Chapter 11 of this SER.

2.4 EVALUATIONS FINDINGS

WEC described its organization and management policies for providing adequate safety management and management measures for the safe operation of the facility. The NRC staff reviewed the organization described in the LRA and responses to the request for additional information dated March 28, 2018 (WEC, 2018c) as well as the final LRA submitted on September 21, 2021 (WEC, 2021b). The organizational and administrative elements discussed above describe WEC's responsibilities and associated resources for the safe operation of the facility. The NRC staff concludes that WEC has an acceptable organization, administrative policies, and sufficient qualified resources to provide for the safe operation of the facility under both normal and abnormal conditions, and the requirements of 10 CFR 70.22(a)(6), 10 CFR 70.22(a)(8), and 10 CFR 70.23(a)(2).

CHAPTER 3 INTEGRATED SAFETY ANALYSIS

3.1 PURPOSE OF REVIEW

The purpose of the staff's review of the integrated safety analysis (ISA) information was to determine whether the applicant has established a safety program as stated in 10 CFR 70.62(a) that complies with, and will continue to be in compliance with, Title 10 of the *Code of Federal Regulations* (10 CFR) Part 70, Subpart H, "Additional Requirements for Certain Licensees Authorized to Possess a Critical Mass of Special Nuclear Material." The staff also determined if the ISA Summary provided reasonable assurance in the following three areas:

1) whether the applicant conducted an ISA of appropriate detail for each applicable process, using methods and qualified staff adequate to meet the requirements of 10 CFR 70.62, "Safety program and integrated safety analysis,"
2) whether the applicant identified and evaluated in the ISA credible events involving process deviations or other events internal to the facility (e.g., explosions, spills, and fires) and credible external events that could result in facility-induced consequences to workers, the public, or the environment, that could exceed the performance requirements of 10 CFR 70.61, "Performance requirements," and
3) whether the applicant appropriately designated items relied upon for safety (IROFS), evaluated those IROFS for preventing or mitigating the applicable accident sequences, and applied management measures to provide reasonable assurance that the performance requirements of 10 CFR 70.61 are met.

3.2 REGULATORY REQUIREMENTS

The U.S. Nuclear Regulatory Commission (NRC) staff evaluated Westinghouse Electric Company, LLC's (WEC) ISA program as described in its license renewal application (LRA) and ISA Summary to determine whether WEC meets the following requirements. The regulations in 10 CFR 70.62 specifies the requirement to establish and maintain a safety program, including process safety information, the performance of an ISA that demonstrates compliance with the performance requirements of 10 CFR 70.61 and management measures. The ISA must identify radiological hazards, chemical hazards, facility hazards that could affect the safety of licensed materials and thus present an increased radiological risk, potential accident sequences, consequence and likelihood of occurrence of each potential accident sequence and each IROFS.

The regulations in 10 CFR 70.61 require that the licensee evaluate, in its ISA, its compliance with the performance requirements. Those requirements specify that the risk of each credible high-consequence event must be limited such that the likelihood of occurrence is highly unlikely, and the risk of each credible intermediate consequence event must be limited such that the likelihood of occurrence is unlikely. In addition, the risk of nuclear criticality accidents must be limited by assuring that under normal and credible abnormal conditions, all nuclear processes are subcritical, including use of an approved margin of subcriticality for safety. Preventive controls and measures must be the primary means of protection against nuclear criticality accidents.

In addition, 10 CFR 70.65, "Additional content of application," which specifies the requirement to describe the safety program in the application and outlines the contents of an ISA Summary, is applicable to this license renewal.

3.3 STAFF REVIEW AND ANALYSIS

The NRC staff used the acceptance criteria in Chapter 3 of NUREG-1520 (NRC, 2010a) for this review. The staff evaluated the LRA, the current and previous ISA summaries, the current license, license amendments issued since the last renewal in 2007, inspection reports, and the licensee's responses to the staff's requests for additional information (RAIs). The staff conducted onsite reviews of the ISA program, to assess both the completeness of the ISA as well as the ISA methods used to assess individual facility processes of the ISA program, including a sample of processes and IROFS described in the ISA Summary. The following sections summarize the staff's review and analysis of the licensee's safety program and the ISA Summary.

For fuel cycle facility license applicants under 10 CFR Part 70, NUREG-1520 discussed the acceptance criteria regarding an applicant's safety program as required per 10 CFR 70.62. The staff reviewed the application for demonstration of compliance with Paragraph 70.62(a)–(d). The three elements of the safety program, specifically, process safety information, integrated safety analysis, and management measures are discussed in the following sections.

3.3.1 PROCESS SAFETY INFORMATION

The staff reviewed the ISA Summary and conducted onsite reviews to confirm that WEC provided written information on: (1) the hazards of all materials used or produced in the processes, (2) the technology of the processes, and (3) the equipment used in the processes. The staff finds this information is consistent with the types of process safety information the licensee commits to maintaining in Chapters 3–8 of the LRA. The staff finds that the application has met the acceptance criteria for providing written safety information as outlined in Section 3.4.3.1 of NUREG-1520.

3.3.2 INTEGRATED SAFETY ANALYSIS

In Chapter 4, "Integrated Safety Analysis (ISA)," of the LRA, the licensee committed to conducting and maintaining an ISA of appropriate complexity for each process. The staff performed an onsite review to confirm that the licensee conducts process hazard analyses using acceptable methodologies. The licensee demonstrated, via the ISA Summary, that the results of the ISA have been used to identify process hazards, credible accident scenarios, the consequences and likelihood of those scenarios, and the IROFS needed to meet the performance requirements of 10 CFR 70.61.

As stated in LRA Chapter 4, "Integrated Safety Analysis (ISA)," (WEC, 2019e) and the licensee's response to the NRC's request for information dated, August 31, 2016 (WEC, 2016f), the licensee committed to using methods listed in NUREG-1513, "Integrated Safety Analysis Guidance Document," (NRC, 2001), and CFFF's internal "Integrated Safety Analysis Handbook," to identify credible accident sequences. The licensee also committed to maintaining an accurate and up to date ISA using the configuration management process described in Chapter 3, "Management Measures," of the LRA which serves as WEC's facility change mechanism that meets the requirements of 10 CFR 70.72. The LRA states the ISA team members will use this process to evaluate proposed changes to the facility or its processes. If the evaluation of a proposed change identifies new accident scenarios or increases in accident sequences or likelihoods, Chapter 3, "Management Measures," of the LRA states that WEC uses the configuration management process to promptly evaluate changes to associated IROFS

and management measures. In addition to its configuration management process, the licensee committed to audits of the ISA program every 3 years and the implementation of its ISA methodology every 5 years. As stated in Chapter 4, “Integrated Safety Analysis (ISA),” of the LRA, the 3-year ISA program audit includes the program elements cited in Chapter 4 such as the demonstration of compliance with 10 CFR 70.61, and the maintenance of the ISA and ISA Summary. The 5-year audit evaluates the technical bases and assumptions of the ISA, and monitors the proper implementation of the safety basis. The staff reviewed and discussed with the licensee their results of a 5-year audit, as recorded in a CFFF internal document dated April 10, 2018. The staff found that the audit process was designed to cover all 21 process areas discussed in the ISA Summary and requires, by procedure, a review of the previous two audits and entry of all non-compliances and items for improvement into the corrective action program.

Chapter 4, “Integrated Safety Analysis (ISA),” of the LRA, and the responses to the RAIs related to ISA states that ISA team members must be knowledgeable in ISA methods and in the operation, hazards, and safety design criteria of the process being analyzed. Furthermore, Chapter 3, “Management Measures,” of the LRA described how the ISA team will maintain the appropriate experience and expertise to maintain the ISA.

Based on the onsite review and a review of the documentation mentioned above, the staff found that the application met the acceptance criteria for conducting and maintaining an ISA as outlined in Section 3.4.3.1 of NUREG-1520.

3.3.3 MANAGEMENT MEASURES

In Chapter 3 of the LRA (WEC, 2019e), WEC committed to applying management measures to IROFS specified in the ISA for ensuring the reliability and availability of each IROFS. The staff’s detailed review and analysis of management measures is in Chapter 11 of this safety and safeguards evaluation report (SER).

3.3.4 ISA SUMMARY

The NRC staff reviewed the ISA Summary, including conducting onsite reviews which sampled the ISA. The staff compared the information found during those reviews to the ISA Summary. The staff concluded that the ISA Summary discussed the nine elements required by 10 CFR 70.65(b), which are: (1) a description of the site, (2) a description of the facility, (3) a description of each process in sufficient detail to understand the theory of the process, (4) information that demonstrates the licensee’s compliance with the performance requirements of 10 CFR 70.61, (5) a description of the team, qualifications, and the methods used to perform the ISA, (6) a list briefly describing each IROFS, (7) a description of the proposed quantitative standard used to assess the consequences in 10 CFR 70.61 (b)(4) and (c)(4), (8) a descriptive list that identifies all sole IROFS, and (9) a description of the definitions of “unlikely”, “highly unlikely”, and “credible” as used in the ISA.

However, the staff observed irregularities in the 2014-2017 ISA Summary updates [see (WEC, 2014), (WEC, 2015b), (WEC, 2016), (WEC, 2017a)] and their resolution, which are described further below. Specifically, the staff identified potential non-conservative approaches to determining the likelihood of initiating events, establishing the failure frequency or probability of IROFS, and consistently applying likelihood definitions to accident sequences in its process safety areas. These issues were addressed satisfactorily in the consolidated WEC response to a request for additional information (RAI) dated March 28, 2018 (WEC, 2018c), as

supplemented in the 2018 ISA Summary update (WEC, 2018), 2019 ISA Summary update (WEC, 2019), and the August 22, 2019 LRA (WEC, 2019e).

Table 4.1, "Risk Analysis Table," in the March 7, 2016, LRA represents the criteria used for determining whether the likelihood and consequence of an accident sequence meets the performance requirements of 10 CFR 70.61. A note on the table stated, "When the overall likelihood is calculated quantitatively in units of 'events per year,' the exponent of the likelihood value is used. That is, for an event calculated to occur 4E-5 / year, the overall likelihood index is -5." Using this approach, if the calculated event frequency is 9E-4/year, according to the note from Table 4.1, the licensee would assign an index of -4 even though the frequency is close to 1E-3. In this case, ignoring the significance is equivalent to decreasing the sequence frequency by nearly an order of magnitude without an equivalent change in the availability or reliability of any associated IROFS. Based on its review of the consolidated RAI responses dated March 28, 2018 (WEC, 2018c), the staff confirmed that some calculations in the ISA would change with a more conservative approach to determining the overall likelihood index or accident sequence frequency that may affect its safety determination.

The licensee subsequently revised the note on Table 4.1 in the March 28, 2019 LRA (WEC, 2019b), to conservatively round the likelihood index. The licensee also entered the issue into its corrective action program to evaluate and address the extent of condition from using the non-conservative approach. A record of the licensee's corrective action program showed that the licensee revised the probabilities and frequencies of a list of IROFS using the conservative approach discussed above. The staff confirmed that these changes were reflected in the 2022 ISA Summary (WEC, 2022). As a result, the staff concluded that WEC addressed the issue adequately.

During the onsite reviews of the ISA, the staff discussed with the licensee the uranyl nitrate bulk storage system, the plant ventilation system, the ammonium diuranate (ADU) pelleting system, the scrap uranium processing system, the ADU fuel rod manufacturing area, the integrated fuel burnable absorber (IFBA) rod manufacturing area, the IFBA processing system, the burnable absorber expansion (Erbia) system, the ADU conversion vaporizer area, and the safe geometry dissolver system. Within these systems, the staff reviewed accident sequence fault trees, the associated IROFS and their designated failure rates, probabilities of failure on demand, and resulting likelihood indices.

During the review of the ISA Summary updates submitted in 2014–2017 [see (WEC, 2014), (WEC, 2015b), (WEC, 2016), and (WEC, 2017a)], the staff identified more than one instance where the licensee inconsistently modeled the dependencies of administrative controls. Specifically, a review of the associated procedures identified dependent administrative controls, as described in NUREG1520, Chapter 3, Appendix B, "Qualitative Criteria for Evaluation of Likelihood," credited - non-conservatively - as independent. Evidence of dependence, as described in NUREG-1520, included two different operators performing administrative actions, but using the same equipment and/or procedures. The staff also identified that the failure indices the licensee assigned to many administrative controls involving independent verification, the response to alarms, and visual inspection were not consistent with the reference cited as the justification for the assigned index.

In the consolidated RAI response submitted on March 28, 2018 (WEC, 2018c), the licensee corrected the instances the staff identified, confirmed that the performance requirements were still met, and entered the issue into its corrective action program to assess and address the extent of condition from inconsistently and non-conservatively crediting administrative actions.

In 2022, the licensee provided justifications (WEC, 2022a), supplemented with operating procedures, for the list of IROFS pairs that the staff identified could have dependence effects that would increase the joint failure probability of the IROFS pair, as compared to without dependence effects. The staff agreed with some of the licensee's justifications to treat some IROSF pairs without dependence effects, but not all. As a result, dependence in the remaining IROFS pairs remained an issue. All the IROFS pairs in question were related to criticality events, and the licensee used a fault tree to model each criticality event. The staff reviewed these fault trees to identify the event sequences containing IROFS pairs which should have dependence effects. The staff calculated the dependence effect on the IROFS pairs and the corresponding event sequences. The staff concluded that, even with inclusion of dependence effects, the criticality event sequences still meet the performance requirements in 10 CFR 70.61. For this reason, the staff concluded the dependence issue is closed.

The staff identified in WEC's 2022 ISA Summary that some administrative controls have the same task characteristics (i.e., periodic tasks with a long time between two performances) but have different likelihood estimates. The licensee provided justifications for the different likelihood estimates in response to the staff's information request (WEC, 2022a). The staff concluded that the licensee's justification was acceptable. As a result, the issue is closed.

The staff evaluated how the licensee implements its likelihood definitions, as specified in its ISA methodology, for unlikely, highly unlikely, and not credible. The staff reviewed accident sequences associated with criticality, chemical, fire, and radiological safety. The staff found that for credible fire and radiological accident sequences, the licensee designated initiating event frequencies, failure frequencies, and consequences consistent with its ISA methodology. For chemical accident sequences, Table 4.2 of the LRA dated, August 22, 2019 (WEC, 2019e), refers to emergency response planning guidelines (ERPGs) which are based on acute inhalation toxicity. However, the American Industrial Hygiene Association does not develop ERPGs based on other exposure routes unless inhalation data are unavailable or limited. Although the ISA Summary does not apply quantitative standards for all exposure routes for chemical accident sequences, the staff found that all exposure pathways are considered via the chemical safety program as required by 10 CFR 70.62. In Chapter 6, the staff provides a detailed discussion of those quantitative standards and the licensee's methodology for considering all exposure routes.

The staff reviewed the licensee's criticality safety evaluations (CSEs) and evaluated rationales for concluding that an accident sequence is not credible. The ISA Summary lists three criteria that a sequence or event must meet to be considered as not credible. These three criteria are consistent with those in NUREG-1520, Chapter 3, Appendix B, "Qualitative Criteria for Evaluation of Likelihood" and include consideration of the frequency of occurrence, the need for many unlikely upsets, and bounding physical laws. The first and third criteria were explicitly documented in the ISA Summary. The second criterion is subject to some interpretation regarding the bases for evaluating the effects of task dependency on the reliability of administrative IROFS. Therefore, during the review of the CSEs, the staff focused on the second criterion for an event or sequence that is not credible, as stated in the licensee's ISA Summary (WEC, 2019). The second criterion states:

> A process deviation that consists of a sequence of many unlikely upsets, including human actions or errors for which there is no reason or motive. (In determining that there is no reason for such actions, a wide range of possible motives, short of intent to cause harm, must be considered. Necessarily, no such sequence of events can ever have actually happened in any fuel cycle facility).

The staff identified some CSEs in the 2014–2017 ISA Summary updates, (see (WEC, 2014), (WEC, 2015b), (WEC, 2016), (WEC, 2017a)), in which the information presented did not support the conclusion that the sequence was incredible. Specifically, the information in the CSE would provide only a few upsets; did not justify qualitatively or quantitatively the assumption of “unlikely;” would not consistently identify whether the upsets in question were human actions or did not fully explain the underlying assumptions for concluding “no reason or motive.” For a number of accident sequences identified by the NRC staff, the licensee corrected the CSE to conclude that the sequence was credible but highly unlikely. In the other cases, the staff determined there was insufficient documentation in the CSE to allow the staff to accept the licensee’s conclusion that an event sequence was incredible. In the consolidated responses to the RAIs submitted on March 28, 2018 (WEC, 2018c), the licensee entered the issue of incorrectly determining or better documenting the credibility of accident sequences into its corrective action program to evaluate the extent of condition. The staff reviewed the 2018 ISA Summary update to confirm that the licensee made changes based on the entries into its corrective action program. Based on its evaluation of these actions, the staff concluded that the 2018 ISA Summary update (WEC, 2018) and 2019 ISA Summary update (WEC, 2019), demonstrates that the licensee conservatively and consistently applied its ISA methodology to the process safety areas.

For natural phenomena hazards (NPH), the staff performed an evaluation and inspection of the readiness of WEC to address NPH and other licensing bases events concerning NPH in 2016. The staff's evaluation of NPH for WEC was documented in a 2016 Staff Evaluation Report (NRC, 2016c). For this license renewal safety evaluation, the staff reviewed the 2022 ISA Summary to determine whether WEC continues to identify and evaluate all credible accident sequences including natural phenomena such as floods, high winds, tornadoes, and earthquakes. For NPH other than flooding, the staff found that the NPH assessments as well as the IROFS and accident sequences relating to these NPH did not significantly change comparing to the staff’s 2016 NPH review, which found that Westinghouse adequately addressed the potential consequences of NPH events. The staff concluded that the review and findings described in the 2016 Staff Evaluation Report remain applicable for NPH other than flooding at the CFFF facility. Therefore, the staff concludes that the CFFF complies with the performance requirements of 10 CFR 70.61 with regard to natural phenomena events other than flooding.

For the flood hazard, the staff reviewed the licensee’s evaluation in Section 4.2 of the Sites and Structures ISA Summary. As part of the staff’s environmental review, the staff issued an RAI on February 18, 2022 (NRC, 2022) requesting information regarding the flood hazard evaluation. WEC responded to the RAI on March 21, 2022 (WEC, 2022d) and enclosed an update to their Site and Structures ISA Summary (WEC, 2022a), which included a revised flood hazard evaluation. WEC revised the flood hazard evaluation using the current flood map data from the Federal Emergency Management Agency’s Flood Insurance Rate Map, which has a 2017 effective date for the CFFF site. The flood map showed that a small, undeveloped area of the site lies in a 100-year floodplain (i.e., a flooding is expected within 100 years). However, the manufacturing area of the facility and the majority of the site was outside of a 500-year floodplain (I.e., a flooding event is not expected within 500 years). WEC concluded that it was highly unlikely that flooding would cause a safety impact to facility. The staff reviewed the results from the updated flood map and the accident sequences and IROFS relating to the flood hazard. The staff noted that WEC’s previous flood hazard evaluation similarly concluded a small area of the site was susceptible to the 100-year flood, the facilities were outside of the 500-year flood plain, and the consequences from a flood event were highly unlikely. The staff noted that

no significant changes were made to the flood-related IROFS or accident sequences. Because the results and conclusions of the flood hazard analysis did not significantly change, the staff determined that the previously approved IROFS and accident sequences related to flooding remained acceptable. The staff concluded that the flood hazard evaluation followed a methodology that was consistent with NRC guidance in NUREG-1520, Chapter 3, Appendix D, "Natural Phenomena Hazards." Because the evaluation determined the main manufacturing building of the facility remained above the 500-year flood plain and no significant changes were made to flood-related IROFS or accident sequences, the staff concluded that the CFFF complies with the performance requirements of 10 CFR 70.61 with regard to flooding events.

The acceptance criteria in Section 3.4.3.2 of NUREG-1520 included an ISA Summary that contains the information as outlined in 10 CFR 70.65(b) and demonstrated that the ISA Summary consistently identifies and evaluates credible events involving process deviations or other events internal to the facility (e.g., explosions, spills, and fires) and credible external events that could result in facility-induced consequences to workers, the public, or the environment, that could exceed the performance requirements of Section 70.61 and documents IROFS designated to maintain compliance with Section 70.61. Based on the onsite review, the review of the documentation mentioned above, and the licensee's corrective actions, the staff finds that the licensee meets the acceptance criteria of Section 3.4.3.2 of NUREG-1520 and demonstrates reasonable assurance of compliance with 10 CFR 70.61 and 70.65.

3.4 EVALUATION FINDINGS

The staff finds that the licensee described a safety program that complies with the requirements of 10 CFR 70.65(a) and commits to maintain a safety program compliant with 10 CFR 70.62. The staff finds that the safety program includes process safety information, an ISA, and management measures that demonstrate the safety program meets the performance requirements of 10 CFR 70.61.

The staff finds that the ISA Summary demonstrated that the licensee has established an ISA methodology with the necessary elements to designate IROFS, evaluate those IROFS for preventing or mitigating the applicable accident sequences, and applying management measures that meet the performance requirements of 10 CFR 70.61. The staff also finds that the ISA Summary contains the contents as outlined in 10 CFR 70.65(b). The staff's review also determined that the ISA Summary demonstrates the licensee consistently identified and evaluated credible criticality, fire and radiological events involving process deviations or other events internal to the facility (e.g., explosions, spills, and fires). The licensee also identified credible external events that could result in facility-induced consequences to workers, the public, or the environment, that could exceed the performance requirements of 10 CFR 70.61. The ISA Summary describes quantitative standards for inhalation chemical exposure accident sequences. The staff found that all exposure pathways are considered via the chemical safety program as required by 10 CFR 70.62. In addition, the licensee's chemical safety program, as described in Chapter 6, demonstrates that the licensee's ISA considers all exposure pathways.

The NRC staff finds that the licensee established an ISA program that is in compliance with 10 CFR Part 70, Subpart H. The staff finds that the ISA Summary demonstrates compliance with the performance requirements of 10 CFR 70.61. Specifically, the staff finds that the licensee has conducted an ISA of appropriate detail for each applicable process, using methods adequate to achieve the requirements of 10 CFR 70.62. The licensee has identified and evaluated in the ISA credible events involving process deviations or other events internal to the facility (e.g., explosions, spills, and fires) and credible external events that could result in

facility-induced consequences to workers, the public, or the environment, that could exceed the performance requirements of 10 CFR 70.61. In addition, WEC designated IROFS, evaluated those IROFS for preventing or mitigating the applicable accident sequences, and applied management measures that meet the performance requirements of 10 CFR 70.61.

CHAPTER 4 RADIATION PROTECTION

4.1 PURPOSE OF REVIEW

The U.S. Nuclear Regulatory Commission (NRC) staff conducted this review to determine whether the radiation safety program (RSP) described in the Westinghouse Electric Company, LLC (WEC) license renewal application (LRA) (WEC, 2019c) is adequate to protect the radiological health and safety of workers and to comply with the regulatory requirements in Title 10 of the *Code of Federal Regulations* (10 CFR) Part 19, "Notices, Instructions and Reports to Workers: Inspection and Investigations," 10 CFR Part 20, "Standards for Protection Against Radiation," and 10 CFR Part 70, "Domestic Licensing of Special Nuclear Material."

4.2 REGULATORY REQUIREMENTS

The regulatory requirements for this review of radiation protection are generally described in 10 CFR 70.23(a)(3) and (4). Approval of an application requires that the proposed equipment and facilities are adequate to protect health and minimize danger to life or property, and that the licensee's proposed procedures to protect health and to minimize danger to life or property are adequate. The radiation protection program must address radiation protection measures identified in 10 CFR Parts 19, 20, and 70. Part 20 has specific radiation protection requirements which are addressed in this section. Section 20.1101(a) states that each licensee shall develop, document, and implement a radiation protection program commensurate with the scope and extent of licensed activities and sufficient to ensure compliance with the provisions of Part 20.

4.3 STAFF REVIEW AND ANALYSIS

The NRC staff used the acceptance criteria in Chapter 4 of NUREG-1520, Revision 1, "Standard Review Plan for Fuel Cycle Facilities License Application" (NRC, 2010a) to guide this portion of the review. The information to support this review was obtained from multiple submittals, including the original submittal of the license application dated July 31, 2014 (WEC, 2014b). WEC supplemented its application with additional submittals dated December 17, 2014 (WEC, 2014d), August 31, 2016 (WEC, 2016f), March 22, 2017 (WEC, 2017b), March 28, 2018 (WEC, 2018c), June 21, 2018 (WEC, 2018d), and July 11, 2019 (WEC, 2019c).

The staff notes that the CFFF has an existing RSP which has been reviewed and inspected for many years. In its LRA, WEC proposes no significant changes to the program and commits to maintaining the various elements of the program during the term of the renewed license, as discussed below. The NRC staff evaluated the various elements of the program to determine compliance with the applicable regulations.

4.3.1 RADIATION PROTECTION PROGRAM IMPLEMENTATION

The NRC staff evaluated the information provided by the licensee following the guidance and acceptance criteria found in Chapter 4.4.1.3 of NUREG-1520 (NRC, 2010a).

In Section 5.2.2 of the application, the licensee committed to implementing and maintaining an RSP which assures that exposure of workers to radiation and radioactive materials is kept as low as reasonably achievable (ALARA). Section 2.1.1.3, "Position Accountability and Requirements," of the LRA provides an overview of the CFFF organizational structure and programs, including the radiation safety function, which describes general requirements for

ALARA, radiation protection, nuclear criticality safety, license and permit administration, emergency planning, monitoring and reporting of the effectiveness of programs, and maintenance of regulatory procedures and plans. Specific details of the RSP are identified in Section 5 of the LRA.

Figure 2.1, CFFF Organization, shows the organizational relationships. The CFFF plant manager has the ultimate responsibility for ensuring plant operations utilizing special nuclear material (SNM) are conducted in a manner that is protective of its workers, the public, and the environment. The organizational chart demonstrates that the radiation safety function manager will be responsible directly to the regulatory component safety manager in matters of radiological safety. Section 2.1.1.3(c) lists several of the general responsibilities of regulatory component management. The regulatory component is responsible for the establishment, conduct, and continuing evaluation of licensed activities to assure the protection of CFFF employees, the public, and the environment. The licensee stated in Section 3.4.2.2, “Job Specific Training and Qualification,” of the LRA that individuals assigned to positions/activities involving licensed materials will be trained and qualified to perform their job in a manner that does not adversely affect safety. Section 2.1.1.3, “Position Accountability and Requirements,” of the LRA states that the licensee will maintain and implement the RSP independent from facility operations. As stated in section 5.2.6, WEC tracks ALARA progress in an evaluation of the RSP which is conducted annually and reported to the ALARA Committee.

The LRA included the use of engineered and administrative controls to maintain radiation exposure ALARA; development of procedures for implementation of the RSP; implementation of a self-assessment program to periodically (at least annually) review the RSP; and a staff of suitably trained radiation protection personnel, with sufficient resources to implement the RSP independent from facility operations.

The RSP is administered by the regulatory component function. The manager of the radiation safety function is responsible for administering the activities associated with radiological safety as necessary to ensure the protection of employees at WEC CFFF and the community. The radiation safety function administers the safety monitoring program to comply with license conditions and all applicable local, state, and Federal regulations. Regulatory engineers function in assisting the manager, and are charged with developing and implementing radiological control programs to meet the safety goals and objectives.

Section 3.6, “Audits,” of the LRA stated the regulatory component oversees an internal audit program to verify that operations are being performed in compliance with regulatory requirements and license commitments. Section 5.2.7 describes an annual ALARA audit and assessment schedule is planned and documented.

The licensee committed to establishing key program personnel with program ownership and responsibility. The licensee currently staffs its existing RSP with sufficient personnel and resources to implement the program. During the 2022 license performance review (NRC, 2022a) the NRC found the licensee to have no specific areas needing improvement with regard to radiological controls.

As indicated above, 10 CFR 20.1101(a) requires a licensee to have a program commensurate with the scope of activities requested. The LRA described an RSP appropriate for possession, handling, and procedures for use of materials described. The RSP describes an adequate organizational structure, providing appropriate management oversight of materials, ensuring the radiation safety organization is adequately trained and staffed, with sufficient independence to

safely carry out work, and is annually reviewed by key management personnel as required by 10 CFR 20.1101(c). Based on the staff's evaluation of the licensee's commitments pertaining to the acceptance criteria in Section 4.4.1 of NUREG-1520 (NRC, 2010a), the staff finds that the current RSP satisfies the requirements in 10 CFR 20.1101(a) and will continue to do so during the renewed license term. Therefore, the NRC staff finds that the RSP is acceptable.

4.3.2 ALARA PROGRAM

The NRC staff reviewed the licensee's ALARA program commitments against the acceptance criteria in NUREG-1520 (NRC, 2010), Section 4.4.2.3. The following discussion identifies each acceptance criterion from NUREG-1520 (NRC, 2010a) and provides the staff's evaluation as to whether the information provided by the licensee meets the criterion.

In Section 5.2.2 of the application, WEC commits to implementing an ALARA program using written procedures to ensure that radiation exposures to workers and off-site releases of radioactivity are kept both below regulatory limits and ALARA such that exposures are consistent with the requirements of 10 CFR 20.1101. Section 5.2.3 of the LRA states that an ALARA Committee is established to review and recommend actions to minimize radiation exposures, consider alternative engineered controls, establish program goals, and implement other dose reduction techniques. The ALARA Committee includes personnel from radiation protection, environmental safety, operations managers, and other professionals, as needed.

LRA Section 5.2.4 stated the appropriate senior component manager maintains oversight of the CFFF commitment to assure exposures to radiation and radioactive materials remain ALARA. Requirements are established to prevent or minimize the hazards of radioactivity and radioactive materials. The licensee stated that ALARA requirements are included in all operating procedures. Section 3.4.1, "Procedures," stated that activities involving licensed material are conducted in accordance with properly issued and approved procedures. Section 3.4.1 states that a technical review of CFFF procedures are performed every 2 years.

Section 5.1 of the application stated that the CFFF maintains a radiation safety program for the site, with the purpose of assuring that exposure of workers to radiation and radioactive materials is kept ALARA. Section 5.2.7 stated the content and implementation of the RSP is reviewed annually. The ALARA Committee reviews the program, and evaluates if exposures, releases and contamination levels are in accordance with the ALARA concept. Two of the functions of the ALARA Committee, described in Section 5.2.3 of the LRA, is the establishment of program goals and reviewing the implementation of required changes. The senior regulatory component manager is the Chairperson of the ALARA Committee. The committee reviews short and long-term ALARA progress, which are reported to management at least annually.

Procedures are issued to ensure safe operation of routine work and compliance with State and Federal regulations, permits, and licenses. A process is established for procedure generation, modification, approval, distribution, and training. Non-routine processes performed by the CFFF are administered by a radiation work permit (RWP) system, also described in written procedures. The RWPs specify the necessary radiation safety controls, as appropriate. Regulatory component approvals are required for all aspects of changes to procedures involving nuclear materials. The appropriate component manager is responsible for communicating the content of such procedural changes to appropriate personnel, through training and posting of instructions. Each affected individual involved in work under an RWP reviews the requirements, and work is subject to monitoring by the radiation safety function.

Based on the NRC staff's evaluation of the LRA commitments pertaining to the acceptance criteria in Section 4.4.2.3 of NUREG-1520 (NRC, 2010a), the staff finds that the ALARA program is acceptable because the procedures are based upon sound radiation protection principles to achieve occupational doses and doses to members of the public that are ALARA, as required by 10 CFR 20.1101(b). Section 3.4.1, "Procedures," of the LRA states activities involving licensed material are conducted in accordance with properly approved and issued procedures. Section 5.2.3 of the LRA establishes that the CFFF will use, to the extent practical, procedures and engineering controls to assure that operations utilizing SNM are conducted in a manner that is protective of its workers, the public, and the environment and that is in compliance with applicable Federal, State, and local regulations, licenses, and permits. The NRC staff concludes that WEC's radiation safety program and implementation procedures will continue to satisfy the requirements in 10 CFR Paragraph 20.1101(c) during the renewed license term. Therefore, the NRC staff finds that the ALARA Committee and its program review process to be acceptable.

4.3.3 ORGANIZATION AND PERSONNEL QUALIFICATIONS

The staff reviewed the licensee's organization and personnel qualifications against the acceptance criteria in NUREG-1520, Section 4.4.3.3. Section 19.12 of 10 CFR, "Instructions to workers," identifies basic training criteria for all individuals, who in the course of their employment, are likely to receive in a year an occupational dose in excess of 100 millirem (mRem). The NRC staff reviewed the licensee's organization and personnel qualifications, as described in Section 3.4.2, "Training and Qualification." An LRA should sufficiently describe an adequately staffed and trained organization, appropriate procedures and approval authority, and necessary equipment and documentation to ensure protection of health and the environment relative to the material or process requested. The following discussion identifies each acceptance criterion from NUREG-1520 and summarizes the staff's evaluation as to whether the information provided by the licensee meets the criterion.

General employee training (GET) is required for individuals who perform work at the CFFF. Job-specific training is required for specific positions to assure activities relied on for safety are properly performed. Refresher training and/or requalification is performed on a periodic frequency. The CFFF has established a training program to ensure all personnel on site are trained to work safely and possess the knowledge of appropriate actions to take during an emergency, as discussed in Section 3.4.2.1, "General Employee Training (GET), of the LRA. New employees receive training in regulatory policies, safety and safeguards. Employees are trained commensurate with the work assignment and the risk involved.

Refresher training is required periodically and provides continuing training in safety hazards and proper radiation protection procedures through annual radiation safety presentations. Section 3.4.2, "Training and Qualification," of the LRA describes further detail on the training program, to include the selection of instructors, testing and feedback, retraining requirements, and records.

The licensee described the organization of and personnel qualifications for the regulatory component staff in Section 2.1.1.3 of the LRA. The CFFF plant manager directs all activities of licensed operations, either directly or through designated management personnel. Safety and control of operations is managed by delegating and assigning responsibility to qualified area managers who are charged with operating the facility in accordance with regulations. Figure 2.1 of the LRA shows the organizational chart for the CFFF and Section 2.1.1.3, "Position Accountability and Requirements," of the application provides a description of the components.

To the extent practical, the regulatory component safety functions are administratively independent of production and key responsibilities as outlined in Section 2.1.1.3(c), "Regulatory Component Managers and Engineering Functions." The minimum requirements for a position of regulatory component manager are a baccalaureate degree, or equivalent (i.e., 8 years of applicable experience), with a science or engineering emphasis, along with at least 2 years of experience in the nuclear business. Programs under the regulatory component safety manager include nuclear criticality safety, radiation safety, environmental protection, industrial, fire, and chemical safety, and safeguards.

Section 2.1.1.3(c), "Regulatory Component Managers and Engineering Functions," of the LRA describes the responsibilities and requirements of the radiation safety function program for the CFFF. The minimum requirements for a position of site representative are a baccalaureate degree or equivalent in science and engineering and at least 2 years of experience in applied radiation protection. Section 2.1.1.3(c) , "Regulatory Component Managers and Engineering Functions," of the LRA describes the responsibilities administered by the radiation safety functions including the development of procedures to control contamination, exposure of individuals to radiation, and integrity and reliability of radiation detection instruments; the evaluation of radioactive effluents and material releases from the sites; maintaining a robust program for keeping exposures to radiation and radioactive material, and releases of radioactive materials to the environment ALARA; maintaining required records and reports to document RSP activities.

Minimum training requirements for RSP staff were prescribed in Section 2.1.1.3(d), "Regulatory Component Managers and Engineering Qualifications," of the LRA. A site regulatory function engineer shall hold a bachelor's degree or equivalent in science and engineering, and at least 2 years of experience in applied radiation protection. Regulatory function engineers receive training and documented qualification specific to their regulatory activities, as stated in Section 3.4.2.2 of the application. In addition to a didactic component, there is a skills and abilities evaluation performed by the individual's supervisor, which may include reports of internal and compliance audits, and results of safety analyses and regulatory evaluations performed by the engineers. This evaluation is in accordance with written procedure and documented. An engineer-in-training that does not meet these requirements is assigned to a qualified engineer, who will provide direct advice and consultation until the minimum requirements prescribed by an approved checklist are fully met. Refresher training varies by departments and functions and is specified in the CFFF Electronic Training and Procedure System (ETAPS), which specifies training certifications and requirements for individuals.

The CFFF plant manager has overall responsibility for safety and the activities conducted at the facility. Responsibilities are delegated to component managers, who are knowledgeable in the operating procedures in their work areas. The regulatory component function is an area manager designated with overall responsibility to ensure compliance with Federal, State, and local regulations governing operations at the CFFF. The radiation safety function is part of the described regulatory component function. The LRA committed to have a staff of suitably trained radiation protection personnel at the facility with sufficient resources to implement the RSP independent from facility operations. A regulatory component manager-in-training that does not meet these requirements will be assigned to an individual, at the next higher management level, to provide direct advice and consultation until the minimum requirements are met, prescribed by an approved checklist are fully met. Typically, the advisor in this capacity would be an individual who was formerly a regulatory component manager or possesses equivalent experience in health physics.

Based on the staff's evaluation of the application commitments pertaining to the acceptance criteria in Section 4.4.3.3 of NUREG-1520 (NRC, 2010a), the staff finds the RPP organization will adequately protect health and minimize danger to life and property in accordance with 10 CFR 70.23(a)(4), and that CFFF personnel will be qualified by reason of training and experience to use the licensed material for the purpose requested in accordance with 10 CFR 70.23(a)(2). Therefore, the NRC staff finds that the organization and personnel qualifications are acceptable. The CFFF has established a training program commensurate with the scope of licensed activities and personnel activities. All CFFF personnel on site receive general employee training and employees with more specialized functions receive additional training. The NRC staff concludes that the CFFF program for training of the workforce will continue to satisfy the requirements in 10 CFR 70.23(a)(2). Therefore, the NRC staff finds that WEC's CFFF training program to be acceptable.

4.3.4 WRITTEN PROCEDURES

The NRC staff reviewed the licensee's written procedure commitments against the acceptance criteria in NUREG-1520 (NRC, 2010a), Section 4.4.4.3. The following discussion identifies each acceptance criterion from NUREG-1520 and summarizes the staff's evaluation as to whether the information provided by the licensee meets the criterion.

In Section 3.4.1, “Procedures,” of the LRA, the licensee describes the general operating philosophy of WEC, committing to written procedures in all of its facilities. Section 3.1, “Configuration Management,” of the LRA states that design requirements are governed by written plant procedures which establish specifications and standards applicable to the design process for engineered systems and equipment installed or modified at the CFFF. Furthermore, the configuration management procedures are in place by the regulatory component to include how regulatory reviews of changes are performed. Procedures include instructions to establish an integrated process for providing the environmental protection, radiation safety, criticality safety, chemical safety, and fire safety reviews. Section 3.4.1, “Procedures,” of the LRA states activities involving licensed material are conducted in accordance with properly issued and approved procedures and acceptable practices for safety and safeguards activities are provided to operations components in procedures that are approved by the safety or regulatory component. Section 5.2.8 of the LRA describes the WEC process for generation of RWPs. An RWP is required for all temporary configuration changes, to include change duration for all work for which safety requirements are not specifically covered by an approved procedure.

Procedures, training, and qualification are integrated into a combined process to assure that safety and safeguards activities are being conducted by trained and qualified individuals, in accordance with WEC policies, procedures, and commitments to regulatory agencies. Section 3.4.1, “Procedures,” commits to technical review of procedures every 2 years, or more frequently if the document owner determines more frequent review is needed.

The content of these procedures is communicated through incorporation into appropriate operating and quality procedures. Regulatory component approvals are required for all aspects of procedures, and changes to such procedures, involving nuclear materials. WEC management is responsible for communicating the content of procedures through training, access to the electronic training and procedure system, and the posting of instructions. The corrective action program (CAP) can also identify the need for procedure review and revision. When a modification is proposed, it is reviewed by various disciplines to assure that the requirements of 10 CFR 70.72 are met. When a modification has an impact on existing items relied on for safety (IROFS) or requires new IROFS, procedures affecting IROFS must be approved and issued

prior to implementation. The WEC CFFF configuration management program assures that WEC CFFF maintains control of changes to procedures and requires review and approval to ensure these continue to meet applicable regulations.

The RWPs will be used to delineate radiological controls, special monitoring, surveillance, and safety precautions that must be taken to maintain exposure ALARA as stated in Section 5.2.9 of the LRA. The RWP and job site/work evolution is reviewed before beginning work. This review normally includes a visual inspection of the work site to determine the appropriateness of proposed controls and a pre-job briefing for workers. Specific criteria are outlined in Section 5.2.8 for RWP generation and include the potential release of detectable contamination outside of a contamination controlled area (CCA), concentrations of airborne radioactivity greater than 50 percent of the derived air concentration (DAC), a deep dose equivalent (DDE) in excess of 100 millirem (mRem), or a total effective dose equivalent (TEDE) predicted to exceed 10 percent of a 10 CFR 20.1201 or 20.1301 limit. The RWPs shall be posted at the work site and only personnel who have completed required safety training and are on the approved personnel access list are assigned to work under an RWP. The RWPs shall include personnel qualification forms, procedure lists, surveillance forms, configuration control forms, the installation package, and specific protection requirements as determined by the regulatory component the radiological hazards, and the sufficiency of radiological controls provided by other means.

Based on the staff's evaluation of the LRA commitments pertaining to the acceptance criteria in Section 4.4.4.3 of NUREG-1520 (NRC, 2010a), the staff finds that the procedural controls will adequately protect health and minimize danger to life and property in accordance with 10 CFR 70.23(a)(4). The LRA prescribes the use of written procedures, which are prepared, authorized, and approved through the ETAPS as stated in response to the request for additional information (RAI 41) of the March 28, 2018 submittal (WEC, 2018c). The WEC's configuration management program maintains control of procedures and requires multi-disciplinary review and approval to ensure procedures comply with regulations. The WEC has established an adequate program for the development of written procedures that incorporate engineering controls with the goal of minimizing personnel exposures in keeping with ALARA policy. The NRC staff concludes that WEC's program for the use of written procedures will continue to satisfy the requirements in 10 CFR 20.1101(b) during the renewed license term. Therefore, the NRC staff finds that WEC's use of written procedures and engineering controls are acceptable.

4.3.5 TRAINING

The staff reviewed the licensee's training commitments against the acceptance criteria in NUREG-1520, Section 4.4.5.3. The following discussion identifies each acceptance criterion from NUREG-1520 (NRC, 2010a) and provides the NRC staff's evaluation as to whether the information provided by the licensee meets the criterion:

In Section 3.4.2, "Training and Qualification," of the LRA, WEC committed to providing training to every employee at the CFFF commensurate with their duties. Section 3.4.2.1, "General Employee Training," of the LRA described the CFFF requirement for general radiation worker initial and refresher training. A description of the topics that are a part of radiation worker training are generally identified and include regulatory aspects of radiation and radioactive materials, risks involved in receiving low-level radiation exposure, basic criteria and practices for radiation protection, maintaining radiation exposures and radioactivity in effluents ALARA, nuclear criticality safety, and nuclear material safeguards. The training provided for general radiation workers is consistent with the requirements set forth in 10 CFR 19.12. All new employees receive training in regulatory policies, general safety and safeguards practices, and

emergency response. Employees designated to be radiation workers receive additional training relative to the regulatory aspects concerning radiation and radioactive materials, risks involved in low-level radiation exposure, basic practices for radiation protection, and maintaining radiation exposures ALARA. Refresher training is scheduled for radiation workers annually, to include a written examination. Key training topics for annual refresher training include:

(a) ALARA principles
(b) General health physics rules and practices
(c) General nuclear criticality safety practices
(d) Industrial safety and hygiene practices
(e) Chemical area work practices
(f) Radiation risks
(g) Fire safety practices
(h) Environmental protections
(i) Emergency planning, and
(j) Safeguards

Section 3.4.2.1, "General Employee Training (GET)," of the LRA stated facility visitors are provided with training commensurate with their visit's scope and are escorted by trained employees. Employees or visitors for whom respiratory protection devices might be required receive pre-work training on the use of such devices. Section 3.4.2.2 of the LRA states that training and qualification of regulatory component personnel includes the necessary requirements to assure personnel are trained and qualified to perform specific regulatory activities in accordance with approved procedures and/or applicable regulations.

The WEC's training and qualification program is performance-based to meet specific job competencies and requirements. The training and qualification program is conducted in accordance with approved procedures. The WEC maintains the documentation and generation of training requirements in the ETAPS. The system includes programmatic requirements for the preparation, approval, distribution, revision, control, and use of electronic training certifications at the CFFF. The system also includes tracking and documentation of training requalification.

