Appendix A

Applicable Guidelines, Standards, and Regulations

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THE Savannah River Site (SRS) environmental monitoring program is designed to meet state and federal regulatory requirements for radiological and nonradiological programs. These requirements are stated in U.S. Department of Energy (DOE) Order 5400.5, "Radiation Protection of the Public and the Environment"; in the Clean Air Act [Standards of Performance for New Stationary Sources, also referred to as New Source Performance Standards, and the National Emission Standards for Hazardous Air Pollutants (NESHAP)]; in the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA—also known as Superfund); in the Resource Conservation and Recovery Act (RCRA); in the Clean Water Act (i.e., National Pollutant Discharge Elimination System—NPDES); and in the National Environmental Policy Act (NEPA). Compliance with environmental requirements is assessed by DOE–Savannah River Operations Office (DOE–SR), the South Carolina Department of Health and Environmental Control (SCDHEC), and the U.S. Environmental Protection Agency (EPA).

The SRS environmental monitoring program's objectives incorporate recommendations of

- the International Commission on Radiological Protection (ICRP) in *Principles of Monitoring for the Radiation Protection of the Public*, ICRP Publication 43
- DOE Order 5400.5
- DOE/EH–0173T, "Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance"

Detailed information about the site's environmental monitoring program is documented in Section 1100 (SRS Environmental Monitoring Program) of the *SRS Environmental Monitoring Section Plans and Procedures*, WSRC–3Q1–2, Volume 1. This document is reviewed annually and updated every 3 years.

SRS has implemented and adheres to the SRS Environmental Management System (EMS) Policy. Implementation of a formal EMS, such as that described in the International Organization for Standardization (ISO) 14001 standard, is an Executive Order 13148 ("Greening the Government Through Leadership in Environmental Management") and DOE Order 450.1 ("Environmental Protection Program") requirement. SRS maintains an EMS that fully meets the requirements of ISO 14001. The full text of the SRS EMS Policy appears in chapter 2.

Drinking water standards (DWS) can be found at http://www.epa.gov/safewater/standards.html on the Internet, and maximum allowable concentrations of toxic air pollutants can be found at http://www.scdhec.net/baq/. More information about certain media is presented in this appendix.

Air Effluent Discharges

DOE Order 5400.5 establishes Derived Concentration Guides (DCGs) for radionuclides in air. DCGs, calculated by DOE using methodologies consistent with recommendations found in ICRP publications 26 *(Recommendations of the International Commission on Radiological Protection)* and 30 *(Limits for Intakes of Radionuclides by Workers)*, are used as reference concentrations for conducting environmental protection programs at DOE sites. DCGs are not considered release limits. DCGs for radionuclides in air are discussed in more detail on page 116.

Radiological airborne releases also are subject to EPA regulations cited in 40 CFR 61, "National Emission Standards for Hazardous Air Pollutants," Subpart H ("National Emission Standards for Emissions of Radionuclides Other Than Radon from Department of Energy Facilities").

Regulation of radioactive and nonradioactive air emissions—both criteria pollutants and toxic air pollutants—has been delegated to SCDHEC. Therefore, SCDHEC must ensure that its air pollution regulations are at least as stringent as federal regulations required by the Clean Air Act. This is accomplished by SCDHEC Regulation 61–62, "Air Pollution Control Regulations and Standards." As with many regulations found in the Code of Federal Regulations (CFR), many of SCDHEC's regulations and standards are source specific. Each source of air pollution at SRS is permitted or exempted by SCDHEC, with specific emission rate limitations or special conditions identified. The bases for the limitations and conditions are the applicable South Carolina air pollution control regulations and standards. In some cases, specific applicable CFRs also are cited in the permits issued by SCDHEC. The applicable SCDHEC regulations are too numerous to discuss here, so only the most significant are listed.

Two SCDHEC standards, which govern criteria and toxic air pollutants and ambient air quality, are applicable to all SRS sources. Regulation 61–62.5, Standard No. 2, "Ambient Air Quality Standards," identifies eight criteria air pollutants commonly used as indices of air quality (e.g., sulfur dioxide, nitrogen dioxide, and lead) and provides allowable site boundary concentrations for each pollutant, as well as the measuring intervals. Compliance with the various pollutant standards is determined by conducting air dispersion modeling for all sources of each pollutant, using EPA-approved dispersion models and then comparing the results to the standard. The pollutants, measuring intervals, and allowable concentrations are provided in table A–1. The standards are in micrograms per cubic meter, unless noted otherwise.

Toxic air pollutants can be found at http://www.scdhec.net/baq/.

A total of 258 toxic air pollutants and their respective allowable site boundary concentrations are identified in Regulation 61–62.5, Standard No. 8, "Toxic Air Pollutants." As with Standard No. 2, compliance is determined by air dispersion modeling.

