

6.0 Environmental Impacts of the Uranium Fuel Cycle and Solid Waste Management

Environmental issues associated with the uranium fuel cycle and solid waste management were discussed in the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS), NUREG-1437 (NRC 1996; 1999).^(a) The GEIS included a determination of whether the analysis of the environmental issue could be applied to all plants and whether additional mitigation measures would be warranted. Issues were then assigned a Category 1 or a Category 2 designation. As set forth in the GEIS, Category 1 issues are those that meet all of the following criteria:

- (1) The environmental impacts associated with the issue have been determined to apply either to all plants or, for some issues, to plants having a specific type of cooling system or other specified plant or site characteristics.
- (2) A single significance level (i.e., SMALL, MODERATE, or LARGE) has been assigned to the impacts (except for collective offsite radiological impacts from the fuel cycle and from high-level waste (HLW) and spent fuel disposal).
- (3) Mitigation of adverse impacts associated with the issue has been considered in the analysis, and it has been determined that additional plant-specific mitigation measures are likely not to be sufficiently beneficial to warrant implementation.

For issues that meet the three Category 1 criteria, no additional plant-specific analysis is required unless new and significant information is identified.

Category 2 issues are those that do not meet one or more of the criteria of Category 1, and therefore, additional plant-specific review for these issues is required.

This chapter addresses the issues that are related to the uranium fuel cycle and solid waste management during the license renewal term that are listed in 10 CFR Part 51, Subpart A, Appendix B, that are applicable to the Edwin I. Hatch Nuclear Plant (HNP), Units 1 and 2. The generic potential impacts of the radiological and non-radiological environmental impacts of the uranium fuel cycle and transportation of nuclear fuel and wastes are described in detail in the GEIS based, in part, on the generic impacts provided in 10 CFR 51.51(b), Table S-3, "Table of Uranium Fuel Cycle Environmental Data," and in 10 CFR 51.52(c), Table S-4, "Environmental Impact of Transportation of Fuel and Waste to and from One Light-Water-Cooled Nuclear

(a) The GEIS was originally issued in 1996. Addendum 1 to the GEIS was issued in 1999. All references to the "GEIS" include the GEIS and its Addendum 1.

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Power Reactor.” The GEIS also addresses the impacts from radon-222 and technetium-99. There are no Category 2 issues for the uranium fuel cycle and solid waste management.

6.1 The Uranium Fuel Cycle

Category 1 issues in 10 CFR Part 51, Subpart A, Appendix B, that are applicable to HNP from the uranium fuel cycle and solid waste management are listed in Table 6-1.

Table 6-1. Category 1 Issues Applicable to the Uranium Fuel Cycle and Solid Waste Management During the Renewal Term

ISSUE—10 CFR Part 51, Subpart A, Appendix B	GEIS Sections
URANIUM FUEL CYCLE AND WASTE MANAGEMENT	
Offsite radiological impacts (individual effects from other than the disposal of spent fuel and HLW)	6.1; 6.2.1; 6.2.2.1; 6.2.2.3; 6.2.3; 6.2.4; 6.6
Offsite radiological impacts (collective effects)	6.1; 6.2.2.1; 6.2.3; 6.2.4
Offsite radiological impacts (spent fuel and HLW disposal)	6.1; 6.2.2.1; 6.2.3; 6.2.4
Nonradiological impacts of the uranium fuel cycle	6.1; 6.2.2.6; 6.2.2.7; 6.2.2.8; 6.2.2.9; 6.2.3; 6.2.4; 6.6
Low-level waste storage and disposal	6.1; 6.2.2.2; 6.4.2; 6.4.3; 6.4.3.1; 6.4.3.2; 6.4.3.3; 6.4.4; 6.4.4.1; 6.4.4.2; 6.4.4.3; 6.4.4.4; 6.4.4.5; 6.4.4.5.1; 6.4.4.5.2; 6.4.4.5.3; 6.4.4.5.4; 6.4.4.6
Mixed waste storage and disposal	6.4.5.1; 6.4.5.2; 6.4.5.3; 6.4.5.4; 6.4.5.5; 6.4.5.6; 6.4.5.6.1; 6.4.5.6.2; 6.4.5.6.3; 6.4.5.6.4
Onsite spent fuel	6.1; 6.4.6; 6.4.6.1; 6.4.6.2; 6.4.6.3; 6.4.6.4; 6.4.6.5; 6.4.6.6; 6.4.6.7; 6.6
Nonradiological waste	6.1; 6.5; 6.5.1; 6.5.2; 6.5.3; 6.6
Transportation	6.1; 6.3.1; 6.3.2.3; 6.3.3; 6.3.4; 6.6, Addendum 1