Based on the staff's evaluation of the LRA commitments pertaining to the acceptance criteria in Section 4.4.5.3 of NUREG-1520 (NRC, 2010a), the staff finds that the training program will continue to ensure that WEC CFFF personnel are qualified by training and experience to safely use licensed material in accordance with the 10 CFR 70.23(a)(2) requirements. The WEC LRA describes a robust training program that includes refresher training and on-the-job training. Training programs are managed within the ETAPS. Appropriate training is provided to individuals likely to receive more than 100 mrem of occupational exposure in a year. All such individuals receive training in accordance with 10 CFR 19.12. Therefore, the NRC staff finds that this program is acceptable.

4.3.6 VENTILATION AND RESPIRATORY PROTECTION PROGRAMS

The staff reviewed the licensee's ventilation and respiratory protection program commitments against the acceptance criteria in NUREG-1520 (NRC, 2010a), Section 4.4.6.3. The following discussion identifies each acceptance criterion from NUREG-1520 (NRC, 2010a) and provides the staff's evaluation as to whether the information provided by the licensee meets the criterion:

Section 5.2.14 of the LRA stated that the design criteria for inward air flow through the open face of a containment enclosure in a process area used to handle radioactive material that has a propensity to suspend in air is at least 100 linear feet per minute. Enclosure velocities are tested quarterly and all systems that fail to meet velocity criteria are corrected immediately or taken out of service until corrected. Gloveboxes or similar enclosures are used when containment by conventional ventilation hoods is not possible or practical. These systems are operated at a negative pressure normally and equipped with instrumentation for measuring differential pressure. Ventilation hoods and gloveboxes are constructed primarily of metal and use glass or Underwriters Laboratories fire-rated plastic.

Sections 5.2.13 of the LRA discussed general ventilation design. The ventilation systems are designed and operated to assure adequate control of radioactive dust and particulate. Air flows are typically maintained from non-process areas to process areas and are monitored and corrected as needed as directed by the radiation safety function. The design is to direct flow from areas of low contamination potential to areas of increasing contamination potential when uncontained radioactive material is present. Ventilation for occupied areas will be designed to maintain average work station concentrations of airborne radioactive materials, during normal conditions, below the DAC values in Appendix B to 10 CFR Part 20. Ventilation systems exhausting to the atmosphere are sampled continuously for radioactivity. If action levels are exceeded, mitigating actions will be taken to minimize release to the public and the environment. The administrative limit for dose to the public is reviewed and approved annually by the ALARA Committee. In special circumstances where engineering controls are impractical or infeasible, alternatives such as portable containment or respiratory protection devices, will be implemented to limit exposure to radioactive materials.

In sections 5.2.55 to 5.2.57 of the LRA, WEC's application described its respiratory protection program. The staff finds that WEC's respiratory protection program provides reasonable assurance of compliance with requirements in 10 CFR Part 20, Subpart H, "Respiratory Protection and Controls to Restrict Internal Exposure in Restricted Areas." When engineering or administrative controls are not practical for protecting individuals from radioactive material, WEC will implement its respiratory protection program. The primary objective of the program is to prevent or mitigate a hazardous condition at the source. The program delineates responsibility, conditions of use, and guidelines for limitations on work periods.

Areas where exposure to airborne radioactive material is a risk are monitored by air sampling, as stated in Section 5.2.24. The licensee committed to the guidance in Regulatory Guide 8.25, "Air Sampling in the Workplace," (NRC, 1992b) to assess breathing zone representation. All new operations and substantive modifications to existing equipment are evaluated to assess the need for air sampling. Air flow measurement devices on air samplers are routinely verified for proper adjustment and operation by the radiation safety function. Chapter 3 of the LRA describes the management measures for maintaining IROFS reliable and available. Management measures are addressed in another section of this safety and safeguards evaluation report (SER).

Section 5.2.19 stated that exhausts from hoods, gloveboxes, and similar enclosures are passed through high-efficiency particulate air (HEPA) filtration that is monitored on a routine basis to assure they meet maximum differential pressure, as approved by the radiation safety function. The HEPA filters are replaced using one or more of these criteria; a routine schedule, airborne radioactive concentrations, hood velocity, the evaluation of differential pressure, and particulate penetration. HEPA filters from exhausts from re-circulating process air cleaning systems are tested for penetration efficiency or sampled for airborne radioactivity on a quarterly basis.

Maintenance is performed on systems found to exceed 25 percent of the DAC as stated in Section 5.2.20.

Enclosure face velocities are tested quarterly. The performance of HEPA filter is also tested quarterly for airborne radioactivity concentrations. Filters are also tested quarterly. A HEPA filter will be replaced when the filter or the exhaust system is unable to perform its function properly. In no case will filters continue to be operated when differential pressures exceed the manufacturer's rating. Routine schedules are established to ensure performance testing of process ventilation equipment for hood velocities, airborne radioactive concentrations, and particulate penetration. Ventilation ducts are designed to minimize accumulations of radioactive material and are inspected on a frequency commensurate with the potential accumulation.

Section 5.2.56 of the LRA stated that respiratory protection equipment is used only in accordance with written procedures and these procedures must identify requirements for selection, fitting, issuance, maintenance, testing, supervision, monitoring (including air sampling and bioassay), and recordkeeping. Whenever possible, the process or engineering controls will be identified, and the duration of respirator use will be specified. WEC maintains the records of its respiratory protection program, and all facility safety-related documents, in accordance with the facility records management system, which is described in Section 3.9 of the LRA. Section 3.4.1 commits to technical review of procedures every 3 years, or more frequently if the document owner determines more frequent review is needed. Surveillances, incident investigations, and the CAP can also identify the need for procedure review and revision.

Based on the NRC staff's evaluation of the LRA commitments to follow the acceptance criteria in Section 4.4.6.3 of NUREG-1520, the staff finds that the equipment and procedures to be used in the ventilation and respiratory protection program adequately protect health and minimize danger to life and property, as required by 10 CFR 70.23(a)(3) and (a)(4). Ventilation systems are designed and operated to ensure adequate control of radioactive dust and particulate. The system is designed to direct flow from areas of low contamination potential to areas of increasing contamination potential. Air flows are maintained from non-process areas to process areas and are monitored and corrected as needed. Exhaust is monitored continuously to prevent inadvertent releases to the environment. Therefore, the NRC staff finds that these programs are acceptable.

4.3.7 RADIATION SURVEY AND MONITORING PROGRAMS

The staff reviewed the licensee's radiation survey and monitoring program commitments against the acceptance criteria in NUREG-1520 (NRC, 2010a), Section 4.4.7.3. The following discussion identifies each acceptance criterion from NUREG-1520 (NRC, 2010a) and summarizes the staff's evaluation as to whether the information provided by the licensee meets the respective criterion.

Section 5.2.29 of the LRA discusses radiation survey and monitoring programs and committed to routine contamination survey monitoring in accordance with the requirements in 10 CFR Part 20, Subpart F, "Surveys and Monitoring." Section 3.4.1, "Procedures," stated activities involving licensed material are conducted in accordance with properly issued and approved procedures.

The licensee has a radiation survey and monitoring program using prepared written procedures that address monitoring of the work place, the individuals, and the environment. The facility

work place and the individuals are monitored using routine monitoring, operational monitoring, and special monitoring as applicable to the situation.

Section 5.2.58 of the LRA discussed equipment and instrumentation, both fixed and portable. The licensee states that an adequate number of radiation detection instruments will be available to ensure that proper radiation surveys can be performed. Selection criteria for portable and laboratory counting equipment will be based on the types of radiation detected, maintenance requirements, ruggedness, interchangeability, and the upper and lower limits of detection.

The radiation safety function reviews the types of instruments being used for each monitoring purpose and makes appropriate recommendations based upon regular input and ongoing evaluation. Monitoring instruments used for routine radiation protection purposes will be calibrated before initial use, after major maintenance, and on a routine basis in accordance with the manufacturer's recommendation following the last calibration. Minimum detection limits and instrument ranges are stated in LRA section 5.2.58(a). Prior to each use, operability checks are performed on monitoring and laboratory counting instruments. The backgrounds and efficiencies are determined on a daily basis when in use.

A prospective analysis is performed to determine monitoring requirements for each department. The analysis is based on a review of historical exposure data and any process/facility changes that may increase personnel exposure. The results of the analysis will determine those individuals that must be monitored for occupational exposure and those individuals that must be part of external and/or internal monitoring programs. Procedures, training, and qualifications are integrated into a combined process to assure that safety and safeguards activities are being conducted by trained and qualified individuals, in accordance with WEC's policies, procedures, and commitments to regulatory agencies.

If the results of radiation surveys and air sampling identify a contaminated area, the boundary of the area is established and appropriate signage or labeling is put in place. The radiation surveys or air sampling results are also conducted in radiation areas and radioactive material storage areas and are posted in accordance with Subpart J, "Precautionary Procedures," of 10 CFR Part 20. Survey frequencies are determined by the radiation safety function and documented in procedures. Contamination survey limits and frequencies for various working areas of the CFFF are displayed in Figure 5.1. Protective clothing is provided to individuals entering posted contaminated areas, as described in Section 5.2.38. The amount of protective clothing is specified based on the contamination potential. Change facilities and instrumentation are provided at the exit points of potentially contaminated areas to limit the spread of contamination.

The primary means of controlling concentration of airborne or surface contamination at the CFFF is through access control procedures, described in Section 5.2.33. Only trained and qualified staff, or authorized visitors are provided access into areas of the CFFF where contamination controls are required. Contaminated area boundaries are established and identified with appropriate signage or labeling.

Section 5.2.23 described the air sampling program for the CFFF. Stationary air sampling follows the criteria in Regulatory Guide 8.25, "Air Sampling in the Workplace," (NRC, 1992b). The primary means of controlling concentration of airborne and surface contamination at the CFFF is through access control procedures, described in Section 5.2.33. Sections 5.2.24 through 5.2.28 describe additional procedures used to control and measure airborne radioactivity. Only trained

and qualified staff, or authorized visitors are provided access into areas of the CFFF where contamination controls are required.

Section 5.2.29 of the LRA stated that WEC committed to routine contamination survey monitoring in potentially contaminated areas in accordance with 10 CFR 20.1501. Figure 5.1 identifies survey limits and frequency. Measurements of removable contamination are performed commensurate with the nature of the work being conducted, the quantities of material being used, and operational experience. Section 5.2.41 of the LRA states that the licensee will implement corrective actions through the WEC corrective action program in the event of personnel contamination exceeding the administrative action levels in the LRA.

Section 5.2.42 of the LRA discussed the external monitoring program. Adults likely to receive greater than 0.5 rem in a year from sources external to the body are monitored by personnel dosimeters. Minors or declared pregnant women are limited to exposures of 0.1 rem DDE and 0.1 rem committed effective dose equivalent (CEDE).

The external radiation exposures of individuals are monitored with thermoluminescent dosimeters (TLDs) and provide the dose of record. The results of monitoring are analyzed at least quarterly by a vendor accredited by the National Voluntary Laboratory Accreditation Program (NVLAP). Self-reading dosimeters may be used in specific areas as an ALARA tool. Sections 5.2.48 and 5.2.49 of the LRA identify the restrictions on work activities that are imposed when an individual’s exposure exceeds 80 percent of the applicable dose limits of Subpart C of 10 CFR Part 20. When contamination levels exceed the action, limits specified in the LRA, corrective actions are taken to minimize personnel exposure and investigate the cause(s) of abnormal events.

WEC will use a Type 16 TLD760 dosimeter from Mirion to provide individual dose monitoring based of an individual's potential for exposure. The LRA states the dosimetry devices are sensitive to beta and gamma radiation, are capable of measuring levels as low as approximately 10 mrem, and they are sensitive to beta, gamma, x-ray, and neutron radiation.

Section 5.2.46 of the LRA describes the internal monitoring program. Workers who are likely to receive an intake greater than 10 percent of the applicable annual limit on intake (ALI) during a 1-year period are monitored for exposures. A CEDE is calculated using the assumption that an intake of one ALI results in a CEDE of 5 rem. Bioassay measurements are conducted on an annual frequency in accordance with Table 1 of Regulatory Guide 8.34, “Monitoring Criteria and Methods to Calculate Occupational Radiation Doses,” (NRC, 1992c), and guidance given in Regulatory Guide 8.9, “Acceptable Concepts, Models, Equations, and Assumptions for a Bioassay Program” (NRC, 1993).

The CEDE is established by measuring the concentrations of radioactive material in air via sampling. Restrictions on work activities are imposed when air sample results exceed the administrative limits established in Sections 5.2.48 and 5.2.49. Room air is continuously sampled in areas in which dispersible SNM is used and that are occupied by workers. Samples are analyzed for gross alpha and beta-gamma activity. Samples are collected from the air that workers normally breathe to measure representative intakes for workers. The radiation safety function monitors air sampling results to determine if exposure controls are effective. Filters from air samplers are changed daily during normal operating periods or at more frequent intervals, as necessary. Portable air sampling is conducted for non-routine work and would be specified in an RWP. Bioassay measurements (including urinalysis and in vivo counting) are used to evaluate the effectiveness of contamination control and personnel protection practices.

Section 5.2.52 of the LRA stated that WEC will sum external and internal exposures consistent with the requirements of 10 CFR 20.1202, "Compliance with requirements for summation of external and internal doses," and through procedures consistent with Regulatory Guide 8.7, "Instructions for Recording and Reporting Occupational Radiation Exposure Data," (NRC, 2005) or Regulatory Guide 8.34 "Monitoring Criteria and Methods to Calculate Occupational Radiation Doses," (NRC, 1992c).

Section 5.2.41 of the LRA described the CAP for the CFFF and committed to maintaining a system to identify, track, investigate, and implement corrective actions for abnormal events as described in written procedures.

The WEC LRA described a comprehensive survey and monitoring program, which includes appropriate calibrated instrumentation, and personnel dosimetry to evaluate staff exposure to ionizing radiation. The NRC staff evaluated the commitments in the LRA pertaining to the acceptance criteria in Section 4.4.7.3 of NUREG-1520. The staff finds the radiation survey and monitoring programs and the equipment and procedures as described in the LRA provide reasonable assurance that public health and safety and the environment are adequately protected and will minimize danger to life and property, as required by 10 CFR 70.23(a)(3) and (a)(4). These programs are based on written procedures, consistent with 10 CFR 20.1101(b), and have been used and evaluated over several years. Results of the analysis are interpreted using methodologies consistent with Regulatory Guide 8.9, "Acceptable Concepts, Models, Equations, and Assumptions for a Bioassay Program" (NRC, 1993). The NRC staff concludes that WEC's radiation personnel monitoring program will continue to satisfy the requirements in 10 CFR 20.1502. Therefore, the NRC staff finds that WEC's instrumentation and personnel monitoring programs are acceptable.

4.3.8 ADDITIONAL PROGRAM REQUIREMENTS

The staff reviewed the licensee's additional program commitments against the acceptance criteria in NUREG-1520, Section 4.4.8.3. The following discussion identifies each acceptance criterion from NUREG-1520 and summarizes the staff's evaluation as to whether the information provided by the licensee meets the criterion.

Section 3.9, "Records Management," of the LRA described the overall records management system. The regulatory component function oversees records management for the RSP, as stated in Section 2.1.1.3(c), "Regulatory Component Managers and Engineering Functions." Training record requirements are specified in Section 3.4.2, "Training and Qualification." Respiratory protection records are kept as specified in Section 5.2.56. Instrument calibration records are retained in accordance with Section 5.2.61.

Section 5.2.52 of the LRA stated that personnel exposure reports will be made in accordance with Regulatory Guide 8.7, "Instructions for Recording and Reporting Occupational Radiation Exposure Data," (NRC, 2005). WEC will submit to the NRC an annual report of individual monitoring, consistent with the requirements of 10 CFR 20.2206(b).

In Section 3.7, "Incident Investigation," of the LRA, WEC committed to notifying the NRC of events involving radiation or radioactive materials in accordance with 10 CFR 20.2201–20.2203 and 10 CFR 70.50. Reports will be made to the NRC Headquarters Operations Center (HOC) and pertinent local or state agencies. Section 5.2.54 of the LRA states that any incident in which the resulting dose exceeds either the 10 CFR 20 Appendix B dose limits or 10 CFR 70.61 will

be entered to the corrective action program as described in Section 3.8, "Corrective Action Program (CAP)," of the LRA.

Section 3.9, "Records Management," of the LRA described WEC's records management system for the preservation and control of regulatory records. The system is implemented in accordance with approved administrative procedures. Records included are radiation protection, criticality, environmental, training, safeguards, safety, and emergency preparedness. The licensee will make reports in accordance with internally established requirements and procedures. Formal reports will be issued in accordance with the applicable regulatory requirements. Records associated with ALARA findings, employee training, personnel radiation exposures, and environmental activities will be generated and retained in such a manner as to comply with the relevant requirements of 10 CFR Part 20.

The staff finds that the WEC LRA complies with the reporting and documentation requirements. Based on the staff's evaluation of the LRA commitments pertaining to the acceptance criteria in Section 4.4.8.3 of NUREG-1520 (NRC, 2010a), the staff finds LRA meets the requirements of 10 CFR 20.2202, 20.2206, and 10 CFR 70.61. Therefore, the NRC staff finds that these program commitments are acceptable.

4.4 EVALUATION FINDINGS

The licensee has committed to maintaining an acceptable RSP that includes the following:

- an effective, documented program to ensure that occupational radiological exposures are ALARA
- an organization with adequate qualification requirements for the radiation protection personnel
- approved, written radiation protection procedures and RWPs for radiation protection activities
- radiation protection training for all personnel who have access to restricted areas
- a program to control airborne concentrations of radioactive material with engineering controls and respiratory protection
- a radiation survey and monitoring program that includes requirements for controlling radiological contamination within the facility and monitoring of external and internal radiation exposures
- other programs to maintain records, report to the NRC in accordance with 10 CFR Part 20 and Part 70, and to implement an appropriate corrective actions program at the facility.

The NRC staff concludes that during the renewed license term the licensee's radiation safety program will meet the applicable requirements of 10 CFR Parts 19, 20, and 70 as discussed in Section 4.3 above.

CHAPTER 5 NUCLEAR CRITICALITY SAFETY

5.1 PURPOSE OF THE REVIEW

The purpose of this review was to determine, with reasonable assurance, whether Westinghouse Electric Company, LLC's (WEC) has designed a facility that will provide adequate protection for the health and safety of workers and the public against criticality hazards under both normal and credible abnormal conditions related to the storage, handling, and processing of licensed materials, as required by Title 10 of the *Code of Federal Regulations* (10 CFR) Part 70, "Domestic Licensing of Special Nuclear Material."

5.2 REGULATORY REQUIREMENTS

The U.S. Nuclear Regulatory Commission (NRC) staff conducted its NCS review to ensure that WEC's program meets the requirements required by 10 CFR Sections 70.22, "Contents of applications," 70.61 "Performance Requirements" and 70.62, "Safety program and integrated safety analysis." The following specific regulatory requirements are applicable to the NCS program:

- 10 CFR 70.22, "Contents of applications," requires the licensee to describe the facilities, equipment, and procedures used to protect health and minimize danger to life and property, including the consequences of a criticality accident.
- 10 CFR 70.24, "Criticality accident requirements," requires the licensee to maintain a criticality accident alarm system (CAAS) and emergency procedures.
- 10 CFR Part 70, Subpart H, "Additional Requirements for Certain Licensees Authorized to Possess a Critical Mass of Special Nuclear Material," applies generally to hazards exceeding the thresholds in 10 CFR 70.61, "Performance requirements," including nuclear criticality. More specifically, 10 CFR 70.61 requires the licensee to limit the risk of criticality by ensuring that high-consequence events (which include criticality) to be highly unlikely, as defined by the licensee, by ensuring that all nuclear processes will be subcritical under normal and credible abnormal conditions, including use of an approved margin of subcriticality for safety, and by using prevention as the primary means of protection.
- 10 CFR 70.50, "Reporting requirements," 70.52 "Reports of accidental criticality," and Appendix A to Part 70, "Reportable Safety Events," require the licensee to report specific events and conditions within specified timeframes to the NRC, including criticality accidents and other NCS-related events.

5.3 STAFF REVIEW AND ANALYSIS

The NRC staff evaluated WEC's LRA (WEC, 2018d) following the acceptance criteria outlined in Chapter 5 of NUREG-1520, Rev. 1, "Standard Review Plan for the Review of a License Application for a Fuel Cycle Facility" (hereinafter NUREG-1520) (NRC, 2010a).

5.3.1 CRITICALITY ACCIDENT ALARM SYSTEM COMMITMENTS

Westinghouse's commitments to a CAAS that meet the requirements of 10 CFR 70.24 are stated in Section 6.1.8, "Criticality Accident Alarm System (CAAS)," of its LRA. This includes a commitment to follow the requirements of American National Standards Institute (ANSI) / American Nuclear Society (ANS) - 8.3, "Criticality Accident Alarm System" (ANS, 1997a), as

modified by NRC Regulatory Guide 3.71, “Nuclear Criticality Safety Standards for Fuels and Material Facilities” (NRC, 2010a), in regard to detector placement, and further states that the CAAS will remain operational during credible events, will describe actions taken when the CAAS is out of service, and will describe actions taken in response to an alarm signal.

5.3.1.1 Criticality Accident Alarm System

The WEC committed to follow the requirements of ANSI/ANS-8.3-1997 in LRA Section 6.1.8 in regard to placement of the detectors. In addition, the licensee stated that it would follow the guidance for use of the CAAS, which is endorsed in Regulatory Guide 3.71 with exceptions necessitated by the requirements of 10 CFR 70.24. Therefore, the staff finds these commitments to be consistent with the acceptance criteria of Section 5.4.3.1 to NUREG-1520. The LRA Section 6.1.8 addresses the acceptance criteria in Section 5.4.3.1 of NUREG-1520. Specifically, the LRA states that shielding will be taken into consideration, and detectors will be located to minimize the effect of shielding. Spacing between detectors is reduced where high-density materials (e.g., concrete, cinder block, brick) could impact monitoring. However, low-density materials (e.g., wood, corrugated metal, plaster), do not significantly attenuate neutron and gamma radiation and may therefore be safely ignored. The LRA states that detector placement will comply with ANSI/ANS-8.3-1997 and 10 CFR 70.24, which provides sufficient monitoring to detect the minimum dose threshold identified in 10 CFR 70.24(a). The LRA Section 6.1.8 also states that the CAAS will be designed to remain in operation during credible events and that it will be clearly audible in all areas required to be evacuated, as ensured by quarterly testing.

In Section 6.1.8 of the LRA, the licensee stated that they will suspend movement and processing of special nuclear material (SNM) in the coverage area within one hour, except as needed to ensure a safe shutdown condition, if the CAAS is out of service. The movement and processing of SNM will not resume until CAAS coverage has been restored, or until continuously attended portable detection instrumentation is provided.

The staff finds the commitments to implement compensatory measures are acceptable and consistent with the acceptance criteria in Section 5.4.3.1 of NUREG-1520. The 1-hour time frame, which permits additional time if needed to perform the safe shutdown of all processes, limits the risk associated with a loss of CAAS coverage. The staff finds the controls necessary to ensure that criticality remains “highly unlikely” and the controls that satisfy the double contingency principle will remain in effect during this time period. Additionally, the compensatory measures provide for portable monitoring instruments to ensure the safety functions normally performed by the CAAS continue. The compensatory measures provide protection for the prompt evacuation of personnel, in the highly unlikely event of a criticality accident. The staff evaluated the compensatory measures and finds they provide reasonable assurance of safety during the short time period discussed above. For these reasons, the staff finds that the licensee’s commitments to the CAAS follow the requirements of 10 CFR 70.24. The exceptions as described and proposed for implementation during times when CAAS is not available are consistent with the acceptance criteria in NUREG-1520, Section 5.4.3.1, and therefore the staff finds them acceptable.

5.3.1.2 Emergency Planning and Response

In Section 6.1, “NCS Program Structure” of the LRA, the licensee committed to follow the requirements of ANSI/ANS-8.23-1997, with regard to emergency response to ensure personnel are protected from the consequences of a criticality accident. In the event of a criticality

accident, the licensee committed to follow the requirements of ANSI/ANS-8.23-1997, as stated in LRA Chapter 9.0, “Emergency Management Program” which is consistent with the acceptance criteria in Section 5.4.3.1 of NUREG-1520 (NRC, 2010a). In Section 6.1.8 of the LRA, the licensee also stated that the response to CAAS activation is found in the facility’s emergency plan and emergency procedures. The LRA Section 6.1.8 further stated that wherever the CAAS is deployed, fixed and personnel accident dosimeters will be available. Prompt on-site dosimetry readout (i.e., real-time dose measurements) will be made available to responders outside the immediate evacuation zone. These commitments satisfy the acceptance criteria in Section 5.4.3.1 of NUREG-1520 (NRC, 2010a) with regard to emergency response and the staff, therefore, finds reasonable assurance of adequate protection with respect to emergency planning and response to criticality accidents.

The staff determined that the licensee’s commitments with regard to its CAAS and to the associated emergency procedures meet the requirements of 10 CFR 70.24 and provide reasonable assurance of adequate protection against the consequences of a criticality accident.

5.3.2 NUCLEAR CRITICALITY SAFETY PROGRAM

General requirements to protect health and minimize danger to life and property in 10 CFR 70.22 are implemented by licensees adhering to the performance requirements in 10 CFR 70.61—specifically 70.61(b) and (d). WEC has committed to establish and maintain an NCS Program to ensure that all nuclear processes will be subcritical, including use of appropriate margin, under both normal and credible abnormal conditions in accordance with 10 CFR 70.61(d). This is implemented in accordance with the double contingency principle (DCP) as stated in ANSI/ANS-8.1-2014, “Nuclear Criticality Safety in Operations with Fissionable Materials Outside Reactors” (ANS, 2014).

Westinghouse’s commitments to these NCS Program elements are stated in Section 6.1, Sections 6.1.1–6.1.7, and Sections 6.1.9–6.1.10 of its LRA. This includes commitments in the areas discussed in the subsections below.

5.3.2.1 Use of Industry Standards

Section 5.4.3.2 on NUREG-1520 (NRC, 2010a), states that licensees should, in general, use the most recent version of ANS-8 Series, “Fissionable Material Outside Reactors,” standards endorsed by the NRC, and in general follow the requirements (i.e., “shall” statements) of endorsed standards or provide sufficient information to justify taking exception to the requirements of those standards. The licensee has committed to complying with the requirements of the following NCS-related standards in whole or in part:

- ANSI/ANS-8.1-1998, “Nuclear Criticality Safety in Operations with Fissionable Materials Outside Reactors,” (ANS, 1998)

  The licensee has committed to follow the requirements of ANSI/ANS-8.1-1998 in regard to its NCS Program. Specific commitments for WEC to follow the requirements of ANSI/ANS-8.1-1998 in regard to the DCP and validation are also included. The NRC had endorsed the ANSI/ANS-8.1-1998, in Revision 2 of RG 3.71. ANSI/ANS-8.1-1998 was revised in 2014, but the newer version has not been endorsed in the current version of Regulatory Guide 3.71.

- ANSI/ANS-8.3-1997, “Criticality Accident Alarm System” (ANS, 1997a)

  The licensee’s commitments with regard to ANS-8.3-1997 are discussed in Section 5.3.1.1 of this SER above.

- ANSI/ANS-8.5-1996, “Use of Borosilicate-Glass Raschig Rings as a Neutron Absorber in Solutions of Fissile Material” (ANS, 1996)

  The licensee committed to the requirements of ANSI/ANS-8.5-1996 wherever Raschig rings (i.e., borosilicate glass) are used for NCS, with the exceptions that system pH must be maintained to no more than 11 and system temperature no more than 60° C, when used for basic solutions. The licensee has also committed to verifying the condition of the Raschig rings annually. Section 3.2.3 of this standard states that Raschig rings shall not be used for criticality control in basic solutions unless chemical and physical limits have been determined and documented. The NRC has endorsed ANSI/ANS-8.5-1996, in Revision 2 of RG-3.71. On that basis, the licensee’s commitments to ANSI/ANS-8.5-1996, apart from the temperature and pH limits for use with basic environments stated above, are consistent with the acceptance criteria of Section 5.4.3.1 to NUREG-1520. The staff’s evaluation of the limits and the technical basis for them is provided in Section 6.4.2.5 of this SER.

- ANSI/ANS-8.19-2005, “Administrative Practices for Nuclear Criticality Safety” (ANS, 2005)

  The licensee committed to an NCS Program that meets the requirements of ANSI/ANS-8.19-2005 in LRA Section 6.1. The LRA Section 6.1.9, “Audits and Assessments,” commits to follow the requirements of ANSI/ANS-8.19-2005 with regard to audits and assessments, and LRA Section 6.1.10, “Procedures, Training, and Qualification,” commits to the standard with regard to training, procedures, and the requirement that no single inadvertent departure from a procedure can cause an inadvertent criticality. These more specific commitments are captured in the overall commitment in LRA Section 6.1. The ANSI/ANS-8.19-2005 is endorsed in Revision 2 of Regulatory Guide 3.71. Therefore, the staff finds these commitments to be consistent with the acceptance criteria of Section 5.4.3.1 to NUREG-1520.

- ANSI/ANS-8.20-1991, “Nuclear Criticality Safety Training” (ANS, 1991)

  The licensee committed to follow the requirements of ANSI/ANS-8.20-1991 with regard to training in LRA Section 6.1.10. The ANS-8.20-1991, reaffirmed in 2005, is endorsed in Revision 2 of Regulatory Guide 3.71. Therefore, the staff finds this commitment to be consistent with the acceptance criteria of Section 5.4.3.1 to NUREG-1520.

- ANSI/ANS-8.21-1995, “Use of Fixed Neutron Absorbers in Nuclear Facilities Outside Reactors” (ANS, 1995)

  The licensee committed to follow the requirements of ANSI/ANS-8.21-1995 in LRA Section 6.1.3.8. The 1995 version of this standard, reaffirmed in 2001, is endorsed in Revision 2 of Regulatory Guide 3.71. Therefore, the staff finds this commitment to be consistent with the acceptance criteria of Section 5.4.3.1 to NUREG-1520.

- ANSI/ANS-8.22-1997, "Nuclear Criticality Safety Based on Limiting and Controlling Moderators" (ANS, 1997)

  The licensee committed to follow the requirements of ANSI/ANS-8.22-1997 in LRA Section 6.1.3.2, "Moderation," with one exception. The licensee stated that it will follow ANS-8.22-1997 in areas where moderation is used as the sole controlled parameter. Where moderation control is used in conjunction with other controlled parameters, the licensee stated that it will follow ANS-8.22-1997 with the exception that the affected areas will not be designated as moderator control areas, to avoid diluting the significance of that designation. Whereas each licensee implements its own NCS program with distinctive nomenclature, procedures, and practices, implementing all the requirements of the standard while using different terminology is consistent with the acceptance criteria of Section 5.4.3.1 to NUREG-1520. Moreover, it is reasonable and proper to use practices that focus attention on areas where certain controls are of heightened importance, such as areas relying solely on moderator control. The 1997 version of this standard, reaffirmed in 2006, is endorsed in Revision 2 of Regulatory Guide 3.71. Along with the exception as justified above, WEC's commitment is therefore consistent with the acceptance criteria of Section 5.4.3.1 to NUREG-1520.

- ANSI/ANS-8.23-2007, "Nuclear Criticality Accident Emergency Planning and Response" (ANS, 2007, ANSI/ANS-8.23-2007, "Nuclear Criticality Accident Emergency Planning and Response," 2007, ANS, LaGrange Park, IL)

  The licensee's commitments with regard to ANS-8.23-2007 are discussed in Section 5.3.1.2 of this SER above.

- ANSI/ANS-8.24-2007, "Validation in Neutron Transport Methods for Nuclear Criticality Safety Calculations" (ANS, 2007a)

  The licensee committed to follow the requirements of ANSI/ANS-8.24-2007, for validations performed after June 27, 2007. The validations performed before that date were in place at the time of the last renewal in 2007 and were done consistent with ANSI/ANS-8.1-1998. The ANSI/ANS-8.1-1998 has been endorsed in Revision 2 of Regulatory Guide 3.71 and is therefore consistent with the acceptance criteria of Section 5.4.3.1 to NUREG-1520. Both the guidance in ANS-8.1-1998 and 8.24-2007 are considered acceptable methods for performing code validation as both standards have been endorsed in Regulatory Guide 3.71.

  While LRA Section 6.1.5.3, "Validation Techniques," states that validations will be done in accordance with ANSI/ANS-8.1-1998. However, ANSI/ANS-8.1-1998 no longer contains detailed guidance on performing validation since an ANSI/ANS standard specific to validation now exists in ANSI/ANS-8.24. Per the commitments discussed above, new validations performed after June 27, 2007, must comply with both ANSI/ANS-8.24-2007, as well as ANS-8.1-1998. The requirements of ANSI/ANS-8.24-2007 are more detailed than those in ANSI/ANS-8.1-1998 and have been endorsed in Revision 2 of Regulatory Guide 3.71. Compliance with ANSI/ANS-8.24-2007 requires that when an older validation report is revised, it will be performed and documented consistent with the commitments for a new validation. The LRA Section 6.1.5.3 states that ANSI/ANS-8.24-2007 will be used, "except as modified by specific License Application commitments." Currently, Chapter 6.0 of the LRA does not contain any commitments that deviate from those in ANS-8.24-2007. The

commitments in LRA Section 6.1.5.3 to follow the requirements of ANSI/ANS-8.1-1998 and ANSI/ANS-8.24-2007 are consistent with the acceptance criteria of Section 5.4.3.1 to NUREG-1520 because conformance of these standards has been endorsed by NRC in Regulatory Guide 3.71.

Section 5.4.3.2 of NUREG-1520 (NRC, 2010a) stated that if a licensee is conducting activities to which an NRC-endorsed standard applies, the licensee should address the subject of the standard by either committing to the requirements of the standard or justifying an acceptable alternative. With regard to endorsed ANS-8 Series standards other than those listed above, the staff finds that none are applicable to WEC's facility (ANSI/ANS--8.6, -8.10, -8.12, 8.14, and 8.15) or the facility is otherwise subject to other standards (ANSI/ANS-8.7 and -8.17) via commitments. In the case of ANSI/ANS-8.7-1998 (ANS, 1998a), in lieu of using the limits in the standard, subcritical limits may be determined using validated methods and technical practices employed in accordance with ANSI/ANS-8.1-1998 (ANS, 1998). In the case of ANSI/ANS-8.17-2004, "Criticality Safety Criteria for the Handling, Storage, and Transportation of LWR Fuel Outside Reactors" (ANS, 2004), this standard involves the handling, storage, and transportation of light-water reactor fuel. Transportation is outside the scope of the licensee's Part 70 license and therefore those provisions are not applicable to this review. For handling and storage, WEC's commitments to follow ANSI/ANS-8.1-1998, -8.3-1997, and -8.24-2007 are sufficient with regard to the performance of criticality safety evaluations, use of a CAAS, and criticality code validation. Regulatory Guide 3.71 also endorses ANSI/ANS-8.26-2007, "Criticality Safety Engineer Training and Qualification Program" (ANS, 2007b), which entails criticality safety engineer training. The training and qualification of NCS Program staff is discussed in Section 5.3.2.4 of this SER.

5.3.2.2 Subcriticality and Double Contingency Principle

In Section 6.1.1, "General Control Program Practices," of the LRA, the licensee committed to using the DCP as the basis for the design and operation of nuclear processes at its facility. This commitment is consistent with the guidance in Section 5.4.3.1 of NUREG-1520 (NRC, 2010a). This includes the preferred reliance on two independent controlled parameters. When multiple controls are used to control a single parameter, sufficient redundancy and diversity must be employed to ensure that they are independent. The use of a single control to maintain the values of two or more parameters constitutes only one component necessary to meet the DCP. The licensee also stated that it would describe assumptions, limits, and controls to ensure subcriticality under normal and credible abnormal conditions (consistent with its commitment to the DCP) in documented criticality safety evaluations. The staff finds that the above commitments are standard industry practice and are consistent with the acceptance criteria in Section 5.4.3.1 of NUREG-1520 (NRC, 2010a).

5.3.2.3 Organization and Administration of the NCS Program

The licensee's NCS Program is described in LRA Sections 6.1, "NCS Program Structure," and 6.1.1. This includes a commitment to meet the requirements of ANSI/ANS-8.19-2005, in LRA Sections 6.1 and 6.1.1. As stated in LRA Section 6.1, all activities of the NCS Program will be performed in accordance with written procedures. The staff finds that the description of WEC's NCS Program throughout LRA Chapter 6 addresses all the elements outlined in Chapter 5 of NUREG-1520 (NRC, 2010a). The WEC NCS Program includes: performing and documenting criticality safety evaluations (CSEs) for all new and revised fissile material operations; establishing criticality controls and limits; evaluating facility changes; maintaining controls and limits through the use of management measures such as training, procedures, and audits and

inspections; establishing and maintaining a CAAS and emergency procedures; and responding to any defective NCS conditions. Specific commitments to each of those program areas are discussed in the sections below.

The staff reviewed the organization chart in LRA Figure 2.2, [Columbia Fuel Fabrication Facility] "CFFF Organization." The NCS function reports directly to the regulatory component, who in turn reports to the plant manager. The NCS function is therefore independent to the greatest practical extent from the manufacturing component, consistent with the acceptance criteria in Section 5.4.3.2 of NUREG-1520 (NRC, 2010a). The essential duties for the NCS function and the minimum qualifications for all regulatory component managers (including the NCS manager) are described in LRA Section 2.1.1.3(d). This includes the education and experience requirements for regulatory component managers and regulatory component function engineers. The staff has determined that the educational levels of these positions are consistent with the criteria in Section 11.4.3.3 of NUREG-1520 (NRC, 2010a) and are therefore acceptable.

Section 2.1.1.3, "Position Accountability and Requirements," of the LRA states that safety and regulatory function engineers must at a minimum have at least a baccalaureate degree or equivalent (i.e., 8 years of industry experience), with a science or engineering emphasis, and 2 years of experience in positions involving assigned functions in the nuclear industry. Specifically, positions having NCS responsibilities consist of NCS engineers, senior NCS engineers, and the NCS group manager. General NCS engineers must have at least a baccalaureate degree in science and engineering and 2 years of experience in the nuclear industry and have authored three mentored CSEs and three mentored calculation documents. They must also have demonstrated proficiency in the ANSI/ANS-8 standards, licensee NCS and ISA procedures, calculational methods, and other principles of NCS, and have completed a university or national laboratory-sponsored training course or have equivalent job experience. Safety and regulatory function managers (e.g., the NCS group manager) must have similar qualifications, including at least a baccalaureate degree with a science or engineering emphasis and at least 2 years of experience in assignments involving regulatory activities in the nuclear industry.

The training of NCS personnel is done in accordance with facility procedures, and those who do not meet minimum requirements must perform their duties under the advice and consultation of more senior staff until all required training requirements are met.

The staff reviewed these minimum qualifications and determined that they are consistent with standard industry practice and the acceptance criteria in Section 11.4.3.3 of NUREG-1520 (NRC, 2010a), and that they are commensurate with the assigned duties of those positions. As described in LRA Section 6.1.4.2, "Criticality Safety Evaluation (CSE)," CSEs are performed by qualified NCS staff in accordance with written procedures and must be reviewed by qualified criticality safety technical reviewers and approved by NCS and operations managers or their designees. Technical reviewers must be mentored until the technical reviewer has reached the status of a senior NCS engineer. Based on the above, the description of the NCS program and the qualifications and duties of associated personnel are consistent with the acceptance criteria of Section 5.4.3.1 to NUREG-1520.

5.3.2.4 Management Measures Applied to the NCS Program

The NCS management measures discussed as part of the licensee's NCS program consist of training, procedures (which include postings of NCS limits at staff workstation), audits, and

assessments. These aspects of the NCS program are discussed in LRA Sections 6.1.9, “Audits and Assessments,” and 6.1.10, “Procedures, Training and Qualification.”

With regard to NCS training, the licensee stated that it will meet the requirements of ANSI/ANS-8.19-2005 and ANSI/ANS-8.20-1991. These standards have been endorsed in Regulatory Guide 3.71, and this commitment is consistent with the acceptance criteria in Section 5.4.3.2 of NUREG-1520 (NRC, 2010a). Section 6.1.8 of the LRA also states that employees and visitors are trained in responding to the CAAS alarm signal.

With regard to procedures, the licensee has also committed in LRA Section 6.1.10 to follow both of the requirements contained in ANSI/ANS-8.19-2005 and ANSI/ANS-8.20-1991. Section 6.1 of the LRA states that any activities that may affect NCS shall be performed in accordance with written and approved procedures. The staff understands this to include both activities by operators and actions taken by the NCS program staff. Section 6.1 of the LRA also states that if no procedure exists applicable to a given situation, work will not be performed until NCS staff has evaluated the situation and has provided guidance. Furthermore, WEC’s procedures direct personnel to report any defective NCS conditions to the NCS staff. In addition to written procedures, the licensee also uses distinctive NCS postings, as described in LRA Section 6.1.7, “Posting of Limits and Controls.” The above commitments are consistent with the acceptance criteria in Section 5.4.3.2 of NUREG-1520 (NRC, 2010a).

With regard to audits and assessments, as described in LRA Section 6.1.9, the licensee performs several different types of NCS audits and assessments, which will be done consistent with the requirements of ANSI/ANS-8.19-2005. This standard has been endorsed in Regulatory Guide 3.71. The audits and assessments consist of: (1) triennial audits of all aspects of the NCS Program, (2) audits of the ISA on a 5-year frequency, and (3) facility walkthrough assessments (FWAs) on a quarterly or semi-annual basis, depending on risk. WEC will ensure the independence of the auditors conducting the triennial NCS program audit by using auditors external to the CFFF who have not performed any previous in-house work at the site. At least two of the three audit team members must have experience in NCS, including the team leader, at least one of whom shall have experience performing CSEs. Although Section 5.4.3.2 of NUREG-1520 (NRC, 2010a) contains the acceptance criterion that the NCS program be audited every 2 years, an alternate timeframe may be used, with sufficient justification.

WEC committed to conduct a programmatic audit of the NCS program every 3 years. The staff finds the longer audit interval is acceptable, because the licensee also committed to conduct an annual review to ensure that procedures are properly implemented, are being followed, and that process conditions have not been altered, consistent with ANSI/ANS-8.19-2005 and ANSI/ANS-8.1-1998. The triennial audit is a programmatic audit of the NCS program whereas the annual review looks at procedures and implementation (i.e., not necessarily programmatic). The licensee stated that for systems in which there are no credible criticality scenarios, or in which the frequency of all credible scenarios is less than 10^{-5}/yr, FWAs will be performed at least semi-annually (or more frequently depending on special circumstances, such as prior findings), whereas for those with scenarios with a frequency greater than 10^{-5}/yr they will normally be performed quarterly. Based on the above commitments to annual reviews and the more frequent FWAs, the staff finds a triennial program audit schedule to be justified and acceptable.

The results of audits and assessments will be documented and placed into the licensee’s corrective action program (CAP). The overall program for performing these and other facility audits is described in Section 3.6, “Audits,” of the LRA.

5.3.2.5 Technical Practices for NCS

The licensee's commitments with regard to technical practices for NCS are included in Sections 6.1.2 to 6.1.5 of the LRA. These include the performance and documentation of CSEs, the choice of criticality control methods, including control and modeling of criticality safety parameters, and the use and validation of calculational codes and methods to ensure that all nuclear processes will be subcritical under both normal and credible abnormal conditions.

The CSEs are performed for each nuclear material process to identify the controlled parameters, controls, and limits that are necessary to demonstrate subcriticality under normal and credible abnormal conditions, as required by 10 CFR 70.61(d). The bases for demonstrating that fissile material operations meet the double contingency principle (DCP), as stated in ANSI/ANS-8.1, are contained in CSEs. Before a new operation begins or an existing operation is changed, the licensee confirms and documents that the operation will remain subcritical under normal and credible abnormal conditions. If the licensee determines a criticality analysis is not required prior to a change being implemented, the decision must be justified and documented. The justification will evaluate whether the assumptions stated in the CSEs are still valid and whether the assumptions could be impacted by the change. The licensee will provide the bases for its determinations that engineered and administrative NCS controls are effective and reliable. The assumptions and bases are to be documented in the CSEs. Specifically, the licensee will independently review its assumptions and technical bases when initially established for CSEs, and at least triennially thereafter.

In a letter dated March 7, 2011 (ADAMS Accession No. ML110660378), the NRC reported the results of its 2009 – 2010 licensee performance review fort the WEC CFFF. The performance review included the NRC's inspection results and data on the performance of NRC-licensed activities at CFFF. The NRC identified an area needing improvement (ANI) in the area of nuclear criticality safety. In response to the identification of an ANI, the WEC developed and implemented the Nuclear Criticality Safety Improvement Project – II (NCSIP-II) to address the weaknesses noted by the NRC staff. Specifically, the NCSIP-II was developed to address WEC's inappropriate determinations that certain criticality accident sequences were "not credible" despite the existence of, and reliance upon, engineered controls. These criticality accident sequence determinations were problematic because an improper determination that an event or upset condition is "not credible" eliminates (screens out) the need for further analysis and documentation of the event in CSEs and the Integrated Safety Analysis (ISA). Furthermore, such an improper determination fails to designate necessary controls as IROFS and circumvents the management measures requirements of 10 CFR 70.62.

