SOUTHERN COMPANY

Radiological Impacts

Phil Young
Tetra Tech

Phil Young

- Professional Experience
  - Over 17 years experience assessing environmental impacts of nuclear facilities, managing NEPA documents, and performing radiological human health and ecological risk assessments.
  - Served as Project Manager for SRS High Level Waste Tank Closure EIS (DOE/EIS-0303)
  - Served as Radiological Health, Safety, and Accident Manager for Modern Pit Facility EIS
  - Served as Project Manager for SRS Spent Nuclear Fuel Management EIS (DOE/EIS-0279)
  - Currently Project Manager/Health Physicist – Tetra-Tech NUS – Aiken, SC

- Education
  - B.S., Radiation Health (Health Physics), Oregon State University 1989
  - M.S., Health Physics, Georgia Institute of Technology, 1989
  - Certified Health Physicist, American Board of Health Physics, 1995 (recertification 2007)

SNC Exhibit SNC000071

Radiological Impacts of Normal Operations

- Regulatory requirements
  - 10 CFR 50 Appendix I
  - 10 CFR 20.1301(a)
  - 40 CFR 190

Radiological Impacts of Normal Operations

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Maximally Exposed Individual (MEI)

A hypothetical individual who, because of proximity, activities, or living habits, could potentially receive the maximum possible dose of radiation. Calculated as residing at the site boundary.

NRC RegGuide 1.109, Appendix I, Rev.1, Oct.1977

Radiological Impacts of Normal Operations

Population Dose

- The dose to the population living within a 50 mile radius of the proposed facility.

  NRC RegGuide 1.109, Appendix I, Rev.1, Oct.1977

Dose to Population and Maximally Exposed Individual (MEI)

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- Radiological Sources
  - Liquid Effluent
  - Gaseous Effluent
  - Direct Radiation

Liquid Effluent Dose to MEI

- Exposure Pathways Considered
  - Ingestion of Aquatic Food
  - Ingestion of Drinking Water
  - Direct Radiation Exposure from Shoreline Activities

Exhibit SNC000072

Liquid Effluent Population Dose

- Exposure Pathways Considered
  - Ingestion of Aquatic Food
  - Direct Radiation Exposure from Shoreline, Swimming and Boating Activities

Exhibit SNC000072

(Drinking water was not evaluated because most recent land-use census showed no drinking water use of the river within 100 miles downstream of the site)

Liquid Pathway Doses

- Calculated using LADTAP II computer program
- Liquid effluent release estimates derived from data provided in Westinghouse DCD Rev 15

Additional LADTAP II inputs

- Effluent Discharge Rate
- Dilution Factor for Discharge
- Transit Time to Receptor
- Consumption and Usage Factors (Fish and Drinking Water)

Gaseous Effluent Dose to the MEI

- Exposure Pathways Considered
  - Immersion in Radioactive Plume
  - Direct Exposure from Deposited Radioactivity
  - Inhalation
  - Ingestion of Garden Fruit and Vegetables
  - Ingestion of Beef

NRC RegGuide 1.109, Appendix I, Rev.1, Oct.1977 and NRC RegGuide 1.11, Rev.1, July 1977

(Dose from milk ingestion was not evaluated because most recent land-use census indicated that no milk cows existed within 5 miles of the site)

Gaseous Effluents Population Dose

- Exposure Pathways Considered
  - Immersion in Radioactive Plume
  - Direct Exposure from Deposited Radioactivity
  - Inhalation
  - Ingestion of Garden Fruit and Vegetables
  - Ingestion of Beef
  - Ingestion of Cows Milk

NRC RegGuide 1.109, Appendix I, Rev.1, Oct.1977 and NRC RegGuide 1.11, Rev.1, July 1977

Gaseous Pathway Doses

- Calculated Using GASPAR II Computer Program
- Gaseous effluent release estimates derived from data provided in Westinghouse DCD Rev 15

Additional GASPAR II inputs

- Population Data
- Atmospheric Dispersion Factors
- Ground Deposition Factors
- Receptor Locations
- Consumption Factors

Calculated Doses to Maximally Exposed Individual

Table 5-9. Comparison of Maximally Exposed Individual Dose Estimates for a Single New Nuclear Unit from Liquid and Gaseous Effluents to 10 CFR Part 50, Appendix I, Design Objectives

Pathway/Type of Dose	Southern (2007a)[a]	Appendix I Design Objectives[a]
Liquid Effluents		
Total body dose	0.00017 mSv/yr (adult)	0.03 mSv/yr
Maximum organ dose	0.00021 mSv/yr (child liver)	0.1 mSv/yr
Gaseous Effluents (Noble gases only)		
Gamma air dose	0.0068 mGy/yr	0.1 mGy/yr
Beta air dose	0.0284 mGy/yr	0.2 mGy/yr
Total body dose	0.0056 mSv/yr	0.05 mSv/yr
Skin dose	0.0230 mSv/yr	0.15 mSv/yr
Gaseous Effluents (Radioiodines and particulates)		
Organ dose	0.0591 mSv/yr (child thyroid)	0.15 mSv/yr

(a) Multiply mSv/yr or mGy/yr times 100 to obtain mrem/yr or mrad/yr.
Source: Southern 2008a, 10 CFR Part 50 Appendix I.