1 Southern Nuclear Operating Company (SNC) stated in its Environmental Report (ER; SNC
2 2000) that it is not aware of any new and significant information associated with the renewal of
3 the HNP operating licenses (OLs). No significant new information has been identified by the
4 staff during its review. Therefore, the staff concludes that there are no impacts related to these
5 issues beyond those discussed in the GEIS. For all of those issues, the staff concluded in the
6 GEIS that the impacts are SMALL, and plant-specific mitigation measures are not likely to be
7 sufficiently beneficial to be warranted.

8
9 A brief description of the staff review and the GEIS conclusions, as codified in Table B-1, for
10 each of these issues follows:

- 11
12 • Offsite radiological impacts (individual effects from other than the disposal of spent fuel and
13 HLW). Based on information in the GEIS, the Commission found:

14
15 Off-site impacts of the uranium fuel cycle have been considered by the Commission in
16 Table S-3 of this part [10 CFR 51.51(b)]. Based on information in the GEIS, impacts on
17 individuals from radioactive gaseous and liquid releases including radon-222 and
18 technetium-99 are small.

19
20 The staff has not identified any significant new information during its independent review of
21 the SNC ER (SNC 2000), the staff's site visit, the scoping process, or its evaluation of other
22 available information. Therefore, the staff concludes that there are no offsite radiological
23 impacts of the uranium fuel cycle during the renewal term beyond those discussed in the
24 GEIS.

- 25
26 • Offsite radiological impacts (collective effects): Based on information in the GEIS, the
27 Commission found:

28
29 The 100 year environmental dose commitment to the U.S. population from the fuel
30 cycle, high level waste and spent fuel disposal is calculated to be about 14,800 person
31 rem [148 person Sv], or 12 cancer fatalities, for each additional 20-year power reactor
32 operating term. Much of this, especially the contribution of radon releases from mines
33 and tailing piles, consists of tiny doses summed over large populations. This same dose
34 calculation can theoretically be extended to include many tiny doses over additional
35 thousands of years as well as doses outside the U.S. The result of such a calculation
36 would be thousands of cancer fatalities from the fuel cycle, but this result assumes that
37 even tiny doses have some statistical adverse health effect which will not ever be
38 mitigated (for example no cancer cure in the next thousand years), and that these doses
39 projected over thousands of years are meaningful. However, these assumptions are

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1 questionable. In particular, science cannot rule out the possibility that there will be no
2 cancer fatalities from these tiny doses. For perspective, the doses are very small
3 fractions of regulatory limits, and even smaller fractions of natural background exposure
4 to the same populations.

5
6 Nevertheless, despite all the uncertainty, some judgement as to the regulatory NEPA
7 [National Environmental Policy Act] implications of these matters should be made and it
8 makes no sense to repeat the same judgement in every case. Even taking the
9 uncertainties into account, the Commission concludes that these impacts are acceptable
10 in that these impacts would not be sufficiently large to require the NEPA conclusion, for
11 any plant, that the option of extended operation under 10 CFR Part 54 should be
12 eliminated. Accordingly, while the Commission has not assigned a single level of
13 significance for the collective effects of the fuel cycle, this issue is considered
14 Category 1.