The current license application SNM-1107 (WEC, 2021b) contains License Condition S-5 to ensure that WEC corrected the affected CSEs in which inappropriate "not credible" determinations were made, correctly makes "not credible" determinations for future CSEs, and otherwise implements the criteria described in the NCSIP-II. In its application for renewal of SNM-1107, the WEC proposed to revise License Condition S-5 and renumber it as License Condition S-3:

> **Safety Condition S-3:**
> The licensee will implement the criteria presented in the second Nuclear Criticality Safety Improvement Program (NCSIP-II) to evaluate the technical bases for events classified as not credible. When criticality safety evaluations are revised or added, the licensee shall incorporate justifications for determining that accident sequences are

> incredible (not credible). The licensee will specifically list which item under Section 1.1.6.21 of the Application applies and state the justification for using the item. The documentation will contain sufficient detail to demonstrate the decision is reasonable and adequate. Incredible (not credible) scenarios may contain administrative SSCs; however, the demonstration of not credible must be convincing despite the absence of any designated controls, including SSCs and IROFS.

NRC staff reviewed the proposed License Condition S-3, along with NRC inspection reports and licensee performance reviews. The staff noted that NRC, Region II inspection staff tracked the progress of the NCSIP-II in reports via Inspector Follow-up Item (IFI) 70-10-1151/2013-201-01, and that the IFI was closed in NRC inspection report 70-1151/2014-004 (ML14300A057). As stated in the inspection report,

> The inspectors determined that further tracking of the completion of [NCSIP-II] is no longer needed based on the sample of [CSEs] reviewed, the progress of the licensee's implementation of the revised CSEs, and proper designation of IROFS in credible accident sequences in the samples reviewed…This item is considered closed."

Based on the evaluations made by the NRC staff and Region II inspection staff, and the closure of the ANI in the area of nuclear criticality safety associated with the NCSIP-II, the staff determined that the proposed License Condition S-3 is no longer necessary for reasonable assurance of adequate protection against credible criticality hazards. For these reasons, NRC staff removed License Condition S-5 and is not incorporating the proposed License Condition S-3 into the license, as was requested in the renewal application. WEC agreed that the license condition is no longer needed.

WEC maintains and updates its CSEs and calculation documents (calculation notes) in accordance with the facility configuration management and document control programs. CSEs are performed by qualified NCS engineers, reviewed by NCS technical reviewers, and then approved by the NCS operations managers in accordance with plant procedures, as stated in Section 5.3.2.3 of this SER. The staff reviewed the operational and technical review processes associated with CSEs and calculation notes described in LRA Section 6.1.4, "Criticality Safety Documentation." The staff determined that the configuration management and document control programs are consistent with standard industry practice and the acceptance criteria in Sections 5.4.3.1 and 5.4.3.2 of NUREG-1520 (NRC, 2010a).

Sections 6.1.1, "General Control Program Practices" and 6.1.2, "Control Methods," of the LRA discuss the various control methods available for NCS, including preference for engineered over administrative, and passive engineered over active engineered, means of control. These control methods are consistent with the acceptance criteria in Section 5.4.3.2 of NUREG-1520 (NRC, 2010a). Controls are established on criticality parameters to limit them within subcritical limits, as described in LRA Section 6.1.1, and in Section 6.1.3, "Controlled Parameters," and its subsections. Each parameter is considered to be at its optimum (most reactive) or most credibly reactive (i.e., worst-credible) value, with demonstration, unless specific controls are established as items relied on for safety (IROFS). In determining the optimal or worst-credible conditions, the licensee stated that it will conservatively account for dimensional and material tolerances, and any assumptions relied upon in making the demonstration of subcriticality will be justified, documented, and independently reviewed. These commitments are in accordance with standard

industry practice and are consistent with the acceptance criteria in Section 5.4.3.2 of NUREG-1520 (NRC, 2010a).

The staff reviewed the licensee's commitments with regard to control and modeling of each of the various criticality parameters in LRA Sections 6.1.3.1 through 6.1.3.10. These parameters consist of mass, moderation, concentration, geometry and volume, material composition and process characteristics, enrichment, heterogeneity, neutron absorption, reflection, and interaction or spacing. The licensee stated in LRA Section 6.1.3.11 that it will not rely on density as a controlled parameter, as explained below.

The staff notes that several acceptance criteria in Section 5.4.3.2 of NUREG-1520 (NRC, 2010a) are specifically under one or more of the individual parameters covered by the more general commitments in LRA Sections 6.1.1 and 6.1.3. For example, the expectation that instrumentation relied on to verify compliance with limits on mass, density, enrichment, etc., will be subjected to facility management measures is covered by a general commitment in LRA Section 6.1.1. The expectations that firefighting procedures will be evaluated for moderator intrusion, or that all precipitating agents will be identified and controlled against, are corollary to the general requirement that the licensee ensure that processes are subcritical under all credible abnormal conditions. WEC also commits to follow the requirements of ANSI/ANS-8.22--1997 on limiting and controlling moderators. With regard to the staff considered the criteria in ANSI/ANS--8.22-1997 that states that process variables that can affect the value of a particular parameter should be controlled by IROFS. The staff finds it is sufficient for the licensee to follow its ISA methodology in determining what controls should be designated as IROFS. Based on WEC's proposed methodology as described and evaluated in Chapter 11, "Management Measures" of this SER, and the general commitment in LRA Section 6.1.3(b), the staff finds reasonable assurance of compliance with the requirements of 10 CFR 70.61 and 70.62. Several of the subsections of LRA Section 6.1.3 pertaining to the parameters contain provisions which are simply definitions of the parameter or state that the parameter may be used on its own in combination with other parameters. This is allowed under the DCP. The above discussion is applicable to each of the parameters discussed in the subsections of LRA Section 6.1.3.

The licensee's commitments regarding *mass control* are contained in LRA Section 6.1.3.1, "Mass." The licensee commits that whenever mass limits are based on assuming a certain weight percent of uranium, either the entire mass present will be ascribed to uranium or the actual weight percent determined by physical measurement. Thus, any material associated with an SNM process will be treated as having a high uranium content until demonstrated otherwise. These commitments follow from the general commitments in LRA Section 6.1.3(b) and (c) and are consistent with the acceptance criteria for mass control in Section 5.4.3.2 of NUREG-1520 (NRC, 2010a). The licensee's commitments do not explicitly address the acceptance criterion related to use of conservative process densities. However, any such use would be covered by the general principle that the use of less-than-optimal conditions and assumptions must be justified and documented. The licensee has also stated in Section 6.1.3.11, "Density," of its LRA that it will not use density as a controlled parameter, rendering such a commitment unnecessary.

The staff notes that the licensee commitments regarding mass control include the statement that double batching is generally considered the worst-credible upset condition when mass is controlled administratively. Double batching is not always the worst-credible upset, because an upset depends on the specifics of the process. However, the licensee also committed to justify and document the validity of assumptions in the applicable CSEs. The licensee also states that,

when relying on a single-parameter limit derived from experimental data, mass will be limited to no more than 45 percent of the mass limit when double batching is credible and no more than 75 percent of the mass limit when double batching is not credible. Although the acceptance criteria pertaining to these limits were removed from NUREG-1520 (NRC, 2010a), the staff acknowledges they provide for a safety margin sufficient to provide reasonable assurance of subcriticality under abnormal conditions. The staff notes that these limits are applicable only in rare circumstances, where the limits are based on *experimental* data. The usual limits on 95/95 k_{eff} (LRA Section 6.1.5.2) apply when the mass limits are derived using deterministic or probabilistic calculational methods. The staff finds the licensee's commitments to implement mass control measures are acceptable.

The licensee's commitments regarding *moderation control* are contained in Section 6.1.3.2, "Moderation," of the LRA. The acceptability of the licensee's commitment to ANSI/ANS-8.22-1997 is discussed above in Section 5.3.2.1 of this SER. The licensee's commitments when relying on moderation as the only controlled parameter follow from the independence requirement of the DCP, and from the need to protect against the introduction of "uncontrolled" and "unauthorized" moderators to ensure subcriticality under normal and credible abnormal conditions. These commitments are consistent with standard industry practice and with ANSI/ANS-8.22-1997, an NRC-endorsed standard. The licensee's commitments do not include the acceptance criterion related to the design of physical structures to prevent moderator ingress. However, this is unnecessary given that the use of passive engineered control is only one acceptable (although preferred) method for criticality control. Based on the above considerations, the licensee's commitments with regard to moderation control provide reasonable assurance of adequate protection with respect to moderation control.

The licensee's commitments regarding *concentration control* are contained in Section 6.1.3.3, "Concentration," of the LRA. With regard to securing tanks to prevent addition of precipitating agents, Section 6.1.3.3(5) states that as required in an implementing CSE (equivalent to the acceptance criterion language in Section 5.4.3.2, NUREG-1520 (NRC, 2010a), "…*when using a tank containing concentration-controlled solution*…"), tanks will be closed and locked except where the system design otherwise precludes the inadvertent addition of precipitating agents. This qualification is acceptable because there may be other ways of meeting the underlying requirement to ensure subcriticality under normal and credible abnormal conditions. As with moderation control, the licensee's other commitments address the acceptance criteria in Section 5.4.3.2 of NUREG-1520 (NRC, 2010a).

The licensee's commitments regarding *geometry and volume control* are contained in Section 6.1.3.4, "Geometry/Volume," of the LRA and provide reasonable assurance of adequate protection with respect to control of geometry and volume based on the same considerations as above. The licensee's commitments include the provision that, when limits are based on experimental data, the margins of safety are no more than 90 percent of the minimum critical cylinder diameter, 85 percent of the minimum critical slab thickness, or 75 percent of the minimum critical volume. Similar to the use of specific fractional limits for mass control, the corresponding acceptance criteria were removed from NUREG-1520 (NRC, 2010a). While these limits are considered to conservatively provide for sufficient safety and subcritical margin to ensure subcriticality, they are, like the over-batching limits for mass control, only applicable to limits derived from experimental data. The usual limits on 95/95 k_{eff} (LRA Section 6.1.5.2) apply when the mass limits are derived using deterministic or probabilistic calculational methods. In addition, LRA Section 6.1.3.4(5) describes the management measures to be applied to geometry controls, and states that "where appropriate, passive geometry controls are entered into the management measures program for routine inspection and maintenance." Consistent

with the general requirement that subcriticality must be ensured under all normal and credible abnormal conditions, “where appropriate” means that wherever a credible failure mechanism leading to a loss of geometry control (e.g., leak, rupture, bulging, backflow) can be identified, appropriate management measures will be applied. Based on the above considerations, the licensee’s commitments with regard to mass control provide reasonable assurance of adequate protection with respect to mass control.

The licensee’s commitments regarding material composition and process characteristics are contained in Section 6.1.3.5, “Material Composition and Process Characteristics,” of the LRA. These are not among the parameters discussed explicitly in Section 5.4.3.2 of NUREG-1520 (NRC, 2010a) (e.g., mass, moderation, geometry, enrichment). However, the material composition and process characteristics are used to control one or more of these parameters, indirectly. For example, specifying the material form as uranyl nitrate solution may be necessary to use certain dimensional or mass limits, and implicitly takes credit for the neutron absorbing properties of nitrogen. As another example, specifying the form as uranium dioxide (UO_2 and process characteristics consists of criticality handbooks, industry standards, and data from the Handbook of Chemistry and Physics (Lide, 2005). The staff finds this sufficient to ensure that appropriate reliance is placed on as-found conditions or on process assumptions and characteristics. While NUREG-1520 does not specifically list material composition and process characteristics in the acceptance criteria, the control of these parameters is consistent with the general principles that apply to all parameters, as discussed above. Therefore, the staff finds the commitments in LRA Section 6.1.3.5 to provide reasonable assurance of adequate protection with respect to the control of material composition and process characteristics.

The licensee’s commitments regarding *enrichment control* are contained in Section 6.1.3.6, “Enrichment,” of the LRA. The plant-wide limit of 5 wt% U-235 is ensured through the possession limits and controls on the receipt of feed material, and Westinghouse does not have any processes capable of further enriching SNM. In response to RAI 18 (WEC, 2018c), the licensee has stated that it does not take credit for lower enrichments than the plantwide limit of 5 wt-% U-235. The licensee’s commitments are consistent with the general commitments applied to all parameters and are, therefore, provide reasonable assurance of adequate protection with respect to enrichment control.

The licensee’s commitments regarding *heterogeneity control* are contained in Section 6.1.3.7, “Heterogeneity,” of the LRA. WEC states that fissionable materials may be considered homogeneous when the particle diameter is no greater than 150 μm (microns) and commits to analyze the effects of heterogeneity if the particle size exceeds this amount. The staff reviewed the licensee’s technical basis for the particle diameter criterion. The staff notes that as described in the NRC’s Safety Evaluation Report for the 1985 version of the LRA (NRC, 1985), homogeneous single-parameter limits (SPLs) were applied to uranium solutions and powder-water mixtures and heterogeneous SPLs were applied to fuel rods and assemblies. The distribution of particle sizes for all special nuclear material processed at the licensee’s facility is bimodal, with a broad gap between the size distribution for UO_2 powders and the size distribution for finished fuel (pellets, rods, and assemblies). Few, if any, instances of particles with sizes between these values are expected. The NRC staff examined the UO_2 powder particle size distribution, which the licensee measured by laser diffraction. Based on those measurements, the staff determined that essentially all of the powder was composed of particles with diameters significantly smaller than 150 microns. Because the 150 micron threshold occurs in the broad gap between the maximum size of powder particles and the minimum size of finished fuel, the exact point at which heterogeneity effects appear does not

need to be ascertained with high precision. The onset of heterogeneity effects is gradual, as discussed below.

The staff reviewed two of the licensee's on-site analyses, which were parametric studies performed to determine the reactivity effect of particle heterogeneity. The first analysis the staff reviewed (WEC, 2006) determined the effect of particle size on dimensional SPLs for UO_2-water spheres, cylinders, and slabs, at several different values of the hydrogen-to-fissile (H/X) ratio. The calculations used the SCALE-4.4 code with the 44-group ENDF/B-V cross section library and considered particle diameters down to 2000 microns. The second analysis reviewed, (WEC, 1998) provided similar results for the spherical radius for particle sizes ranging from 20 to 15,000 microns, and the calculations used the XSDRN-PM code with 227 and 27-group cross section libraries. Both of these studies show that the optimal particle diameter (e.g., diameter producing the smallest SPL value) is roughly in the 4-to-8 cm (4,000 to 8,000 micron) range, depending on H/X. Heterogeneous effects decrease steadily for particle diameters larger or smaller than the optimal, but some effect was still observed for diameters of 150 microns and below.

The NRC staff conducted a literature search and performed confirmatory analysis to determine the magnitude of the effect at 150 microns. Okuno, *et al*. (Okuno, 1994) performed peer-reviewed, published studies at varying enrichments and H/X ratios for both homogeneous and heterogeneous systems, with particle sizes for the heterogeneous cases down to 200 microns. By interpolating between the data points in Okuno, *et. al.,* it can be demonstrated that for particle diameters of 150 microns, the heterogeneous case will be roughly 0.25 percent higher in k_{eff} than the corresponding homogeneous case. The Okuno paper concludes that systems with particle sizes less than 100 microns may be treated as homogeneous "if a 0.3 percent increase in reactivity is disregarded." This paper also cites the French criticality guide CEA R3114 (CEA, 1967). Section III.2.1 of this reference contains a table of permissible values below which heterogeneity effects may be ignored. Okuno, *et al*. determined that this table corresponded to the criterion that the particle diameter should be less than 1/5 of the mean free path of a thermal neutron (2200 m/s) in the fuel region. The mean free path decreases with increasing density; at the maximum theoretical uranium oxide density of 10.96 grams per cubic centimeter (g/cc), this results in a diameter value of approximately 1500 microns. Okuno, *et al*. found a small but measurable effect down to 100 microns, however, the French CEA guide determined that as a practical matter, this effect could be ignored for diameters smaller than 1500 microns. However, this criterion must be understood in the context of all the technical practices and their associated safety margins presented in the CEA guide. That is, these small reactivity effects may be ignored if sufficient margin has been provided to account for them.

The staff also performed a confirmatory analysis to verify the licensee's results (WEC, 1998) and convert the differences in SPLs values to differences in k_{eff}. This conversion was done because the WEC analysis reports the spherical radius SPLs at specific k_{eff} values, so that differences due to particle size are observed as differences in the SPLs. The staff therefore constructed homogenized spherical models at similar conditions as the licensee's heterogeneous cases (e.g., having the same geometry, and an H/X value corresponding to the space-averaged fuel-to-moderator ratio, as for the licensee's heterogeneous cases). For these calculations, the staff used the SCALE-6.1 (KENO-VI) code with the Continuous Energy ENDF/B-VII cross section library. The staff's models resulted in a calculated k_{eff} within 0.1 to 0.2 percent of the licensee's target k_{eff} value. The heterogeneity effects were greatest at the lowest H/X value, which corresponds to the most intermediate neutron energy spectrum. For the most conservative H/X of ~18 in WEC's analysis (WEC, 1998) and a target k_{eff} of 0.95, the difference in spherical radius between the homogeneous case and the heterogeneous case at a particle

diameter of 150 microns was ~0.3 mm. The NRC staff determined that this change in radius corresponded to a change in k_{eff} of 0.1 percent.

Small but measurable reactivity differences due to heterogeneity (on a 20 to 150 micron scale) were identified in the CEA, Okuno, and WEC studies [(CEA, 1967), (Okuno, 1994), and (WEC, 1998)]. As stated above, the NRC staff confirmed these results. Under normal and anticipated abnormal conditions, the minimum subcritical margin of 0.05 calculated by the licensee significantly exceeds the 0.1 to 0.3 percent reactivity difference due to heterogeneity. Credible abnormal configurations using a minimum subcritical margin of 0.02 provide additional margin in k_{eff}. This available margin significantly exceeds the magnitude of the heterogeneity effect and provides reasonable assurance that subcriticality will be maintained as required by 10 CFR 70.61(d).

Most of the systems modeled at the licensee's facility will be homogeneous or heterogeneous on a scale significantly less (e.g., solutions, powders) or significantly greater (e.g., pellets, rods, assemblies) than the 150 micron threshold. Cases involving particle size lower than the 150 micron threshold will be evaluated as homogeneous, and cases involving particle size greater than the 150 micron threshold will be evaluated as heterogeneous, as appropriate and consistent with standard industry practice. While it is possible that some future systems could involve inhomogeneity on a scale nearer to the 150 micron threshold, the staff finds the licensee's commitments regarding the NCS technical practices discussed above sufficient to ensure that any such case will be appropriately evaluated. In particular, the licensee committed to evaluate parameters at their optimum or worst-credible values in LRA Section 6.1.3. It may be necessary to evaluate the effects of heterogeneity for some particle size distributions, in accordance with the commitment in LRA Section 6.1.3, if the effects are not bounded by existing analysis, particularly if the calculated k_{eff} is very close to the license limit (so that there is not sufficient margin to bound those effects). Therefore, based on the foregoing considerations, the licensee's commitments provide reasonable assurance of adequate protection with respect to heterogeneity control.

The licensee's commitments regarding *neutron absorption control* are contained in Section 6.1.3.8, "Neutron Absorbers," of the LRA. In addition to committing to ANSI/ANS-8.22-1997 for fixed neutron absorbers, the licensee plans to continue to use borosilicate glass Raschig rings (a neutron absorber) for neutron absorber control. Currently, WEC only uses Raschig rings in the unfavorable geometry Quarantine Tanks (Q-Tanks) in the ammonium diuranate (ADU) conversion process.

The ANSI/ANS-8.5-1996 states that Raschig rings shall not be used in basic environments, unless chemical and physical limits have been determined and documented. The licensee committed to follow the requirements of ANSI/ANS-8.5-1996 for acidic and neutral solutions but proposed an exception to the requirements of ANSI/ANS-8.5-1996 regarding the use of Raschig rings in basic environments. ANSI/ANS-8.5-1996 also recommends that the rings be inspected for degradation on a frequency derived from a trending analysis derived from the operationally observed corrosion rate. Section 6.1.3.8(2) of the LRA adopts the ANSI/ANS procedures recommended to prevent degradation. The WEC commits to limiting basic solutions to a pH level of no more than 11 and a temperature of no more than 60°C, when Raschig rings will be used. The LRA also states the conditions of Raschig rings in the Q-Tanks will be verified annually.

The technical basis presented in ANSI/ANS-8.5-1996 for restricting the use of Raschig rings in basic environments has been extensively substantiated in the literature. Historical data

demonstrates that degradation of the Raschig ring increases significantly with increases in temperatures and pH levels (Nichols, 1971). Nichols reported that at a temperature of 95° C, the corrosion depth in Raschig rings increases from 0.01" at a pH level of 10 to 0.3" at a pH level of 14. In a 2 percent sodium hydroxide (NaOH) solution, the depth of corrosion on Raschig rings increases from 0.01" at 60°C to 0.3" at 100° C. Building on the results in the Nichols study, Ketzlach examined the effect of this type of degradation on the infinite neutron multiplication factor, k_∞ (Ketzlach, 1979). Ketzlach determined that an inspection period of 13 months was the maximum period acceptable when rings are used for primary criticality control. Ketzlach found a 26-month inspection period was acceptable for rings used for secondary criticality control. Ketzlach recommended against the use of Raschig rings as a primary neutron absorber control because the chemistry of uranium basic environments leads to clogging of the rings and necessitates frequent and difficult cleaning.

The NRC staff determined that the licensee's use of Raschig rings in the basic environment of the Q-Tanks, as described in the LRA (WEC, 2017e), is much less harsh than the conditions evaluated in the experimental studies reported by Nichols and Ketzlach. The licensee reported that the typical temperature of the solution in the Q-Tanks is 90° F (32° C), the maximum operating temperature of solution within the Q-Tanks is 115° F (46° C), and that an alarm is triggered when temperatures in the Q-tanks reach 130°F (54° C). The pH limit of 11 in LRA Section 6.1.3.8 is also much lower than that reported in the experimental studies (13.7 for a 2 percent NaOH solution and 14 for a 1N NaOH solution). In addition, an alarm is triggered when a pH level reaches 10.6. The WEC also commits to measure temperature and pH daily to ensure that levels remain within limits. The licensee also commits to perform annual inspections for ring degradation. The inspections will measure the ring level and glass volume inside the Q-Tanks and will remove ring samples for measurement of mechanical strength, mass, and Boron-10 (^{10}B) content. The ring samples will be taken from the top and bottom of the tanks, and new rings added to the tanks are tagged to ensure they are not included in the samples. These inspection and sampling procedures are consistent with ANSI/ANS-8.5-1996.

The staff reviewed WEC's records of annual ring testing during an on-site review and determined that some degradation of the rings had occurred over a period of several years. Because the chemical environment of WEC's Q-Tanks is much less harsh than the tanks in the experimental studies, the rate of degradation of the Raschig rings at WEC was much lower as well. The staff determined that WEC's Q-Tanks operate at a lower temperature (46° C) and lower pH (10.6) than that in LRA Section 6.1.3.8 (60° C and 11).

The NRC staff finds that the data from the annual measurements reported in WEC's operating history does not demonstrate that the limits and controls on the Q-Tanks are adequate up to the temperature and pH conditions for which approval is sought in LRA Section 6.1.3.8. Consequently, the staff performed an independent assessment using the glass erosion data in Nichols, *et al.* and Shand's "Glass Engineering Handbook" (Shand's Handbook) (Shand, 1958) in order to evaluate how the erosion rate varies as a function of temperature and pH. The staff used the data in these studies (i.e., corrosion depth and weight loss from Nichols *et. al*., and weight loss per surface area from Shand's Handbook, as a function of time) to calculate an annual weight and glass volume loss. The staff's calculations demonstrated that it would take several years of sustained operation at a temperature of 60° C and a pH level of 11 for the glass erosion of Q-tanks to exceed the available margin in the glass volume fraction. As such, the staff determined that annual surveillance, along with WEC's commitment to perform daily monitoring for degradation, allows for the early identification of erosion of glass long before glass erosion could challenge the assurance of subcriticality.

Table 1 of ANSI/ANS-8.5-1996 stated that uranium solutions at a maximum enrichment of 5 wt% U-235 are safely subcritical at any uranium concentration when the glass volume fraction is at least 24 percent. Below 24 percent, a high concentration would still have to occur for there to be a criticality, as indicated by the observation that the safe concentration for high-enriched (100 wt%U-235) solutions at 24 percent glass volume fraction is still 270 g/l. The safe concentration at 5wt% U-235 is unlimited for a 24 percent glass volume and would be substantially higher than for 100 wt% U-235 at lower glass volumes. While the concentration is not controlled in the Q-Tanks, it is normally very low, as is necessary for transfer to the unfavorable geometry water glass vessels, which are not protected by Raschig rings, through in-line gamma monitors. Based on the annual glass volume measurements, the typical glass volume fraction ranges from about 35-40 percent. The staff also notes that additional uncredited margin is provided by the low uranium concentration in the Q-tank solution.

Because of WEC's commitment to perform annual inspections, the staff has reasonable assurance that such degradation of the safety margin provided by the high glass volume would be detected before conditions could lead to criticality. Section 7.4 of ANSI/ANS-8.5-1996 allows the inspection interval to be increased based on trends in the operating data. However, because the operational history of the Q-Tanks does not include conditions up to 60° C and a pH of 11, NRC staff notes that WEC needs to exercise caution when considering operational history as a basis for increasing inspection intervals.

The staff concludes the licensee's commitment to perform annual inspections of the rings provides reasonable assurance of subcriticality in operations relying on Raschig rings as the primary criticality control (as is the case for the Q-Tanks) in basic environments up to the license limits.

The staff finds the licensee's commitments regarding *reflection control*, contained in Section 6.1.3.9, "Reflection," of the LRA are consistent with standard industry practice and the general requirement to ensure subcriticality under normal and credible abnormal conditions in 10 CFR 70.61(d). Therefore, the staff finds that these commitments provide reasonable assurance of adequate protection with respect to reflection control.

The licensee's commitments regarding *interaction or spacing control* are described in LRA Section 6.1.3.10, "Interaction/Spacing," of the LRA. The staff determined that the licensee adopted the applicable ANSI/ANS standards (as discussed above) for evaluating whether individual units are non-interacting, which eliminated the need to model them together in criticality analyses. Therefore, the interaction or spacing control criteria provide reasonable assurance of adequate protection with respect to interaction control. The licensee also stated that it may evaluate the interaction of units using validated methods, including the use of deterministic or probabilistic computer codes, standards, and hand calculations. The staff finds the licensee's commitments for interaction control are consistent with the acceptance criteria in Section 5.4.3.2 of NUREG-1520 (NRC, 2010a), with the following exception:

> The licensee stated in LRA Section 6.1.3.10 that spacing control will be based on engineered devices, however, where the use of engineered devices is not feasible, administrative controls may be used. The WEC's commitment to use engineered controls or, where not feasible, administrative controls, is consistent with the acceptance criterion in Section 5.4.3.2 of Revision 2 of NUREG-1520 (NRC, 2010a), which allows the use of engineered controls or, where not feasible, administrative controls. The NUREG language is consistent with the preferred hierarchy committed to by WEC in

LRA Section 6.1.2. The LAR Section 6.1.2 also states that the choice of administrative controls will be justified in the CSE.

In addition to committing to follow the preferred control hierarchy and to justify the use of administrative controls, the licensee also agrees to not rely solely on administrative spacing controls to maintain subcriticality. This is consistent with LRA Section 6.1.1 to follow the double contingency principle, which relies on control through two independent parameters.

The staff noted that a justification will be provided when administrative controls are to demonstrate that multiple procedural errors would not by themselves lead to a criticality. Moreover, any such controls could only be used if they comply with the double contingency principle and requirement for all nuclear processes to be subcritical under normal and credible abnormal conditions, as stated in 10 CFR 70.61(d). The staff finds that the commitments stated in LRA Section 6.1.3.10 to use administrative controls, in conjunction with management measures and the other commitments mentioned above, meet the requirements of 10 CFR 70.61(d) and provide reasonable assurance of subcriticality.
The staff reviewed WEC's analytical methods, including the use and validation of computer codes and its application of subcritical margin in Section 6.1.5, "Analytical Methods," of the LRA. In LRA Section 6.1.5.3, the licensee committed to perform future validations in accordance with the criteria of ANSI/ANS-8.1-1998. The NRC staff conducted an in-depth review of a previous revision of the validation report and the calculational methodology, as part of the 2007 license renewal as documented in the 2007 SER (NRC, 2007e). In the NRC staff's review of the validation report as part of the 2007 license renewal, the NRC staff evaluated WEC's methods for determining bias, bias uncertainty, and calculational methodology (subject to whether modeled conditions meet the criteria for being a "credible abnormal configuration" as defined in LRA Section 6.1.4.2[6]). Section 6.1.5.3 of the LRA incorporates the 2017 version of the validation report, LTR-ESH-05-146, Revision 2, "Validation of the CSAS25 Sequence in SCALE-4.4 and the 238-Group ENDF/B-V Cross Section Library for Homogeneous Systems at the Westinghouse Columbia Fuel Fabrication Facility" (WEC, 2006a). Under its commitment in the LRA, WEC will continue to submit new or revised validation reports to the NRC for review on an as-needed basis. The 2017 version was reviewed by the NRC staff.

The staff reviewed the description of the licensee's k_{eff} limits, validation methodology, and hardware and software verification commitments in LRA Sections 6.1.5.2 through 6.1.5.3. After evaluating WEC's commitments in the LRA, including the commitments to ANSI/ANS-8.1-1998 and ANSI/ANS-8.24-2007, the staff determined the licensee's technical practices as described in the LRA are consistent with standard industry practice and the acceptance criteria in Section 5.4.3.2 of NUREG-1520 (NRC, 2010a).

5.4 EVALUATION FINDINGS

The staff has reviewed the NCS program and finds the following items.

(1) The licensee will have managers, supervisors, engineers, process operators, and other support personnel, who are qualified to develop, implement, and maintain the NCS program in accordance with the facility organization and management measures.
(2) The licensee's conduct of operations will be based on NCS technical practices, which will ensure that the fissile material will be possessed, stored, and used safely, according to the requirements of 10 CFR Part 70.

(3) The licensee will develop, implement, and maintain a criticality accident alarm system in accordance with both the requirements in 10 CFR 70.24 and the facility emergency management program.
(4) The licensee will have in place an NCS Program in accordance with the performance requirements of 10 CFR 70.61, including the subcriticality requirement of 10 CFR 70.61(d).

Based on this review, the staff concludes that the licensee's NCS program meets the requirements of 10 CFR Part 70 and provides reasonable assurance of the protection of public health and safety, including workers, and the environment.

CHAPTER 6 CHEMICAL SAFETY REVIEW

6.1 PURPOSE OF REVIEW

The purpose of this review was to determine, with reasonable assurance, if the licensee qualifications, equipment, facilities and procedures are adequate to protect health and minimize danger to life and property from chemical hazards that are under NRC's regulatory jurisdiction. This review is also to determine whether the licensee's chemical safety program includes the elements required by Title 10 of the *Code of Federal Regulations* (CFR) Section 70.62, "Safety program and integrated safety analysis," and if it provides reasonable assurance that the program meets the chemical safety performance requirements of 10 CFR 70.61, "Performance requirements."

6.2 REGULATORY REQUIREMENTS

The U.S. Nuclear Regulatory Commission (NRC) staff conducted the chemical safety review to ensure that the Westinghouse Electric Company, LLC's (WEC's) program meets the requirements required by Title 10 of the *Code of Federal Regulations* (10 CFR) Sections 70.22, "Contents of applications," 70.23, "Requirements for the approval of applications," 70.62, "Safety program and integrated safety analysis", 70.65 "Additional content of applications", and 70.66, "Additional requirements for approval of license application."

6.3 STAFF REVIEW AND ANALYSIS

The NRC staff reviewed and evaluated WEC's license renewal application (LRA) following the acceptance criteria for the NRC's review of chemical process safety for the proposed facility. The staff also reviewed WEC's responses to requests for additional information (RAIs), audit reports, and inspection reports to have a better understanding of WEC's processes and safety program. The review criteria are presented in Section 6.4.3 of NUREG-1520, Revision 1, "Standard Review Plan for Fuel Cycle Facilities License Application" (NUREG-1520) (NRC, 2010a).

The staff reviewed WEC's ISA documents during a site visit as well as a 2022 WEC document report that presented the January 2022 version of the ISA summary (WEC, 2022).

The staff review focused on the following areas:

1. Chemical Safety Program;
2. Chemical Process Description;
3. Chemical Accident Sequences;
4. Chemical Accident Consequences;
5. Items Relied on for Safety (IROFS); and
6. Management Measures

The review and evaluation are summarized in the following sections.

6.3.1 CHEMICAL SAFETY PROGRAM

The regulation in 10 CFR 70.62(a) stated in part that a licensee must establish and maintain a safety program that meets the 10 CFR 70.61 performance requirements, and thus adequately protects the worker, public health and safety, and the environment from the chemical hazards of licensed material. The NRC staff review of the WEC chemical safety program included an evaluation of the elements of the safety program found in Chapter 3, “Management Measures;” Chapter 4, “Integrated Safety Analysis (ISA);” and Chapter 7, “Chemical Safety Program” of the LRA (WEC, 2019b).

Chapter 7 of the LRA presented the WEC chemical safety program. The chapter included references to other portions of the application including ISA (Chapter 4), management measures (Chapter 3) and emergency planning (Chapter 9). The LRA included commitments to the identification and analysis of chemical hazards, procedures that define authority and responsibly for safety, procedures for minimizing accidents and injuries, a hazard communication program, training for employees using hazardous chemicals, an energy isolation and lock-out-tag-out program, procedures for section of PPE, the availability of eyewash stations and safety showers, and inclusion of how WEC responds to any accidental release of hazardous chemicals. WEC also has a configuration management program that includes consideration of chemical hazards when changes are being planned as well as an audit program that assesses compliance with chemical safety standards.

The LRA committed to identify and evaluate potential accident sequences caused by process upset situations and credible external events. In response to RAI 55 (WEC, 2018c), WEC clarified that the ISA considered all phases of operation (i.e., startup, shut down, maintenance, and non-routine operations). The LRA also states that a hazard and operability (HAZOP) analysis, what-if/checklist, and/or other recognized method will be conducted to systematically evaluate the safety of chemical operations at the Columbia Fuel Fabrication Facility (CFFF). WEC selected the hazard evaluation method based on the complexity of the process being analyzed. In response to RAI 51 (WEC, 2018c), WEC stated that its plant procedures provide guidance on the selection of the appropriate methodology to use in a process hazard analysis (PHA).

The WEC chemical safety program has the elements required according to 10 CFR 70.62. The program has been refined over the years to build on the WEC experience in facility operation, maintenance and modification. The program has also been refined in response to NRC licensing activities and inspections.

6.3.2 CHEMICAL PROCESS DESCRIPTION

Section 70.65(b)(3) of 10 CFR requires an ISA Summary to include a description of the process covered by the ISA Summary.

The primary operation of the CFFF is the manufacture of nuclear fuel assemblies for commercial nuclear power plants. The CFFF operations involve receiving low-enriched uranyl nitrate solution and uranium hexafluoride (UF_6) which are converted into uranium dioxide (UO_2) powder with the powder then pressed into pellets, which are sintered, sized, and loaded into fuel rods. Loaded rods are combined to make a fuel assembly.

The primary manufacturing operations are supported by coating operations, laboratory activities, scrap recovery operations, and waste management operations. Detailed information was

provided in the ISA summaries on the individual processes, including buildings, processes, and systems. Most of the manufacturing operations are conducted in the main manufacturing building, which contains two areas—the chemical area and the mechanical area.

The NRC staff reviewed the process descriptions provided in the appropriate sections of the ISA summaries. The staff focused its review of those ISA summaries that covered operations with the greater potential for chemical hazards. These include ISA-03 which covers the ADU Conversion System, ISA-07 which covers the uranium recovery and recycling services (URRS) Solvent Extraction System, and ISA-11 which covers the Scrap Uranium Processing System.

The staff review concluded that the ISA summaries contain process descriptions as required by 10 CFR 70.65(b)(3). The process description meets the criteria of section 6.4.3.1 of NUREG-1520.

6.3.3 CHEMICAL HAZARD IDENTIFICATION

Regulations in 10 CFR 70.62(c) require that a licensee conduct and maintain an integrated safety analysis that includes the identification of chemical hazards of licensed material, chemical hazards produced from licensed material and facility hazards that could affect the safety of licensed materials.

The staff reviewed WEC's process for screening and classifying chemicals and identifying chemical hazards for their ISAs. The staff reviewed the WEC ISA Handbook which is maintained onsite and describes the WEC chemical hazard identification process. In response to RAI 56 (WEC, 2018c) WEC clarified that the chemical safety and ISA Programs evaluate all exposure pathways (i.e., inhalation, dermal and ocular exposure). The staff also reviewed the results of the hazard identification process presented in the various ISA summaries. Particular attention was paid to ISA summaries for chemical processing operations including ISA-03 which covers the ADU Conversion System, ISA-07 which covers the URRS Solvent Extraction System, and ISA-11 which covers the Scrap Uranium Processing System. In addition, the staff reviewed the ISA Summary titled "Site and Structures" which provides additional discussion of CFFF operations and hazards and includes a table that identifies quantities and location of hazardous chemicals at the site.

The staff review found that the ISA summaries identified important chemical hazards including UF_6 and its hydrolysis product hydrofluoric acid (HF) as well as hazards from nitric acid, and ammonia. HF can be a significant hazard at the CFFF because exposure by any route may be fatal (NRC, 2007d). The staff also examined WEC methods and results for identifying reactive chemical hazards. During a site visit, the staff examined a WEC document that presented a chemical interaction matrix that identified potential interactions between materials used at the CFFF. The staff also found that the ISA summaries identified important reactive hazards including "red oil" which was discussed in ISA-07 URRS Solvent Extraction System.

Based on its review of WEC procedures, ISA guidance documents and ISA summaries, the staff concluded that WEC has established and is implementing an adequate process for identifying chemical hazards associated with CFFF operations as required by 10 CFR 70.62(c).

6.3.4 CHEMICAL ACCIDENT CONSEQUENCES

Regulations in 10 CFR 70.62(c) require that a licensee conduct and maintain an integrated safety analysis that included identification of chemical accident sequences involving licensed material and hazardous chemicals produced from licensed material as well as facility hazards that could affect the safety of licensed materials. Guidance for reviewing accident sequences is provided in section 6.4.3.2 of NUREG-1520, Revision 1.

The NRC staff reviewed the methodology that WEC used to identify accident sequences and reviewed accident sequences identified in the ISA summaries. For example, in ISA Summary 03, the NRC staff reviewed an accident sequence in the HF spiking area which resulted in personnel exposure to HF during HF spiking operations. This accident sequence was the subject of RAI 58 provided in consolidated RAI package dated March 28, 2018 (WEC, 2018c). The staff requested clarification to determine if WEC's ISA Summary and the underlying ISA considered all credible accident scenarios that could lead to a potential worker exposure in the HF spiking area. In response to RAI 58, WEC stated that they recently completed an update of the PHA evaluating the system and a new initiating event was determined to be possible. Specifically, WEC included an accident sequence that involved a programmatic logic controller (PLC) error with the potential to cause a loss of containment event.

The NRC staff reviewed the loss of containment accident scenarios at the HF spiking station described in the ISA Summary 03 "ADU Conversion System." The scenarios were caused by: (1) the failure of piping or tank; (2) overfill resulting in tank overflow; or (3) high/low system pressure. Staff also examined inspection records as part of this review.

Based on its review, the NRC staff concluded that the licensee ISAs include accident sequences as required by 10 CFR 70.62(c)(iv) and the information is consistent with the acceptance criteria presented in Section 6.4.3.2 of NUREG-1520 (NRC, 2010a).

6.3.5 CHEMICAL ACCIDENT CONSEQUENCES

Integrated safety analyses are required to identify accident sequence consequences according to 10 CFR 70.62(c)(v). Guidance for reviewing accident sequences is provided in section 6.4.3.3 of NUREG-1520, Revision 1.

In Section 7.1.3.4 of the LRA, WEC described its approach for conducting chemical safety analysis, which evaluates chemical accident sequences using an accident flow diagram. The method used by WEC in the ISA summaries traces each sequence through the diagram, beginning with the initiating event and continuing the analysis to the classification of consequence (high, intermediate, less than intermediate) for the sequences being analyzed.

The ISA summaries provide tables identifying the consequence categories for credible events. The tables identify the consequences of chemical accident sequence as being high, intermediate, or less than intermediate. The tables include the chemical quantitative standards in accordance with 10 CFR 70.65(b)(7). The binning process used several sources of information in determining the consequences including:

(1) a report that estimated the minimum spill volume that would be required to exceed emergency response planning guidelines (ERPG) values. This report included spill volume estimates for various concentrations of ammonia solutions, for 5 percent hydrofluoric acid solutions, and for perchloroethylene,

(2) site measurements of nitric acid in the air following spills of uranyl nitrate solutions at the site
(3) estimates of UF_6 release quantities and consequences presented in WASH-1248, "Environmental Survey of the Uranium Fuel Cycle."

The staff review found that the WEC estimation of consequences that supports the binning process were often conservative. A specific example was the use of an older, more restrictive (i.e., lower) value for ERPG 3 for ammonia. Also, most worker HF exposure consequences were conservatively categorized as high.

The standards used for judging chemical exposure consequences were consistent with NRC guidance in NUREG-1520 and FCSE Interim Staff Guidance ISG-14, "Acute Uranium Exposure Standards for Workers" (NRC, 2015f).

The NRC staff finds that WEC used acceptable methods for classifying the consequences of chemical accident sequences. The staff finds the classification results reasonable and include elements of conservatism in the classification. The NRC staff finds that the licensee ISA summaries include accident sequence consequence estimates as required by 10 CFR 70.62 (c)(v), and that the methods used to determine the consequences are consistent with the acceptance criteria presented in Section 6.4.3.3 of NUREG-1520 (NRC, 2010a).

6.3.6 ITEMS RELIED ON FOR SAFETY

According to 10 CFR 70.62(c)(iv), items relied on for safety (IROFS) are required. Guidance for reviewing accident sequences was provided in section 6.4.3.4 of NUREG-1520, Rev. 1.

Chapter 4 of the LRA discusses WEC's approach for identifying items relied on for safety. The approach applies the identification of IROFS that are necessary to assure compliance with the chemical safety aspects of the performance requirements of 10 CFR 70.61.

The ISA summaries identify the specific IROFS that are applied to prevent or mitigate the consequences of specific accident sequences including those involving chemical hazards. The ISA Summary table describes the safety functions of IROFS, the specific accident sequence to which each IROFS is applied and the type of IROFS (e.g., passive engineered control, active engineered control, administrative control, administrative control with computer alarm or assist). Some IROFS are solely for chemical safety while other IROFS manage both chemical hazards as well as other hazards (e.g., fire, criticality). The identified IROFS provide protection to prevent a loss of confinement of licensed material during operation at the facility.

Based on its review of IROFS tables in the ISA summaries and the NRC staff's on-site visit, the staff concluded that WEC has identified chemical process IROFS that help provide assurance that the chemical safety performance requirements of 10 CFR 70.61 are met at the CFFF.

The NRC staff finds that the licensee's ISAs contain IROFS related to chemical safety consistent with the requirements of 70.62(c)(iv) and that the information is consistent with the acceptance criteria presented in Section 6.4.3.4 of NUREG-1520 (NRC, 2010a).

6.3.7 MANAGEMENT MEASURES

Management measures are required to be in the ISA according to 10 CFR 70.62 (d). Guidance for reviewing accident sequences is provided in section 6.4.3.5 of NUREG-1520, Revision 1.

Chapter 3 of the LRA discusses WEC's development and use of management measures to assure the availability and reliability of IROFS. The staff's review of the WEC management measures program is discussed in Chapter 11 of this SER. The staff's chemical safety review was coordinated with the management measures review.

The WEC ISA summaries that identify IROFS also have a table that identifies the specific management measures (e.g., configuration management, procedures, human performance, program audit, etc.) that are applied to each IROFS type (e.g., passive engineered control, active engineered control, administrative control, etc.).

The staff reviewed the specific management measures that are applied to the types of chemical safety IROFS identified in the various ISA summaries.

The NRC staff finds that the licensee's management measures being applied to chemical safety IROFS are consistent with the requirements of 10 CFR 70.62(d) and that the information is consistent with the acceptance criteria presented in Section 6.4.3.5 of NUREG-1520 (NRC, 2010a).

6.4 EVALUATION FINDINGS

WEC has established and implemented a program that identifies and manages chemical hazards that are under NRC's regulatory jurisdiction. The program includes ISA analysis of chemical hazards, the development of chemical safety IROFS as appropriate and the use of management measures to assure the availability and reliability of the chemical safety IROFS. The program is consistent with the requirements of 10 CFR Part 70 including the requirements of 10 CFR Part 70 Subpart H.