FEIS Table 5-9

Calculated Doses to the Population

- Total Body Dose 1.837 person-rem/yr
- Natural Background 2.43 x 10^3 person-rem/yr

FEIS Section 5.9.2 ,Table 5.9
SNC 000001, section 5.4.2, 5.4.3, Table 5.4-8

Direct Radiation – Dose to MEI and Population

- Primary Sources Considered
  - Reactor Buildings
  - Independent Spent Fuel Storage Installation (ISFSI)

FEIS Section 4.9.1 analysis based on SNC000072

Direct Radiation – Dose to MEI and Population

- Data taken from Unit 1&2 TLD results from 1992-2001
- Range of average annual direct exposure
  - Control Stations 48.4 to 54.4 mR
  - Indicator Stations 48.0 to 54.4 mR

Cumulative Impacts

- Vogtle Units 1 & 2
- Vogtle Units 3 & 4
- Savannah River Site
- MOX facility (proposed)

Estimated Cumulative Impacts

MEI - 2.9 mrem/yr

Population Dose - 30 person-rem/yr

Exhibit SNC000001, section 10.5, FEIS Section 7.8

Environmental Impact of Postulated Accidents

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Design Basis Accidents (DBAs)

- DBAs derived from Rev 15 of Westinghouse DCD
  - Consequences of DBAs depend on:
    - Specific radionuclide released
    - Amount of each radionuclide released
    - Meteorological conditions
- Source terms and method for evaluation based on RegGuide 1.183
- X/Q methodology based on RegGuide 1.145

Environmental Impact of Postulated Accidents

- DBA dose at EAB calculated for short term using 2 hour dose and X/Q values
- DBA dose for LPZ calculated longer term (entire term of accident ~30 days (720 hours))
- DBA dose presented as TEDE in REM using site specific meteorology
- In all cases, TEDE doses are considerably smaller than NRC review criteria ***FEIS Section 5.10.1, Table 5-14***
- FEIS concludes that environmental consequences from dose associated with DBAs are SMALL ***FEIS Section 5.10.1***

Environmental Impact of Postulated Accidents

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Severe Accidents

- Defined as accidents beyond DBA with substantial damage to the reactor core and degradation of containment *(ER Section 7.2, Ref. NRC Policy Statement on Severe Reactor Accidents Regarding Future Designs and Existing Plants, 1985)*
- Westinghouse completed PRA in DCD Rev 15 using generic meteorology and regional characteristics *(Design Control Document (DCD) for AP-1000, Revision 15)*
- SNC ER analysis provides update of generic analysis to include site specific characteristics and impacts over entire life cycle of a severe accident *(ER Section 7.2)*
- This analysis discloses the complete impacts of a severe accident, demonstrates it is bounded by the DCD, and supports future SAMA analysis

Environmental Impact of Postulated Accidents

- SNC considers three primary pathways to analyze the consequences of severe accidents.
  - Air
  - Surface water
  - Groundwater
- MACCS2 Code used to model most releases
- MACCS2 code focuses on atmospheric releases, including deposition and considers these pathways
  - Exposure to passing plume
  - Exposure to material deposited on surfaces and on skin
  - Inhalation of plume or re-suspended material
  - Ingestion of contaminated food or water

Environmental Impact of Postulated Accidents

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- MACCS2 does not consider fishing, swimming, or groundwater pathways; GEIS used to provide this information
- Three types of Severe Accident consequences assessed
  - Human health
  - Economic costs
  - Land area affected by contamination

Environmental Impact of Postulated Accidents

- Human health consequences expressed in terms of risk where risk is the product of accident frequency (probability) and consequences (accident dose)
- Risks determined to be SMALL for all risk categories considered
- In addition to individual (acute and latent cancer risk) and population risk, NRC also determines average individual fatalities risks and compares them to the Safety Goal Policy Statement (51 FR 30028)
- Comparison in FEIS Table 5-16 confirms VEGP risks are well below risks defined in NUREG 1150 and well below NRC Safety Goal Policy values.

Environmental Impact of Postulated Accidents

- FEIS concludes that environmental risks from Probability-weighted consequences of a Severe Accident at VEGP Units 3 and 4 are SMALL ***FEIS Section 5.10.2***
- Severe Accident Mitigation Design Alternatives (SAMDAs) will be addressed in separate presentation by NRC

QUESTIONS