15
16 The staff has not identified any significant new information during its independent review of
17 the SNC ER (SNC 2000), the staff's site visit, the scoping process, or its evaluation of other
18 available information. Therefore, the staff concludes that there are no collective impacts of
19 the uranium fuel cycle during the renewal term beyond those discussed in the GEIS.

- 20
21 • Offsite radiological impacts (spent fuel and high-level waste disposal): Based on informa-
22 tion in the GEIS, the Commission found:

23
24 For the high level waste and spent fuel disposal component of the fuel cycle, there are
25 no current regulatory limits for offsite releases of radioactive nuclides for the current
26 candidate repository site. However, if we assume that limits are developed along the
27 lines of the 1995 National Academy of Sciences (NAS) report, "Technical Bases for
28 Yucca Mountain Standards," and that in accordance with the Commission's Waste
29 Confidence Decision, 10 CFR 51.23, a repository can and likely will be developed at
30 some site which will comply with such limits, peak doses to virtually all individuals will be
31 100 millirem [1 mSv] per year or less. However, while the Commission has reasonable
32 confidence that these assumptions will prove correct, there is considerable uncertainty
33 since the limits are yet to be developed, no repository application has been completed or
34 reviewed, and uncertainty is inherent in the models used to evaluate possible pathways
35 to the human environment. The NAS report indicated that 100 millirem [1 mSv] per year
36 should be considered as a starting point for limits for individual doses, but notes that
37 some measure of consensus exists among national and international bodies that the
38 limits should be a fraction of the 100 millirem [1 mSv] per year. The lifetime individual
39 risk from 100 millirem [1 mSv] annual dose limit is about 3×10^{-3} .

1 Estimating cumulative doses to populations over thousands of years is more
2 problematic. The likelihood and consequences of events that could seriously
3 compromise the integrity of a deep geologic repository were evaluated by the
4 Department of Energy in the "Final Environmental Impact Statement: Management of
5 Commercially Generated Radioactive Waste," October 1980 [DOE 1980]. The
6 evaluation estimated the 70-year whole-body dose commitment to the maximum
7 individual and to the regional population resulting from several modes of breaching a
8 reference repository in the year of closure, after 1,000 years, after 100,000 years, and
9 after 100,000,000 years. Subsequently, the NRC and other federal agencies have
10 expended considerable effort to develop models for the design and for the licensing of a
11 high level waste repository, especially for the candidate repository at Yucca Mountain.
12 More meaningful estimates of doses to population may be possible in the future as more
13 is understood about the performance of the proposed Yucca Mountain repository. Such
14 estimates would involve very great uncertainty, especially with respect to cumulative
15 population doses over thousands of years. The standard proposed by the NAS is a limit
16 on maximum individual dose. The relationship of the potential new regulatory require-
17 ments, based on the NAS report, and cumulative population impacts has not been
18 determined, although the report articulates the view that protection of individuals will
19 adequately protect the population for a repository at Yucca Mountain. However, EPA's
20 generic repository standards in 40 CFR part 191 generally provide an indication of the
21 order of magnitude of cumulative risk to population that could result from the licensing of
22 a Yucca Mountain repository, assuming the ultimate standards will be within the range of
23 standards now under consideration. The standards in 40 CFR part 191 protect the
24 population by imposing "containment requirements" that limit the cumulative amount of
25 radioactive material released over 10,000 years. Reporting performance standards that
26 will be required by EPA are expected to result in releases and associated health conse-
27 quences in the range between 10 and 100 premature cancer deaths with an upper limit
28 of 1,000 premature cancer deaths worldwide for a 100,000 metric tonne (MTHM)
29 repository.