The ISA summaries include the identification and analysis of accident sequences involving chemical hazards, the identification of IROFS selected to assure compliance with the chemical safety performance requirements of 10 CFR 70.61, and management measures to assure the availability and reliability of the chemical safety IROFS.

The staff finds the definition and implementation of the chemical safety program acceptable.

Based on its review of LRA and ISA summaries using the chemical safety review criteria previously listed, the NRC staff finds that the performance requirements in 10 CFR 70.61 related to chemical safety are met. The staff concludes that WEC's program for identifying and managing chemical hazards under NRC's regulatory jurisdiction meets the applicable requirements of 10 CFR Part 70 and finds there is reasonable assurance that public health and safety, and the environment are protected from chemical hazards under NRC's regulatory jurisdiction.

CHAPTER 7 FIRE SAFETY

7.1 PURPOSE OF REVIEW

The purpose of this review was to determine with reasonable assurance that the facility provides adequate protection against fires and explosions that could affect the safety of licensed materials and thus present an increased radiological or chemical risk. The review also examined whether the licensee adequately considered the radiological and chemical consequences of fire, and identifies suitable safety controls to protect workers, the public, and the environment.

7.2 REGULATORY REQUIREMENTS

The U.S. Nuclear Regulatory Commission (NRC) staff conducted this review to ensure that the Westinghouse Electric Company, LLC's (WEC's) fire safety program meets the requirements required by Title 10 of the *Code of Federal Regulations* (10 CFR) Sections 70.22, "Contents of applications," and 70.65, "Additional content of applications." In addition, the fire safety must provide reasonable assurance of compliance with 10 CFR 70.61, "Performance requirements," and 70.62, "Safety program and integrated safety analysis."

The acceptance criteria that the NRC uses for reviews of fire safety are outlined in Sections 7.4.3.1 through 7.4.3.5 of NUREG-1520, Revision 1, "Standard Review Plan for Fuel Cycle Facilities License Application" (NUREG-1520) (NRC, 2010a).

7.3 STAFF REVIEW AND ANALYSIS

7.3.1 FIRE SAFETY MANAGEMENT MEASURES

The licensee described the fire safety management measures throughout the license renewal application (LRA) (WEC, 2019e). The management measures include fire safety organization; fire prevention; inspection, testing, and maintenance of fire protection systems; emergency response organization and training; and pre-fire plans. These management measures are applied to items relied on for safety (IROFS) to provide reasonable assurance that they are available and reliable to perform their intended functions when needed.

7.3.1.1 Fire Safety Organization

As described in LRA Section 8.1.1.1, the fire safety function position is the "authority having jurisdiction" to make a change to the fire safety program that provides at least an equivalent level of safety. For such a change, the licensee committed to perform an equivalency evaluation, as defined by the National Fire Protection Association (NFPA) and make such records available for NRC inspection. A change that does not provide an equivalent level of safety will be submitted to the NRC, prior to its implementation, for review and approval. Advisory and service groups provide assistance to management on their areas of control.

The fire safety function position is also responsible for the implementation and management of many areas of the fire safety program. In response to NRC's request for additional information (RAI) 59 (WEC, 2018c), the licensee states that the fire safety function must meet the applicable requirements in LRA Section 2.1.1.3, "Position Accountability and Requirements." The individual holding the fire safety function position must meet the specified requirements for qualification and undergo a training program. Training records are maintained on site. In the same RAI, the

licensee described the qualifications for a senior fire safety engineer that would be involved in implementing the fire safety program. The position requires the individual to be an NFPA-certified fire protection specialist.

7.3.1.2 Fire Prevention

The licensee's fire prevention program is described in LRA Section 8.1.1, "Basic Fire Protection," and consists of an approved hot work permit system, hot work procedures, and welder training; flammable liquid storage and handling procedures; and combustible material inventory controls and audits.

7.3.1.3 Inspection, Testing, and Maintenance of Fire Protection Systems

As described in LRA Section 8.1.10, "Audits," the licensee performs periodic audits of the fire protection system. The entire fire safety program is audited triennially, and the results are made available for NRC review and inspection. Section 8.1.1.9 of the LRA states that a preventative maintenance program is in place for fire protection systems. Automatic water-based fire suppression systems are maintained in accordance with the testing frequencies specified in NFPA 25, "Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems" (NFPA, 2013a). The integrated safety analysis (ISA) summary lists the fire-related IROFS and their associated management measures.

7.3.1.4 Emergency Response Organization and Training

Section 8.1.1.11 of the LRA stated that all new employees and contractors receive training related to fire safety as described in LRA Section 3.4, "Procedures, Training and Qualification." Members of the emergency response team (ERT) are given extensive additional training. In response to RAI 60 (WEC, 2018c), the licensee stated that the training provided to the ERT is described in the site emergency plan. The site emergency plan is reviewed and requires the approval by the NRC staff.

Section 8.1.1.7 of the LRA states that an emergency exercise that includes facility evacuation is conducted annually at the facility. Periodically, as prescribed by the fire safety function, a fire scenario is included as part of a drill.

7.3.1.5 Pre-fire Plans

Section 8.1.8, "Pre-Fire Plans," of the LRA stated that the fire safety function prepares and maintains the pre-fire plans for the facility that include site information and sketches, assignment of ERT responsibilities and checklists, listings of fire detection and protection devices, as well as other site details. Copies of these plans are made available to the responding off-site fire department for assistance.

The licensee identified a senior-level manager who has the authority to approve pre-fire plans and staff to ensure that fire safety receives appropriate priority. The duty of implementing the fire safety function is carried out by staff trained in fire protection principles. The fire safety function reports to the plant manager, and advisory groups also provide input on their specific area of operations.

The licensee's fire safety management measures include an appropriately qualified management structure, fire prevention, inspection, testing, and maintenance of fire protection

systems, emergency response organization qualifications, drills, and training, and pre-fire plans. The licensee documented the fire safety management measures in sufficient detail and has committed to relevant NFPA codes regarding the maintenance and testing of fire sprinklers. Based on the information presented in Sections 8.1.1, 8.1.8, and 8.1.10 of the LRA, the NRC staff finds that the application meets the acceptance criteria for fire safety management measures, as outlined in Section 7.4.3.1 of NUREG-1520 (NRC, 2010a).

7.3.2 FIRE HAZARD ANALYSIS

In Section 8.1.9, "Fire Safety Analysis" of the LRA, the licensee describes their fire hazard analyses (FHAs). The FHAs for the site were performed for all plant manufacturing areas that require analysis to support ISAs and determine if IROFS are required and is an input into the ISA process. The FHAs are kept current as a part of the configuration management program described in Section 3.1, "Configuration Management" and Section 4.1, "ISA Program Structure," of the LRA. The FHA identifies controls required to maintain a sufficient margin of safety and analyzes fire accident sequences using an accident flow diagram. The qualified analyst traces all accident sequences from initiating event to a consequence of interest. In response to an RAI, the licensee stated that the FHA is performed using conservative assumptions, and the results are used to assess whether the facility meets the guidance in NFPA 801, "Standard for Fire Protection for Facilities Handling Radioactive Materials" (NFPA, 2013).

The WEC performed an FHA that meets the guidance in NFPA 801, as described in Section 8.1.9 of the LRA. The NRC staff finds that the license application is consistent with the acceptance criteria as outlined in Section 7.4.3.2 of NUREG-1520 (NRC, 2010a).

7.3.3 FACILITY DESIGN

In LRA Section 8.1.2, "Building Construction," the licensee described the facility design. The facility and its original fire protection systems were designed and constructed to industrial standards that were in effect at the time of construction. The licensee committed to meeting the prevailing codes whenever facilities are expanded or modified. Facilities are constructed of non-combustible or limited combustible materials. All fire-rated barriers are equipped with fire-rated doors and penetrations. The facility enables rapid personnel egress in accordance with the guidance provided in NFPA 101, "Life Safety Code" (NFPA, 2018). The electrical installations and wiring are in accordance with NFPA 70, "National Electric Code" (NFPA, 2016).

Section 8.1.3, "Ventilation Systems," of the LRA described the ventilation systems. The facility heating and ventilation are designed for fire protection and the space heating furnaces were built to industry and NFPA 70 (NFPA, 2016) standards. The fire barrier penetration employs fire dampers designed to specifications. Automatic closing is required for fire doors and dampers and Underwriters Laboratories listed final HEPA filters are used.

Section 8.1.6.2, "Fire Suppression Services," of the LRA described the fire suppression services. The building is protected by automatic sprinklers, except in areas where the use of water presents a criticality hazard. The use of water for firefighting in areas with special nuclear material is restricted unless authorized by the Environmental Health & Safety Engineering Criticality Safety Section. The sprinklers were installed in accordance with the version of NFPA 13, "Standard for the Installation of Sprinkler Systems" (NFPA, 2018b), that was current at the time of installation. The fire water supply meets the requirements of NFPA 801, because the system demand is adequately supplied by a 10-in main water line connected to the city

water supply. The system is designed such that a failure in one part of the water distribution system will not disrupt the water supply to the rest of the facility. Fire pumps are installed to deliver water from the main line to the hydrants, standpipes, and sprinkler systems. The fire pumps are outfitted with back-up diesel pumps in case of a power outage. The sprinkler system is supplied throughout the facility.

The licensee has documented the fire safety considerations used in the general design of the facility. The facility construction is adequately designed to prevent the spread of fire from one area to another non-combustible building materials and fire-rated barriers around high-risk areas (e.g., the incinerator). Applicable codes are adhered to in the areas of life safety and electric installation and wiring. The NRC staff finds that the application meets the acceptance criteria as outlined in Section 7.4.3.3 of NUREG-1520 (NRC, 2010a). The licensee has addressed industrial fire safety concerns involving nuclear safety, environmental protection, and physical security. The NRC staff finds that the application meets the acceptance criteria as outlined in Section 7.4.3.3 of NUREG-1520 (NRC, 2010a). Based on the information presented in Section 8.1.2 of the LRA, the NRC staff concludes that the application meets the applicable regulations.

7.3.4 PROCESS FIRE SAFETY

The licensee discussed process fire safety in LRA Section 8.1.4, “Process Fire Safety.” Chemicals used at the facility are evaluated for fire-related hazards and controlled as specified by the fire safety function. As stated in LRA Section 8.1.4.1, use of hazardous chemicals (i.e., ammonium hydroxide, hydrogen, nitric acid, sulfuric acid, natural gas, and diesel/fuel oil) are subject to the following requirements, as specified by the fire safety function: “hazard recognition by handlers, training in safe handling and spill prevention techniques, storage, containment, maintenance, leak testing, and/or safety shutoff valve verifications.” Section 7.1.2.4 of the LRA states that, “employees using hazardous chemicals are specifically trained in procedures for safe handling and disposal of them.”

As stated in LRA Section 8.1.4.2 and 8.1.4.3, flammable or combustible gases and liquids are evaluated for safety concerns and controls are applied before being introduced into the facility. Flammable and combustible liquids are stored in accordance with NFPA 30, “Flammable and Combustible Liquids Code” (NFPA, 2018c). Gases are stored in accordance with NFPA 55, “Compressed Gases and Cryogenic Fluids Code” (NFPA, 2019). An analysis of combustible gases is performed prior to open flame hot work. Sintering furnaces are equipped with flame curtains to continually burn off excess hydrogen gas. Process interlocks are used to ensure the flame curtains work properly. Sintering furnaces are in compliance with NFPA 86, “Standard for Ovens and Furnaces” (NFPA, 2018a). Above ground storage tanks for flammable liquids are equipped with emergency relief vents in accordance with industry standards. Supports for these storage tanks are protected from potential fire exposure. Construction and operation of bulk gas and liquid storage systems are in accordance with prudent industry standards (e.g., NFPA 30, NFPA 55).

As stated in LRA section 8.1.4.4, in areas of the facility where a spontaneous exothermic reaction of uranium oxide powder is a concern, non-combustible materials are used. Operators received instruction and training on how to monitor and be aware of the hazards associated with the storage and transportation of active uranium oxides.

As stated in LRA sections 8.1.4.6, “The Facility Incinerator,” and 8.1.4.7, the facility incinerator is separated from the rest of the facility by a fire-rated barrier and the incinerator exhaust is

water cooled and filtered before release to the environment. In addition, boiler houses are physically separate from manufacturing buildings. In addition, accident sequences involving a fire in the incinerator area are examined in the ISA. The incinerator area has a sprinkler system installed and all penetrations are equipped with fire-rated dampers and doors.

As stated in LRA section 8.1.4.8, combustion engines are evaluated, and their controls are specified by the fire safety function. The safety controls are applied to the areas with combustion engines, engine exhaust systems, and backup generators or fire pump storage tanks. Section 8.1.4.9 of the LRA describes the evaluation of hoods and gloveboxes for fire hazards and specifies the controls by the fire safety function. The safety controls have been applied to construction of hoods and gloveboxes and prevention of explosive mixtures in gloveboxes.

The licensee identified fire hazards in the operation process and controlled those hazards through hazard analysis, fire safety function, and personnel training. The NRC staff finds that the application meets the acceptance criteria as outlined in Section 7.4.3.4 of NUREG-1520 (NRC, 2010a).

7.3.4.1 Items Relied on For Safety (IROFS) Related to Fire Safety

As part of the ISA development, the licensee identified IROFS that ensure the performance requirements of 10 CFR 70.61 are met. The IROFS-related to fire safety are shown in Table 7-1 below.

Table 7-1. Fire Safety IROFS

IROFS	**Mitigating Event Index**	**Description**
ADUFIRE-901	-2	An Administrative Control consisting of the Fire Protection Program [combustible controls in the storage area (i.e., housekeeping), flammable material storage cabinets, fire pre-plans, and cutting welding permit system (hot work permits)]
ADUFIRE-902	-2	An Administrative Control where proper fire-fighting methods are utilized to suppress a fire in the vicinity of SNM
CHEM-407	-2	Excess flow shutoff valves for hydrogen. These valves prevent excess gas from being released. Upon sensing pressure drop which is indicative of a leak, shutoff valve activates.
VENT-SEPF-401	-1	An Administrative Control, in which hydrogen supplies are secured upon failure of plant-wide ventilation and inability to restore.
ADUHOS-906	-3	A passive Engineered Control Fire Barrier designed to prevent the spread of a fire from the hot oil room. The walls, floor, doors and ceiling of the hot oil room are rated for a least a 1.5-hour fire.
ADUHOS-907	-3	Structural integrity of hot oil system components to prevent a significant hot oil spill.
ADUHOS-910	-3	Hot Oil Room Dike to prevent the spread of hot oil and a fire from hot oil room.
ADUHOS-908	-2	An Active Engineered backup High Oil temperature shutoff Control, which terminates power to the Hot Oil system heater

		when the temperature exceeds 600 °F, to avoid over pressurization.
ADUHOS-901	-2	An Active Engineered High Oil temperature shutoff Control, which terminates power to the Hot Oil system heater when the temperature exceeds 600 °F, to avoid over pressurization.
ADUHOS-909	-2	An Active Engineered backup High Oil temperature shutoff Control, which terminates power to the Hot Oil system heater when the temperature exceeds 600 °F, to avoid over pressurization.
ADUHOS-902	-2	An Active Engineered High Oil temperature shutoff Control, which terminates power to the Hot Oil system heater when the temperature exceeds 600 °F, to avoid over pressurization.
ADUHOS-407	-2	An Administrative Control with Computer/Alarm Assist, in which a Hot oil emergency shutdown system provides emergency manual shutdown control (including de-energizing heaters and pumps) upon over-temperature or loss of containment.
UF6FIRE-901	-2	An Administrative Control consisting of the Fire Protection Program [(housekeeping, flammable material storage, fire plans, cutting/welding permits)].
UF6FIRE-902	-1	An Administrative Control where proper fire-fighting methods are utilized to suppress a fire in the vicinity of SNM.
ADUHOS-404	-2	An Administrative Control consisting of the Fire Protection Program shall be in place at the CFFF to limit combustibles in the Hot Oil Room.
ADUHOS-405	-3	A Passive Engineered Control Fire Barriers (e.g., Fire Doors) to prevent the spread of a fire from the Hot Oil Room
UF6CYL-905	-3	Uranium Hexafluoride (UF_6) Pad Annex and Expansion Area Bollards. Prevent vehicles from damaging UF_6 cylinders. Stops unauthorized vehicles from inadvertently entering UF_6 Pad Expansion Area.
SOLX-903	-3	Passive SSCs, including Tanks/Vessels and the associated piping and equipment, in the SOLX process shall be constructed of materials that resist degradation.
SOLXFIRE-901	-2	A Fire Protection Program [Applicable NFPA compliance, combustible controls in the storage area (i.e., housekeeping), flammable material storage cabinets, fire pre-plans, and cutting welding permit system (hot work permits)]
SOLXFIRE-902	-2	Proper fire-fighting methods shall be utilized to suppress a fire.

All other aspects of the fire protection system that are not indicated as IROFS provide defense-in-depth protection. There are no sole IROFS-related to fire safety.

The licensee identified fire hazards and accident sequences in the ISA Summary, as well as the mitigating IROFS needed to meet the performance requirements of 10 CFR 70.61. Several IROFS are directly inherent to process design (See Table 7-1). The management measures for these IROFS are identified in the ISA Summary. The staff reviewed the reliability of the IROFS as indicated by the licensee and in Table 7-1 and the fire-related accident sequences presented

in the FHA and ISA Summary. The staff found that the reliability of the IROFS and the analyses are adequately detailed and described, consistent with the acceptance criteria in Section 7.4.3.4.2 in NUREG-1520 (NRC, 2010a).

7.3.4.2 Accident Sequences

As part of the FHA and ISA development process, the licensee analyzed fire risk throughout the facility. The following fire or explosion accident sequences analyzed represent the major fire-related accident scenarios:

1. Fire in the Hot Oil Room

   The licensee considered a fire in the hot oil room caused by a mechanical failure or system over pressurization, leading to an unmitigated high-consequence event. The maximum possible fire loss was determined by the licensee to be an over-temperature condition leading to a loss of hot oil containment. The licensee analyzed all combustibles in the room and determined that a fire involving the entire hot oil room would burn for 1.5 hours. This analysis assumed the failure of the automatic sprinkler system and no attempts to put out the fire manually. The hot oil room is enclosed in 2-hour rated fire-barriers, which are expected to contain the fire. This event could lead to a fatality of personnel in close proximity, indicating a high-consequence event.

   Several IROFS are applied to mitigate the consequences of the event to meet the performance requirements in 10 CFR 70.61. High oil temperature shutoff interlocks automatically shut off the hot oil system when temperatures exceed 600 °F to avoid over pressurization. Backup interlocks are also in place. The automatic sprinkler system is a defense-in-depth control.

2. Hydrogen Explosion/Fire in the Ventilation System

   Hydrogen is used in various locations throughout the facility and is piped into the main process building from outside. The licensee analyzed the consequences of a potential fire or explosion involving hydrogen in the ventilation system. Several initiating events were considered, including a natural phenomenon event and a significant failure of the piping. An unmitigated significant hydrogen leak leading to a fire or vapor cloud deflagration could lead to serious worker injury or fatality from falling debris, indicating a high-consequence event.

   The licensee identified several IROFS to reduce the consequence of the event to below the performance requirements in 10 CFR 70.61, including the pre-fire plans and use of the on-site fire brigade, both administrative IROFS. An excess flow shutoff valve activates when a pressure drop is sensed, indicating a leak is occurring, restricting the amount of hydrogen released. In the event of a plant-wide failure of the ventilation system, an administrative IROFS is employed to manually secure the hydrogen supply.

3. Fire on the UF_6 Storage Pad

The licensee considered the possibility of a fire in the UF_6 storage pad leading to a loss of cylinder containment. Unmitigated, this event could lead to serious injury to on-site personnel and would be classified as an intermediate consequence event. Several fire-related IROFS are applied to reduce the consequences to meet the performance requirements in 10 CFR 70.61. Bollards are used in the UF_6 Annex and Expansion area to prevent a vehicle from driving onto the site and damaging a cylinder or causing a vehicle fire near the cylinders. In addition, an NFPA compliant fire protection prevention program is employed. Several other IROFS, that are not directly fire-related, are used to make sure the UF_6 cylinders are code-compliant and meet the expected conditions for use.

4. Fire in the Ammonium Diuranate Conversion Calciner System

The calciners operate at temperatures between 900 ˚F and 1200 ˚F and are fired by natural gas. The licensee analyzed the calciner system for fire and explosion hazards. The most likely cause of a fire event is a natural gas explosion that occurs during calciner startup. Several air purges occur before gas is allowed to enter the calciner burn chamber. Before the natural gas valve is opened, pilot lights are ignited. For an explosion to occur, there would have to be a failure of the air purge or a buildup of natural gas before the pilot lights go on. The worst-case fire scenario for the calciner system would involve the failure of the burner flame and then reignition of the built-up natural gas in the chamber leading to an explosion.

The licensee stated in their ISA Summary that the consequences of a fire in this system will be bounded by the chemical and radiological consequences discussed in this accident, and neither of these consequences will exceed intermediate or high consequences as defined in 10 CFR 70.61. In addition, multiple IROFS have been established for prevent a fire or an explosion from this equipment and therefore prevent the follow-up external consequences.

5. Fire Involving the Incinerator

The most likely area where a fire would start in the facility is the incinerator. There are Class A and Class B combustibles in the area, as well as natural gas present to burn the combustibles in the incinerator. The licensee stated in their ISA Summary that the incinerator system does not present a serious fire risk because, although an unmitigated fire in the incinerator could lead to the fire burning through the ductwork on the roof and a limited amount of uranium being released into the atmosphere, the consequences would not exceed the performance requirements of 10 CFR 70.61.

There are no IROFS specified for this accident sequence, but there are several defense-in-depth controls in place, including hot work safety training and a fire watch, a high temperature interlock on the column scrubber, and high temperature interlocks on the lower and upper chambers of the incinerator.

The licensee identified the fire and explosion risks. The risk of fire or explosion from combustible or flammable gases is analyzed and minimized through the use of proper storage techniques. In addition, sintering furnaces adhere to NFPA 86. The NRC staff finds that the application meets the acceptance criteria as outlined in Section 7.4.3.4 of NUREG-1520 (NRC, 2010a).

Based on the information presented in Section 8.1.4 of the LRA, the NRC staff concludes that the application meets the applicable regulations.

7.3.5 FIRE PROTECTION AND EMERGENCY RESPONSE

In Sections 8.1.7, “Emergency Response Team” and Chapter 9, “Emergency Management Program” of the LRA, the licensee described the organization and training of the ERT. In response to RAI 60 (WEC, 2018c), the licensee stated that more information about the ERT can be found in the site emergency plan (WEC, 2018f). The on-site ERT is trained in fire-fighting and first aid and staffed by site employees. For several accident sequences within the facility, proper fire brigade response is considered an IROFS. The ERT training sessions take place at least four times per year and members also participate in the biennial exercises. Members of the ERT receive training in cardiopulmonary resuscitation, first aid, and proper firefighting techniques. Team members are aware of the potential radiological hazards associated with using water for firefighting and of the proper firefighting method to use for the different types of fires they may encounter. The ERT will respond in the event of a minor fire on site. A letter of understanding exists between the licensee and Columbia Fire Department indicating that the fire department will respond to support ERT fire-fighting efforts and hazardous materials response if needed. The fire department has been provided with copies of the pre-fire plan.

The licensee described the system of fire detection and alarm in section 8.1.5, “Fire Detection and Alarm Systems” of the LRA. Automatic fire detectors are installed in areas of the facility with substantial combustible loading, as determined by the fire safety function. Audible fire alarms are installed throughout the facility. In high noise areas, visual alarms are installed as well. Manual pull stations are installed throughout the facility. Portable fire extinguishers, with the appropriate suppression agent for their location, are maintained throughout the facility in accordance with NFPA 10, “Standard for Portable Fire Extinguishers” (NFPA, 2017).

As stated in Section 8.1.6.2, “Fire Suppression Services” of the LRA, water supply for fire protection systems is assured. The site is equipped with 10-inch water main that supplies process and drinking water and also supplies two water tanks. A single tank contains the necessary supply and hose stream requirements as required by NFPA 801 and NFPA 13, “Standard for the Installation of Sprinkler Systems.” Diesel fire pumps, with battery back-up power, are used at the site and are test-started weekly. Emergency response personnel are also trained to manually start the pumps if necessary. Numerous 6-inch fire hydrants and 1.5-inch standpipes are installed throughout the facility. As stated in Section 8.1.6.1, “Fire Suppression Equipment,” automatic fire sprinklers are installed throughout the facility, except in areas where moderation control is mandated for criticality safety purposes.

The NRC staff finds that the application meets the acceptance criteria as outlined in Section 7.4.3.5 of NUREG-1520 (NRC, 2010a). The licensee has described the fire protection and detection systems where licensed material is present. The licensee identified fire-related IROFS (see Table 7-1). The risk of fires starting or spreading is minimized through the use of automatic fire sprinklers and detectors in high combustible areas. Meeting the criteria for fire water capacity as specified in NFPA 801 and NFPA 13 provides assurance that the water supply is adequate.

The NRC staff finds that the application meets the acceptance criteria as outlined in Section 7.4.3.5 of NUREG-1520 (NRC, 2010a). The licensee has described their on-site ERT. The licensee has a robust ERT that is adequately trained in fire-fighting techniques and the potential criticality hazards. The on-site fire responders are adequately equipped and trained to handle

most small fires that occur. In the event of a larger fire, the on-site emergency response capability is supplemented by the off-site Columbia Fire Department.

Based on the information presented in Section 8.1.5-8.1.7 of the LRA, the NRC staff concludes that the application meets the applicable regulations.

7.4 EVALUATION FINDINGS

The NRC staff reviewed the information presented in the LRA and RAI responses provided. On the basis of this review, the NRC staff has determined that the fire protection program presented by the application meets the acceptance criteria presented in NUREG-1520 (NRC, 2010), and is adequate to protect against fires and explosions that could affect the safety of licensed materials. Therefore, the staff concludes that the licensee meets the requirements of 10 CFR 70.22, 10 CFR 70.61, 10 CFR 70.62, and 10 CFR 70.65.

CHAPTER 8 EMERGENCY MANAGEMENT

8.1 PURPOSE OF REVIEW

The purpose of reviewing Westinghouse Electric Company, LLC's (WEC's) Site Emergency Plan (SEP) for Columbia Fuel Fabrication Facility (CFFF) was to determine if WEC has established adequate emergency facilities and procedures to protect workers, the public and the environment. The current WEC Site Emergency Plan, Revision 19, dated December 18, 2018 (WEC, 2018f), was previously approved by the U.S. Nuclear Regulatory Commission (NRC) on April 9, 2019 (NRC, 2019d).

8.2 REGULATORY REQUIREMENTS

The NRC staff conducted this review to ensure that the WEC license renewal application (LRA) and emergency plan meets the requirements for emergency preparedness. These requirements include the following regulations of Title 10 of the *Code of Federal Regulations* (10 CFR):

Section 70.22(i)(1)(ii) requires the licensee to have an emergency plan for responding to the radiological hazards of an accidental release of special nuclear material (SNM) and to any associated chemical hazards directly incident thereto.

8.3 STAFF REVIEW AND ANALYSIS

The acceptance criteria for the NRC's review of the emergency management plan are outlined in Section 8.4.3 of NUREG-1520, Revision 1, "Standard Review Plan for the Review of a License Application for a Fuel Cycle Facility" (NUREG-1520) (NRC, 2010a).

The adequacy of the emergency plan has been evaluated against the requirements in 10 CFR 70.22(i)(3), and the specific acceptance criteria provided in Section 8.4.3 of NUREG-1520 (NRC, 2010a). The information to support the review was provided in the "Westinghouse Electric Company Nuclear Fuel Application for Renewal of a Special Nuclear Material License for the Columbia Fuel Fabrication Facility Columbia, South Carolina," dated July 31, 2014, the "Westinghouse Columbia Plant-Site Emergency Plan, Revision 17," dated December 12, 2013, and a site visit by the NRC staff conducted July 14, 2015. The staff also reviewed inspection reports dating from January 2012 through April 2015 (NRC, 2012), (NRC, 2015b), and (NRC, 2015c). Subsequently, the current WEC Site Emergency Plan, Revision 19, dated December 18, 2018 (WEC, 2018f), was previously approved by the U.S. Nuclear Regulatory Commission (NRC) on April 9, 2019 (NRC, 2019d).

8.3.1 FACILITY DESCRIPTION

Section 1.0, "Facility Description," of the WEC Site Emergency Plan contains descriptions of the licensed activity, the facility and site, and the area near the site. The information provided includes:

1. The Westinghouse CFFF is located in the central part of South Carolina in Richland County, approximately 8 miles southeast of Columbia on South Carolina Highway #48. The major site facilities include the manufacturing plant building, uranium hexafluoride (UF_6) storage area, treatment area, shipping container refurbishing building and storage area, storage building, water glass advanced water treatment building, and

tank farm raw material storage area. The main plant building utilizes approximately 550,000 square feet of floor space for the administration and manufacture of nuclear fuel assemblies.

2. The manufacturing operations consist of receiving low-enriched UF_6; converting the UF_6 to produce uranium dioxide ($U0_2$) powder; and, processing the $U0_2$ powder through pellet pressing and sintering. These processes are followed by fuel rod loading and sealing, and fuel assembly fabrication.

3. The CFFF is located on a semi-rural plot of approximately 1,150 acres. The main manufacturing building, waste treatment areas and holding ponds, parking lots, and other miscellaneous buildings occupy approximately 68 acres of the site area. About 1,080 acres of the site remain undeveloped. Farms, single-family dwellings, and light commercial activities are located chiefly along nearby highways. The region around the CFFF site is sparsely settled, and the land is characterized by timbered tracts and swampy areas, penetrated by unimproved roads. Figure 1.4, “Estimated Resident Population Density,” shows the estimated population density within a five-mile radius of the CFFF.

4. Hazardous materials at the CFFF are listed in the Tables 1.1, “Hazardous Materials,” and 1.2, “Chemical Listing,” in the WEC Site Emergency Plan. Information contained in the tables include location(s) of the chemical, amounts stored in those locations, types of containers and information concerning the hazardous nature of the chemical, including toxicity values.

5. One of the most serious credible, although highly unlikely, accidents postulated to occur in a fuel fabrication plant would be a nuclear criticality accident. A nuclear criticality in a fuel fabrication plant would result in an unplanned, uncontrolled, unshielded, nuclear fission chain reaction, releasing potentially dangerous high levels of neutron and beta-gamma radiation at the source. The CFFF maintains a Nuclear Criticality Safety (NCS) Program for the site. The NCS Program designates the controls and barriers relied upon to prevent criticality in operations involving special nuclear material.

The NRC staff finds that the information provided in the licensee’s LRA and SEP is acceptable and is consistent with the acceptance criteria in NUREG-1520, Revision 1, Section 8.4.3.1.1, and meets the requirements of 10 CFR 70.22(i)(3)(i).

8.3.2 ONSITE AND OFF-SITE EMERGENCY FACILITIES

Section 6.0, “Emergency Response Equipment and Facilities,” of the WEC Site Emergency Plan described designated emergency response facilities and equipment. Conference Room 200 is identified as the principal Emergency Operations Center (EOC), with the Emergency Response Facility, Entry Control Point, and Gate One Guard Station identified as the backups to the primary EOC, if necessary. These alternate on-site EOC locations may be used based on conditions caused by an emergency event. These areas are supplied electrical power from a separate source than the main plant and by a standby generator.

The WEC Site Emergency Plan, site emergency procedures, the hazardous material (HAZMAT)/best management practices (BMP) plan, photos of the facility, pre-fire plans, and radios are located at the entry control point, so they can be used, if necessary.

Detection systems and monitoring equipment are described in Section 2.2, “Detection of Accidents,” of the WEC Site Emergency Plan. A site portable weather station is included as one method of monitoring meteorological conditions, as well as using information obtained from the National Oceanic and Atmospheric Administration, local weather stations, and internet data. Additionally, the site has dual criticality monitoring stations with immediate evacuation signals. These alarms are monitored at the continuously-manned guard station. There is also a criticality monitoring station at the gate one guard station.

The site’s Environment, Health and Safety (EH&S) Department maintains portable instruments capable of detecting alpha, beta-gamma, neutron, and X-ray radiation. Additionally, there is a fully-equipped health physics emergency equipment cabinet at the Gate One Guard Station. Air sampling is continuously performed on all stacks exhausting from the chemical area to the environment. Environmental air samplers are installed at various locations in prevailing wind directions near the site boundary.

Section 6.2.1, “Onsite Communications,” of the WEC Site Emergency Plan describes available communication systems, including commercial telephone service, portable radios, and independent telephone lines located in the primary EOC and Emergency Brigade Building in the event of a power failure causing an interruption of commercial telephone landlines.

Section 2.2.3, “Personnel Evacuation Alarms,” of the WEC Site Emergency Plan described the alarm systems at the CFFF. The Criticality Alarm System indicates a high radioactivity level caused by a nuclear criticality. This alarm will initiate actions for the immediate rapid, complete facility evacuation of all personnel to established assembly areas. A chemical area emergency light system consisting of a rotating blue beacon and a message panel installed at entrances and exits in the chemical area give personnel visual indication as to the type of emergency occurring. The fire alarm and a voice communication system notifies facility personnel of an emergency or evacuation.

Sections 6.3, “Onsite Medical Facilities,” of the WEC Site Emergency Plan provides that certain plant personnel have been trained in first aid and will immediately administer first aid, if plant nursing staff are not available, and automated external defibrillators and sufficient supplies are stored onsite for extended first aid response. Section 5.8, “Medical Treatment,” identifies that the Palmetto Health Richland Hospital maintains an emergency room facility and team capable of handling medical treatment of contaminated and/or exposed patients. Section 5.7, “Medical Treatment,” identifies that the Richland County Emergency Medical Services will provide transportation for injured personnel from the plant site to Palmetto Health Richland Hospital in Columbia.

Section 6.2.2, “Off-site Communications,” of the WEC Site Emergency Plan stated that the Richland County Sheriff’s Office will be contacted should off-site law enforcement assistance be necessary.

Section 4.3, “Local Off-site Assistance to Facility,” of the WEC Site Emergency Plan stated that the City of Columbia Fire Department will respond to support firefighting efforts and hazardous materials response, if required.

Written letters of agreement with the Richland County Sheriff’s Office, City of Columbia Fire Department, Palmetto Health Richland Hospital, and Richland County Emergency Medical Services are described in Section 7.7, “Letters of Agreement,” of the WEC Site Emergency Plan

to ensure that there is a clear understanding of assigned responsibilities and proper coordination of activities in the event of an emergency. Letters of agreement between WEC and off-site support services are maintained by the emergency preparedness manager and are reviewed annually and renewed at least every 4 years or as frequently as needed.

In addition, in the event of an emergency, South Carolina Department of Health and Environmental Control (SCDHEC) will respond with radiological assistance, as needed, to aid in controlling radiation exposure to the public and minimize the spread of radioactive contamination. The State of South Carolina will coordinate any request for assistance from State and Federal agencies such as State of South Carolina Emergency Management Division, South Carolina Department of Natural Resources, South Carolina Highway Patrol, and the Department of Energy Radiological Assistance Team (located at the Savannah River Site), if necessary.

The NRC staff finds that the information provided in the licensee's LRA and SEP is acceptable and is consistent with the acceptance criteria in NUREG-1520, Revision 1, Section 8.4.3.1.2, and meets the requirements of 10 CFR 70.22(i)(3)(j) and 10 CFR 70.22(i)(3)(vii).

8.3.3 TYPES OF ACCIDENTS

Section 2.1, "Description of Postulated Accidents," of the WEC Site Emergency Plan identifies types of radiological accidents, which could occur at the CFFF. These events include nuclear criticality, security events, fire, explosion, flooding, uranium hexafluoride release, and ventilation failures. Non-radioactive hazardous material releases, which could impact emergency response efforts, are included.

The licensee stated that, one of the most serious credible (although highly unlikely) accidents postulated to occur in a fuel fabrication plant would be a nuclear criticality accident. Consequences of such an event are evaluated in the CFFF Integrated Safety Analysis Summary. The site posture must ensure the likelihood of a nuclear criticality accident be highly unlikely. Items relied on for safety are implemented to provide this assurance. Procedures for mitigating the effects of the events or the release of the materials are described.

Table 2.1, "Detection of Emergency Events," of the WEC Site Emergency Plan provided examples of how WEC will detect emergency events. Mitigating and preventative actions are described in Section 5.4, "Mitigating Actions," and Section 5.5, "Protective Actions," of the WEC Site Emergency Plan respectively. Table 5.2, "On-site Protective Actions," of the WEC Site Emergency Plan provides on-site protective actions for the various emergency events that could occur at the CFFF site.

The NRC staff finds that the information provided in the licensee's LRA and SEP is acceptable and consistent with the acceptance criteria in NUREG-1520, Revision 1, Section 8.4.3.1.3, and meets the requirements of 10 CFR 70.22(i)(3)(ii).

8.3.4 CLASSIFICATION OF ACCIDENTS

Section 3.1, "Classification System," of the WEC Site Emergency Plan described the classification levels of accidents at the CFFF. The classification system includes the alert and site area emergency classification levels as defined in NRC Regulatory Guide 3.67, "Standard Format and Content for Emergency Plans for Fuel Cycle and Materials Facilities," Revision 1 (NRC, 2011). A lower-level classification, listed as a local response event, is also defined. A

local response event is described as an emergency that does not affect or require response by employees outside the affected area. Additionally, a transportation emergency is defined for conditions in which a vehicle carrying radioactive or hazardous materials is involved in an off-site accident requiring emergency response.

The factor that differentiates between an alert and a site area emergency event is the event's potential effect to the off-site community. Any condition that warrants precautionary notification of the public near the site or activation of off-site emergency response organizations will result in a declaration of a site area emergency. The Emergency Director, as the person designated as responsible for the overall management of the emergency, is responsible for accident classification, if it was not performed by the incident commander.

The NRC staff finds that the information provided in the licensee's LRA and SEP is acceptable and consistent with the acceptance criteria in NUREG-1520, Revision 1, Section 8.4.3.1.4, and meets the requirements of 10 CFR 70.22(i)(3)(iii).

8.3.5 DETECTION OF ACCIDENTS

Methods and systems to detect accidents are explained in Section 2.2, "Detection of Accidents," of the WEC Site Emergency Plan. Specifically, Table 2.1, "Detection of Emergency Events," lists emergencies, and the mechanism for detection and stage of detection for each emergency. Section 2.0 of the WEC Site Emergency Plan, "Types of Accidents," described the alarm systems including alarms associated with process liquid effluents, fire alarms activated by smoke detectors, heat detectors, sprinkler head flow switches and pull stations, criticality alarms, and alarms associated with ventilation systems.

Section 6.2.1, "Onsite Communications," of the WEC Site Emergency Plan described methods of alerting the CFFF personnel to hazards, including the fire alarm, voice communication system, criticality alarm, and emergency warning light system in the chemical area, as well as expected CFFF personnel responses to emergencies, which in all cases involves evacuation of the affected area. Section 5.5, "Protective Actions," of the WEC Site Emergency Plan describes how evacuations are conducted and what actions are expected after the evacuation.

The NRC staff finds that the information provided in the licensee's LRA and SEP is acceptable and consistent with the acceptance criteria in NUREG-1520, Revision 1, Section 8.4.3.1.5, and meets the requirements of 10 CFR 70.22(i)(3)(iv).

8.3.6 MITIGATION OF CONSEQUENCES

Section 4, "Responsibilities," and Section 5, "Emergency Response Measures," of the WEC Site Emergency Plan described the responsibilities and actions of the facility personnel and onsite emergency response organization in support of the measures used for safe shutdown and mitigation of consequences of emergency events that could occur at the facility, including coordination with participating government agencies. The tables in the WEC Site Emergency Plan, Section 5.0 provided recommended protective actions for workers and the public personnel based on total effective dose equivalent, projected thyroid doses or soluble uranium uptake, and protective actions to be initiated at various times after an accident based on exposure pathways.

Section 2.1.1, "Nuclear Criticality Safety," of the WEC Site Emergency Plan described the Nuclear Criticality Safety Program which utilizes the double contingency principle, designating

the controls and barriers used to prevent a criticality event. Examples of engineered and key administrative controls are described therein.

The information provided for mitigation of consequences is acceptable and consistent with the acceptance criteria in NUREG-1520, Revision 1, Section 8.4.3.1.6, and meets the requirements of 10 CFR 70.22(i)(3)(v).

Section 5.5.1, “Onsite Protective Actions,” of the WEC Site Emergency Plan described site evacuation procedures. Personnel evacuation is implemented upon activation of either a criticality alarm or a fire alarm. Evacuation routes are presented in Figure 5.1, “Evacuation Routes & Assembly Areas,” of the WEC Site Emergency Plan.

The NRC staff finds that the information provided in the licensee’s LRA and SEP is acceptable and consistent with the acceptance criteria in NUREG-1520, Revision 1, Section 8.4.3.1.6, and meets the requirements of 10 CFR 70.22(i)(3)(v).

8.3.7 ASSESSMENT OF RELEASES

Section 5.1, “Emergency Event Recognition,” of the WEC Site Emergency Plan stated that models of atmospheric dispersions are performed using established computer programs, with field information supplied from the event site and meteorological data to determine any potential on-site and off-site consequences. The SEP provided that dispersion equations using meteorological and radiological data collected from stack and environmental monitors and surveys are used. Meteorological data is obtained by various methods as described in Section 2.2.1, “Examples of Detectable Emergency Events,” of the WEC Site Emergency Plan. Portable instruments are available for use in field for conducting dose rate surveys. Projections of off-site radiation exposures will be based on the radiological data taken from stack and environmental monitors and surveys, the point of release, and the meteorological conditions at the time of the release.

The NRC staff finds that the information provided in WEC’s LRA and SEP is acceptable and is consistent with the acceptance criteria in NUREG-1520, Revision 1, Section 8.4.3.1.7, and meets the requirements of 10 CFR 70.22(i)(3)(vi).

8.3.8 RESPONSIBILITIES

Section 4.2, “Onsite Emergency Response Organization,” of the WEC Site Emergency Plan described the National Incident Management System (NIMS) command structure utilized by the CFFF, as illustrated in Figure 4.1, “NIMS Incident Command System.” The onsite emergency response organization (ERO) consists of two specific groups of specially trained staff: (1) the Emergency Command Staff, and (2) the On-Scene Command Staff.

The Emergency Command Staff, located in the EOC, is headed by the Emergency Director. This position is filled by the CFFF plant manager, or a designated qualified individual. Section 4.2.2.1, “Emergency Command Staff,” of the WEC Site Emergency Plan identifies the primary responsibilities of the Emergency Director as:

1. Classifying the emergency event, if not performed by the incident commander
2. Maintaining the time event log
3. Managing plant population

4. Determining protective action measures in coordination with the incident commander
5. Determining and approve life saving measures
6. Approving emergency exposures
7. Approving re-entry in coordination with the incident commander
8. Authorizing changes in policy, and
9. Notifying off-site organizations

Section 4.2.2.1 of the WEC Site Emergency Plan also described the responsibilities of the other specially trained members of the emergency command staff, including the information officer, logistics officer, safety officer, planning chief, and liaison officer.

Section 4.2.2.2, "Emergency Operations Center (EOC) Support Staff," of the WEC Site Emergency Plan identified a group, which provides support for the emergency command staff and requires no special emergency response training for these positions. The members of this group include a technical specialist, employee relations support, finance, and legal affairs.

Responsibilities assigned to members of the on-scene command staff, which is comprised of the incident commander, on-scene safety officer, operations chief, emergency medical services, health physics coordinator, and security, are described in section 4.2.2.3, "On-Scene Command Staff," of the WEC Site Emergency Plan. In charge of the overall management of the emergency is the incident commander, whose specific responsibilities include:

1. Functioning as the alternate emergency director, if the emergency director or assigned alternate emergency staff member is not present
2. Classifying the emergency event
3. Establishing unified command
4. Determining response objectives and strategy
5. Establishing immediate priorities
6. Establishing the incident command post
7. Approving and authorizing the implementation of an incident action plan
8. Activating elements of the incident command system, and
9. Briefing command staff.

The NRC staff finds that the information provided in the licensee's LRA and SEP is acceptable and is consistent with the acceptance criteria in NUREG-1520, Revision 1, Section 8.4.3.1.8, and meets the requirements of 10 CFR 70.22(i)(3)(vii).

8.3.9 NOTIFICATION AND COORDINATION

As discussed in Section 8.3.4 above, the classification of emergencies as described in Section 4.2.2 of the WEC Site Emergency Plan is the responsibility of the emergency director, if not performed by the incident commander. The emergency director has the responsibility to declare an emergency as an alert or site area emergency, and activate the on-site ERO. The liaison officer is assigned by the emergency director and serves as the point of contact for the assisting and cooperating agencies.

As described in Section 4.2.2.1 of the WEC Site Emergency Plan, it is the responsibility of the emergency director, or designated alternate, to notify the NRC Operations Center and the South Carolina Department of Health and Environmental Control (SCDHEC). Per Section 6.2.2, the SCDHEC will be responsible for notifying the South Carolina Emergency Management Division

(SCEMD) and the Department of Energy Radiation Assistance Team. The State will be notified after the Richland County Local Emergency Planning Committee (LEPC), but within 15 minutes of any incident classified as an alert level event or greater, and the NRC Operations Center will be notified within 60 minutes.

The CFFF has several means of communications available for both normal and emergency conditions. Commercial telephones consist of both inbound and outbound dedicated lines for off-site communications. Other public access telephones are located throughout the facility. Should a power failure interrupt the telephone system, Conference Room 200 and the Emergency Brigade Building are equipped with two independent telephone lines. These locations are also equipped with satellite phones.

The incident commander or the emergency director can request support from off-site organizations. The information officer, who is a member of the emergency command staff and is assigned by the emergency director, will deliver information releases to the public.

The NRC staff finds that the information provided in the licensee's LRA and SEP is acceptable and is consistent with the acceptance criteria in NUREG-1520, Revision 1, Section 8.4.3.1.9, and meets the requirements of 10 CFR 70.22(i)(3)(viii).

8.3.10 INFORMATION TO BE COMMUNICATED

Section 3.3, "Information to be Communicated," of the WEC Site Emergency Plan provides a description of the type of information to be given to the NRC and the SCDHEC in the event of an emergency at CFFF requiring a formal notification. Station procedures contain a form for making the notifications. The following minimum information provided includes:

1. A description of the event–classification and magnitude
2. A description of any injuries or fatalities
3. A description of property damage;
4. Current facility status
5. Types or radioisotopes and/or hazardous material released, and
6. Recommended protective actions.

The NRC staff finds that the information provided in the licensee's LRA and SEP is acceptable and is consistent with the acceptance criteria in NUREG-1520, Revision 1, Section 8.4.3.1.10, and meets the requirements of 10 CFR 70.22(i)(3)(ix).

8.3.11 TRAINING

As described in Section 7.2, "Training," of the WEC Site Emergency Plan, ERO personnel receive annual training on their respective emergency response assignments, with additional training provided when changes to the emergency plan or emergency procedures occur. Personnel not assigned ERO responsibilities receive annual training on actions to take during an emergency. Visitors and temporary workers are given sufficient instruction on emergencies in that they could be involved. Health physics personnel, who may perform re-entry surveys, receive annual training that includes selection and use of survey instruments, air sampling equipment, and re-entry criteria. The EH&S Department provides emergency response team training at least four times per year and tracks qualifications to assure only qualified individuals are on the teams.

Off-site groups, such as fire departments, police and ambulance and other medical services, who may participate in on-site activity, will be encouraged to attend a Columbia Site training course to ensure that they are familiar with the plant layout and actions required of them in the event of an incident. Off-site group training will be offered annually.

The NRC staff finds that the information provided in the licensee's LRA and SEP is acceptable and is consistent with the acceptance criteria in NUREG-1520, Revision 1, Section 8.4.3.1.11, and meets the requirements of 10 CFR 70.22(i)(3)(x).

8.3.12 SAFE SHUTDOWN (RECOVERY AND FACILITY RESTORATION)

Safe shutdown, re-entry, plant restoration, and resumption of operations are discussed in section 9.0, "Recovery and Plant Restoration," of the WEC Site Emergency Plan. The incident commander is responsible for ensuring that critical processes and equipment is safely shutdown and that nuclear criticality safety is maintained. Implementing procedures describe the re-entry process. The emergency director is responsible for approving re-entry in coordination with the incident commander. The WEC Site Emergency Plan states that the restoration of the Columbia site to normal operations after an emergency event is dependent upon the specific nature of the emergency condition. Detailed procedures for return to normal operations covering all possible situations are beyond the scope of this plan. If an incident should occur, procedures will be developed at the time to adequately cover actions required to return the plant and its environs to a normal operating status.

The NRC staff finds that the information provided in the licensee's LRA and SEP is acceptable and is consistent with the acceptance criteria in NUREG-1520, Revision 1, Section 8.4.3.1.12, and meets the requirements of 10 CFR 70.22(i)(3)(xi).

8.3.13 EXERCISES AND DRILLS

Section 7.3, "Drills and Exercises," of the WEC Site Emergency Plan provided descriptions of drills and exercises at the CFFF. Practice drills are conducted biennially in years in which exercises are not required to be performed. These drills address specific areas of emergency response and will simulate accidents involving explosion, fire, hazardous material release, hazardous weather, power loss, radiation, radioactive material release, transportation and/or water loss and other areas. Off-site agency participation may be actual or simulated in drills.

The objectives of practice drills will be to:

1. Test the content, adequacy and use of the emergency procedures.
2. Test emergency equipment and instrumentation.
3. Keep affected personnel aware of their role.
4. Test communications networks, and
5. Provide the ERO with the skills necessary to function as a single, cohesive unit when responding to emergency situations.

In addition, biennial full-scale exercises shall be performed. Off-site organizations are required to be invited to participate in the biennial exercises. The NRC is provided the dates and times, the objectives, and the scenario to be used at least 60 days in advance of the biennial exercises. The complete scenario, including controller information, messages and simulation data are provided to the NRC at least 20 days in advance. Critiques are held after exercises and

any corrective actions are identified and assigned. Areas evaluated include the adequacy of the WEC Site Emergency Plan, procedures, equipment, facilities, and personnel training.

The NRC staff finds that the information provided in the licensee's LRA and SEP is acceptable and is consistent with the acceptance criteria in NUREG-1520, Revision 1, Section 8.4.3.1.13, and meets the requirements of 10 CFR 70.22(i)(3)(xii).

8.3.14 RESPONSIBILITIES FOR DEVELOPING AND MAINTAINING THE EMERGENCY PROGRAM AND ITS PROCEDURES

As discussed in Section 7.0, "Maintaining Emergency Preparedness Capability," of the WEC Site Emergency Plan, the EH&S Department is responsible for an annual review of the WEC SEP and updating the plan, as necessary. Changes to the WEC SEP are communicated to controlled copy holders by written notification. Major changes will be reviewed by the applicable emergency staff.

Calibration of portable instrumentation designated for emergency use is performed periodically per procedures. Quarterly inspections are performed of all equipment and supplies designated for use in the event of an emergency to verify supplies are adequate and functional.

Communication checks are performed quarterly as directed by the emergency preparedness manager. Phone lists in the emergency procedures are verified and updated as necessary during these communication checks. The licensee will perform an annual review of the emergency plan and procedures.

Comprehensive independent audits of the emergency preparedness program, including the WEC Site Emergency Plan and emergency procedures, training activities, emergency facilities, equipment, supplies, record, etc., shall be performed biennially.

Letters of agreement with off-site support groups will be reviewed annually and renewed at least every 4 years or as frequently as needed.

The NRC staff finds that the information provided in the licensee's LRA and SEP is acceptable and is consistent with the acceptance criteria in NUREG-1520, Revision 1, Section 8.4.3.1.14, and meets the requirements of 10 CFR 70.22(i)(3)(vii).

8.3.15 COMPLIANCE WITH THE EMERGENCY PLANNING AND COMMUNITY RIGHT-TO-KNOW ACT OF 1986

Section 10.0, "Compliance with Community Right-To-Know Act," of the WEC Site Emergency Plan stated that the Westinghouse EH&S Department shall comply with the U.S. Environmental Protection Agency's SARA Title III regulations, also known as the "Emergency Planning and Community Right-to-Know Act," which specifies action in emergency response planning, emergency release reporting, hazardous chemical inventory reporting, toxic chemical release reporting and participation in the local emergency planning committee.

Response to an emergency involving hazardous material (non-radioactive) is described in the BMP, which is a separate document maintained to assure that requirements of this section are met with regards to spill prevention control and countermeasures requirements. Material safety data sheets and safety data sheets are accessible throughout the facility.

The NRC staff finds that the information provided in the licensee's LRA and SEP is acceptable and is consistent with the acceptance criteria in NUREG-1520, Revision 1, Section 8.4.3.1.1, and meets the requirements of 10 CFR 70.22(i)(3)(xiii).

8.4 EVALUATION FINDINGS

The NRC staff reviewed the WEC Site Emergency Plan with respect to the regulatory requirements of 10 CFR 70.22(i)(1)(ii) and 70.22(i)(3), and the acceptance criteria in Section 8.4.3 of NUREG-1520. The NRC staff finds that the licensee's emergency plan demonstrates compliance with regulatory requirements, in that: (1) the facility is properly configured to limit releases of radioactive materials in the event of an accident; (2) a capability exists for measuring and assessing the significance of accidental releases of radioactive materials; (3) appropriate emergency equipment and procedures are provided onsite to protect workers against radiation and other chemical hazards that might be encountered after an accident; (4) a system has been established to notify Federal, State and local government agencies, and to recommend appropriate protective actions to protect members of the public; and (5) necessary recovery actions are established to return the facility to a safe condition after an accident.

CHAPTER 9 ENVIRONMENTAL PROTECTION

9.1 PURPOSE OF THE REVIEW

The purpose of the U.S. Nuclear Regulatory Commission's (NRC) review of the Westinghouse Electric Company, LLC (WEC) Environmental Protection Program for its Columbia Fuel Fabrication Facility (CFFF) was to determine whether the proposed environmental protection measures are adequate to protect the environment, and the health and safety of the public, as required by Title 10 of the *Code of Federal Regulations* (10 CFR) Part 20, "Standards for Protection Against Radiation," and Part 70, "Domestic Licensing of Special Nuclear Material."

9.2 REGULATORY REQUIREMENTS

The NRC staff conducted this review to ensure that WEC's environmental protection program meets the requirements in 10 CFR Parts 20 and 70. WEC must satisfy the following regulatory requirements regarding environmental protection:

- 10 CFR Part 20 Subpart B, "Radiation Protection Programs;" Subpart D, "Radiation Dose Limits for Individual Members of the Public;" and Subpart F, "Surveys and Monitoring," specify the effluent control and treatment measures necessary to meet the dose limits and dose constraints for members of the public. Subpart F also states the survey requirements. Subpart K, "Waste Disposal," specifies the waste disposal requirements; Subpart L, "Records," specifies the records requirements; and Subpart M, "Reports," specifies the reporting requirements.
- 10 CFR Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions," provides that the licensee must include, in an environmental report required by 10 CFR 51.60(a), a discussion of the status of compliance with applicable environmental quality standards and requirements such as water pollution limitations or requirements imposed by Federal, State, regional, and local agencies as indicated in 10 CFR 51.45(d), which is demonstratable through effluent and environmental monitoring as required in 10 CFR 20 Subpart F.
- 10 CFR Part 70 requires the licensee to describe that proposed facilities and equipment, including measuring and monitoring instruments and devices for the disposal of radioactive effluents and wastes, are adequate to protect the environment and public health and safety, as specified in 10 CFR 70.22(a)(7).
- 10 CFR Part 70 also provides that the licensee for a facility (as described in 10 CFR 70.4, "Definitions") must submit a safety assessment of the design basis of the principal structures, systems, and components of the plant, including provisions for protection against natural phenomena, as specified in 10 CFR 70.22(f).
- 10 CFR Part 70 also provides that a licensee for a facility must provide an integrated safety analysis (ISA) summary that includes a list of the items relied on for safety (IROFS) established by the licensee and other elements, as described in 10 CFR 70.65(b).
- 10 CFR 70.59, "Effluent monitoring reporting requirements," outlines the reporting requirements for radiological effluent monitoring for a Part 70 licensee.

The acceptance criteria for the NRC's review of WEC's environmental protection program are outlined in Section 9.4.3 of NUREG-1520, Revision 1, "Standard Review Plan (NUREG-1520) for Fuel Cycle Facilities License Applications" (NRC, 2010a).

9.3 STAFF REVIEW AND ANALYSIS

The NRC staff's evaluation included three main areas of review identified in Section 9.3 of NUREG-1520, Revision 1: effluent and environmental controls and monitoring, the ISA Summary, and environmental protection management measures. The NRC staff's review of the licensee's environmental report and the staff's preparation of environmental review documents are also briefly described in this section.

The information to support this review was obtained from the license renewal application (LRA) dated September 20, 2021 (WEC, 2021b; WEC, 2021c) and environmental report (ER) dated March 28, 2019 (WEC, 2019b). The NRC staff also conducted site visits in May 2019 and January 2022 to gather additional information to complete the review (NRC, 2019b; NRC 2022).

9.3.1 ENVIRONMENTAL REPORT

In accordance with 10 CFR 51.60(b), WEC submitted an ER in 2014 (WEC, 2014b, 2014c) describing the site, the activities, and the potential environmental impacts of CFFF license renewal for an additional 40 years. In compliance with 10 CFR 51, the NRC's implementing regulations of the National Environmental Policy Act (NEPA), the NRC documented the results of its environmental review in an Environmental Impact Statement (EIS).

The NRC first published an Environmental Assessment (EA) and a Finding of No Significant Impact (FONSI) in June 2018 (NRC, 2018b; 83 FR 28014). However, shortly after its publication, there was an equipment leak that released radioactive material to the subsurface. In addition, the NRC learned of additional characterization efforts taken by WEC to delineate the extent of a historical leak from a buried pipe. As a result of the new information and concerns from the public, the NRC decided to re-open its NEPA review. The WEC submitted a revised ER in March 2019 in response to an NRC request for additional information (RAI) regarding WEC's environmental protection and decommissioning programs (NRC, 2019a). The 2019 ER superseded the 2014 ER. The NRC withdrew the June 2018 EA and FONSI and published a Draft EA in October 2019 (NRC, 2019e; 84 FR 57777). Following the draft EA public comment period, the NRC staff determined that a FONSI could not be reached after considering new information provided by WEC related to the remedial investigation being conducted under a Consent Agreement (CA) with the South Carolina Department of Health and Environmental Control (SCDHEC) (SCDHEC/WEC, 2019). The new information revealed uncertainty regarding the source and extent of contamination onsite and the potential future offsite migration pathways. Therefore, on June 5, 2020, the NRC staff informed WEC that it would prepare an EIS. The draft EIS was published on August 6, 2021 (NRC, 2021; 86 FR 43276).

The NRC staff conducted outreach to the public to obtain input for the EIS in multiple ways. The NRC staff communicated the availability of the draft EIS for public comment via an NRC press release, NRC social media, NRC e-mail distribution, NRC listserv, local newspapers, and radio stations, including a flyer containing plain language information about the draft EIS. The staff made hard copies of the draft EIS available to the public at three area libraries and sent postcards via U.S. mail to residences in the immediate vicinity of the CFFF. The mailing provided notification of the availability of the draft EIS and the public comment period. The communications included notice of an NRC public webinar that was held on August 26, 2021, to gather comments on the draft EIS. The NRC addressed public comments on the draft EIS and issued a Final EIS on July 29, 2022 (NRC, 2022d). The Final EIS was noticed in the *Federal Register* on August 5, 2022 (87 FR 48044).

9.3.2 EFFLUENT AND ENVIRONMENTAL CONTROLS AND MONITORING

The NRC staff reviewed Chapter 10, “Environmental Protection,” of the LRA, which describes WEC’s controls for gaseous and liquid effluents, solid waste disposal, environmental sampling and monitoring, and off-site dose control. The WEC has an effluent control and environmental sampling and monitoring program that is inspected by the NRC routinely. Due to historical releases that have affected onsite water quality, WEC has made significant changes to its environmental monitoring program since the license was last renewed in 2007. During the NRC’s routine inspections of the CFFF, the NRC inspectors review the licensee’s effluent control and environmental protection program, including effluent and environmental monitoring, for compliance with 10 CFR Parts 20 and 70 and in accordance with the license application. In preparation of the SER, the NRC staff reviewed recent inspection reports (NRC 2018c; NRC 2020a; NRC 2020b).

9.3.2.1 Effluent Controls and Waste Minimization

In accordance with 10 CFR 20.1101(b), WEC must implement a radiation protection program based on sound principles to achieve occupational doses as well as doses to the members of the public that are as low as reasonably achievable (ALARA). This review of the radiation protection program focuses on WEC’s methods to maintain public doses ALARA, to meet ALARA goals for effluents, to conduct ALARA reviews, and to minimize waste. Chapter 4 of this safety evaluation report (SER) discusses the radiation protection program for workers.

In Sections 10.1.1, “Gaseous Effluent Control” and 10.1.2, “Liquid Effluent Control”, WEC stated that the ALARA goals and investigation levels were established based on guidance in Regulatory Guide 8.37, “ALARA Levels for Effluents from Materials Facilities” (NRC 1993a). If ALARA goals and investigation levels are exceeded for gaseous or liquid effluents, corrective actions are taken to reduce emissions or effluents. WEC states in its LRA that if gaseous effluents result in a total effective dose equivalent (TEDE) over 10 mrem/year to a member of the public in the unrestricted area, WEC will submit within 30 days upon discovery a report to the NRC, prepared in accordance with 10 CFR 20.2203(a) and 10 CFR 20.2203(b). Control of uranium in liquid effluents is achieved by treatment in the main plant building to a nominal level of 24 parts per million (ppm) and by subsequent treatment in the Wastewater Treatment Facility (WTF) to an ALARA nominal limit of 0.2 ppm (LRA Section 10.1.2).

In LRA Section 10.1.7, “Off-Site Dose Control,” WEC stated that compliance with 10 CFR Part 20 requirements for off-site dose to the maximally exposed member of the public is demonstrated in accordance with the requirements of 10 CFR 20.1302. If any regulatory limits are exceeded, WEC will submit a report to the NRC, in accordance with 10 CFR 20.2203(a) and 10 CFR 20.2203 (b).

WEC submits semi-annual discharge reports as required by 10 CFR 70.59, “Effluent Monitoring Reporting Requirements.” In these reports, WEC reports the quantity of each principal radionuclide released in its effluents based on sampling results. At the CFFF, the principal radionuclides are uranium and technetium-99 (Tc-99). As part of the semi-annual discharge reports, WEC provides dose information recommended in Regulatory Guide 4.16, “Monitoring and Reporting Radioactivity in Releases of Radioactive Materials in Liquid and Gaseous Effluents from Nuclear Fuel Processing and Fabrication Plants and Uranium Hexafluoride Production Plants” (NRC, 2010c). As required by 10 CFR 20.1302, “Compliance with Dose Limits for Individual Members of the Public,” WEC uses the sampling results to calculate dose to

a member of the public, at the nearest point on the site boundary for gaseous effluents and at the discharge point in the Congaree River for liquid effluents, to ensure it remains ALARA. In the July-December 2021 semi-annual discharge report, WEC calculated the annual whole-body dose for 2021 to be 0.24 mrem/year, which is below the ALARA goal (1 mrem/year) and regulatory limit (100 mrem/year) (WEC, 2022e).

WEC conducts an annual radiation protection program review, which includes its ALARA program and effluent and environmental monitoring program. The LRA Section 10.1.6, "Periodic Reporting of Surveillance Data," notes that the radiological effluent monitoring data is reported to NRC on a semi-annual basis. The licensee conducts audits of the environmental protection program triennially, as stated in LRA Section 10.1.9, "Audits."

In addition to the effluent controls and monitoring described above, the WEC implements other operational procedures to minimize waste and avoid contamination of the environment. Nonradioactive gaseous effluents from the CFFF are normally treated by HEPA filters, scrubbers, or both prior to discharge in accordance with 40 CFR Part 50 and 40 CFR Part 61, and 10 CFR Part 20 (WEC, 2019a). WEC has an air permit (renewal application pending) with SCDHEC, and adherence to the permit is needed to remain in compliance with regulatory limits. WEC has also eliminated plating activities that occurred prior to 2020, reducing air emissions (WEC, 2020a). All liquid discharges must comply with the facility's NPDES permit (SC0001848; SCDHEC, 2017). WEC has closed the East Lagoon and anticipates closing the Sanitary Lagoon and replacing it with a fully contained above-ground treatment system for uranium recycle and recovery services (URRS) process streams (WEC, 2021d). Closing lagoons avoids contamination of the environment from inadvertent lagoon releases to surface and ground waters. WEC eliminated the use of PCE in the solvent extraction process in 2020, and that change will continue to reduce the hazardous material in the liquid effluent streams and elimination of PCE degradation products in the solid mixed wastes (WEC, 2020a).

Based on the staff's evaluation of the LRA pertaining to the acceptance criteria in Section 9.4.3.2.1 of NUREG-1520 (NRC, 2010a), the staff finds that the licensee's effluent controls and radiation protection program meets the dose requirements in 10 CFR 20.1101 and 10 CFR 20.1302 for members of the public during the renewed license term.

9.3.2.2 Effluent Monitoring

Operations at the WEC CFFF generate gaseous and liquid effluent streams and solid waste. The licensee monitors gaseous and liquid effluents and reports the results to the NRC in accordance with 10 CFR 70.59 and guidance in Regulatory Guide 4.16, "Monitoring and Reporting Radioactive Materials in Liquid and Gaseous Effluents from Nuclear Fuel Cycle Facilities" (NRC, 2010b). In preparation of this SER, NRC staff reviewed discharge reports for 2018 through 2021 (WEC, 2018g; 2019i; 2019j; 2020b; 2020c; 2021e; 2021f; 2022e). Minimum detection limits provided in the discharge reports are appropriate for determining compliance with the effluent limits. As described in LRA Section 10.1.1 and 10.1.2, corrective actions to reduce radioactive effluents are taken if investigation levels are exceeded. If monitoring results indicate the dose limits to the public could be exceeded, immediate steps are taken to reduce effluents to levels that comply with the dose limits (LRA Sections 10.1.1 and 10.1.2).

<u>Gaseous Effluents</u>

The licensee continuously samples gaseous effluents and conducts representative stack sampling to monitor gaseous effluents from more than 40 locations, typically roof vents or

short stacks (WEC 2019b, 2022e). Sampling locations are identified in the discharge reports. As noted in LRA Section 10.1.1, determination of sampling and monitoring methods and frequencies is consistent with Regulatory Guidance (RG) 8.37, “ALARA Levels for Effluents from Materials Facilities.” Gaseous effluents are monitored for uranium (WEC, 2019b). Total 6-month measured effluent concentrations of uranium (measured as gross alpha) were less than the NRC’s discharge limits during 2018 to 2021, as reviewed in the semi-annual discharge reports.

Liquid Effluents

WEC maintains two sequential treatment systems to ensure liquid process waste meets the NRC’s discharge limits in 10 CFR Part 20, Table 2 of Appendix B for uranium and Tc-99. The WEC’s limit for liquid process waste transferred from the controlled area into the external WTF is 24 ppm for uranium. Treatment at the WTF ensures the discharge contains less than 0.2 ppm of uranium. The WTF process waste stream is combined with the treated sanitary waste stream and is discharged into the Congaree River. The licensee collects a continuous proportional sample of the effluent discharged to the Congaree River and analyzes a monthly composite of this sample for isotopic uranium and Tc-99. During 2018 to 2021, the total 6-month measured effluent concentrations of uranium isotopes and Tc-99 were less than the NRC’s discharge limits in 10 CFR Part 20, Appendix B, Table 2, Column 2, as reviewed in the semi-annual discharge reports.

WEC holds a National Pollutant Discharge Elimination System (NPDES) permit (No. SC00001848) administered by the SCDHEC that allows controlled discharge of CFFF treated process and sanitary wastewaters into the Congaree River. The NPDES permit was last modified in May 2017 and expired in March 2018; however, the WEC submitted a renewal application in September 2017 (WEC 2017d) and is operating under the previously issued permit while the State completes its review.

The current NPDES permit requires WEC to monitor and report CFFF effluent discharge rate and non-radiological water quality. In addition, the NPDES permit requires monitoring of groundwater wells on the CFFF Site for radiological and non-radiological contaminants, including contaminants from leaks or unplanned releases from the lagoons of the WTF. The SCDHEC implements the U. S. Environmental Protection Agency’s environmental regulations and enforces the federal drinking water standards (i.e., maximum contaminant levels or MCLs). Treated wastewater containing trace amounts of radioactive materials is released from CFFF to the Congaree River as permitted by SCDHEC in the NPDES permit. The WEC conducts radiological and nonradiological effluent and environmental monitoring and sampling to comply with the SCDHEC’s NPDES permit, the SCDHEC CA (SCDHEC/WEC, 2019), and its NRC license. The WEC stated in LRA Section 10.1.6 that WEC will inform the NRC if the NPDES permit is renewed, revised, or revoked, and if there is an NPDES Notice of Violation.

Solid Waste

WEC CFFF generates several types of solid waste from operations – combustible, hazardous, nonhazardous, industrial, mixed, and low-level radioactive waste (LLRW). The licensee manages these wastes by a combination of onsite processing, permitted onsite storage, off-site disposal, incineration, and recycling. WEC has waste minimization programs in place in addition to procedures for waste handling, storage, and monitoring (WEC, 2019g).

Combustible wastes containing uranium are either incinerated and leached to recover the uranium or shipped offsite to other licensed facilities for recovery. Hazardous wastes (degreasing solvents, lubricating and cutting oils, and zirconium-laden wastes) are stored at an onsite storage pad until being shipped for disposal offsite through permitted contractors. Mixed waste generated at the site (batteries, polychlorinated biphenyl-containing ballasts, contaminated lamps, and lead shielding) is disposed of offsite through permitted contractors. The LLRW generated onsite, such as contaminated packaging, clothing, and tools, is sorted, transferred to an onsite processing station, and surveyed for radioactivity before being decontaminated for free release, reuse, or shipped off-site for disposal (WEC, 2019). The licensee has approval from the NRC to release calcium fluoride, with less than 30 pCi/g of uranium, to an off-site concrete plant (see Section 14.3.1.4). Between the years 2020 and 2022, the NRC issued four conforming license amendments in conjunction with granting exemptions from 10 CFR 70.3, “License requirements,” and 10 CFR 30.3, “Activities requiring license,” to allow WEC to transfer calcium fluoride sludge and other low-activity radioactive waste materials to the U.S. Ecology Idaho, Inc. hazardous waste disposal facility near Grand View, Idaho (85 FR 81525; 86 FR 16239; 86 FR 57705; and 87 FR 16772) in accordance with 10 CFR 20.2002, which includes maintaining public doses ALARA. Additional details regarding these conforming license amendments are included in Section 14.3.1.11.

Finding

The staff’s evaluation of the LRA finds that the liquid and gaseous effluent monitoring program meets the effluent limits in 10 CFR Part 20, Appendix B, Table 2, is consistent with the acceptance criteria in Section 9.4.3.2.2 of NUREG-1520 (NRC, 2010a), and provides adequate protection of public health and safety. The staff also finds the applicant established a solid waste handling and disposal program that provides reasonable assurance the storage and dispositioning of the solid waste will provide adequate protection of public health and safety.

9.3.2.3 Environmental Monitoring

Licensees are required, under the Decommissioning Planning Rule (per 10 CFR 20.1406(c)), to “conduct operations to minimize the introduction of residual radioactivity into the site, including the subsurface…” In addition, licensees must comply with 10 CFR Part 20, Subpart F, “Surveys and Monitoring”, which requires surveys, including surveys of the subsurface, that are reasonable to evaluate the concentrations or quantities of residual radioactivity.

The WEC conducts environmental monitoring, as outlined in LRA Section 10.1.4, “Environmental Sampling and Monitoring,” that includes sampling and analyzing ambient air, onsite surface water, groundwater, Congaree River water, sediment, surface soil, vegetation, and fish collected from the Congaree River. Current sample locations described in LRA Section 10.1.4 are adequate and appropriate to evaluate background levels of potential contaminants and to provide for monitoring the potential effects of CFFF operations on the surrounding environment. The current minimum sampling frequencies identified in LRA Table 10.1 range from continuous (for air particulates) to annual (e.g., for soil) and are appropriate for each medium. As provided in LRA Table 10.1, isotopic uranium and Tc-99 analyses are performed for samples from each medium, with the exception of air particulates, for which alpha analyses are performed.

Currently, contamination of groundwater, surface water, and sediment from past releases is present at the CFFF site. In February 2019, SCDHEC entered into Consent Agreement 19-20-HW (CA) with WEC regarding the investigation and remediation of contamination at the

CFFF and to establish protocols for communicating and responding to future releases (SCDHEC/WEC, 2019). In LRA Section 10.1, "Environmental Protection Program Structure," WEC commits to execute the CA and associated remedial investigations until completion. In LRA Section 10.1.10, "Environmental Risk Reduction Commitments," WEC defines completion of the CA as, "submittal of the final written report to SCDHEC documenting remedial action completion."

Under the CA, the WEC is conducting a remedial investigation to address radiological and non-radiological contamination at the CFFF site and establish protocols for communicating and responding to future releases (SCDHEC/WEC, 2019). The WEC is expected to continue to follow the Remedial Investigation Work Plan (RIWP) (WEC 2019) approved by the SCDHEC. Upon completion of the RIWP, WEC is required by the CA to submit a Remedial Investigation (RI) Report, to include a risk evaluation, for SCDHEC review and approval. The RI report is expected to be delivered to SCDHEC in August 2022. WEC will then evaluate remedial alternatives and will select and pursue a remedial design that is approved by SCDHEC. Upon completion of the terms in the CA, WEC must submit to SCDHEC a "written Final Report." WEC states in LRA Section 10.1.6, "Periodic Reporting of Surveillance Data" that it will send copies of CA progress reports to NRC, at least annually, until CA completion.

WEC made significant changes to its environmental monitoring program since the last license renewal in 2007 because of leaks and spills resulting in contamination of the CFFF site environment. Monitoring changes include:

- Collection of two additional sediment samples at Gator Pond and Sunset Lake to determine if contaminants are accumulating in the sediments of the onsite surface water bodies.
- Collection of an additional soil sample from a surface water drainage ditch to monitor for the potential migration of the uranium groundwater plume into surface water.
- Collection of an additional surface water sample from Lower Sunset Lake. The surface water and sediment sample from Lower Sunset Lake are to monitor for potential migration of contamination from the Lower Sunset Lake into a recently identified ditch that travels from Lower Sunset Lake, toward the site boundary, and back into Mill Creek.
- Analyses of samples for uranium and Tc-99 instead of indicators of gross alpha and gross beta.
- Collection of groundwater samples semi-annually, during the dry and wet season, which will account for differences in the water table that fluctuates with precipitation.
- Increasing the number of groundwater wells monitored from 10 to 118. Additional groundwater wells were installed under the SCDHEC-approved RIWP as part of the CA activities. In addition, sampling is conducted under the WEC's current NRC license (WEC, 2021b). WEC created four categories of monitoring wells:

    - Perimeter wells to monitor for potential migration of groundwater contamination offsite.
    - Sentinel wells to monitor for releases from operable units (work areas).
    - Wells identified in WEC's NPDES permit to monitor for potential leaks from the WTF lagoons. The NRC expects this list of wells could change when the NPDES permit is renewed by SCDHEC.
    - Area of impact wells to monitor known areas of uranium and Tc-99 groundwater contamination. The WEC will monitor, at a minimum, three wells per known plume

of radioactive contamination. One well will monitor the highest known concentration and two wells will monitor downgradient of the impacted area to detect movement of the plume (LRA Section 10.1.4 and Table 10.2).

Samples are analyzed by the CFFF Site's Chemical Laboratory or by an off-site certified laboratory using U.S. Environmental Protection Agency and U.S. Department of Energy standard methods (LRA Section 10.1.4). The environmental data management process defines how samples are collected and how data is managed and controlled at the site (LRA Section 10.1.5 and WEC Procedure RA-434). The environmental data management process describes investigation levels for radionuclides and environmental media and outlines the actions WEC will take when the results of the sample analyses exceed these levels or deviate from historic averages (LRA Section 10.1. 5 and WEC Procedure RA-434). These actions include increased sampling frequency, new sampling locations, review of manufacturing operations, and review of data within the CSM (WEC Procedure RA-434). When the results of the sampling reach the investigation levels, WEC will initiate the remediation process described in LRA Section 11.1.1 (and WEC Procedure RA-433, "Environmental Site Remediation"). ALARA investigation levels are based on guidance in Regulatory Guide 8.37 (NRC 1993a). Minimum detection levels defined in LRA Table 10.3 are sufficiently sensitive to support the investigation levels.

LRA Section 10.1.4 stated that the sampling criteria, sensitivities, and/or locations defined in the environmental sampling and monitoring program can be changed without prior NRC approval. However, the organization of environmental protection at the CFFF must complete an evaluation of the changes to demonstrate that the overall effectiveness of the monitoring program is not decreased, and changes are to be provided to NRC for review.

In LRA Section 11.1.1, "Conceptual Decommissioning Plan," WEC stated it will implement the best practices from Regulatory Guide 4.22, "Decommissioning Planning During Operations" (NRC, 2012d), and NEI 07-07, "Industry Groundwater Protection Initiative" (NEI, 2019), to prevent the migration of licensed material off-site and to minimize decommissioning impacts. Consistent with NEI 07-07, the WEC developed a conceptual site model (CSM) to help identify the sources of past contaminant releases and groundwater transport pathways (LRA Section 10.1.5 and WEC Procedure RA-435, "Conceptual Site Model Development"). The WEC committed to the use of this Procedure RA-435 to maintain the CSM (WEC, 2021a). The CSM provides information for the establishment of a groundwater monitoring network to provide timely detection of inadvertent contaminant releases (LRA Section 10.1.4); assists the WEC with maintaining a data management process for record keeping (LRA Section 10.1.5 and WEC Procedure RA-434); and provides information for the establishment of a remediation process to prevent offsite contaminant migration (LRA Section 10.1.5 and WEC Procedure RA-433). The CSM is a graphical visualization of the CFFF site's hydrogeology, including the location and extent of existing and past contamination releases to the environment and the constituents of concern. New environmental monitoring data are inputted to update the CSM on a periodic frequency (WEC Procedure RA-435). The WEC stated that the CSM would provide insight about any contamination observed or measured in the site's environment (WEC, 2021b; WEC, 2021c). The WEC will use data obtained from the CSM to inform decisions involving environmental monitoring and sampling. The WEC will compare monitoring data against previous results to detect potential contaminant releases, consistent with WEC's Procedure RA-434, "Environmental Data Management Procedure," which WEC commits to use and maintain (WEC, 2021a). Additionally, the WEC developed Procedure RA-433, "Environmental Site Remediation," which established a risk-based process for remediation decision-making (WEC, 2021a).

LRA Section 10.1.5 stated that WEC will enter issues identified through the environmental sampling and monitoring programs into the Corrective Action Program (CAP) (WEC, 2021b; WEC, 2021c). Action levels and the actions WEC will take when those levels are exceeded are specified in CFFF Procedures RA-434 and RA-433, along with other site procedures referenced therein. To ensure the NRC staff can be informed of any significant contamination that could affect the NRC's area of responsibility, the staff is adding the following safety condition S-16 to the renewed license:

- License Condition S-16: WEC shall enter into its Corrective Action Program (CAP) exceedances of Federal and State standards for the maximum contaminant levels (MCLs) under the U.S. Environmental Protection Agency's (EPA's) National Primary Drinking Water Regulations.

In the EIS for the WEC's license renewal application, the staff determined that potential for contaminants to move offsite is low because WEC has implemented the environmental sampling and monitoring program to minimize the effects of releases on off-site users of the local groundwater resources. However, WEC's ongoing activities under the CA related to site characterization, fate and transport, risk assessment, and potential future remediation, could provide new information that would potentially cause WEC to make changes to its environmental sampling and monitoring program (e.g., reductions in sampling locations, increased monitoring frequency, or sampling of new media). Therefore, the staff is adding the following safety conditions S-17 and S-18 to the renewed license to inform and facilitate the NRC's oversight of the sampling and monitoring as a result of the CA activities:

- License Condition S-17: WEC shall submit its environmental sampling and monitoring program (Section 10.1.4 of the LRA) to the NRC for review and approval upon South Carolina Department of Health and Environmental Control approval of the Remedial Investigation Report, or within five years of the license renewal (whichever comes first).

- License Condition S-18: Within 90 days of submittal of the CA final written report to SCDHEC, WEC shall submit its environmental sampling and monitoring program described in Section 10.1.4 of the LRA to the NRC for review and approval.

Based on the staff's evaluation of the LRA and WEC commitments to use procedures RA-433, RA-434, and RA-435, the staff finds that the environmental monitoring program meets the requirements of 10 CFR 20.1501 and is consistent with the acceptance criteria in Section 9.4.3.2.2 of NUREG-1520 (NRC, 2010a). The staff also finds the scope of the environmental monitoring program is commensurate with the activities at the facility and will adequately protect the public health and environment from potential impacts from operations.

9.3.3 ISA SUMMARY

The NRC staff conducted onsite and offsite reviews of credible high- and intermediate-consequence accident sequences with the potential to impact the environment, which were reported in the ISA Summary. No accident sequences with the potential for high-consequence impacts to the environment were identified in the ISA Summary. An intermediate-consequence

accident would result in a 24-hour averaged radioactive release outside the restricted area greater than 5,000 times the limits in 10 CFR Part 20, Appendix B, Table 2 (see 10 CFR 70.61(c)). The ISA Summary identifies accident sequences with potential to cause intermediate-consequence environmental impacts; these involve failures in the uranyl nitrate bulk storage system (UNBSS). The unmitigated consequences of these potential accidents could cause the release of uranyl nitrate to the surrounding soil and from there to the CFFF storm drain, which leads to Sunset Lake, and subsequently to Mill Creek and the Congaree River. The staff finds that the number and location of the monitoring wells identified in LRA Section 10.1.4 are adequate to assess impacts of an accidental release from the UNBSS. The staff finds the surface water monitoring described in LRA Section 10.1.4 is adequate to assess the impacts to Mill Creek and the off-site movement of contaminants via a surface water pathway. The staff finds the release of uranyl nitrate to the ground surface would initiate the remediation process (LRA Section 11.1.1 and WEC Procedure RA-433) and could trigger remediation and additional sampling.

As part of its review of the ISA Summary, the NRC staff evaluated the IROFS needed to control effluent concentrations and planned releases and for the prevention or mitigation of credible accident sequences that could result in releases of licensed material. The results of the staff's analysis are detailed in Chapter 3 of this SER. The staff finds that the ISA Summary demonstrates the licensee established an ISA methodology that provides reasonable assurance that the performance requirements in 10 CFR 70.61 are met. The staff also finds the ISA Summary demonstrates the licensee identified and evaluated internal events (e.g., spills and fires) and credible external events that could result in facility-induced consequences to workers, the public, or the environment with the potential to exceed the performance requirements of 10 CFR 70.61.

9.3.4 ENVIRONMENTAL PROTECTION MANAGEMENT MEASURES

The staff's evaluation of WEC's management measures, which ensures that IROFS are reliable and available when needed, is included in Chapter 11 of this SER. The staff concludes that the licensee has established adequate management measures to ensure that the IROFS will perform their intended safety function when needed to prevent or mitigate the consequences of accidents to the environment in accordance with 10 CFR 70.61 to an acceptable level.

9.4 EVALUATION FINDINGS

The licensee has committed to adequate environmental protection measures, including (1) environmental and effluent monitoring program and (2) effluent controls to maintain public doses ALARA as part of the radiation protection program. The NRC staff finds that the licensee's conformance to its application is adequate to protect the environment and public health and safety and to comply with the regulatory requirements imposed by the Commission in 10 CFR Part 20, 10 CFR Part 51, and 10 CFR Part 70. The bases for these findings are:

- The licensee's effluent controls are acceptable because they satisfy the criteria in 10 CFR 20.1101, 10 CFR 20.2203, 10 CFR 20.1406, and 10 CFR 20.1302 and are consistent with guidance in Section 9.4.3.2.1 of NUREG-1520. The staff finds reasonable assurance that WEC maintains dose requirements to the public as ALARA, has procedures for reporting to the NRC when dose constraints are exceeded, will minimize and control waste generation during operations as part of the radiation protection program to facilitate eventual decommissioning, and known or expected

concentrations of radioactive materials in airborne and liquid effluents are ALARA and below limits in 10 CFR part 20.

- The licensee's effluent monitoring is acceptable because it meets the acceptance criteria in 10 CFR 20.1302 and 10 CFR 20.2003 and is consistent with guidance in Section 9.4.3.2.2 of NUREG-1520. The staff finds reasonable assurance that WEC meets the effluent limits for radioactive materials in airborne and liquid effluents and releases to the Congaree River in 10 CFR Part 20, Appendix B, Table 2.

- The scope of the licensee's environmental monitoring program is acceptable because WEC demonstrated the survey and monitoring requirements in 10 CFR 20.1501 have been met and are consistent with guidance in Section 9.4.3.2.2 of NUREG-1520. The WEC conducts radiological and nonradiological effluent and environmental monitoring and sampling to comply with SCDHEC's NPDES permit, SCDHEC CA (SCDHEC/WEC 2019), and its NRC license.

To address past non-radiological and radiological releases at the site, the WEC entered into a CA with the SCDHEC, committing to investigate and remediate site contamination and restore on-site water quality. The WEC has modified its environmental monitoring program for radiological contamination and has also instituted new site procedures (RA-433, "Environmental Remediation," RA-434, "Environmental Data Management," and RA-435, "Conceptual Site Model") to guide its environmental monitoring program and to respond to potential future detection and release of contaminants.

The staff is adding the following three safety license conditions to inform and facilitate the NRC's oversight of the environmental sampling and monitoring program:

- License Condition S-16: WEC shall enter into its Corrective Action Program (CAP) exceedances of Federal and State standards for the maximum contaminant levels (MCLs) under the U.S. Environmental Protection Agency's (EPA's) National Primary Drinking Water Regulations.

- License Condition S-17: WEC shall submit its environmental sampling and monitoring program (Section 10.1.4 of the LRA) to the NRC for review and approval upon South Carolina Department of Health and Environmental Control's approval of the Remedial Investigation Report, or within five years of the license renewal (whichever comes first).

- License Condition S-18: Within 90 days of submittal of the CA final written report to SCDHEC, WEC shall submit its environmental sampling and monitoring program described in Section 10.1.4 of the LRA to the NRC for review and approval.

CHAPTER 10 DECOMMISSIONING

10.1 PURPOSE OF THE REVIEW

The purpose of this review was to determine whether Westinghouse Electric Company, LLC's (WEC) will be able to decommission the Columbia Fuel Fabrication Facility (CFFF) safely and in accordance with U.S. Nuclear Regulatory Commission (NRC) regulations. Nuclear facilities licensed under Title 10 of the *Code of Federal Regulations* (10 CFR) Part 70 are required to comply with financial assurance and recordkeeping requirements in 10 CFR 70.25, "Financial assurance and recordkeeping for decommissioning," and 10 CFR Part 20, "Standards for Protection Against Radiation," Subpart E, "Radiological Criteria for License Termination."

10.2 REGULATORY REQUIREMENTS

The NRC staff conducted this review to assess whether WEC's decommissioning plan meets the requirements under 10 CFR Parts 20 and 70. WEC must satisfy the following regulatory requirements regarding decommissioning planning:

- 10 CFR 20.1406(c) requires that licensees shall, to the extent practical, conduct operations to minimize the introduction of residual radioactivity into the site, including the subsurface, in accordance with the existing radiation protection requirements in 10 CFR Part 20 Subpart B.

- 10 CFR 70.25(e) requires that each decommissioning funding plan be submitted for review and approval and must include, but is not limited to, these attributes; a detailed cost estimate (DCE), key assumptions, costs of using a third-party contractor to perform all decommissioning activities, the cost of criteria for unrestricted use, and an adequate contingency factor.

- 10 CFR 70.22(a)(9) requires that applications must contain a proposed decommissioning funding plan or a certification of financial assurance for decommissioning.

- 10 CFR 70.25(f) requires that the financial instrument must include information identifying the licensee, the issuer of the instrument, the trustee if a trust is used, and the license and docket numbers. Financial assurance for decommissioning must be provided by one or more methods specified in 10 CFR 70.25(f), including a surety method, insurance, or a prepayment, in an amount that is sufficient to pay for the cost of decommissioning, or an external sinking fund coupled with another approved guarantee method. All financial assurance instruments must be acceptable to the NRC.

- 10 CFR 70.25(g) requires that each licensee keep records of information important to the decommissioning of a facility in an identified location until the site is released for unrestricted use.

- 10 CFR 70.38(g)(1) requires that a decommissioning plan be submitted if required by license condition or if the procedures and activities necessary to carry out decommissioning of the site or separate building or outdoor area have not been previously approved by the Commission since these procedures could increase potential

health and safety impacts to workers or to the public, e.g., 10 CFR 70.38(g)(1)(i) through (iv).

The acceptance criteria for the NRC staff's review of WEC's decommissioning planning are outlined in Section 10.4 of NUREG-1520, Revision 1, "Standard Review Plan (NUREG-1520) for the Review of a License Application for a Fuel Cycle Facility" (NRC 2010a).