30
31 Nevertheless, despite all the uncertainty, some judgement as to the regulatory NEPA
32 implications of these matters should be made and it makes no sense to repeat the same
33 judgement in every case. Even taking the uncertainties into account, the Commission
34 concludes that these impacts are acceptable in that these impacts would not be
35 sufficiently large to require the NEPA conclusion, for any plant, that the option of
36 extended operation under 10 CFR part 54 should be eliminated. Accordingly, while the
37 Commission has not assigned a single level of significance for the impacts of spent fuel
38 and high level waste disposal, this issue is considered Category 1.

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1 The staff has not identified any significant new information during its independent review of
2 the SNC ER (SNC 2000), the staff's site visit, the scoping process, or its evaluation of other
3 available information. Therefore, the staff concludes that there are no collective impacts of
4 the uranium fuel cycle during the renewal term beyond those discussed in the GEIS.

- 5
6 • Nonradiological impacts of the uranium fuel cycle: Based on information in the GEIS, the
7 Commission found: "The nonradiological impacts of the uranium fuel cycle resulting from
8 the renewal of an operating license for any plant are found to be small." The staff has not
9 identified any significant new information during its independent review of the SNC ER
10 (SNC 2000), the staff's site visit, the scoping process, or its evaluation of other available
11 information. Therefore, the staff concludes that there are no nonradiological impacts of the
12 uranium fuel cycle during the renewal term beyond those discussed in the GEIS.
13
- 14 • Low-level waste storage and disposal: Based on information in the GEIS, the Commission
15 found:

16
17 The comprehensive regulatory controls that are in place and the low public doses being
18 achieved at reactors ensure that the radiological impacts to the environment will remain
19 small during the term of a renewed license. The maximum additional on-site land that
20 may be required for low-level waste storage during the term of a renewed license and
21 associated impacts will be small. Nonradiological impacts on air and water will be
22 negligible. The radiological and nonradiological environmental impacts of long-term
23 disposal of low-level waste from any individual plant at licensed sites are small. In
24 addition, the Commission concludes that there is reasonable assurance that sufficient
25 low-level waste disposal capacity will be made available when needed for facilities to be
26 decommissioned consistent with NRC decommissioning requirements.

27
28 The staff has not identified any significant new information during its independent review of
29 the SNC ER (SNC 2000), the staff's site visit, the scoping process, or its evaluation of other
30 available information. Therefore, the staff concludes that there are no impacts of low-level
31 waste storage and disposal associated with the renewal term beyond those discussed in the
32 GEIS.

- 33
- 34 • Mixed waste storage and disposal: Based on information in the GEIS, the Commission
35 found:

36
37 The comprehensive regulatory controls and the facilities and procedures that are in
38 place ensure proper handling and storage, as well as negligible doses and exposure to
39 toxic materials for the public and the environment at all plants. License renewal will not
40 increase the small, continuing risk to human health and the environment posed by mixed

1 waste at all plants. The radiological and nonradiological environmental impacts of long-
2 term disposal of mixed waste from any individual plant at licensed sites are small. In
3 addition, the Commission concludes that there is reasonable assurance that sufficient
4 mixed waste disposal capacity will be made available when needed for facilities to be
5 decommissioned consistent with NRC decommissioning requirements.
6

7 The staff has not identified any significant new information during its independent review of
8 the SNC ER (SNC 2000), the staff's site visit, the scoping process, or its evaluation of other
9 available information. Therefore, the staff concludes that there are no impacts of mixed
10 waste storage and disposal associated with the renewal term beyond those discussed in the
11 GEIS.
12