10.3 STAFF REVIEW AND ANALYSIS

The NRC staff's review covers the conceptual decontamination and decommissioning plan, decommissioning costs, and financial assurance submitted by WEC under 10 CFR 70.25(e) as part of its LRA. The decommissioning cost and funding information to support this review was obtained from WEC's license renewal application (LRA) dated September 20, 2021 (WEC 2021b) and the decommissioning funding plan (DFP), originally dated July 25, 2019 (WEC 2019d) then revised on December 10, 2019 (WEC 2019c). The DFP submittal and its 2020 approval by NRC reflect the most recent review and approval of WEC's DFP (NRC, 2020c). A DFP triennial update was submitted to NRC for review on May 9, 2022 (WEC, 2022g). It will be reviewed on a separate schedule, independent of this license renewal.

The DFP submittal contains cost estimates for decommissioning including cleanup of contamination and financial assurance mechanisms to perform the needed decommissioning activities. WEC's actions to address current contamination concerns as part of its remedial investigations are contained in WEC procedures RA-433, "Environmental Remediation," RA-434, "Environmental Data Management," and RA-435, "Conceptual Site Model." Additional actions to address contamination under the Consent Agreement with South Carolina Department of Health and Environmental Control (SCDHEC/WEC 2019) are outlined in Chapter 9 of this document.

10.3.1 DECOMMISSIONING PLANNING

In LRA Section 11.1.1, "Conceptual Decommissioning Plan," WEC stated they will implement their remediation process to minimize contamination and reduce exposures and effluent releases. WEC states that its remediation process follows Nuclear Energy Institute (NEI) best practices, "Industry Groundwater Protection Initiative" (NEI 2019), and NRC's Regulatory Guide 4.22, "Decommissioning Planning During Operations" (NRC 2012a).

As described in Chapter 9, "Environmental Protection," WEC implemented best practices from Regulatory Guide 4.22, "Decommissioning Planning During Operations" (NRC, 2012d), and NEI 07-07, "Industry Groundwater Protection Initiative" (NEI, 2019), to prevent off-site migration of radioactivity as required by 10 CFR 20.1406(c), "Minimization of Contamination." As described in Chapter 4 of this SER and in Section 5 of the LRA, the CFFF has an existing Radiation Safety Program (RSP) which has been reviewed and is inspected by NRC staff. The RSP includes both engineered and administrative controls to maintain radiation exposure ALARA (consistent with the requirements of 10 CFR 20.1101) and has sufficient resources to be implemented independent from facility operations.

The WEC resubmitted its decommission funding plan for the CFFF as part of its LRA, as required by 10 CFR 70.25(e)(2). The DFP will be updated with a detailed decommissioning plan submitted to the NRC at the time the decision is made by WEC to decommission the CFFF, in accordance with the requirements of 10 CFR 70.38. WEC indicated in the DFP that it will decommission the site for unrestricted use.

10.3.2 DECOMMISSIONING FUNDING PLAN

In the LRA Section 11.1.2, "Decommissioning Funding Plan," WEC stated that its DFP includes cost estimates for decommissioning and the financial assurance mechanism used to secure the funds associated with the cost estimate, both of which are submitted to the NRC for review and approval in accordance with 10 CFR 70.25.

As required by 10 CFR 70.25(e)(2), WEC must revise the DFP at the time of license renewal and in periods not to exceed 3 years. The WEC submitted its triennial update of the DFP for CFFF in July 2019 (WEC 2019d). In November 2019, the NRC staff requested additional information (RAI) from WEC (NRC 2019a). The WEC responded to the RAIs and resubmitted a revised DFP on December 10, 2019 (WEC 2019c).

The NRC staff reviewed the DFP submittal and determined it adequately estimates the cost of decommissioning (NRC 2020c). The NRC staff's review of the DFP included the decommissioning cost estimate (DCE), key assumptions, and methods for assuring funds. The NRC staff determined that the DCE was consistent with NRC guidance in NUREG-1757, Vol. 3, Rev. 1, "Consolidated Decommissioning Guidance: Financial Assurance, Recordkeeping, and Timeliness, Final Report" (NRC 2012b). A DFP triennial update was submitted to NRC for review on May 9, 2022 (WEC 2022g) will be reviewed on a separate schedule, independent of this license renewal.

The NRC staff reviewed the DFP, submitted in conjunction with the LRA, and found reasonable assurance the 2019 DCE would continue to provide adequate protection of public health, safety, safeguards, security, and the protection of the environment (NRC 2020c). The NRC staff found that the DCE is based on reasonable and documented assumptions, and that it reasonably estimated the cost to decommission the facility at the time of submittal, if necessary (NRC 2020c). Therefore, the NRC finds that the DFP submitted in conjunction with the LRA is acceptable and meets the regulatory requirements to provide financial assurance, as set forth in 10 CFR 70.25(e). The licensee remains liable for any costs not covered by the financial instruments.

10.3.3 DECOMMISSIONING RECORDKEEPING

In Section 11.1.1, "Conceptual Decommissioning Plan," of the LRA, WEC stated it maintains records important to decommissioning in accordance with 10 CFR 70.25(g) and its internal procedures. The NRC staff reviewed the decommissioning records during a site visit in May 2019 (NRC 2019b). Based on WEC's statement and the staff's site visit, the NRC staff finds that WEC demonstrates compliance with maintaining records important to decommissioning in accordance with 10 CFR 70.25(g).

10.4 EVALUATION FINDINGS

The NRC staff evaluated the licensee's plans and financial assurance for decommissioning and found they meet the financial assurance requirements provided in 10 CFR 70.25 and to be consistent with the guidance provided in NUREG-1757, Vol. 3, Rev. 1 (NRC 2012b). The NRC staff finds that the 2019 decommissioning funding plan, and WEC procedures will continue to provide adequate protection of public health, safety, safeguards, security, and the protection of the environment. As noted in Chapters 4 and 9 of this SER, WEC commits to implementing and maintaining an RSP and continue routine monitoring to ensure that contamination and

exposures to workers and members of the public are kept ALARA and in accordance with the provisions in 10 CFR Part 20. In addition, the estimated costs of the activities were included in the 2019 DCE. Therefore, NRC finds the 2019 DFP submittal, including the 2019 DCE, is acceptable and provides adequate financial assurance, as set forth in 10 CFR 70.25(e). The licensee remains liable for any costs not covered by the financial instrument(s). The NRC staff has determined that the licensee's decommissioning plan and financial assurance for decommissioning comply with the NRC's regulations and provide reasonable assurance of adequate protection for workers, the public, and the environment.

CHAPTER 11 MANAGEMENT MEASURES

11.1 PURPOSE OF REVIEW

Management measures are activities performed by a licensee, on a continuing basis, that are applied to items relied on for safety (IROFS) to ensure that they will perform their intended safety function when needed to prevent accidents or mitigate the consequences of accidents to an acceptable level. The purpose of the staff's review of management measures was to ensure compliance with Title 10 of the *Code of Federal Regulations* (10 CFR) Section 70.61. Many factors are considered such as maintenance, operating limits, common-cause failures, and the likelihood and consequences of failure or degradation of the IROFS and the measures. As defined in 10 CFR 70.4, "Definitions," management measures include configuration management (CM), maintenance, training and qualification, procedures, audits and assessments, incident investigations, records management, and other quality assurance (QA) elements.

11.2 REGULATORY REQUIREMENTS

The U.S. Nuclear Regulatory Commission (NRC) staff conducted the management measures review to ensure that the Westinghouse Electric Company, LLC's (WEC's) program meets the requirements required by 10 CFR 70.22 and 70.65. In addition, the following specific regulatory requirements are applicable to the management measures program:

- 10 CFR 70.22(a)(8) requires that each application for a license must contain proposed procedures to protect health and minimize danger to life or property.
- 10 CFR 70.62(a)(3) states that records must be kept for all IROFS failures, describes required data to be reported, and sets time requirements for updating the records.
- 10 CFR 70.62(d) requires an applicant to establish management measures for engineered and administrative controls and control systems that are identified as IROFS, in accordance with 10 CFR 70.61(e), to ensure that they are available and reliable to perform their functions when needed.
- Facility change and change processes must conform to 10 CFR 70.72, "Facility changes and change process."
- 10 CFR 70.74 requires incident investigation and reporting.

The acceptance criteria used for this review are outlined in Section 11.4.3 of NUREG-1520, Revision 1, "Standard Review Plan for Fuel Cycle Facilities License Application" (NUREG-1520) (NRC, 2010a).

11.3 STAFF REVIEW AND ANALYSIS

The NRC staff reviewed Chapter 3.0 of the license renewal application (LRA) (WEC, 2019b). This chapter provided a description of the management measures that are implemented on a continuing basis at WEC. The management measures are applied to IROFS based on the unmitigated consequence and the type of control. Grading of management measures at WEC is not performed. The implementation of management measures at WEC is controlled and monitored via approved procedures. Failure to establish and implement management measures required under 10 CFR 70.61, could undermine the reliability of IROFS to perform their intended function, and therefore, result in an increased potential for accidents.

WEC's management measures program includes activities for protection of the environment, health, and safety and are performed in accordance with regulatory requirements mentioned above. The management measures applied to IROFS are specified in the integrated safety analysis (ISA). These management measures are applied to IROFS based on the type of control (i.e., engineered or administrative). Management measures are implemented to assure compliance with performance requirements, as evaluated in the ISA. This chapter addresses each of the management measures included in 10 CFR 70.4: (1) CM; (2) maintenance, (3) training and qualifications, (4) procedures, (5) audits, (6) incident investigations, (7) records management, and (8) other quality assurance elements.

11.3.1 CONFIGURATION MANAGEMENT

In Section 3.1, "Configuration Management," of the LRA, WEC stated that the CM program is implemented in accordance with approved procedures; the procedures are descriptive and define the review and approval process used to ensure that new or modified structures, systems, and components comply with applicable regulatory requirements. The licensee's CM program structure defines the following key elements for the program:

- Management—the organizational structure, procedures, and responsibilities necessary to implement the CM program are in place.

- Design Requirements—this element assures the development, application and maintenance of design specifications and requirements.

- Document Control—this element assures that plant procedures are established to specify the requirements for review, approval, issuance, and revision of documents important to the program. The following types of documents are controlled: technical specifications and requirements, special procurement or construction provisions, licensing documents, drawings, procedures and training, software for IROFS, maintenance and surveillance, and ISA and identification of IROFS.

- Change Control—this includes the elements of the CM program to control changes to the facility structures, processes, systems, equipment, components, computer programs, and activities of personnel. The LRA states that prior to implementing any changes, the following items are addressed and documented: (1) technical basis for the change, impact on safety and health control of license material, (2) modification of existing drawings, procedures and training, (3) authorization requirements for the change, (4) procedures for temporary changes, and (5) impact on the ISA in accordance with 10 CFR 70.62 requirements. All changes to the facility structures, processes, systems, equipment, components, computer programs, and personnel activities are evaluated under 10 CFR 70.72(a) before the change is implemented. The change control element monitors changes to documentation are made to avoid inadvertent access by facility personnel to outdated designs and other specifications related to IROFS. The Regulatory Component and the engineering component are responsible for the review, approval and documentation of facility changes.

- Audits—this element assures that the implementation of the program is adequate and in accordance with procedures. The audits for the CM program are systematically planned and performed in accordance with the requirements specified in approved procedures.

WEC has committed to performing assessments that include both initial and periodic assessments to verify and assure the efficiency of the CM program.

- Design Reconstitution—the CM program specified that procedures are in place to monitor periodic ISA Summary updates as required by the regulations (10 CFR 70.72(d)(2)–(3)), and these updates are incorporated into an NRC submittal on an annual basis. The WEC states that complete, accurate, and retrievable design information needed to support facility design changes and their evaluation is available. As stated in Section 3.1 of the LRA and RAI responses dated, July 29, 2016, during design reconstitution, current design bases will be readily available and verified for all IROFS such that the configuration will be consistent with the as-built facility documentation. This control is specified in approved procedures for the ISA Summary preparation in accordance and compliance with regulatory requirements in 10 CFR 70.72(d)(2)–(3).

The staff has reviewed the CM program functions against the guidance of NUREG-1520 Chapter 11. The application adequately identifies the elements of the CM program, including the methods of implementation used to establish consistency among design requirements, physical configuration, and facility documentation. Management level policies and procedures, including an analysis and a review of any proposed activity involving IROFS, are also adequately described in Chapter 3 of the LRA.

The LRA described the applicable documents and the key elements of the CM program and how it is applied to IROFS. The CM program is used to control and analyze new structures, systems and components, and modifications to existing structures system and components within the facility. The CM program is implemented in accordance with approved procedures and is assessed in accordance with a formal audit plan. When deficiencies are identified, corrective actions are taken to correct the condition.

The CM program includes the key elements discussed above to assure that information used to operate and maintain safety controls is kept current.

The NRC staff has concluded that the CM program's content and organizational structure is acceptable because it is consistent with the acceptance criteria in Section 11.4.3.1 of NUREG-1520 and is in compliance with the regulatory requirements in 10 CFR Part 70.

11.3.2 MAINTENANCE

The WEC maintenance program, described in Section 3.2, "Maintenance," of the LRA, is designed to keep IROFS available and reliable to perform their intended function when needed. The program is implemented in accordance with procedures, and the operations component is responsible for maintaining it. The program uses a computerized maintenance planning and control system to plan, schedule, track and maintain records of maintenance activities for IROFS. The maintenance program includes commitments on the following key elements: corrective maintenance, preventive maintenance, surveillance and monitoring, and functional testing. These key elements apply to all IROFS (i.e. administrative and engineered) as described in approved WEC procedures.

The LRA stated that maintenance is implemented to keep IROFS in a condition of readiness such that they are available and reliable to perform their intended function when called upon to do so. The maintenance program assures IROFS are installed, tested and maintained in

accordance with approved procedures. When maintenance activities require changes to existing facility design, equipment, components, physical configuration, or safety documentation, these changes are performed in accordance with Section 3.1 of the LRA. Maintenance for administratively controlled IROFS is performed through the procedure review and approval process described in Section 3.4, “Procedures, Training and Qualification,” of the LRA. Maintenance and surveillance activities are controlled so that activities are only performed by trained and qualified personnel. All IROFS-related maintenance activities are reviewed and approved by the regulatory component in conjunction with the operations component. Procedures identify controls to assure that IROFS may never be defeated, bypassed, overridden, or forced off unless specifically approved in advance by the regulatory component and only when conducting operability tests in accordance with written procedures.

The maintenance program is controlled in accordance with WEC approved procedures that cover the following key elements:

- Corrective Maintenance—this element includes procedures in which maintenance refers to any activities associated with a defective IROFS that requires repair, replacement or major adjustment.

- Preventive Maintenance—this element includes procedures in which the maintenance refers to activities that are performed as precautions to help assure that systems remain operational and avoid unexpected failures. WEC performs preventive maintenance activities at specified frequencies to assure the availability and reliability of IROFS. The procedures assure that IROFS shall not be disconnected or removed from service (while the process continues to operate) during calibration or functional testing, unless authorized in a written procedure approved by the regulatory component.

- Surveillance and Monitoring—this element includes procedures in which the maintenance refers to the established activities to monitor the current and long-term performance of IROFS. The operations component monitors the performance of safety systems and IROFS while activities are being conducted. Abnormal occurrences are reported to the regulatory component, as described in Sections 3.7 “Incident Investigations” and 3.8 “Corrective Action Program.”

- Functional Testing—this element includes procedures in which maintenance is performed to confirm the availability and reliability of IROFS. Functional testing is performed: (1) as part of pre-operational testing for new or modified processes as prescribed by the CM program, (2) as part of preventive maintenance, and/or (3) as part of post-maintenance testing to verify that a routine or corrective maintenance activity did not adversely affect the functionality of the IROFS. The procedures assure that tests are performed in accordance with written instructions which define the methodology and acceptance criteria.

The staff found that the licensee committed to the maintenance of engineered and administrative IROFS and that the commitments contain the basic elements to maintain availability and reliability, corrective maintenance, preventive maintenance, surveillance and monitoring, and functional testing. The licensee’s maintenance function is proactive, using maintenance records, preventive maintenance records, and surveillance tests to analyze equipment performance and to seek the root causes of repetitive failures. The maintenance

activities described in the LRA ensure that the IROFS identified in the ISA Summary will be available and reliable to prevent or mitigate accident consequences.

The program is reviewed and approved by the regulatory component and supported by the operation component. The maintenance function (1) is based on approved procedures, (2) employs work control methods that properly consider personnel safety, awareness of facility operating groups, QA, and the rules of CM, (3) uses the ISA Summary to identify IROFS that require maintenance, (4) justifies the preventive maintenance intervals in terms of the equipment reliability goals, (5) provides for training and emphasizes the importance of IROFS, regulations, and codes, and (6) creates and maintains records of surveillances, inspections, equipment failures, repairs and replacements of IROFS.

The staff reviewed the maintenance program functions against the guidance of NUREG-1520 (NRC, 2010a), Chapter 11 and concludes that the program meets the acceptance criteria in Section 11.4.3.2. Therefore, the staff determines that the maintenance functions meet the requirements of 10 CFR Part 70 and provide reasonable assurance of public health and safety and the protection of the environment.

11.3.3 TRAINING AND QUALIFICATION

The WEC training and qualification program describes the general authorities and overall procedure for the qualification of personnel. The objective of the program is to ensure individuals performing activities relied on for safety have the proper knowledge, skills and abilities to perform work activities in a safe and compliant manner. The LRA described an overview of requirements for general employee training, job-specific training, and on-the-job training.

Section 3.4.2 “Training and Qualification,” of the LRA described the training and qualification program for WEC. The facility implements a performance-based training and qualification program supplemented by operating experience. The program is implemented in accordance with approved procedures depending on the type of activity conducted. The objective of the program is to assure individuals performing activities relied on for safety have the proper knowledge, skills, and abilities to perform work activities in a safe and compliant manner. Individual component managers (i.e., engineering component, regulatory component) are responsible for establishing and documenting training requirements for their personnel, identifying training needs, verifying proficiency on an annual basis, ensuring personnel are properly trained and qualified to perform tasks, and that untrained/unqualified personnel do not work independently until trained/qualified.

Training and qualification are controlled by a computerized system. There are different types of training depending on the position. Each position defines the minimum requirements and specific qualifications to be completed in order to perform each task. There is general employee training that is required for all individuals that work at WEC CFFF, and there is job-specific training which is required for particular positions to assure activities relied on for safety are properly performed. Refresher training and qualification is performed on a periodic frequency depending on the type of training.

The training and qualification program is implemented by procedures that include a process for WEC to analyze, design, develop, implement, and evaluate the effectiveness of training. In addition, the program seeks to assure that training is conducted in a reliable and consistent manner. Training may be instructor led, computer-based, on-the-job, self-study of procedures

and work instructions, demonstration of skills which may include assignments and/or tests, and/or special training which may include conferences or courses. The mechanism of training will depend on the position or task to be executed. Approved procedures provide the basis for the training content. Training materials are updated to remain current with the latest revisions of procedures. Employees are refreshed as training is updated.

Types of training include:

- General Employees Training—this type of training is provided to all WEC employees. The training includes regulatory policies, general safety and safeguards practices, and emergency response. Facility visitors are provided with training commensurate with their visit's scope, and/or are escorted by trained employees. Radiation workers receive additional training and annual refresher training, and require successful completion of an examination on 10 CFR Part 19 and 10 CFR Part 20 requirements.

- Job-specific training—this type of training is assigned to individuals in positions/activities involving licensed material with emphasis on safety requirements where human actions are important to safety, including the implementation of administrative IROFS. There are two types of training in this category:
    - Management—qualification requirements for key WEC management positions are described in Chapter 2.0, "Management Organization," of the LRA. A more detailed review of the qualification requirements can be found in Chapter 2.0 of this safety and safeguards evaluation report.
    - Operators—on-the-job training is the preferred method of training for the process operator qualification.

- Regulatory Component Personnel Training—the program procedure includes the requirements to assure personnel are trained and qualified to perform specific regulatory activities in accordance with approved procedures and/or applicable regulations. Typically, this training is accomplished through several methods, such as computer-based, on-the-job training by a qualified individual, and self-study of regulations, license application, integrated safety analysis process, and procedures.

The staff has reviewed the training and qualification program functions against the guidance of NUREG-1520 (NRC, 2010a), Chapter 11. The staff finds that the application includes sufficient information to conclude that training and qualification is integrated into a combined process to ensure that safety and safeguards activities are conducted by trained and qualified individuals. Functional elements of the integrated process are developed and reviewed and approved by cognizant individuals in the area of performance. Diverse mechanisms of training are applied to WEC personnel based on their work area. Training and qualification records of personnel is subject to review and approval by component management, and records are kept for the period of the qualification. The NRC staff concludes that the WEC has adequately described and assessed its personnel training and qualification in a manner that is consistent with the acceptance criteria in NUREG-1520 (NRC, 2010a), Chapter 11.4.3.3, and therefore satisfies the regulatory requirements in 10 CFR 70.22.

The NRC staff concludes that the implementation of the described training and qualification will result in personnel who are qualified and competent to operate, modify, and maintain the facility safely. The staff concludes that the licensee's plan for personnel training and qualification meets the requirements of 10 CFR Part 70.22.

11.3.4 PROCEDURES

The regulations in 10 CFR 70.22(a)(8) require that a license application contain proposed procedures to protect public health and minimize danger to life or property. Section 3.4 of the LRA described the procedure process at WEC. The section provides a general description on the types of procedures used at the facility.

In Section 3.4.1 of the LRA, WEC stated that procedures assure safe and compliant activities are conducted at the CFFF. Procedures direct activities involving IROFS, management measures, site-wide industrial safety work practices, criticality safety, radiation safety, chemical process safety, fire safety, environmental protection, emergency management, material control and accounting, and physical security. Each component is responsible for establishing and maintaining its procedures. These procedures are reviewed and approved by an independent, multidisciplinary safety review team. Procedures are considered to be a type of management measure applied to IROFS.

The procedure process specifies requirements and responsibilities for preparation, review and approval, distribution, control, validation, and periodic review of at least 3 years to assure that procedures are technically accurate and can be performed as written. Procedures are approved by appropriate component management personnel who are responsible and accountable for the activity governed by the procedure. Procedures are maintained and controlled as records by an electronic training and procedure system. All procedures include a title, identification number, revision number and date.

The procedures at WEC are classified into the following categories:

- Management control procedures—these are administrative procedures that are not considered administrative IROFS. These procedures provide the administrative and general employees with regulatory requirements applicable to the facility. They include applicable instructions on the purpose, policy and scope, terms and definitions, responsibilities, regulatory requirements, procedure requirements and references.
- Operating procedures—these procedures give step-by-step process instructions and specify operator actions necessary to prevent or mitigate accidents identified in the ISA Summary for a particular process. These procedures include applicable instructions for operating limits, administrative IROFS, and required actions for startup, normal operations, shutdown and emergency shutdown.
- Maintenance procedures—these procedures specify how maintenance activities are performed at WEC CFFF. These procedures assure maintenance work is executed with a level of rigor that is controlled. These procedures include pre- and post-maintenance requirements for the verification of IROFS after maintenance is performed. In addition, they incorporate safe work practices including specific instruction to avoid bypassing an IROFS without adequate approval.
- Emergency Procedures—procedures governing the emergency management program and safe work practices are described in Chapter 8.0 of this SER.

- Temporary Operating Procedures—these are supplemental operating instructions that can be used to document a series of clear and concise steps that formulate a systematic sequence of work to be used on a temporary basis. The procedure specifies the allowable period it can exist, but no longer than 6 months per WEC controls.

The NRC staff concludes that the application describes a suitably detailed process for the development, approval, and implementation of procedures. It addresses IROFS, as well as items important to the health of facility workers and the public and to the protection of the environment. The NRC staff concludes that the WEC procedure program satisfies the acceptance criteria of NUREG-1520 (NRC, 2010a), Chapter 11.4.3.4 and meets the requirements of 10 CFR Part 70.

11.3.5 INCIDENT INVESTIGATIONS

Sections 3.7, “Incident Investigations,” of the LRA described the overall specifications of the incident investigations program at WEC CFFF, including the applicability and scope. The program is directly linked to the corrective action program and the ISA.

The incident investigations program at WEC is used to identify, report, and investigate abnormal events at WEC. The incident investigations program incorporates regulatory reporting requirements specified by 10 CFR 70.50 and 70.74, issues with IROFS and management measures, process updates, and procedural inadequacies. It contains a formal process for internal reporting and investigation of abnormal occurrences that occur at WEC CFFF. This process is implemented via approved procedures. The abnormal occurrences are evaluated depending on the severity and compliance with regulatory requirements. The process outlines the requirements for the incident investigation program including documentation requirements, tracking and reporting requirements, specific requirement for abnormal occurrences involving IROFS (ISA Summary, reporting), and requirements for extent of condition evaluation and corrective action program. The regulatory, engineering and operations components are responsible to document, track, and report abnormal occurrences. As specified by procedures, abnormal occurrences are periodically trended and summarized by the regulatory component. Any necessary updates to the ISA or the ISA Summary are also performed by the regulatory component.

The NRC staff evaluated the information provided in Section 3.7 of the LRA and determined that it is consistent with the guidance of NUREG-1520 (NRC, 2010a), Chapter 11. WEC established an organization responsible for: (1) performing incident investigations of abnormal occurrences that may occur during the operation of the facility, (2) determining the root cause(s) and generic implications of the event, and (3) recommending corrective actions for ensuring a safe facility and safe operations in accordance with 10 CFR 70.74(a)–(b).

The licensee committed to monitor and document corrective actions through completion and to maintain documentation so that lessons learned may be applied to future operations of the facility.

The NRC staff concludes that WEC’s description of the incident investigations program is consistent with the acceptance criteria of NUREG-1520 (NRC, 2010a), Chapter 11.4.3.6 and meets the requirements of 10 CFR Part 70.

11.3.6 AUDITS

Section 3.6, “Audits,” of the LRA provided a general description of the applicability of the audit program at WEC. This program is conducted to ensure that operations categorized as being important to radiation safety, environmental protection, health, safety, and safeguards are properly implemented. Assessments, inspections, and program audits are conducted in accordance with specified scope depending on the area of review. Performance standards are consistent with management expectations. Audits are scheduled annually depending on the specified scope and the area.

Audits are periodically performed on management measures as well as in the areas of nuclear criticality safety, radiation safety, chemical safety, fire safety, emergency management, and environmental protection. The regulatory component oversees the internal audit program to verify that operations are performed in compliance with regulatory requirements and license commitments. WEC assigns personnel, and/or external auditors, to conduct the audits in accordance with approved procedures. The audits are led by qualified auditors who do not have direct responsibility for the activity being audited.

Audit results are documented and reviewed by management having direct responsibility in the area audited. They are responsible for follow-up actions, including re-audits of deficient areas as indicated in the report. These follow-up actions are conducted via the corrective action program. All corrective actions from previous audits are reviewed during the initiation of the next audit.

Based on its review of the LRA, the staff determined that WEC has adequately planned for audits to be accomplished and that the necessary programs, personnel, and procedures are established. The staff concludes that WEC’s plan for audits program is consistent with the acceptance criteria of NUREG-1520 (NRC, 2010a), Chapter 11.4.3.5 and meets the requirements of 10 CFR Part 70.

11.3.7 CORRECTIVE ACTION PROGRAM

Section 3.8, Corrective Action Program,” of the LRA stated that WEC maintains a corrective action program that complies with Section C of Regulatory Guide 3.75, “Corrective Action Program for Fuel Cycle Facilities” (NRC, 2014) and provides a structured, disciplined approach to identify, document, and correct conditions adverse to safety and security.”

The NRC staff reviewed WEC’s CAP and concludes that the corrective action program is acceptable. Consistent with Regulatory Guide 3.75, Section B, the staff will add the following license condition to the WEC license:

> License condition S-15: WEC CAP shall comply with the elements outlined in Section C of Regulatory Guide 3.75, “Corrective Action Program for Fuel Cycle Facilities,” Revision 0.

Should WEC decide to pursue NRC accreditation of their CAP program, the licensee will request in writing that the NRC conduct an inspection of their CAP implementation and effectiveness consistent with Section B of Regulatory Guide 3.75.

11.3.8 RECORDS MANAGEMENT

Section 3.9, "Records Management," of the LRA described the records management program, how it is applied, and the retention period for facility records. The WEC record management program is controlled electronically and implemented by approved procedures. As part of this program, a records flow schedule (RFS) is maintained and provides an index of records generated at the facility. The RFS describes the records to be retained, the retention location, and retention time limits. All retained records are stored and maintained readily accessible in order to meet retrieval time restraints. This records retention system includes the capability to retrieve records within 24 hours for records generated within the preceding 12 months and within 7 calendar days for older record generation periods. The regulatory component generates and controls the RFS.

The general categories of these records include radiation protection, nuclear criticality safety, environmental, licenses/permits, procedures, training, safeguards, safety, and emergency preparedness. Records associated with ISAs and IROFS and their associated configuration management, document control, maintenance, and other QA elements are included in the general category for licenses/permits and are retained for 3 years. Records associated with the IROFS and management measures failures required by 10 CFR 70.62(a)(3) and with abnormal occurrences involving IROFS are retained for a minimum of 3 years.

The NRC staff reviewed WEC's records management program against the acceptance criteria in Chapter 11.4.3.7 of NUREG-1520 (NRC, 2010a) and concludes that the system: (1) will be effective in collecting, verifying, protecting, and storing information about the facility and its design, operations, and maintenance and will be able to retrieve the information in readable form for the designated lifetimes of the records, (2) provide a records storage area(s) with the capability to protect and preserve health and safety records that are stored there during the mandated periods, including protection of the stored records against loss, theft, tampering, or damage during and after emergencies, and (3) provide reasonable assurance that any deficiencies in the records management system or its implementation will be detected and corrected promptly. Therefore, the staff concludes that the records management program complies with the regulatory requirements of 10 CFR 70.62(a)(3).

11.3.9 OTHER QUALITY ASSURANCE ELEMENTS

Section 3.3, "Other Quality Assurance Elements," of the LRA described how other quality assurance (QA) elements will be applied to IROFS and other management measures. The staff reviewed the information provided to verify that management measures generally meet the intent of the 18 QA elements. These elements are: (1) organization; (2) program; (3) design control; (4) procurement documentation control; (5) instructions, procedures, and drawings; (6) document control; (7) control of purchased materials, equipment, and services; (8) identification and control of materials, parts, and components; (9) control of special processes; (10) internal inspections; (11) test control; (12) control of measuring and test equipment; (13) handling, storage, and shipping controls; (14) inspection, test and operating status; (15) control of nonconforming materials, parts or components; (16) corrective action; (17) records; and (18) audits. These elements are applied to IROFS in accordance with approved written procedures. WEC does not have a graded approach for the implementation of these QA elements; however, the applicability of these elements to an IROFS depends upon the type of IROFS and as detailed in approved procedures or in other management measures. The intent of these QA elements is as follows:

- Organization—WEC operates within a documented organizational structure in which responsibility and authority for safe operations is defined. More discussion on the management organization is contained in Chapter 2 of this SER. The regulatory component is responsible for assuring oversight of other QA elements.
- Design Control—The approved WEC policies and procedures provide requirements for design control to assure the availability and reliability of IROFS. Details of these requirements for IROFS are described in the configuration management program.
- Procurement Documentation Control—The procurement controls are applied to procured IROFS in accordance with approved written procedures.
- Instructions, Procedures, and Drawings—These activities are performed in accordance with written instructions/procedures defined in the configuration management program, maintenance and procedures, and training and qualification. They will be applied to IROFS as needed.
- Document Control—WEC implements document control as described in the configuration management program.
- Control of Purchased Materials, Equipment, and Services—The control of purchased materials, equipment, and services are applied to IROFS in accordance with approved procedures.
- Identification and Control of Materials, Parts, and Components—The identification and control of procured IROFS is performed in accordance with approved written procedures to assure that only correct items are used and installed.
- Control of Special Processes—The welding and nondestructive examination processes related to IROFS are controlled in accordance with written procedures and conducted by qualified personnel.
- Internal Inspections—The inspections required to assure the availability and reliability of IROFS are performed in accordance with the configuration management and maintenance programs. Each inspection describes the characteristics to be inspected and the methods to be used.
- Test Control—WEC implements a test control program for IROFS through the configuration management and maintenance programs.
- Control of Measuring and Test Equipment—WEC maintains measuring, calibration, and test equipment in accordance with approved written procedures.
- Handling, Storage, and Shipping Controls—If applicable, special handling, storage and shipping controls applied to IROFS are specified in approved written procedures.
- Inspection, Test, and Operating Status—When the ISA requires status indication, the IROFS are marked and tagged.
- Control of Nonconforming Materials, Parts, or Components—Nonconforming IROFS are controlled so that they will not be used until such time as they are repaired and able to perform their intended function.
- Corrective Action—WEC commits to maintain a corrective action program in compliance with Regulatory Guide 3.75. The implementation is defined in approved procedures of the incident investigation and corrective action programs.
- Records—WEC maintains QA records for other QA elements as defined in the records management program.
- Audits—WEC implements an audit program as defined in this Section 3.6 “Audits” of the license application.

The NRC staff concludes that the licensee has addressed all the identified QA elements that will be applied to IROFS and other management measures and adequately described the

application of those QA elements within its management measures program. The staff also concludes the following:

- The licensee established and documented a commitment to an organization responsible for developing, implementing, and assessing the management measures for providing reasonable assurance of safe facility operation in accordance with the acceptance criteria of Section 11.4 of NUREG-1520 (NRC, 2010a).
- The licensee has established and documented a commitment to QA elements, and the administrative measures for staffing, evaluating performance, assessing findings, and implementing corrective actions are in place.
- The licensee has developed a process for preparation and control of written administrative plant procedures, including procedures for evaluating changes to procedures, IROFS, and tests. The licensee has committed to implement and maintain a process for review, approval, and documentation of procedures.
- The licensee has established and documented surveillances, tests, and inspections to provide reasonable assurance of satisfactory in-service performance of IROFS.
- The licensee will ensure that periodic independent audits are conducted to determine the effectiveness of the management measures. Management measures provide for documentation of audit findings and implementation of corrective actions.
- The licensee has established and documented training requirements to provide employees with the skills to perform their jobs safely. The licensee has also provided management measures for the evaluation of the effectiveness of training against predetermined objectives and criteria.
- The organization and persons performing QA element functions have the required independence and authority to effectively carry out their QA element functions without undue influence from those directly responsible for process operations.
- The QA elements cover the IROFS, as identified in the ISA Summary, and the licensee has established measures to prevent hazards from becoming pathways to higher risks and accidents.

Accordingly, the NRC staff concludes that WEC's application of other QA elements meets the regulatory requirements of 10 CFR 70.62(d) and provides reasonable assurance of protection of worker and public health and safety and protection of the environment.

11.3.10 HUMAN PERFORMANCE

Section 3.5, “Human Performance,” of the LRA described how WEC incorporates human performance principles at the facility. These principles include the following: (1) humans are fallible, (2) error is predictable, (3) organizations influence behavior, (4) behaviors are reinforced, and (5) events are avoidable. Human performance tools are used to recognize error-likely situations and prevent them from occurring. These tools include the following: (1) questioning attitude, (2) self-check, (3) peer check, (4) pre-job brief and post-job review, (5) time out, (6) decision-making, (7) independent verification, (8) signature, (9) situational awareness, (10) validation of assumptions, (11) effective communication, (12) procedure use and adherence, and (13) personal safety assessment. The LRA stated that employees are trained in human performance concepts commensurate with the level of their participation in the program. Trained observers conduct systematic observations that focus on high risk or error-likely processes to reduce the likelihood of failures. Human performance tools are an attribute for the constant improvement of WEC programs, including the programs defined as management measures.

The NRC staff finds this approach to be acceptable and useful to ensure that the programs described in the management measure chapter will function adequately. The use of these human performance tools ensure that the overall management measure program will continuously perform in accordance with the regulatory requirements of 10 CFR 70.62(d).

11.4 EVALUATION FINDINGS

Based in its evaluation, the NRC staff reviewed the information presented in the LRA and requests for additional information responses provided. Based on this review, the staff finds that the licensee has established adequate management measures to ensure that the IROFS will perform their intended safety function when needed to prevent or mitigate the consequences of accidents to an acceptable level. Specifically, the staff concludes that the management measures described in this application meets the requirements of 10 CFR 70.61.

CHAPTER 12 MATERIAL CONTROL AND ACCOUNTING

12.1 PURPOSE OF THE REVIEW

The purpose of this review was to determine whether the licensee's material control and accounting (MC&A) program is adequate to detect and protect against the loss, theft, or diversion of special nuclear material (SNM), and to ensure compliance with the applicable requirements.

12.2 REGULATORY REQUIREMENTS

The U.S. Nuclear Regulatory Commission (NRC) staff conducted this review to ensure that the Westinghouse Electric Company, LLC's (WEC) MC&A program meets the requirements of Title 10 of the *Code of Federal Regulations* (10 CFR) Section 70.22, "Contents of applications," and 10 CFR Part 74, "Material Control and Accounting of Special Nuclear Material." Specifically, WEC Columbia Fuel Fabrication Facility (CFFF) is subject to the applicable regulations in 10 CFR Part 74 Subpart B, "General Reporting and Recordkeeping Requirements," and 10 CFR 74.31, "Nuclear material control and accounting for special nuclear material of low strategic significance," which apply to Category III fuel fabrication facilities such as WEC's CFFF. The applicable requirements in Subpart B cover reporting requirements for loss, theft, or attempted theft of SNM (10 CFR 74.11), material status reports (10 CFR 74.13), nuclear material transaction reports (10 CFR 74.15), and physical inventory summary reports (10 CFR 74.17). The requirements in 10 CFR 74.31 cover the specific MC&A program capabilities needed to establish an acceptable MC&A program.

The acceptance criteria used for the review are found in NUREG-1065, "Acceptable Standard Format and Content for the Fundamental Nuclear Material Control (FNMC) Plan Required for Low-Enriched Uranium Facilities" (NRC, 1995).

12.3 STAFF REVIEW AND ANALYSIS

As specified in 10 CFR 70.22(b), an applicant must submit a full description of its program for control and accounting of the SNM in its possession under license to demonstrate how compliance with the requirements in 10 CFR Part 74 will be accomplished. This MC&A program description is provided to the NRC in the form of a fundamental nuclear material control (FNMC) plan.

12.3.1 FUNDAMENTAL NUCLEAR MATERIAL CONTROL PLAN

At the time of the initial submittal of the license renewal application in 2014 (WEC 2014d) the revision of the WEC FNMC Plan was Revision 42, dated August 30, 2012 (WEC, 2012). Revision 42 was approved by the NRC on February 7, 2013. By letter dated December 17, 2018 (WEC, 2018e), WEC submitted Revision 43 of their FNMC Plan. In this letter, the licensee requested that this revision, Revision 43, be approved as a license amendment to their currently approved materials license, SNM-1107. As stated in the December 17, 2018, letter, this revision to the FNMC plan contained changes for the incorporation of several existing safeguards (SG) conditions from the licensee's materials license. In conjunction with the revisions to the FNMC plan, WEC also requested that specific safeguards (SG) conditions be removed from the material license, as they have either expired or been incorporated into the FNMC plan as commitments.

Based on the NRC staff's review and evaluation of the submittal (NRC, 2019b), the NRC staff determined that the revised FNMC plan, Revision 43, dated December 17, 2018, continues to meet the requirements of 10 CFR 74.31, "Nuclear material control and accounting for special nuclear material of low strategic significance," and follows the format and content recommended by NUREG-1065 (NRC 1995). Furthermore, the NRC staff determined the deletion of the specific SG conditions to be acceptable, as the NRC staff verified that they have either expired or been incorporated into the FNMC plan as commitments. Therefore, the NRC amended material license SNM-1107 on December 17, 2018, to incorporate the revised FNMC plan and updated the SG conditions, as discussed in the safeguards evaluation report for the amendment request.

By letter dated July 9, 2019 (WEC, 2019f), WEC submitted page change revisions of the FNMC plan as Revision 44. As described in the July 9, 2019, letter, this revision incorporated several administrative changes which include updates to organization and position names, organization charts, and procedure titles; revision of position responsibilities; and removal of redundant information. WEC further stated that the revision does not decrease the effectiveness of the plan and was processed in accordance with and pursuant to 10 CFR 70.32(c), and therefore did not require NRC approval. For the purposes of the license renewal, the NRC staff reviewed and evaluated the July 2019 submittal. The NRC staff agree that the changes in Revision 44 are administrative in nature and do not decrease the effectiveness of the MC&A program. The NRC staff determined that Revision 44 continues to meet the requirements of 10 CFR 74.31.

12.3.2 MATERIAL LICENSE–SAFEGUARDS CONDITIONS

In accordance with 10 CFR 70.32(c), each license authorizing the use of uranium source material at a uranium enrichment facility or authorizing the use of SNM in a quantity exceeding one effective kilogram must contain a license condition to ensure that such material is adequately controlled and accounted for within the licensed facility. The FNMC plan, Revision 44, ensures that the requirements for MC&A of SNM will be met. Accordingly, the existing license conditions SG-1.1 and SG-1.2 will be retained as follows:

<u>SECTION 1.0–MATERIAL CONTROL AND ACCOUNTING</u>

SG-1.1 The licensee shall follow its "Fundamental Nuclear Material Control Plan for the Columbia Fuel Fabrication Facility," which has been revised as indicated by Revision 44, dated July 9, 2019. Any further revision to this plan shall be made only in accordance with, and pursuant to, either the provisions of 10 CFR 70.32(c) or 70.34.

SG-1.2 Operations involving special nuclear material which are not referenced in the plan identified in Condition SG-1.1 shall not be initiated until an appropriate safeguards plan has been approved by the NRC.

<u>International Safeguards Conditions</u>

WEC is subject to the provisions of 10 CFR Part 75, "Safeguards on Nuclear Material–Implementation of Safeguards Agreements Between the United States and the International Atomic Energy Agency." The purpose of 10 CFR Part 75 is to implement the requirements established by treaties between the United States (U.S.) and the International Atomic Energy Agency (IAEA). These treaties include the agreement between the U.S. and the IAEA for the

Application of Safeguards in the U.S. (Safeguards Agreement) and the Protocol Additional to the Agreement between the US/IAEA for the Application of SG in the U.S. (Additional Protocol). The requirements of 10 CFR Part 75 are to ensure that the U.S. meets its nuclear non-proliferation obligations under these US/IAEA SG treaties. These obligations include providing information to the IAEA on the place of applicant, licensee, or certificate holder activities, information on source and SNMs, and access to the place of applicant, licensee, or certificate holder activities. These obligations are similar to the obligations accepted by other countries.

To implement the above requirements, the license SNM-1107 contains Section 3.0–International Safeguards. The existing SG Conditions, SG-3.1 through SG-3.1.7, will be consolidated as follows:

SECTION 3.0–INTERNATIONAL SAFEGUARDS

SG-3.1 The licensee shall follow all sub-codes within Codes 1 through 8 of the Transitional Facility Attachment No. 5A, dated 2021, to the US/IAEA SG Agreement, as implemented per 10 CFR Part 75. Any further revision to the Transitional Facility Attachment shall be made only in accordance with and pursuant to the provisions of 10 CFR 75.15.

SG-3.2 With respect to Transitional Facility Attachment Code 2.2: Substantive changes to the information provided in the Design Information Questionnaire (DIQ) means those changes requiring amendment of the Transitional Facility Attachment. Such changes shall be provided by letter to the NRC's Office of Nuclear Material Safety and Safeguards in accordance with 10 CFR 75.10(c). Non-substantive changes to the information in the DIQ means those changes not requiring amendment of the Transitional Facility Attachment. Such changes shall be provided by Concise Note (on DOE/NRC Form 740M) at the time that modification is completed.

SG-3.3 Notwithstanding the requirements of 10 CFR 75.35(a) to submit Material Balance Reports on DOE/NRC Form 742, Physical Inventory Listings on DOE/NRC Form 742C and Concise Notes on DOE/NRC Form 740M, the licensee may submit the information specified in 10 CFR 75.35(a) electronically. The electronic submissions must be submitted in the format specified in NUREG/BR-0006 and BR-0007 unless otherwise excepted by license condition.

12.4 EVALUATION FINDINGS

Based on the NRC staff's evaluation discussed above, the NRC staff finds that the facility's MC&A program, as delineated in its approved FNMC plan and related SG conditions, will continue to adequately protect public health and safety and promote the common defense and security during the renewed WEC license term, and is therefore acceptable.

CHAPTER 13 PHYSICAL PROTECTION

13.1 PURPOSE OF THE REVIEW

The purpose of this review was to determine whether the licensee for the Westinghouse Electric Company, LLC (WEC) Columbia Fuel Fabrication Facility has developed and is implementing a physical protection program that meets the applicable requirements in Title 10 of the *Code of Federal Regulations* (10 CFR) Part 73, “Physical Protection of Plants and Materials,” and 10 CFR Part 70, “Domestic Licensing of Special Nuclear Material.” The review is conducted to evaluate whether WEC’s physical protection system provides reasonable assurance that its activities involving the protection of special nuclear material (SNM) are not inimical to the common defense and security and do not constitute an unreasonable risk to public health and safety.

13.2 REGULATORY REQUIREMENTS

The U.S. Nuclear Regulatory Commission (NRC) staff conducted this review to ensure that the WEC Physical Security Plan (PSP) Revision 47 meets the requirements for physical protection of SNM at fixed sites. These requirements include the following regulations:

- 10 CFR 70.22(k)—Physical Security Plan for SNM of Moderate Strategic Significance (Category II quantities of material) and Low Strategic Significance (Category III quantities of material).

- 10 CFR 73.40—Physical Protection: General Requirements at Fixed Sites, requires that the licensee shall provide physical protection at a fixed site, or contiguous sites where licensed activities are conducted, against radiological sabotage, or against theft of special nuclear material, or against both.

- 10 CFR 73.67—Licensee Fixed Site and in-transit requirements for physical protection of special nuclear material of moderate or low strategic significance, requires that the licensee shall establish and maintain a physical protection system.

- 10 CFR 73.71—Reporting of Safeguards Events, requires that the licensee shall notify the NRC Operations Center after discovery of the loss of any shipment of SNM or spent fuel, and after recovery of or accounting for such lost shipment.

Additionally, the NRC issued a series of security orders to fuel cycle facilities following the terrorist attacks of September 11, 2001. In the aftermath of these attacks, the NRC developed security orders containing interim compensatory measures and additional security measures that were applied to existing fuel cycle facilities. The orders contain safeguards information not discussed in this staff evaluation. The NRC staff finds that WEC’s physical security program complies with the additional requirements imposed on WEC by the following orders:

- Interim Compensatory Measures Order, dated February 6, 2003 (NRC, 2003). This order directed WEC to implement changes to the site’s security program.

- Order Imposing Fingerprinting and Criminal Check Requirements for Access to Safeguards Information,” dated March 29, 2007 (NRC, 2007b). This order required WEC to ensure that no person may have access to safeguards information unless that person

has a need-to-know the safeguards information, has been fingerprinted, and has a favorably-decided FBI identification and criminal history records check.

- Order Imposing Fingerprinting and Criminal History Records Check Requirements for Unescorted Access to Radioactive Materia or Other property," dated April 30, 2007 (NRC, 2007c). This order required WEC to ensure that no person may have access to radioactive material unless that person has a favorably-decided FBI identification and criminal history records check.

13.3 STAFF REVIEW AND ANALYSIS

Regulatory Guide 5.59, Revision 1, "Standard Format and Content for a Licensee Physical Security Plan for the Protection of Special Nuclear Material of Moderate or Low Strategic Significance" (NRC, 1983) contains the acceptance criteria the NRC staff used to determine whether WEC meets the applicable 10 CFR Part 73 requirements.

The information to support this review was obtained from the Westinghouse license renewal application and PSP Revision 47. This safety evaluation report (SER) summarizes the contents the PSP without providing specific details because the PSP contain safeguards information.

13.3.1 PHYSICAL PROTECTION AT FIXED SITES

The provisions in 10 CFR 73.40 require that the licensee shall provide physical protection at a fixed site, or contiguous sites where licensed activities are conducted, against radiological sabotage, or against theft of special nuclear material, or against both, in accordance with the applicable sections of Part 73 for each specific class of facility or material license. If applicable, the licensee shall establish and maintain physical security in accordance with security plans approved by the Nuclear Regulatory Commission.

The PSP documents WEC's physical protection program. As discussed more fully below, the NRC staff finds the description of the WEC physical protection program for SNM in the physical security plan meets the applicable sections of Part 73. Therefore, the NRC staff further finds that the PSP meets the requirements of 10 CFR 73.40.

13.3.2 GENERAL PERFORMANCE OBJECTIVES

The provisions of 10 CFR 73.67(a) requires that the licensee shall establish and maintain a physical protection system that will achieve the following objectives: Minimize the possibilities for unauthorized removal of special nuclear material consistent with the potential consequences of such actions, and facilitate the location and recovery of missing special nuclear material. To achieve these objectives, the physical protection system shall provide: Early detection and assessment of unauthorized access or activities by an external adversary within the controlled access area containing special nuclear material, early detection of removal of special nuclear material by an external adversary from a controlled access area, assure proper placement and transfer of custody of special nuclear material, and respond to indications of an unauthorized removal of special nuclear material and then notify the appropriate response forces of its removal in order to facilitate its recovery.

The regulatory requirements in 10 CFR 73.67(a) require that a licensee provide a physical protection system that provides early detection and assessment, assures proper placement and transfer of custody of SNM, and responds to indications of an unauthorized removal of SNM,

including notifying the appropriate response forces of its removal in order to facilitate its recovery. The NRC staff has reviewed the licensee's description of the physical protection of SNM in Chapter 1 of the PSP and finds that it provides adequate measures for early detection and assessment, procedures detailing the proper placement and transfer of custody of SNM, and response to indications of an unauthorized removal of SNM, including notifying the appropriate response forces of its removal in order to facilitate its recovery. Accordingly, the NRC staff has determined that Chapter 1 meets the requirements of 10 CFR 73.67(a).

13.3.3 PHYSICAL SECURITY PLAN

The provisions of 10 CFR 73.67(c) require the licensee to submit a security plan or an amended security plan describing how the licensee will comply with all the requirements of paragraphs (f) and (g) of Section 73.67, as appropriate, including schedules of implementation. The licensee shall retain a copy of the effective security plan as a record for 3 years after the close of period for which the licensee possesses the special nuclear material under each license for which the original plan was submitted. Copies of superseded material must be retained for three years after each change. Within 30 days after the plan submitted pursuant to Section 73.67(c)(1) is approved, or when specified by the NRC in writing, the licensee shall implement the approved security plan.

WEC continues to submit PSP revisions over time as needed. For changes that decrease the effectiveness of the PSP, WEC must follow the requirements in 10 CFR 70.34 and submit a license amendment application. If WEC's changes do not decrease the effectiveness of the PSP, then the licensee has to submit a report within 60 days of the change to NRC consistent with 10 CFR 70.32(e). A revised copy of the PSP does not need to accompany the report. The latest version, Revision 47, reflects changes to the security program to date. Chapter 1 states that a copy of the effective plan will be retained as a record for 3 years after the close of the period for which WEC possesses SNM under its license. A copy of superseded plans will be retrained as a record for 3 years after each change. Accordingly, the NRC staff has reviewed the licensee's description of the physical protection of SNM in Chapter 1 of the PSP and finds that it meets the requirements of 10 CFR 73.67(c).

13.3.4 PHYSICAL PROTECTION MEASURES AND CONTROLLED ACCESS AREA

The provisions of 10 CFR 73.67(f) require that the licensee: (1) store or use the material only within a controlled access area, (2) monitor with an intrusion alarm or other device or procedures the controlled access areas to detect unauthorized penetrations or activities, (3) assure that a watchman or off-site response force will respond to all unauthorized penetrations or activities, and (4) establish and maintain response procedures for dealing with threats of thefts or thefts of this material. The licensee shall retain a copy of the current response procedures as a record for three years after the close of period for which the licensee possesses the special nuclear material under each license for which the procedures were established. Copies of superseded material must be retained for three years after each change.

The NRC staff has reviewed the licensee's description of the physical protection of SNM in Chapter 4 of the PSP and finds that it adequately describes the controlled access area. The NRC staff has reviewed the licensee's description of the physical protection of SNM in Chapters 5 and 6 of the PSP and finds that they adequately describe the monitoring of the controlled access area. The NRC staff has reviewed the licensee's description of the physical protection of SNM in Chapters 3 and 5 of the PSP and finds that they adequately describe the response

force. The NRC staff has reviewed the licensee's description of the physical protection of SNM in Chapter 5 of the PSP and finds that it adequately describes the response procedures. Accordingly, the NRC staff determined that Chapters 3, 4, 5, and 6 meet the requirements of 10 CFR 73.67(f), including having and adequately monitoring the controlled access area and having an adequate response force and procedures.

13.3.5 TRANSPORT AND RECEIVE MATERIAL

The provisions of 10 CFR 73.67(g)(1) and (2) require that a licensee that transports or receives material, including material for export or import shall: notify and confirm shipment and receipt of material, transport the material in a tamper indicating sealed container, check the integrity of the containers and seals prior to shipment, and arrange for the in-transit physical protection of the material. The provisions of 10 CFR 73.67(g)(3) require that the licensee shall: establish and maintain response procedures for dealing with threats or thefts of the material. The licensee shall retain a copy of the current response procedures as a record for 3 years after the close of period for which the licensee possesses the special nuclear material under each license for which the procedures were established. Copies of superseded material must be retained for three years after each change. The licensee shall make arrangements to be notified immediately of the arrival of the shipment at its destination, or of any such shipment that is lost or unaccounted for after the estimated time of arrival at its destination and conduct immediately a trace investigation of any shipment that is lost or unaccounted for after the estimated arrival time and notify the NRC Operations Center within 1 hour after the discovery of the loss of the shipment and within 1 hour after recovery of or accounting for such lost shipment in accordance with the provisions of 10 CFR 73.71.

The regulatory requirements in 10 CFR 73.67(g) require that a licensee notify and confirm shipment and receipt of material; transport the material in a tamper indicating sealed container, check the integrity of the containers and seals prior to shipment; arrange for the in-transit physical protection of the material; and establish and maintain response procedures for dealing with threats or thefts of the material. The NRC staff has reviewed the licensee's description of the physical protection of SNM in Chapter 7 of the physical security plan and finds that it provides adequate measures to notify and confirm shipment and receipt of material; transport the material in a tamper indicating sealed container, check the integrity of the containers and seals prior to shipment; arrange for the in-transit physical protection of the material; and establish and maintain response procedures for dealing with threats or thefts of the material. Accordingly, the NRC staff determined that it meets the requirements of 10 CFR 73.67(g).

13.3.6 REPORTING OF SAFEGUARDS EVENTS

The provisions of 10 CFR 73.71(a) require that the licensee shall notify the NRC Operations Center within 1 hour after discovery of the loss of any shipment of SNM or spent fuel, and within 1 hour after recovery of or accounting for such lost shipment. Additionally, Section 73.71(b) require that the licensee shall: (1) notify the NRC Operations Center within one hour of discovery of the safeguards events described in paragraph I(a)(1) of Appendix G to Part 73, and (2) this notification must be made in accordance with the requirements of 10 CFR 73.71(a)(2)–(5).

The regulatory requirements in 10 CFR 73.71 require that a licensee notify the NRC Operations Center of certain safeguards events. The NRC staff has reviewed the licensee's description of the physical protection of SNM in Chapters 6 and 7 of the PSP and finds that it provides adequate measures to notify the NRC Operations Center as a result of the specified safeguards

events. Accordingly, the NRC staff finds that Chapters 6 and 7 meet the requirements of 10 CFR 73.71.

13.3.7 INTERIM COMPENSATORY MEASURES ORDER

The provisions of the Interim Compensatory Measures Order, dated February 6, 2003, is "Safeguards Information" and is therefore withheld from public disclosure pursuant to 10 CFR 73.21.

The NRC staff has reviewed the licensee's description of the physical protection of SNM in Chapters 3, 4, 5, and 6 of the PSP and finds that it meets the requirements of the Interim Compensatory Measures Order, dated February 6, 2003.

13.4 EVALUATION FINDINGS

For the reasons set forth above, the NRC staff finds that the physical security program, described in PSP Revision 47, satisfies the performance objectives, systems capabilities, and reporting requirements specified in 10 CFR 70.22(k), 73.40, 73.67, 73.71, and the Interim Compensatory Measures Order. Therefore, NRC staff finds that the WEC physical security program is acceptable and meets the applicable requirements for the physical protection of SNM of low strategic significance.

CHAPTER 14 AUTHORIZATIONS AND EXEMPTIONS

14.1 PURPOSE OF REVIEW

The U.S. Nuclear Regulatory Commission (NRC) staff conducted this review to determine whether the authorizations and exemptions described in Westinghouse Electric Company, LLC (WEC) license renewal application (LRA) will ensure that the facility will operate in such a manner to protect health and minimize danger to life or property. The NRC staff reviews the LRA to ensure that the authorizations and/or exemptions already granted by the NRC are clearly discussed and described.

14.2 REGULATORY REQUIREMENTS

The NRC may authorize an activity or grant an exemption from a regulatory requirement, acting on its own initiative or by an application from a licensee. The NRC's regulations address requests for exemptions which are relevant to the Columbia Fuel Fabrication Facility (CFFF), Title 10 of the *Code of Federal Regulations* (10 CFR) 19.31, "Application for exemptions"; 10 CFR 20.2301, "Applications for exemptions"; and 10 CFR 70.17, "Specific exemptions". In addition, a license application should clearly describe any exemptions or authorizations of an unusual nature in accordance with 10 CFR 70.22, "Contents of applications."

14.3 STAFF REVIEW AND ANALYSIS

The NRC staff used the acceptance criteria in Section 1.2.4.3.5 of NUREG-1520, Revision 1, "Standard Review Plan for Fuel Cycle Facilities License Application" (NRC, 2010a) for this review. The staff evaluated the LRA, the current license, previous license amendments, and the licensee's responses to the staff's requests for additional information (RAIs).

14.3.1 AUTHORIZATIONS

14.3.1.1 Authorization to Make Changes to License Commitments

In Section 12.1.1 of the LRA, WEC requested authorization to make changes to license commitments in the LRA. The change process for fuel cycle facilities is described in the NRC Regulatory Guide (RG) 3.74, "Guidance for Fuel Cycle Facility Change Processes" (NRC, 2012a). The NRC staff reviewed the LRA and WEC's criteria for making changes and determined the criteria ensure the changes do not result in a degradation in safety, comply with applicable regulatory requirements, and do not conflict with existing license conditions. The NRC staff also determined that the process for making changes is consistent with NRC's guidance in RG 3.74, is in accordance with 10 CFR 70.72, "Facility changes and change process," and should be submitted in accordance with 10 CFR 70.21, "Filing." The NRC staff is including the following license condition in the license.

S-4 Westinghouse may make changes to the license application without prior NRC approval provided the change meets the following provisions:

- The change does not decrease the effectiveness of the safety program commitments in the license application;
- The change does not result in a departure from the safety program evaluation methods described in the license application;

  - The change satisfies the performance requirements of 10 CFR 70.61 (i.e., the change does not result in a degradation of safety);
  - The change does not affect compliance with applicable regulatory requirements; and
- The change does not conflict with an existing license condition.

Records of such changes shall be maintained, including justification and management approval.

Within 6 months after each change is made, WEC shall submit the revisions to the LRA to the Director, Nuclear Material Safety and Safeguards, using an appropriate method listed in 10 CFR 70.5, with a copy to the appropriate NRC regional office.

14.3.1.2 Leak-testing Sealed Plutonium Sources

In Section 12.1.2, "Authorization for Leak-Testing Sealed Plutonium Sources," of the LRA, WEC requested re-approval of procedures for leak-testing sealed plutonium sources. The WEC provided the alternative leak test criteria and survey and monitoring procedures in the final revision to its application for license renewal dated April 30, 1995 (WEC, 1995). The leak test procedures were approved as an alternative to the survey and monitoring requirements in 10 CFR 20.1501, in the license renewal granted November 3, 1995 (NRC, 1995a). Semi-annual leak-testing is required on plutonium sources that are in use but is not required for sealed plutonium sources in storage. The leak test must be capable of detecting to the stated limit of 0.005 microcurie of removable contamination on the test sample. The licensee must maintain records of leak-tests as required in 10 CFR 20.1501(b). The NRC will be notified if stated leak test limits are exceeded as committed to in Section 12.1.2 of the LRA.

The alternative procedure is consistent with the established NRC staff position in Branch Technical Position: "License Condition for Leak-Testing Sealed Byproduct Material Sources," (NRC, 1993c), which states that the 6-month periodic leak test does not apply to sealed sources that are stored and not being used. Therefore, the NRC staff finds the special authorization for leak-testing sealed plutonium sources by alternative procedures is consistent with NRC guidance. The staff confirms alternative procedures provide reasonable assurance that the survey and monitoring methods are as protective as the requirements in 10 CFR 20.1501 and therefore the authorization is approved.

14.3.1.3 Possession at Reactor Sites

The LRA requested authorization to possess unirradiated fuel assemblies, at nuclear reactor facilities anywhere within the United States, for the purpose of loading the assemblies into shipping packages. The WEC asked for authorization to deliver to an authorized carrier for transport in accordance with regulatory requirements in 10 CFR part 71, "Packaging and transportation of radioactive material." WEC is responsible for handling the special nuclear material under the conditions of its license until the fuel assemblies containing special nuclear material are transferred to and accepted by a power reactor. Once the licensee of a nuclear reactor accepts the unirradiated fuel assemblies the material is regulated under the power reactor license.

The LRA stated that fuel assemblies while in WEC possession are not required to implement a criticality monitoring system under 10 CFR 70.24(a) because the fuel assemblies are subject to the reactor licensee's criticality monitoring program.

WEC must ensure the conditions in the LRA Section 12.1.3 are met. These include maintaining the material in a constrained arrangement that is no more reactive than in the shipping package, ensuring that the fuel assemblies do not exceed the maximum authorized contents of the packaging, ensuring that the reactor site licensee maintains appropriate spacing between packages, ensuring that packages are stored in an approved configuration, and ensuring that the number of packages do not exceed a single shipment.

This authorization is necessary because WEC will possess the fuel at its customer reactor sites during loading and transfer to an authorized shipper, prior to return of the unirradiated fuel to the CFFF, in the case where the fuel assemblies are not accepted by the reactor licensee. The reactor site receiving fuel from WEC will either have a criticality accident alarm system (CAAS) that complies with 10 CFR 70.24(a) or it must meet the requirements of 10 CFR 50.68(b). The provisions in 10 CFR 50.68(b) provide reactor licensees with an alternative to maintaining a CAAS and a monitoring system capable of detecting a criticality as required under 10 CFR 70.24. or reactor licensees during fuel handling and storage operations. Since WEC's repackaging occurs at the reactor's fuel handling and storage operations area, WEC stated in 12.1.3 of the LRA that it is electing to operate under the criticality requirements applicable to reactors, consistent with the requirements in 10 CFR 70.24(d)(2). Fuel assemblies under the possession of WEC at a reactor site, will be subject to the reactor's CAAS or radiation monitors must be present that meet the alternative requirements in 10 CFR 70.68(b). The fuel will be handled and stored in a configuration that is no more reactive than when in its shipping packages.

WEC is authorized to possess unirradiated new fuel at reactor sites and at CFFF for the purpose of loading and storage of fresh reactor fuel prior to shipment in approved shipping containers, subject to the requirements for fissile material packages in 10 CFR 71.55. These packaging requirements provide a large safety margin and reasonable assurance that subcriticality will be maintained in transport. Individual fuel assemblies, or small arrangements of properly spaced multiple assemblies are designed to be subcritical when flooded with water. However, the likelihood of flooding fresh fuel assemblies during loading is extremely small. Furthermore, fresh fuel assemblies are subcritical when dry. Due to the design and fixed configuration of the fuel and the commitments related to its arrangement during handling, the likelihood of criticality is extremely remote. In the very unlikely event of accidental criticality, emergency response will be initiated by the reactor licensee's CAAS or the radiation monitors required under 10 CFR 50.68.

Therefore, the NRC is confirming the licensee's authorization to possess unirradiated fuel assemblies, at nuclear reactor facilities anywhere within the United States, for the purpose of loading or unloading the assemblies into or from shipping packages, and delivery to an authorized carrier for transport in accordance with regulatory requirements and the license. The staff finds the authorization described in LRA Section 12.1.3 provides adequate protection of public health and safety.

14.3.1.4 Transfers as Non-regulated Material under 10 CFR 20.2002

In Section 12.1.4 of the LRA, WEC requested NRC's approval to continue the authorization for the transfer and release of industrial waste treatment products, such as calcium fluoride and other homogeneous mixtures with mean concentrations of uranium constituents that do not exceed 1.11 Becquerel (Bq)/g (30 pCi/g) and contain a minimum of 60 percent solids, under 10 CFR 20.2002, "Method for obtaining approval of proposed disposal procedures." These materials are generated during licensed fuel fabrication processes performed at CFFF.

Currently, the authorization allows these materials to be released for off-site calcium fluoride drying and briquette manufacturing, cement or brick manufacturing, or for disposition at a chemical disposal site or industrial landfill without continuous NRC licensing controls. The current approval of these transfers stipulates efforts shall be made to reduce the radioactive contents of all such material to ALARA. To satisfy these requirements, a sampling plan would be implemented to characterize the materials being transferred.

WEC stated in Section 12.1.4 of the LRA that its sampling plan shall be implemented to characterize the industrial products in accordance with methods identified acceptable in NUREG/CR-2082, “Monitoring for Compliance with Decommissioning Termination Survey Criteria” (NRC,1993d), as follows:

- The estimation of the population mean for uranium concentration shall be representative of the industrial products being transferred;
- The sample size used to calculate the mean uranium concentration value shall be determined such that the 95 percent confidence limit for the value is less than 25 percent of the value;
- The sampling plan is to provide a minimum confidence level of 95 percent that the true mean uranium concentration value, determined for the industrial to be transferred, is less than the maximum permissible limit of 30-picocuries per gram of dry material; and
- Records pertaining to the release of such materials, including identities of receivers, shall be maintained for review by NRC staff.

In assessing WEC’s request, the staff evaluated a 1992 environmental assessment prepared for similar disposals proposed by Allied-Signal, Inc., that entailed using calcium fluoride generated from fuel cycle operations to make briquettes for use in the steel industry (NRC, 1992). The dose assessment in the staff’s 1992 EA assumed that the natural uranium concentration in the calcium fluoride was 3.89 Bq/g (105 pCi/g), which is more than three times the 1.11 Bq/g (30 pCi/g) uranium concentration permitted in the previous authorization granted to WEC. The EA evaluated doses for a critical group of workers that included truck drivers that transported the calcium fluoride to the loading dock, from the dock to the briquette plant, and from the briquette plant to the steel mill, as well as clamshell derrick operators that loaded and unloaded the calcium fluoride from the barges and the briquette plant operator. Doses ranged from 5.2E-7 sieverts per year (Sv/yr) (5.2E-2 mrem/yr) to the truck driver transporting the material from Allied-Signal to the dock to 7.6E-6 Sv/yr (7.6E-1 mrem/yr) to the briquette plant operator. The collective dose for the entire process was calculated to be 1.6E-5 Sv/yr (1.6 mrem/yr). The doses to the individual workers as well as the collective dose to the entire group fit within the criteria of “a few mrem.” The staff finds it reasonable to assume doses to workers associated with making briquettes using calcium fluoride from WEC would be less.

In addition to the 1992 environmental assessment, the NRC staff also considered doses associated with a bounding disposal analysis for a 10 CFR 20.2002 request approved by the NRC in 2022. The approval authorized a total annual volume of 11,327 m^3 (400,000 ft^3) of calcium fluoride sludge dredged from the onsite lagoons along with other waste materials to be disposed at the USEI RCRA Subtitle C disposal facility located near Grand View, Idaho (NRC, 2022). The largest dose to the workers involved in these disposal activities were associated with the landfill cell operators and were also found to be less than “a few mrem.”

Based on a review of the 1992 EA, which evaluates similar calcium disposal actions to what WEC proposed to continue in Section 12.1.4 of the LRA, and the 10 CFR 20.2002 approval authorizing the disposal of calcium fluoride sludge at USEI, staff finds it acceptable to continue the previously approved transfer of materials containing calcium fluoride and other homogeneous mixtures with mean concentrations of uranium not to exceed 1.11 Bq/g (30 pCi/g). As noted above, doses associated with these actions would not be expected to exceed "a few mrem," consistent with Commission policy initially provided in Regulatory Issue Summary (RIS) 2004-08, "Results of the License Termination Rule Analysis" (NRC, 2004), and reaffirmed in SECY-07-0060, "Basis for Justification and Approval Process for 10 CFR 20.2002 Authorizations and Options for Change" (NRC, 2007a).

WEC did not request the continuation of a previous authorization that allowed the transfer of hydrofluoric acid containing trace quantities of uranium, in accordance with 10 CFR 20.2002. WEC notified the NRC in a letter dated March 22, 2017, that this activity is no longer performed at CFFF (WEC, 2017b). Therefore, this authorization is no longer in effect.

14.3.1.5 Release of Contaminated Records

Section 12.1.5 of the LRA documented the existing licensed activity permitting WEC to abandon or dispose of certain papers, notebooks, computer printouts, films, and/or similar items previously retained for record purposes that are contaminated with small quantities of radioactive material in accordance with 10 CFR 20.2002. As noted in the LRA, no licensed controls are required for final dispositioning of these materials and the materials may be comingled with other similar documents found not to contain radioactive materials provided that:

- Prior to transfer from contamination control areas at the licensed facility, a documented survey instrument measurement shall conclude that the following limits are not exceeded: Average uranium-alpha contamination concentration of 220 disintegrations per minute (dpm) per 100 square centimeters (cm^2). Average beta-gamma contamination of 660 dpm per 100 cm^2.

- Such contaminated records shall be kept in locations that are used primarily for record storage and/or disposal.

The release criteria above are based on acceptable industry practices. In addition, these release criteria are below the surface contamination levels approved for uncontrolled release, as described in Regulatory Guide 8.24, "Health Physics Surveys During Enriched Uranium-235 Processing and Fuel Fabrication," Section 1.7, "Surveys of Equipment, Premises, or Scrap before Release for Uncontrolled Use" and Appendix A, "Acceptable Surface Contamination Levels" (NRC, 2012c).

The NRC staff first reviewed and approved these procedures in the November 3, 1995 (NRC, 1995a) license renewal and subsequent renewals. The processes approved for the release of contaminated records continues to be performed in accordance with 10 CFR 20.2002. The NRC staff finds these procedures to survey and dispose of contaminated records, under the specified conditions, is consistent with NRC guidance and complies with the NRC's regulations at 10 CFR 20.2002. Therefore, the staff finds the procedures provide adequate protection of public safety and the environment and reauthorizes their use.

14.3.1.6 Release for Unrestricted Use

In Section 12.1.6 of the LRA, WEC requested continuation of the authorization granted in accordance with 10 CFR 20.2002, allowing licensed material and equipment to be released from contamination areas onsite to clean areas onsite, or from onsite possession or use to unrestricted possession or use offsite, provided such releases are subject to all applicable conditions of the NRC Staff's April 1993 Branch Technical Position, "Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of License for Byproduct, Source, or Special Nuclear Material" (NRC, 1993b).These guidelines are referenced in the standard review plan (NRC, 2010a) as an acceptable method of demonstrating compliance with the radiation survey and monitoring requirements in 10 CFR Part 20. The staff finds the method is still acceptable. Accordingly, a continuation of the approval is granted for the renewal period.

14.3.2 EXEMPTIONS

14.3.2.1 Use of ICRP 68 as an Alternative to Appendix B of 10 CFR Part 20

In Section 12.1.7 of the LRA, WEC requested continued authorization to use values for derived-air concentration (DAC) and annual limit on intake (ALI) based on the dose coefficients published in International Commission on Radiological Protection (ICRP) Publication No. 68 (ICRP, 1994). In 2002 WEC was granted an exemption under 10 CFR 20.2301 from the annual limits of intake DAC and derived ALI values of radionuclides for occupational exposures; effluent concentrations; concentration for release to sewage in Appendix B of 10 CFR Part 20 (NRC, 2002). The NRC staff granted WEC authority to use the ICRP 68 values because they provide adequate protection of the workers.

Although WEC characterized the current request to continue the use of ICRP 68 as an authorization, the staff determined it was an exemption from 10 CFR Part 20, Appendix B. The NRC staff reviewed the request as an exemption that substitutes the methodology in 10 CFR Part 20, Appendix B for assessing the internal dose to workers with the method recommended by the ICRP.

In Staff Commission Paper SECY-99-077 (NRC, 1999), the NRC staff recommended granting exemptions to allow the use of equivalent quantities calculated using internal dosimetry models as described in ICRP 68. In the Staff Requirements Memorandum for SECY-99-077 (NRC, 1999a), the Commission approved the granting of exemptions from portions of 10 CFR Part 20, Appendix B, on a case-by-case basis. The NRC staff authorized the use of the ICRP methodology for calculating occupational exposures in letters of October 15, 2001 (WEC, 2001) and April 26, 2002 (NRC, 2002). As part of the grant of the WEC license renewal in 2007, the NRC staff granted WEC an exemption from the requirement to calculate occupational exposures under 10 CFR Part 20, Appendix B (NRC, 2007e).

The staff evaluated the current exemption request and continues to find that the alternative DAC and ALI values listed in ICRP 68 for occupational dose assessments to be equivalent to the requirements in 10 CFR 20, Appendix B and 10 CFR 20.1201(d). The staff finds that the alternative occupational dose limits provide reasonable assurance that workers will be adequately protected. This exemption is in accordance with the ALARA principle, international standards on radiation protection, and does not conflict with established NRC dose limits. No new accident precursors are created by this exemption to allow modification to the values used to assess internal dose. There is no significant increase in the risk to workers or members of the

public as a result of this exemption. The alternative DAC and ALI values were published by an internationally recognized organization and provides more accurate values using updated internal dosimetry values. Therefore, the NRC staff grants WEC an exemption from Appendix B of 10 CFR Part 20, Appendix B, requiring stated DAC and ALI values.

The NRC staff concludes that the activities to be authorized by the issuance of this exemption are in compliance with law and will not endanger life or property or the common defense and security. Accordingly, the NRC staff hereby grants WEC an exemption from the 10 CFR 20 Appendix B requirements for occupational exposures be specified in terms of DAC or ALI and authorizes the calculation of exposures be made in terms of dose in accordance with ICRP Publication No. 68.

14.3.2.2 Individual Container Posting

Paragraph 20.1904(a) of 10 CFR requires a licensee to ensure that each container of licensed material bears a durable, clearly visible label bearing the radiation symbol and the words "CAUTION, RADIOACTIVE MATERIAL" or "DANGER, RADIOACTIVE MATERIAL." The label must also provide sufficient information (such as the radionuclide[s] present, an estimate of the quantity of radioactivity, the date for which the activity is estimated, radiation levels, kinds of materials, and mass enrichment) to permit individuals handling or using the containers, or working in the vicinity of the containers, to take precautions to avoid or minimize exposures.

In Section 12.2.2 of the LRA, WEC requested an exemption from the requirement that “each container of licensed material bears a durable clearly visible label” provided, in lieu thereof, a sign bearing the legend “EVERY CONTAINER OR VESSEL IN THIS AREA MAY CONTAIN RADIOACTIVE MATERIAL” is posted at each entrance to areas for buildings in which radioactive materials are used or stored, from areas in which such materials are not used or stored. Regarding storage of radioactive material outside the Fuel Manufacturing Building, the number of posted buildings and size of posted areas shall be minimized to the extent practicable, consistent with manufacturing and storage requirements.

The NRC staff continued to authorize this exemption on November 3, 1995 (NRC, 1995a). The licensee has employed these alternative signage and labeling practices approved in 2007 without negative effects to workers or harm to the public health and safety during the past 12 years. The exemption is consistent with industry practice. The NRC staff evaluated the exemption using the requirements in 10 CFR 20.2301. Section 20.2301 of 10 CFR states that the NRC “may, upon application by a licensee or upon its own initiative, grant an exemption from the requirements of the regulations in this part if it determines the exemption is authorized by law and would not result in undue hazard to life or property.” The alternative is an offset of the requirement for individual container labels in that the entrances to an area of containers is posted with the same information. The alternative remains in effect as long as the entrances to the areas are posted with the above-mentioned information.

The NRC staff re-evaluated the WEC’s proposed alternative activities to determine whether they provide reasonable assurance of adequate protection of public safety. Although 10 CFR 20.1904(a) requires that each container of licensed material bears a durable, clearly visible label containing the radiation symbol and specified warnings, the NRC finds the WEC’s alternative means of complying with 10 CFR 20.1904(a). The NRC finds the posting of signs at the entrances to an area with containers holding NRC-licensed material, provides adequate protection. The NRC approves this alternative as long as the entrances to the areas of containers are posted and the number of posted buildings and size of posted areas are

minimized to the extent practical. For these reasons, the NRC staff determined the exemption is authorized by law and will not result in undue hazard to life or property.

14.3.2.3 Criticality Monitoring System Requirements

Section 70.24 of 10 CFR requires a licensee authorized to possess special nuclear material (SNM) in stated amounts to maintain in each area in which such licensed SNM is handled, used, or stored, to employ a CAAS meeting the stated requirements. In LRA Section 12.2.3, WEC requested an exemption from CAAS requirements in 10 CFR 70.24 for areas such as offices, conference rooms, laboratories, machine shops, etc., provided such areas are remote from other operations involving SNM and are administratively limited to 1000 g U-235 (and for labs, 5 g U-233). The licensee stated that “remote areas” are those that are neutronically isolated from other areas to ensure that mass limits are not exceeded. This criterion is applicable to the need for detector placement. Based on the acceptability of the criteria for neutron isolation (discussed in Section 6.4.2.5 of this SER), this ensures such areas will remain subcritical under normal and credible abnormal conditions. For uranium metal and oxide enriched to no more than 5 wt% U-235, the minimum critical mass exceeds 1000 g U-235. With regard to alarm placement, the licensee stated that remote areas are those areas in which the maximum absorbed dose does not exceed an “excessive radiation dose.” This is defined in ANSI/ANS-8.3-1997 as 12 rad of combined neutron and gamma radiation. The NRC has endorsed, with some exceptions, ANSI/ANS-8.3-1997 (ANS, 1997a) (as discussed in Section 6.3.2.1 of this SER). This includes the provision in Section 6.4 of the standard that criticality alarm signals be functional throughout all areas where personnel could be subject to an excessive radiation dose of 12 rad. With regard to both detector and annunciator placement, this treatment of the radiation dose meets the standards in ANSI/ANS-8.3-1997 and is acceptable. Based on its review above, the NRC staff concludes that the activities to be authorized by the issuance of this exemption are in compliance with law and will not endanger life or property or the common defense and security. Additionally, granting an exemption from the requirement for a CAAS this location listed above represents a savings in cost and occupational exposure required to install, maintain, and calibrate the systems. Furthermore, lowering the risk of a criticality event from the affected areas allows persons who are not trained in emergency procedures to enter without such training, because they would not have to be qualified radiation workers. Therefore, the staff also concludes that the exemption for this area is in the public interest.

In addition, LRA Section 12.2.3 requested to continue an exemption from CAAS requirements for low concentration storage areas, for containers having no more than 350 g U-235 per package with no more than 5 g U-235 in any 10 liters, or no more than 50 grams U-235 with an average of 5 g U-235 in any 10 liters of package. The areas to which these criteria are applied are neutronically isolated. The licensee noted that the minimum infinite sea concentration is 11.6 g U-235 per liter, as documented in ANSI/ANS-8.1-1998. The above 5 g U-235 per 10 liters corresponds to an average of 0.5 g U-235 per liter, which is more than a factor of 20 below the minimum critical concentration of 11.6 g U-235 per liter. To achieve a critical concentration would therefore require a concentration by at least this factor. However, the limitation of packages to less than 350 g U-235 each (which is approximately half of the minimum critical mass) precludes a sufficient mass from coming together to allow criticality. Even if several neighboring packages each contained the maximum 350 g U-235, it would be very unlikely for all the material to be concentrated into a compact arrangement in each package, and for the mass in several neighboring packages to be located adjacent to one another, so as to form in excess of a critical mass among the various packages. Similarly, the staff considers it very unlikely for multiple packages to leak their contents, and for the leaked material then to be

concentrated and assembled in such a way as to form a critical mass. To accumulate 350 g of U-235 mass in a single container, given the 5 g U-235 limit in 10 contiguous liters, would require a very large volume, inherently limiting the potential for neutron interaction. Therefore, the staff has determined that the potential for criticality in packages with these masses and concentration limits will not result in undue hazards to life or property. Based on its review above, the NRC staff concludes that the activities to be authorized by the issuance of this exemption are authorized by law and will not endanger life or property or the common defense and security. Additionally, granting an exemption from the requirement for a CAAS in the locations listed above represents a savings in cost and occupational exposure required to install, maintain, and calibrate the systems. Furthermore, lowering the risk of a criticality event from the affected areas allows persons who are not trained in emergency procedures to enter without such training, because they would not have to be qualified radiation workers. Therefore, the staff also concludes that the exemption for this area is in the public interest.

Finally, in LRA Section 12.2.3, WEC requested an exemption from CAAS requirements for storage areas in which the only SNM present is in authorized packages as defined in 49 CFR Part 173. WEC provided that the maximum number of containers permitted in each area shall be unlimited for low specific activity packages, and the maximum number of fissile packages in each area must be limited to a criticality safety index (CSI) of 100, with 20 feet (6 meters) between areas. Section 173.403 of 49 CFR defines low specific activity packages as those that do not contain fissile material or are fissile exempt under 49 CFR 173.453. This material has been determined to be exempt from all requirements for the transport of fissile material, thereby justifying the storage of unlimited numbers of such low specific activity containers. The licensee states that the CSI exemption is justified based on the requirements of 49 CFR 176.704(e). As with the exemption for low specific activity packages, this exemption applies to Class 7 non-fissile or fissile exempt packages. The CSI is determined as specified in 10 CFR 71.22, 71.53 (if applicable), and 71.59. The staff notes that these exemptions are consistent with the transportation regulations of 49 CFR Parts 173 and 176, and 10 CFR Part 71. Those packages that these regulations are applied to are either non-fissile or fissile exempt, meaning they are considered to be of very low risk of inadvertent criticality. The transportation requirements serve to limit SNM quantities to shipping configurations, thus providing limitations on geometry and interaction of fissile material. Therefore, the NRC has granted exemptions to 10 CFR 70.24 for areas involving SNM quantities in excess of those in 10 CFR 70.24(a), but in which the material is stored in accordance with transportation requirements. Based on the low inherent risk of criticality with such materials, the staff has determined that the potential for criticality involving these materials is very low and therefore will not result in undue hazards to life or property. Additionally, granting an exemption from the requirement for a CAAS in each of the locations listed above represents a savings in cost and occupational exposure required to install, maintain, and calibrate the systems. Furthermore, lowering the risk of a criticality event from the affected areas allows persons who are not trained in emergency procedures to enter without such training, because they would not have to be qualified radiation workers.

Based on its review above, the NRC staff concludes that the activities to be authorized by the issuance of this exemption are in compliance with law and will not endanger life or property or the common defense and security.

14.3.2.4 Physician Approval to Use Respiratory Protection Equipment

Section 20.1703(c)(5) of 10 CFR requires a determination by a physician that the individual user is medically fit to use respiratory protection equipment before the initial fitting of a face sealing respirator, before the first field use of non-face sealing respirators, and either every 12 months thereafter, or periodically at a frequency determined by a physician.

The WEC requested an exemption from these requirements and proposed to use a licensed health care professional to determine the medical fitness of personnel at the CFFF to use respiratory protection equipment. The respiratory protection program would be designed by, and under the supervision of, a physician. Though the physician need not administer each evaluation personally, the physician would approve all WEC staff to be included in the respiratory protection program. The physician would be involved in the supervision of the fitness program, the review of overall results, individual cases that fall outside certain predetermined parameters, and supervision of personnel performing the tests.

By letter dated July 18, 2014 (WEC, 2014a), WEC submitted a request for exemption from the requirements of 10 CFR 20.1703(c)(5). By letter dated December 12, 2014 (NRC, 2014b), the NRC granted the exemption, and allowed WEC to have the determination of the fitness of an employee to use respiratory protection to be made by a licensed health nurse practitioner. WEC's procedures provide that a licensed nurse practitioner may make the determination that a person is medically fit to use respiratory protection equipment under the condition that the respiratory protection program is under the oversight of a physician and that the physical evaluations are performed at the CFFF. In the Statement of Considerations published in the *Federal Register* when the applicable portions of Part 20 were revised (64 FR 54548) (NRC, 1999b), the U.S. Nuclear Regulatory Commission (NRC) repeated that its position remained consistent with Regulatory Guide 8.15: "…The established NRC position, as described further is Reg. Guide 8.15, continues to be that a licensed health care professional can administer a medical exam…" (NRC, 1999c).

In addition, the concurrent requirements of the Occupational Safety and Health Administration (OSHA) listed in 29 CFR 1910.134(e)(2)(i) allows a "…physician or other licensed health care professional to perform medical evaluations…."

The NRC staff concludes that granting this exemption is authorized by law and would not result in undue hazard to life or property. Accordingly, the NRC staff hereby grants WEC an exemption from the 10 CFR 20.1703(c)(5) requirement that determination of fitness for respirator wearers be determined by a physician, and WEC commits to use a nurse practitioner under the supervision of a physician to make this determination.

The grant of this exemption to allow a licensed health care professional to determine the medical fitness of personnel at the CFFF to use respiratory protection equipment is also stated in License Number SNM-1107 as License Condition S-9.

14.3.2.5 Exemptions Authorizing Alternative Disposals of Licensed Materials

Section 14.3.1.4 of this SER documents an existing authorization under 10 CFR 20.2002, "Method for obtaining approval of proposed disposal procedures," currently included in the WEC license allowing for the transfer of specific industrial waste treatment products from licensed activities, such as calcium fluoride and other homogenous mixtures, and the basis for its

approval for this license renewal. Since the issuance of the WEC's 2007 license renewal, the staff approved additional 10 CFR 20.2002 alternate disposal requests and issued WEC corresponding exemptions from 10 CFR 70.3, "License requirements," and 10 CFR 30.3, "Activities requiring license," on a case-by-case basis, allowing specific materials to be disposed of at USEI.

On May 8, 2020, WEC submitted an alternate disposal request in accordance with 10 CFR 20.2002 and exemptions from the requirements in 10 CFR 30.3 and 70.3 in order to dispose of specific waste containing special nuclear material and byproduct material at USEI (WEC, 2020d). The material was associated with the East Lagoon, including the liner and soils excavated from below the liner, solid calcium fluoride sludge previously dredged from the Calcium Fluoride Lagoons on the site and placed in a storage pile (all of this material is known to contain <0.5 weight percent U-235), and uranium hexafluoride cylinders previously used for shipping that have gone through an internal wash/rinse process following their last use but still are internally contaminated with special nuclear material. On December 9, 2020, staff approved the alternate disposal request and issued exemptions from the requirements in 10 CFR 30.3 and 10 CFR 70.3, allowing WEC to transfer the specific material to USEI for disposal (NRC, 2020d). The grant of the exemption approving this disposal is also stated in License Number SNM-1107 as License Condition S-11.

On February 8, 2021, WEC submitted an alternate disposal request in accordance with 10 CFR 20.2002 and exemptions from 10 CFR 30.3 and 10 CFR 70.3 to allow for the disposal of 25,900 ft3 of dredged material stored in the Operations Pile on the site at USEI (WEC, 2021g). Combining this material with the dredged material approved and exempted via the previous approval results in a total volume of 50,400 ft3 of specific waste, the volume approved and exempted for disposal at USEI via the December 9, 2020 approval (WEC, 2020d). On March 11, 2021, staff approved the 10 CFR 20.2002 request and issued exemptions to the requirements in 10 CR 30.3 and 10 CFR 70.3, allowing the additional material to be shipped to USEI for disposal (NRC, 2021f). The grant of the exemption approving this disposal is also stated in License Number SNM-1107 as License Condition S-11.

On June 1, 2021, WEC submitted an alternate disposal request in accordance with 10 CFR 20.2002 and requested exemptions from 10 CFR 30.3 and 10 CFR 70.3 in order to dispose of specific waste containing byproduct material and special nuclear waste at USEI (WEC, 2021h). On September 14, 2021, following discussions with NRC staff, WEC revised the scope of the request to only include considerations for the disposal of the remaining 133,000 ft3 of calcium fluoride sludge stored on site from previous dredging activities (WEC, 2021i). On October 12, 2021, staff approved the 10 CFR 20.2002 request and issued exemptions to the requirements in 10 CFR 30.3 and 10 CFR 70.3 allowing WEC to dispose of the remaining calcium fluoride sludge at USEI (NRC, 2021g). This approval enabled WEC to dispose of the remainder of the calcium fluoride sludge pile from which the calcium fluoride sludge approved in the March 11, 2021, approval originated. The grant of the exemption approving this disposal is also stated in License Number SNM-1107 as License Condition S-13.

On November 5, 2021, WEC submitted an alternate disposal request in accordance with 10 CFR 20.2002 and requested exemptions from 10 CFR 30.3 and 10 CFR 70.3 to dispose of bounding annual volumes of volumetrically contaminated and surface-contaminated waste containing byproduct and special nuclear material associated with ongoing remediation activities being performed on the site (WEC, 2021j). As proposed, maximum annual volumes of materials and radionuclide concentration limits based on annual dose requirements for both the volumetrically contaminated and surface-contaminated waste were considered. On March 18,

2022, NRC staff approved the 10 CFR 20.2002 request and issued exemptions to the requirements in 10 CFR 30.3 and 10 CFR 70.7 allowing WEC to package, ship, and dispose of annual volumes of specific volumetrically contaminated and surface-contaminated waste associated with activities performed by WEC at USEI (NRC, 2022c). The grant of the exemption approving this disposal is also stated in License Number SNM-1107 as License Condition S-14.