- 13 • Onsite spent fuel: Based on information in the GEIS, the Commission found: "The
14 expected increase in the volume of spent fuel from an additional 20 years of operation can
15 be safely accommodated on site with small environmental effects through dry or pool
16 storage at all plants if a permanent repository or monitored retrievable storage is not
17 available." The staff has not identified any significant new information during its independ-
18 ent review of the SNC ER (SNC 2000), the staff's site visit, the scoping process, or its
19 evaluation of other available information. Therefore, the staff concludes that there are no
20 impacts of onsite spent fuel associated with license renewal beyond those discussed in the
21 GEIS.
22
- 23 • Nonradiological waste: Based on information in the GEIS, the Commission found: "No
24 changes to generating systems are anticipated for license renewal. Facilities and
25 procedures are in place to ensure continued proper handling and disposal at all plants."
26 The staff has not identified any significant new information during its independent review of
27 the SNC ER (SNC 2000), the staff's site visit, the scoping process, or its evaluation of other
28 available information. Therefore, the staff concludes that there are no nonradiological
29 waste impacts during the renewal term beyond those discussed in the GEIS.
30
- 31 • Transportation: Based on information contained in the GEIS, the Commission found:
32
33 The impacts of transporting spent fuel enriched up to 5 percent uranium-235 with
34 average burnup for the peak rod to current levels approved by NRC up to
35 62,000 MWd/MTU and the cumulative impacts of transporting high-level waste to a
36 single repository, such as Yucca Mountain, Nevada are found to be consistent with the
37 impact values contained in 10 CFR 51.52(c), Summary Table S-4—Environmental
38 Impact of Transportation of Fuel and Waste to and from One Light-Water-Cooled
39 Nuclear Power Reactor. If fuel enrichment or burnup conditions are not met, the

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1 applicant must submit an assessment of the implications for the environmental impact
2 values reported in §51.52.

3
4 HNP meets the fuel enrichment and burnup conditions set forth in Addendum 1 to the GEIS.
5 The staff has not identified any significant new information during its independent review of
6 the SNC ER (SNC 2000), the staff's site visit, the scoping process, or its evaluation of other
7 available information. Therefore, the staff concludes that there are no impacts of
8 transportation associated with license renewal beyond those discussed in the GEIS.
9

10 6.2 References

11
12 10 CFR 51.23, "Temporary storage of spent fuels after cessation of reactor operation—generic
13 determination of no significant environmental impact."

14
15 10 CFR 51.51(b), Table S-3, "Uranium fuel cycle environmental data."

16
17 10 CFR 51.52(c), Table S-4, "Environmental effects of transportation of fuel and waste to and
18 from one light-water cooled nuclear power reactor."

19
20 10 CFR Part 51, Subpart A, Appendix B, "Environmental effects of renewing the operating
21 license of a nuclear power plant."

22
23 10 CFR Part 54, "Requirements for Renewal of Operating Licenses for Nuclear Power Plants."

24
25 40 CFR Part 191, "Environmental Radiation Protection Standards for Management and
26 Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Waste."

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28 National Academy of Sciences (NAS). 1995. *Technical Bases for Yucca Mountain Standards*.
29 Washington, D.C.

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31 National Environmental Policy Act (NEPA) of 1969, as amended, 42 USC 4321, et seq.

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33 Southern Nuclear Operating Company (SNC). 2000. *Application for License Renewal for the*
34 *Edwin I. Hatch Nuclear Plant Units 1 and 2. Appendix D Applicant's Environmental*
35 *Report—Operating License Renewal Stage Edwin I. Hatch Nuclear Plant*.

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37 U.S. Department of Energy (DOE). 1980. *Final Environmental Impact Statement:*
38 *Management of Commercially Generated Radioactive Waste*. DOE/EIS 00046-G, Vols. 1-3,
39 Washington, D.C.
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1 U.S. Nuclear Regulatory Commission (NRC). 1996. *Generic Environmental Impact Statement*
2 *for License Renewal of Nuclear Plants*. NUREG-1437, Washington, D.C.

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4 U.S. Nuclear Regulatory Commission (NRC). 1999. *Generic Environmental Impact Statement*
5 *to License Renewal of Nuclear Plants, Main Report, Section 6.3 - Transportation, Table 9.1,*
6 *Summary of findings on NEPA issues for license renewal of nuclear power plants.*

7 NUREG-1437, Vol. 1, Addendum 1, Washington, D.C.

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