Under 10 CFR 70.17(a) and 10 CFR 30.11, the NRC may, upon application of any interested person or upon its own initiative, grant exemptions from the requirements of 10 CFR Part 70 and Part 30 respectively, if it determines that they (1) are authorized by law, (2) will not endanger life or property or the common defense and security, and (3) are otherwise in the public interest. First, as stated above, the NRC is authorized to grant exemptions from Parts 30 and 70. Granting WEC's requested exemptions above is also not contrary to the Atomic Energy Act of 1954, as amended, and other regulatory requirements or laws. Accordingly, granting the requested exemptions is authorized by law. Second, the safety evaluations incorporated by reference for each 10 CFR 20.2002 authorization documented above conclude that doses to both the workers performing the disposal actions and doses associated with reasonably foreseeable future land uses to the disposal site are acceptable.

Therefore, granting the exemptions will not endanger life or property or the common defense and security. Based on the NRC staff's findings outlined above, issuance of the exemptions to WEC is in the public interest because it would provide for the efficient and safe disposal of the subject waste material, would facilitate the remediation of the CFFF site consistent with the consent agreement between CFFF and the South Carolina Department of Health and Environmental Control, and/or would conserve low-level radioactive waste disposal capacity at licensed low-level radioactive disposal sites, while ensuring that the material being considered is disposed of safely in a regulated facility. Therefore, based upon the evaluation above, the corresponding exemptions to the four 10 CFR 20.2002 are appropriate under 10 CFR 30.11 and 10 CFR 70.17, and are confirmed and stated in the License as License Conditions S-11, S-13, and S-14.

14.3.2.6 Removal of License Condition S-3 Authorizing Short-term Exemption from Requirement to Perform Annual Audits of Site Emergency Plan

The Safety Condition S-3 was removed because the exemption from the requirement in the Site Emergency Plan to conduct annual audits of WEC's emergency plans is no longer needed. The staff had granted the exemption to minimize personnel exposure during COVID, and WEC has resumed conducting the audits on an annual frequency (WEC, 2020e; NRC, 2020e). Inspections of the annual audits were completed by NRC staff in 2021 (NRC, 2022d). Based on satisfactory inspection results, the temporary change added to the WEC license in S-3 is removed with the issuance of this renewed license.

14.4 EVALUATION FINDINGS

The NRC staff discussed and confirmed the bases for the existing 10 CFR 20.2002 approvals, license conditions, authorizations, and exemptions. The NRC staff also identified four additional 10 CFR 20.2002 approvals and corresponding exemptions issued since the WEC license was last renewed in 2007. The revised license conditions and new license conditions are incorporated into license SNM-1107.

CHAPTER 15 REFERENCES

83 FR 28014 *Federal Register* Notice of Environmental Assessment and Finding of No Significant Impact; Issuance related to Westinghouse Electric Company, LLC; Columbia Fuel Fabrication Facility. June 15, 2018.

84 FR 57777 *Federal Register* Notice of withdrawal of environmental assessment; issuance of draft environmental assessment and draft finding of no significant impact; public meeting and request for comments related to Westinghouse Electric Company, LLC; Columbia Fuel Fabrication Facility. October 28, 2019.

85 FR 81525 *Federal Register* Notice of Issuance of License Amendment and Exemption; "Westinghouse Electric Company, LLC; Columbia Fuel Fabrication Facility; and US Ecology, Inc.; Idaho Resource Conservation and Recovery Act Subtitle C Hazardous Disposal Facility Located Near Grand View, Idaho." December 16, 2020.

86 FR 16239 *Federal Register* Notice of Issuance of License Amendment and Exemption; "Westinghouse Electric Company, LLC; Columbia Fuel Fabrication Facility; and US Ecology, Inc.; Idaho Resource Conservation and Recovery Act Subtitle C Hazardous Disposal Facility Located Near Grand View, Idaho." March 26, 2021.

86 FR 57705 *Federal Register* Notice of Issuance of License Amendment and Exemption; "Westinghouse Electric Company, LLC; Columbia Fuel Fabrication Facility; and US Ecology, Inc.; Idaho Resource Conservation and Recovery Act Subtitle C Hazardous Disposal Facility Located Near Grand View, Idaho." October 18, 2021.

87 FR 16772 *Federal Register* Notice of Issuance of License Amendment and Exemption; "Westinghouse Electric Company, LLC; Columbia Fuel Fabrication Facility; and US Ecology, Inc.; Idaho Resource Conservation and Recovery Act Subtitle C Hazardous Disposal Facility Located Near Grand View, Idaho." March 24, 2022.

87 FR 84044 *Federal Register* Notice of Revised Environmental Assessment and Finding of No Significant Impact; Issuance related to Westinghouse

ANS, 1991. (n.d.). ANSI/ANS-8.20-1991 (R2005), "Nuclear Criticality Safety Training," LaGrange Park, IL.

ANS, 1995. (n.d.). ANSI/ANS-8.21-1995 (R2001), "Use of Fixed Neutron Absorbers in Nuclear Facilities Outside Reactors," LaGrange Park, IL.

ANS, 1996. (n.d.). ANSI/ANS-8.5-1996 (R2007), "Use of Borosilicate-Glass Raschig Rings as a Neutron Absorber in Solutions of Fissile Material," LaGrange Park, IL.

ANS, 1997. (n.d.). ANSI/ANS-8.22-1997 (R2006), "Nuclear Criticality Safety Based on Limiting and Controlling Moderators," LaGrange Park, IL.

ANS, 1997a. (n.d.). ANSI/ANS-8.3-1997 (R2017), “Criticality Accident Alarm System,” Reaffirmed - 2017, LaGrange Park, IL.

ANS, 1998. (n.d.). ANSI/ANS-8.1-1998, “Nuclear Criticality Safety in Operations with Fissionable Materials Outside Reactors,” LaGrange Park, IL.

ANS, 1998a. (n.d.). ANSI/ANS-8.7-1998 (R2007), “Nuclear Criticality Safety in Storage of Fissile Material,” LaGrange Park, IL.

ANS, 2004. (n.d.). ANSI/ANS-8.17-2004, “Criticality Safety Criteria for the Handling, Storage, and Transportation of LWR Fuel Outside Reactors,” LaGrange Park, IL.

ANS, 2005. (n.d.). ANSI/ANS-8.19-2005, “Administrative Practices for Nuclear Criticality Safety,” ANS, LaGrange Park, IL.

ANS, 2007. (n.d.). ANSI/ANS-8.23-2007, “Nuclear Criticality Accident Emergency Planning and Response,” 2007, ANS, LaGrange Park, IL.

ANS, 2007. (n.d.). ANSI/ANS-8.26-2007 (R2016), “Criticality Safety Engineer Training and Qualification Program,” LaGrange Park, IL.

ANS, 2007a. (n.d.). ANSI/ANS-8.24-2007, “Criticality Safety Engineer Training and Qualification Program,” LaGrange Park, IL.

ANS, 2014. (n.d.). ANSI/ANS-8.1-2014, “Nuclear Criticality Safety in Operations with Fissionable Materials Outside Reactors,” LaGrange Park, IL.

CEA, 1967. (n.d.). R3114, “Guide de Criticité,” Commissariat à l’Energie Atomique, Saclay, 1967.

EPA, 1988. (n.d.). U.S. Environmental Protection Agency (EPA), "Limiting Values of Radionuclide Intake and Air Concentration and Dose Conversion Factors for Inhalation, Submersion, and Ingestion," Federal Guidance Report (FGR) 11, 1988, EPA-520-1-88-020.

ICRP, 1994. (n.d.). International Commission on Radiation Protection (ICRP) Publication 68, Annals of the ICRP, Volume 24, No. 4, 1994.

Ketzlach, N. (1979). “Proposed Extension of Raschig Ring Standard to Low Enriched Uranium Fuels,” Nuclear Technology, Volume 42, Issue 1, pp. 43, 65.

Lide, 2005. (n.d.). David R. Lide, ed., CRC Handbook of Chemistry and Physics, Internet Version 2005, <http://www.hbcpnetbase.com>, CRC Press, Boca Raton, FL, 2005.

NEI, 2019. (n.d.). Nuclear Energy Institute 07-07, “Industry Groundwater Protection Initiative - Final Guidance Document, Rev. 1,” 2019, NEI, Washington D.C.

NFPA, 2013. (n.d.). “Standard for Fire Protection for Facilities Handling Radioactive Materials,” NFPA 801, 2014 edition, August 21, 2013, Quincy, MA.

NFPA, 2013a. (n.d.). "Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems," NFPA 25, 2017 edition, August 24, 2016, Quincy, MA.

NFPA, 2016. (n.d.). "National Electric Code," NFPA 70, 2017 edition, August 24, 2016, Quincy, MA.

NFPA, 2017. (n.d.). "Standard for Portable Fire Extinguishers," NFPA 10, 2018 edition, August 27, 2017, Quincy, MA.

NFPA, 2018. (n.d.). "Life Safety Code," NFPA 101, 2019 edition, May 24, 2018, Quincy, MA.

NFPA, 2018a. (n.d.). "Standard for Ovens and Furnaces," NFPA 86, 2019 edition, May 24, 2018, Quincy, MA.

NFPA, 2018b. (n.d.). "Standard for the Installation of Sprinkler Systems," NFPA 13, 2019 edition, September 3, 2018, Quincy, MA.

NFPA, 2018c. (n.d.). "Flammable and Combustible Liquids Code," NFPA 30, 2018 edition, September 6, 2017, Quincy, MA.

NFPA, 2019. (n.d.). "Compressed Gases and Cryogenic Fluids Code," NFPA 55, 2020 edition, May 18, 2019, Quincy, MA.

Nichols, S. (1971, July). "Use of Borosilicate-Glass Raschig Rings as a Neutron Absorber in Solutions of Fissile Material," Y/CDC-8, Oak Ridge Y-12 Plant.

NRC, 1968. (n.d.). "Letter informing that SNM-338, dated 06/02/67, is amended to authorize the receipt, possession and use of SNM for the fabrication of fuel assemblies in accordance with application dated 10/24/68," November 19, 1968, ADAMS Accession No. ML011380663.

NRC, 1983. (n.d.). "Regulatory Guide 5.59, Standard Format and Content for a Licensee Physical Security Plan for the Protection of Special Nuclear Material of Moderate or Low Strategic Significance," Regulatory Guide 5.59, February 28, 1983, ADAMS Accession No. ML100341301.

NRC, 1985. (n.d.). "Safety Evaluation Report," March 14, 1985, ADAMS Accession No. ML062270169.

NRC, 1992. (n.d.). Letter to Allied-Signal, Inc., "Environmental Assessment – Release of Calcium Fluoride for Use in the Steel-Making Industry". January 14, 1992, ADAMS Accession No. ML060320548.

NRC, 1992a. (n.d.). "Safety Evaluation Report, Amendment Application Dated July 1, 1991, RE Release of Calcium Fluoride to Briquette Manufacturers for Use in the Steel-Making Industry," January 23, 1992. ADAMS Accession No. ML060320608.

NRC, 1992b. (n.d.). "Air Sampling in the Workplace," Regulatory Guide 8.25, Revision 1, June 1992, ADAMS Accession No. ML003739616.

NRC, 1992c. (n.d.). “Monitoring Criteria and Methods to Calculate Occupational Radiation Doses,” Regulatory Guide 8.34, July 1992, ADAMS Accession No. ML090770221.

NRC, 1993. (n.d.). “Acceptable Concepts, Models, Equations, and Assumptions for a Bioassay Program,” Regulatory Guide 8.9, July 1993, ADAMS Accession No. ML003739554.

NRC, 1993a. (n.d.). “ALARA Levels for Effluents from Materials Facilities.” Regulatory Guide 8.37, July 1993, ADAMS Accession No. ML003739553.

NRC, 1993b. (n.d.). “Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for Byproduct, Source, or Special Nuclear Material,” Branch Technical Position, 1993. ADAMS Accession No. ML061980584.

NRC, 1993c. (n.d.). “License Condition for Leak-Testing Sealed Byproduct Material Sources,” Branch Technical Position, 1993, ADAMS Accession No. ML17208A030.

NRC, 1995. (n.d.). “Acceptable Standard Format and Content for the Fundamental Nuclear Material Control (FNMC) Plan Required for Low-Enriched Uranium Facilities,” NUREG-1065, Revision 2, December 1995, ADAMS Accession No. ML031340288.

NRC, 1995a. (n.d.). “Safety Evaluation Report and Renewal of SNM-1107 for the Westinghouse Electric Corporation,” November 3, 1995, ADAMS Accession No. ML060110462.

NRC, 1999. (n.d.). “To Request Commission Approval to Grant Exemptions From Portions of 10 CFR Part 20,” SECY-99-077, March 12, 1999, ADAMS Accession No. ML992810080.

NRC, 1999a. (n.d.). Staff Requirements – SECY-99-077, “To Request Commission Approval to Grant Exemptions From Portions of 10 CFR Part 20,” April 21, 1999.

NRC, 1999b. (n.d.). "Respiratory Protection and Controls to Restrict Internal Exposures," Federal Register, Vol. 64, No. 194, October 7, 1999, pp. 54543-54559.

NRC, 1999c. (n.d.). “Acceptable Programs for Respiratory Protection,” Regulatory Guide 8.15, October 31, 1999, ADAMS Accession No. ML003739528.

NRC, 2001. (n.d.). “Integrated Safety Analysis Guidance Document,” NUREG-1513, May 2001. ADAMS Accession No. ML011440260.

NRC, 2002. (n.d.). “Westinghouse Electric Company – Amendment 30 – Authorize the Use of ICRP 68,” April 26, 2002, ADAMS Accession No. ML062270273.

NRC, 2003. (n.d.). Interim Compensatory Measures Order, dated February 6, 2003 (SGI).

NRC, 2005. (n.d.). “Instructions for Recording and Reporting Occupational Radiation Dose Data,” Regulatory Guide 8.7, November 2005, ADAMS Accession No. ML052970092.

NRC, 2006. (n.d.). "Maximum 40-Year Licensing Terms for Certain Fuel Cycle Facilities," Federal Register, Vol. 71, No. 232, December 4, 2006, pp. 70441.

NRC, 2006a. (n.d.). “Consolidated Decommissioning Guidance,Decommissioning Process for Materials Licensees,” NUREG-1757, Vol. 1, September 2006, ADAMS Accession No. ML063000243.

NRC, 2007. (n.d.). "Staff Requirements - Briefing on NMSS Programs, Performance, and Plans, 10:00 A.M., Thursday, March 8, 2007, Commissioners’ Conference Room,” SRM-M070308B, March 22, 2007, ADAMS Accession No. ML070820023.

NRC, 2007a. (n.d.). “Basis and Justification for Approval Process for 10 CFR 20.2002 Authorizations and Options for Change,” SECY-07-0060, March 27, 2007, ADAMS Accession No. ML070220045.

NRC, 2007b. (n.d.). “Issuance of Order Imposing Fingerprinting and Criminal History Check Requirements for Access to Safeguards Information,” March 29, 2007, ADAMS Accession No. ML063480561.

NRC, 2007c. (n.d.). “Certain Fuel Cycle Licensees re: Issuance of Order Imposing Fingerprinting and Criminal History Records Check Requirements for Unescorted Access to Radioactive Materials,” April 30, 2007, ADAMS Accession No. ML070950163.

NRC, 2007d. (n.d.). “Recent Hydrogen Fluoride Exposures at Fuel Cycle Facilities,” Information Notice 2007-22, June 2007, ADAMS Accession No. ML071410230.

NRC, 2007e. (n.d.). “License Renewal SNM-1107, Westinghouse Electric Company Columbia Fuel Fabrication Facility (TAC L31911),” September 28, 2007, ADAMS Accession No. ML072150491.

NRC, 2007f. (n.d.). “License Renewal SNM-1107, Westinghouse Electric Company Columbia Fuel Fabrication Facility (TAC L31911),” September 28, 2007, ADAMS Accession No. ML072150491.

NRC, 2010. (n.d.). “Nuclear Criticality Safety Standards for Fuels and Material Facilities,” Regulatory Guide 3.71, Rev. 2, 2010, ADAMS Accession No. ML103210345.

NRC, 2010a. (n.d.). “Standard Review Plan for the Review of a License Application for a Fuel Cycle Facility,” NUREG-1520, Rev. 1, May 2010, ADAMS Accession No. ML101390110.

NRC, 2010b. (n.d.). “Transferring Natural Uranium Hexafluoride From The State License To The NRC License,” July 27, 2010, ADAMS Accession No. ML101800306.

NRC, 2010c. (n.d.). “Monitoring and Reporting Radioactivity in Releases of Radioactive Materials in Liquid and Gaseous Effluents from Nuclear Fuel Processing and Fabrication Plants and Uranium Hexafluoride Production Plants,” Regulatory Guide 4.16. *(*December 2010, ADAMS Accession No. ML101720291).

NRC, 2011. (n.d.). “Standard Format and Content for Emergency Plans for Fuel Cycle and Materials Facilities,” Regulatory Guide 3.67, April 2011, ADAMS Accession No. ML103360487.

NRC, 2011a. (n.d.). “Approval To Transfer Natural (Or Depleted) Uranium From South Carolina State License To The U.S. Nuclear Regulatory Commission Special Nuclear Material License”, February 25, 2011, ADAMS Accession No. ML103560314.

NRC, 2012. (n.d.). “IR 007001151-005, - 10/01/2011- 12/31/2011, Westinghouse Electric Co., Notice of Violation,” January 27, 2012, ADAMS Accession No. ML12027A112.

NRC, 2012a. (n.d.). "Guidance for Fuel Cycle Facility Change Processes," Regulatory Guide 3.74, January 31, 2012, ADAMS Accession No. ML100890016.

NRC, 2012b. (n.d.). “Consolidated Decommissioning Guidance: Financial Assurance, Recordkeeping, and Timeliness,” NUREG-1757, Volume 3, February 2012.

NRC, 2012c. (n.d.). “Health Physics Surveys During Enriched Uranium-235 Processing and Fuel Fabrication," Regulatory Guide 8.24, June, 2012, ADAMS Accession No. ML110400305.

NRC, 2012d. (n.d.). “Decommissioning Planning During Operations," Regulatory Guide 4.22, December 2012, ADAMS Accession No. ML12158A361.

NRC, 2013. (n.d.). “Deferring Review of Application for a 40-Year Renewal of Special Nuclear Materials License SNM-1107,” February 7, 2013, ADAMS Accession No. ML13024A083.

NRC, 2013a. (n.d.). "Staff requirements – SECY-12-0071 – Final Rule: Domestic Licensing of Source Material - Amendments/Integrated Safety Analysis,” SRM-M070308B, May 3, 2013, ADAMS Accession No. ML13123A127.

NRC, 2014. (n.d.). “Corrective Action Programs for Fuel Cycle Facilities," Regulatory Guide 3.75, July 2014, ADAMS Accession No. ML14139A321.

NRC, 2014a. (n.d.). “Summary of Meetings: Westinghouse 40-Year License Renewal: Acceptance Review”, October 3, 2014, ADAMS Accession No. ML14276A432.

NRC, 2014b. (n.d.). “Approval Of Westinghouse Exemption From Title 10 Of The Code Of Federal Regulations, Part 20.1703(C)(5),” December 12, 2014, ADAMS Accession No. ML14303A301.

NRC, 2014c. (n.d.). “Acceptance for Technical Review: 'SNM-1107 License Renewal Supplement,' Dated December 17, 2014,” December 30, 2014, ADAMS Accession No. ML14364A017.

NRC, 2015. (n.d.). "Columbia Fuel Fabrication Facility, License amendment application; opportunity to request a hearing and to petition for leave to intervene," Federal Register, Vol. 80, No. 39, February 27, 2015, pp. 10727-10730.

NRC, 2015a. (n.d.). "Westinghouse Electric Company, Columbia Fuel Fabrication Facility Licensee Performance Review, March 4, 2015, ADAMS Accession No. ML15063A049.

NRC, 2015b. (n.d.). “IR 007001151/2015002 - 01/01/15- 03/31/2015, Westinghouse Electric Co. Fuel Fabrication Facility NRC Integrated Inspection Report,” April 29, 2015, ADAMS Accession No. ML15119A002.

NRC, 2015c. (n.d.). "IR 007001151-13-003 - 04/1/2013- 06/30/2013, Westinghouse Electric Co. Hopkins South Carolina NRC Integrated Inspection" July 24, 2015, ADAMS Accession No. ML13205A174.

NRC, 2015d. (n.d.). "Amendment 18 – Exemption From 10 CFR Part 30, Appendix A, Section Ii.C.1; Exemption From 10 CFR, Part 20.1703(C)(5); Change In The Calibration Interval Of Portable Radiation Survey Instrumentation; Increase In Possession Limits;. (Approval Of Physical Security Plan, Revision 45; Change In Principal Officers; Removal Of Completed License Conditions", November 2, 2015, ADAMS Accession Nos. ML15125A279 and ML15323A130).

NRC, 2015e. (n.d.). "Request For Additional Information: Triennial Update of the Decommissioning Funding Plan (Technical Assignment Control Number L33376)," November 17, 2015, ADAMS Accession No. ML15264B004.

NRC, 2015f "FCSE Interim Staff Guidance ISG-14, "Acute Uranium Exposure Standards for Workers," dated June 8, 2015, ADAMS Accession No. ML15147A682.

NRC, 2016. (n.d.). "Approval Of Decommissioning Funding Plan Dated May 12, 2016 (Cost Activity Code L33419)," October 14, 2016," ADAMS Accession No. ML16277A591.

NRC, 2016a. (n.d.). "Nuclear Regulatory Commission Augmented Inspection Team Report No. 70-1151/2016-007", October 26, 2016. ADAMS Accession No. ML16301A001.

NRC, 2016b. (n.d.). "Nuclear Regulatory Commission Confirmatory Action Letter," November 16, 2016, ADAMS Accession No. ML16323A011.

NRC, 2016c. (n.d.). "Safety Evaluation of Westinghouse Columbia Fuel Fabrication Facility Response to Generic Letter 2015-01: Treatment of Natural Phenomena Hazards in Fuel Cycle Facilities," July 7, 2016, ADAMS Accession No. ML16182A362.

NRC, 2016d. (n.d.). "Nuclear Regulatory Commission Confirmatory Action Letter," November 16, 2016, ADAMS Accession No. ML16323A011.

NRC, 2018a. (n.d.). "Westinghouse Electric Company, Licensee Performance Review (Nuclear Regulatory Commission Inspection Report 70-1151/2018-001)," March 2, 2018, ADAMS Accession No. ML18064A119.

NRC, 2018b. (n.d.). "Columbia Fuel Fabrication Facility, Environmental Assessment and Finding of No Significant Impact," Federal Register, Vol. 83, No. 116, June 15, 2018, pp. 28014-28015 (ADAMS Accession No. ML18120A318).

NRC, 2018c. (n.d.). "Westinghouse Electric Company – Nuclear Regulatory Commission Integrated Inspection Report Number 70-1151/2018-004 and Notice of Violation," October 5, 2018," ADAMS Accession No. ML18278A197.

NRC, 2018d. (n.d.). "Westinghouse Electric Company Llc Approval Of Indirect Transfer Of Control Of Licenses," June 28, 2018, ADAMS Accession No. ML18162A027.

NRC, 2019. (n.d.). "Westinghouse License Renewal - RAIs for the Reopened Environmental Review," January 18, 2019, ADAMS Accession No. ML18308A008.

NRC, 2019a. (n.d.). "Westinghouse Electric Company, Program Adjustment of Licensed Activities (Nuclear Regulatory Commission Inspection Report 70-1151/2019-001)," March 1, 2019, ADAMS Accession No. ML19060A201.

NRC, 2019b Memorandum from J. Quintero to C.I. Román, dated October 16, 2019, regarding "Summary of May 2019 Site Visit and Information Needs Related to the U.S. Nuclear Regulatory Commission's Review of the Environmental Program in the License Renewal Application for the Westinghouse Columbia Fuel Fabrication Facility and Information about Recent Events," Washington, D.C., (ADAMS Accession No. ML19283A811).

NRC, 2019c. (n.d.). "Amendment 21 of Special Nuclear Material License 1107: Fundamental Nuclear Material Control Plan, Revision 43 (Enterprise Project Identifier: 000224/07001151/L-2019-MCA-000) (Docket Number: 70-1151)," June 21, 2019, ADAMS Accession No. ML19112A047.

NRC, 2019d. (n.d.). "Amendment 20: Site Emergency Plan Revision 19," April 9, 2019, ADAMS Accession No. ML19088A239.

NRC, 2019e (n.d.). "Environmental Assessment for the Renewal of SNM-1107 Columbia Fuel Fabrication Facility in Richland County, South Carolina," Draft for Comment, Westinghouse Electric Company, LLC, Hopkins, South Carolina. ADAMS Accession No. ML19228A278.

NRC, 2020. Letter from J.I. Zimmerman to Westinghouse Columbia Fuel Fabrication, dated June 5, 2020, regarding "U.S. Nuclear Regulatory Commission's Determination to Prepare an Environmental Impact Statement for the License Renewal Review of the Columbia Fuel Fabrication Facility," ADAMS Accession No. ML20150A289.

NRC, 2020a Westinghouse Electric Company – Nuclear Regulatory Commission Integrated Inspection Report Number 70-1151/2019-005. January 28, 2020, (ADAMS Accession No. ML20028D930).

NRC, 2020b Westinghouse Electric Company – Nuclear Regulatory Commission Integrated Inspection Report Number 70-1151/2020-002, July 6, 2020, (ADAMS Accession No. ML20189A169).

NRC 2020c, Diaz, Marilyn, "Westinghouse Electric Company, LLC, Interim Approval Of Decommissioning Cost Estimate Amount (Enterprise Project Identifer L-2019-DFA-0004)," February 6, 2020. ADAMS Accession No. ML20029D839.

NRC, 2020d, D. Marcano, dated December 9, 2020, "Westinghouse Electric Company, LLC- Amendment 25 to Material License SNM-1107, Exemption for Alternate Disposal of Specific Waste, " ADAMS Accession No. ML20302A083)

NRC, 2020e, J. Zimmerman to WEC dated May 22, 2020, "Approval of Westinghouse Electric Company Temporary Change to Site Emergency Plan," (ADAMS Accession No. ML20141L555).

NRC, 2021. *Environmental Impact Statement for the Westinghouse Electric Company Columbia Fuel Fabrication Facility License Renewal Application Scoping Process Summary Report.* Washington, D.C. ADAMS Accession No. ML21033A675.

NRC 2021a. "Public Meeting Notice: Westinghouse Fuel Fabrication Facility Columbia Fuel Fabrication Facility License Renewal Application Status, February 4, 2021, ADAMS Accession No. ML21021A120.

NRC 2021b. "Status of NRC's Review of the Westinghouse Columbia Fuel Fabrication Facility License Renewal Application," Presented at the NRC Public Meeting, February 4, 2021, ADAMS Accession No. ML21029A185.

NRC, 2021c. "Environmental Impact Statement for the Westinghouse Electric Company Columbia Fuel Fabrication Facility License Renewal Application Scoping Process Summary Report," ADAMS Accession No. ML21033A675.

NRC 2021d. Memorandum from D.H. Tiktinsky to J.I. Zimmerman, dated March 4, 2021, regarding "Summary of February 4, 2021 Public Meeting to Discuss the Status of the Westinghouse Columbia Fuel Fabrication Facility License Renewal," ADAMS Accession No. ML21054A092.

NRC, 2021e "Environmental Impact Statement for the License Renewal of the Columbia Fuel Fabrication Facility in Richland County, South Carolina: Draft Report for Comment," July 2021, NUREG-2248, (ADAMS Accession No. ML21209A213).

NRC, 2021f J. Zimmerman, dated March 3, 2020, "Westinghouse Electric Company, LLC- Amendment 25 to Material License SNM-1107, Exemption for Alternate Disposal of Specific Waste, " (ADAMS Accession No. ML21053A335).

NRC, 2021g J. Zimmerman, dated October 4, 2021, ""Westinghouse Electric Company, LLC- Amendment 26 to Material License SNM-1107, Exemption for Alternate Disposal of Specific Waste, " (ADAMS Accession No. ML21202A112).

NRC, 2022. (n.d.). "Requests for Additional Information Westinghouse Columbia Fuel Fabrication Facility License Renewal Application," February 18, 2022, ADAMS Accession No. ML22033A070.

NRC, 2022a. "May 18, 2022 Public Meeting Slides, Licensee Performance Review," ADAMS Accession No. ML22122A111.

NRC, 2022b "Summary of Site Visit to Westinghouse Columbia Fuel Fabrication Facility in Hopkins, South Carolina Regarding the License Renewal Application (Docket No. 70-1151)," March 14, 2022, (ADAMS Accession No. ML22041A202).

NRC, 2022c J. Zimmerman, dated March 4, 2022, ""Westinghouse Electric Company, LLC- Amendment 29 to Material License SNM-1107, Exemption for Alternate Disposal of Specific Waste, " (ADAMS Accession No. ML22054A047).

NRC, 2022d E. Michel, dated April 18, 2022, "Columbia Fuel Fabrication Facility- Integrated Inspection Report 07001151/2022001," (ADAMS Accession No. ML22104A135).

Okuno, N. (1994). "Computation on Fuel Particle Size Capable of Being Regarded as Homogeneous in Nuclear Criticality Safety Analysis," Nuclear Science and Technology, pp. 31 and 104.

SCDHEC, 2017 National Pollutant Discharge Elimination System Permit for Discharge to Surface Waters for Westinghouse Electric Company LLC Columbia Fuel Site. Permit No. SC00001848. Columbia, SC, March 30, 2017, (ADAMS Accession No. ML17283A098).

SCDHEC/WEC (South Carolina Department of Health and Environmental Control/Westinghouse Electric Company, LLC). 2019a. "Consent Agreement 19-02-HW between the South Carolina Department of Health and Environmental Control and Westinghouse Electric Company, LLC Westinghouse Fuel Fabrication Facility, Richland, County." Columbia, South Carolina. Accessed October 1, 2020, at https://scdhec.gov/sites/default/files/media/document/BLWM_WestinghouseCA%2019-2-HW.pdf

Shand, E. (1958). "Glass Engineering Handbook," McGraw-Hill, New York.

WEC, 1995. (n.d.). Westinghouse, "WEC Energy System - Application for Renewal of a SNM License for the Commercial Nuclear Fuel Div, at the Columbia, South CFFF License No. SNM-1107," April 30, 1995, (ADAMS Accession No. ML062270174).

WEC, 1998. (n.d.). "Westinghouse Analysis, CN-CRI-95-022, Nuclear Criticality Safety Analysis: Spherical Radius Reduction Due to Heterogenic Effect of Increasing Particle Size," October 23, 1998.

WEC, 2006. (n.d.). Westinghouse Analysis, CN-CRI-06-7, "Determination of Single Parameter Limits for Heterogeneous UO2 Systems," Rev. 0. February 28, 2006.

WEC, 2006a. (n.d.). LTR-ESH-05-146, Rev. 2, "Validation of the CSAS25 Sequence in SCALE-4.4 and the 238-Group ENDF/B-V Cross Section Library for Homogeneous Systems at the Westinghouse Columbia Fuel Fabrication Facility," July 26, 2006.

WEC, 2012. (n.d.). Couture, Gerard F., "Fundamental Nuclear Material Control Plan Revision," Fundamental Nuclear Material Control (FNMC) Plan Revision 42, August 30, 2012, (ADAMS Accession No. ML12248A030).

WEC, 2012a. (n.d.). Couture, Gerard F., "Westinghouse Liscnese Renewal Application," November 30, 2012, ADAMS Accession No. ML12338A041. Retrieved from Name of Site.

WEC, 2013. (n.d.). Parr, Nancy B., "Westinghouse License Renewal Application Revised Chapters," March 7, 2016, ADAMS Accession No. ML16067A295.

WEC, 2014. (n.d.). Parr, Nancy B., "Westinghouse January 2014 Updated Integrated Safety Analysis (ISA) Summary," January 28, 2014. ADAMS Accession No. ML14028A001.

WEC, 2014a. (n.d.). Parr, Nancy B., "Westinghouse License SNM-1107 Exemption Request," July 18, 2014, (ADAMS Accession No. ML14199A593).

WEC, 2014b. (n.d.). Parr, Nancy B., "SNM-1107 License Renewal," July 31, 2014, ADAMS Accession No. ML14213A105.

WEC, 2014c. (n.d.). Parr, Nancy B., "Letter from Nancy Blair Parr re: SNM-1107 License Renewal Supplement," December 17, 2014, ADAMS Accession No. ML14352A111.

WEC, 2014d. (n.d.). Parr, Nancy B., "SNM-1107 License Renewal Supplement," December 17, 2014, ADAMS Accession No. ML14351A316.

WEC, 2015. (n.d.). Parr, Nancy B., "Westinghouse Columbia Physical Security Plan Drawings," January 9, 2015, ADAMS Accession No. ML15040A430.

WEC, 2015b. (n.d.). Parr, Nancy B., "Westinghouse January 2015 Updated Integrated Safety Analysis (ISA) Summary," January 26, 2015, ADAMS Accession No. ML15026A001.

WEC, 2015c. (n.d.). Parr, Nancy B., "Westinghouse Columbia Fuel Fabrication Facility Decommissioning Funding Plan," June 5, 2015, (ADAMS Accession No. ML15156B312).

WEC, 2016. (n.d.). Parr, Nancy B., "Westinghouse January 2016 Updated Integrated Safety Analysis (ISA) Summary," January 25, 2016. ADAMS Accession No. ML16025A113.

WEC, 2016a. (n.d.). Parr, Nancy B., "Westinghouse License Renewal Application Revised Management Measures Chapter," February 29, 2016, ADAMS Accession No. ML16060A464.

WEC, 2016b. (n.d.). Parr, Nancy B., "Westinghouse License Renewal Application Revised Chapter," March 23, 2016, ADAMS Accession No. ML16083A373.

WEC, 2016c. (n.d.). Parr, Nancy B., "Westinghouse Response to Request for Additional Information and Submittal of Revised Decommissioning Funding Plan (TAC # L33376)," May 12, 2016, (ADAMS Accession No. ML16134A095).

WEC, 2016f. (n.d.). Parr, Nancy B., "Westinghouse License Renewal Application Response to Request for Additional Information," August 31, 2016, ADAMS Accession No. ML16246A300.

WEC, 2017a. (n.d.). Parr, Nancy B., "Westinghouse January 2017 Updated Integrated Safety Analysis (ISA) Summary," January 28, 2017, ADAMS Accession No. ML17028A012.

WEC, 2017b. (n.d.). Parr, Nancy B., "Westinghouse License Renewal Application Page Changes," March 22, 2017, ADAMS Accession No. ML17081A424.

WEC, 2017c. (n.d.). Weaver, Douglas, "Westinghouse Electric Company LLC, Licensee for License Numbers SNM-1107 and SNM-33, Notification of Petition for Bankruptcy", March 29, 2017, ADAMS Accession No. ML17115A413.

WEC, 2017d. (n.d.). Parr, Nancy B., "Westinghouse Updated License Renewal Application," September 15, 2017, ADAMS Accession No. ML17261A085.

WEC, 2017e. (n.d.). LTR-ESH-17-80, "Raschig Rings in Alkaline Environment," December 4, 2017.

WEC, 2018. (n.d.). Parr, Nancy B., "Westinghouse Electric Company LLC, Submittal of January 2018 Updated Integrated Safety Analysis (ISA) Summary," January 30, 2018, ADAMS Accession No. ML18030A667.

WEC, 2018b. (n.d.). Parr, Nancy B., "Application for Consent to Indirect Change of Control with Respect to Materials Licenses and Export Licenses and Notification Regarding Quality Assurance Program Approvals, Certificates of Compliance, and Design Certification," March 28, 2018 (ADAMS Accession No. ML18086B504).

WEC, 2018c. (n.d.). Parr, Nancy B., "Response to NRC's Request for Additional Information: Renewal of Special Nuclear Material License SNM-1107", March 28, 2018, (ADAMS Accession No. ML18087A400).

WEC, 2018d. (n.d.). Parr, Nancy B., "Westinghouse - Transmittal of License Renewal Application," June 21, 2018, (ADAMS Accession No. ML18172A286).

WEC, 2018e. (n.d.). Parr, Nancy B., "Westinghouse Fundamental Nuclear Material Control Plan, Revision 43," December 17, 2018, (ADAMS Accession No. ML18351A120).

WEC, 2018f. (n.d.). Parr, Nancy B., "Site Emergency Plan for the Columbia Fuel Fabrication Facility, Revision 19," December 18, 2018, (ADAMS Accession No. ML18353A250).

WEC, 2018g Letter from J. Howell to NRC, dated August 30, 2018, regarding "SNM-11 07/70-1151, NRC Semi-Annual Discharge Report January-June 2018." Hopkins, South Carolina, (ADAMS Accession No. ML18243A170).

WEC, 2019. (n.d.). Parr, Nancy B., "Westinghouse January 2019 Updated Integrated Safety Analysis (ISA) Summary, January 30, 2019, (ADAMS Accession No. ML19030A753).

WEC, 2019a. (n.d.). Parr, Nancy B., "Enclosure 4 - Revised Environmental Report," March 28, 2019, (ADAMS Acession No. ML19088A100).

WEC, 2019b. (n.d.). Parr, Nancy B, "Enclosure 5 - SNM-1107 License Renewal Application," March 28 , 2019, (ADAMS Accession No. ML19088A10).

WEC, 2019c. (n.d.). Couture, Gerard F., "Westinghouse Revised SNM-1107 License Renewal Application," July 11, 2019, (ADAMS Accession No. ML19192A132).

WEC, 2019d. (n.d.). "Westinghouse Submittal of Triennial Update of Decommissioning Funding Plan," July 25, 2019, (ADAMS Accession No. ML19206A043).

WEC, 2019e. (n.d.). "Westinghouse - SNM-1107 License Renewal Application," August 22, 2019, (ADAMS Accession No. ML19234A079).

WEC, 2019f. (n.d.). Parr, Nancy B., "Westinghouse Electric Company - NRC Semi-Annual Discharge Report (July - December 2018)," February 27, 2019, (ADAMS Accession No. ML19059A323).

WEC, 2019g. (n.d.). Parr, Nancy B., "Enclosure 4 - Revised Environmental Report," March 28, 2019, (ADAMS Accession No. ML19088A100).

WEC, 2019h. "Westinghouse Fundamental Nuclear Material Control Plan, Revision 44," dated July 9, 2019, (ADAMS Accession No. ML19190A152)

WEC, 2019i Letter from E. Wills to NRC, dated August 26, 2019, regarding "SNM-1107/70-1151 NRC Semi-Annual Discharge Report January - June 2019." LTR-RAC-19-67, Hopkins, South Carolina, (ADAMS Accession No. ML19238A362).

WEC, 2019k Letter from WEC to SCDHEC regarding “Southern Storage Area Operable Unit Sampling Work Plan – Remedial Investigation Work Plan Addendum 1.” June 18, 2019. Available at: https://www.scdhec.gov/sites/default/files/media/document/BLWM_Westinghouse_%20Addendum%201RIWorkPlan%2006182019.pdf.

WEC, 2019l. Letter from D.P. Joyner to South Carolina Department of Health and Environmental Control Bureau of Land and Waste Management, dated June 18, 2019, regarding "Final Remedial Investigation Work Plan Submission." LTR-RAC-19-44, Hopkins, South Carolina. Accessed October 1, 2020, at https://scdhec.gov/sites/default/files/media/document/BLWM_Westinghouse_RIWORKPLAN%20JUNE%202019.pdf.

WEC, 2020. "Interim Remedial Investigation Data Summary Report Westinghouse Columbia Fuel Fabrication Facility. AECOM, Hopkins, South Carolina, ADAMS Accession No. ML20063P321.

WEC, 2020a "Response to Request for Additional Information." Enclosure 1 in Environmental Review for the Proposed Renewal of the Westinghouse Columbia Fuel Fabrication Facility License. LTR-RAC-20-94, Hopkins, South Carolina, (ADAMS Accession No. ML20353A277).

WEC, 2020b Letter from J. Ferguson to NRC, revision dated September 8, 2020, regarding "SNM-1107/70-1151 NRC Semi-Annual Discharge Report July - December 2019." LTR-RAC-20-21-R1, Hopkins, South Carolina (ADAMS Accession No. ML20255A270).

WEC, 2020c Letter from J. Ferguson to NRC, dated August 25, 2020, regarding "SNM-1107/70-1151 NRC Semi-Annual Discharge Report January - June 2020." LTR-RAC-20-69, Hopkins, South Carolina, (ADAMS Accession No. ML20238C062).

WEC, 2020d Letter from A. Spalding to NRC, dated May 8, 2020, "Request for Alternate Disposal Approval and Exemptions for Specific Columbia Fuel Fabrication Facility Waste," (ADAMS Accession No. ML20129J934).

WEC, 2020e Letter from A. Spalding to NRC, dated April 9, 2020, "Westinghouse Request for Temporary Change to Site Emergency Plan," (ADAMS Accession No. ML20100G526).

WEC, 2021. "*Columbia Risk Reduction & Environmental Update NRC Public Meeting, February 4, 2021*." Hopkins, South Carolina. ADAMS Accession No. ML21026A021.

WEC, 2021a Letter from A. Pope to NRC, dated April 6, 2021, regarding "Westinghouse Columbia Fuel Fabrication Facility License Renewal Environmental Commitments." LTR-RAC-21-28, Hopkins, South Carolina, (ADAMS Accession No. ML21096A268).

WEC, 2021b Malek, Elise, “Westinghouse Revised SNM-1107 License Renewal Application,” September 20, 2021, (ADAMS Accession No. ML21263A217).

WEC, 2021c "Westinghouse Revised SNM-1107 License Renewal Application," September 20, 2021, (ADAMS Accession No. ML21263A218).

WEC, 2021d Letter from C. Teague to South Carolina Department of Health and Environmental Control, dated January 28, 2021, regarding "Sanitary Lagoon Operable Unit Sludge Characterization Work Plan Remedial Investigation Addendum 3." LTR-RAC-21-12, Hopkins, South Carolina, (ADAMS Accession No. ML21187A316).

WEC, 2021e Letter from J. Ferguson to NRC, dated February 15, 2021, regarding "SNM-1107/70-1151 NRC Semi-Annual Discharge Report, July - December 2020." LTR-RAC-21-21, Hopkins, South Carolina, (ADAMS Accession No. ML21046A066).

WEC, 2021f Letter from J. Ferguson to NRC, dated August 25, 2021, regarding "SNM-1107/70-1151 NRC Semi-Annual Discharge Report January - June 2021." LTR-RAC-21-61, Hopkins, South Carolina, (ADAMS Accession No. ML21238A025).

WEC, 2021g Letter from E. Malek to NRC, dated February 8, 2021, "Request for Alternate Disposal Approval and Exemptions for Specific Columbia Fuel Fabrication Facility Waste," (ADAMS Accession No. ML21039A719)

WEC, 2021h Letter from E, Malek to NRC, dated June 1, 2021, "Request for Alternate Disposal Approval and Exemptions for Specific Columbia Fuel Fabrication Facility Waste," (ADAMS Accession No. ML21153A001)

WEC, 2021i Letter from E, Malek to NRC, dated September 14, 2021, "Request for Alternate Disposal Request Revised Scope Review and Approval," (ADAMS Accession No. ML21257A439)

WEC, 2021j Letter from E, Malek to NRC, dated November 5, 2021, "Request for Exemption Associated with Disposal of Specified Columbia Fuel Fabrication Facility Waste," (ADAMS Accession No. ML21309A095).

WEC, 2022 "Integrated Safety Analysis Summary," dated January 27, 2022, (ADAMS Accession No. ML22027A579).

WEC, 2022a. (n.d.). " Revised Sections of the Integrated Safety Analysis of the CFFF Site and Structures," March 21, 2022, ADAMS Accession No. ML22080A283.

WEC, 2022b. (n.d.). "Response to NRC Request for Additional Information associated with the SNM-1107 License Renewal Environmental Impact Statement," February 21, 2022, (ADAMS Accession No. ML22052A012).

WEC, 2022c. (n.d.). "Response to NRC Request for Additional Information associated with the SNM-1107 License Renewal Environmental Impact Statement," March 15, 2022, (ADAMS Accession No. ML22074A129).

WEC, 2022d. (n.d.). "Response to NRC Request for Additional Information associated with the SNM-1107 License Renewal Environmental Impact Statement," March 21, 2022, (ADAMS Accession No. ML22080A282).

WEC, 2022e Letter from J. Ferguson to NRC, dated February 24, 2022, regarding "SNM-1107/70-1151 NRC Semi-Annual Discharge Report July – December 2021. "LTR-RAC-22-17, Hopkins, South Carolina, (ADAMS Accession No. ML22059B021).

WEC, 2022f Correspondence from P. Donnelly to Jennifer Tobin Dated April 29, 2022," (ADAMS Accession No. ML22122A092).

WEC, 2022g "Triennial Decommissioning Funding Plan Review," May 9, 2022, (ADAMS Accession Nos. ML22129A154 and ML22129A155).

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