SCDHEC airborne emission standards for each SRS permitted source may differ, based on size and type of facility, type and amount of expected emissions, and the year the facility was placed into operation. For example, SRS powerhouse coal-fired boilers are regulated

Table A–1
Criteria Air Pollutants

Pollutant	Interval	Unit [a,b]
Sulfur Dioxide	3 hours	1,300 µg/m^3 [c]
	24 hours	365 µg/m^3 [c]
	annual	80 µg/m^3
Total Suspended Particulates	annual geometric mean	75 µg/m3
PM_{10}	24 hours	150 µg/m^3 [d]
	annual	50 µg/m^3 [d]
$PM_{2.5}$ (Primary and Secondary Standards)	24 hours	65 µg/m^3 [d]
	annual	15 µg/m^3 [d]
Carbon Monoxide	1 hour	40 mg/m^3
	8 hours	10 mg/m^3
Ozone	8 hours	0.08ppm[d]
Gaseous Fluorides (as HF)	12-hour average	3.7 µg/m^3
	24-hour average	2.9 µg/m^3
	1-week average	1.6 µg/m^3
	1-month average	0.8 µg/m^3
Nitrogen Dioxide	annual	100 µg/m^3
Lead	calendar quarterly mean	1.5 µg/m^3

[a] Arithmetic average except in case of total suspended particulate matter
[b] At 25 °C and 760 mm Hg
[c] Not to be exceeded more than once a year
[d] Attainment determinations will be made based on the criteria contained in 40 CFR50, appendices H, I, K, and N.

by Regulation 61–62.5, Standard No. 1, "Emissions from Fuel Burning Operations." This standard specifies that for powerhouse stacks built before February 11, 1971, the opacity limit is 40 percent. For new sources constructed after this date, the opacity limit typically is 20 percent. The standards for particulate and sulfur dioxide emissions are shown in table A–2.

Regulation 61–62.5, Standard No. 4, "Emissions from Process Industries," is applicable to all SRS sources except those regulated by a different source-specific standard. For some SRS sources, particulate matter emission limits depend on the weight of the material being processed and are determined from a table in the regulation. For process and diesel engine stacks in existence on or before December 31, 1985, emissions shall not exhibit an opacity

Table A–2
Airborne Emission Limits for SRS Coal-Fired Boilers

Sulfur Dioxide	3.5 lb/10^6 Btu[a]
Total Suspended Particulates	0.6 b/10^6 Btu
Opacity	40%

[a] British thermal unit

Table A–3
Airborne Emission Limits for SRS Fuel Oil-Fired Package Boilers

Sulfur Dioxide	0.5 lb/10^6 Btu[a]
Total Suspended Particulates	0.6 b/10^6 Btu
Opacity	20%

[a] British thermal unit

greater than 40 percent. For new sources, where construction began after December 31, 1985, the opacity limit is 20 percent.

As previously mentioned, some SRS sources have both SCDHEC and CFRs applicable and identified in their permits. For the package steam generating boilers in K-Area and two portable package boilers, both SCDHEC and federal regulations are applicable. The standard for sulfur dioxide emissions is specified in 40 CFR 60, Subpart Dc, "Standards of Performance for Small Industrial-Commercial-Institutional Steam Generating Units," while the standard for particulate matter is found in Regulation 61–62.5, Standard No. 1.

Because these units were constructed after applicability dates found in both regulations, the opacity limit for the units is the same in both regulations. The emissions standards for these boilers are presented in table A–3.

(Process) Liquid Effluent Discharges

DOE Order 5400.5 establishes DCGs for radionuclides in process effluents. (DCGs for radionuclides in liquid are discussed in more detail on page 75.) DCGs were calculated by DOE using methodologies consistent with recommendations found in ICRP, 1987, and ICRP, 1979, and are used

- as reference concentrations for conducting environmental protection programs at DOE sites
- as screening values for considering best available technology for treatment of liquid effluents

DOE Order 5400.5 exempts aqueous tritium releases from best available technology requirements but not from ALARA (as low as reasonably achievable) considerations.

Three NPDES permits are in place that allow SRS to discharge water into site streams and the Savannah River: one industrial wastewater permit (SC0000175) and two stormwater runoff permits (SCR000000 for industrial discharges and SCR100000 for construction discharges).

A fourth permit (ND0072125) is a no-discharge water- pollution-control land application permit that regulates sludge generated at onsite sanitary waste treatment plants.

Detailed requirements for each permitted discharge point—including parameters sampled for, permit limits for each parameter, sampling frequency, and method for collecting each sample—can be found in the individual permits, which are available to the public through SCDHEC's Freedom of Information Office at 803–898–3882.

Site Streams

SRS streams are classified as "Freshwaters" by South Carolina Regulation 61–69, "Classified Waters." Freshwaters are defined in Regulation 61–68, "Water Classifications and Standards," as surface water suitable for

- primary- and secondary-contact recreation and as a drinking water source after conventional treatment in accordance with SCDHEC requirements
- fishing and the survival and propagation of a balanced indigenous aquatic community of fauna and flora
- industrial and agricultural uses

Table A–4 provides some of the specific South Carolina freshwater standards used in water quality surveillance, but because some of these standards are not quantifiable, they are not tracked in response form (i.e., amount of garbage found).

Savannah River

Because the Savannah River is defined under South Carolina Regulation 61–69 as a freshwater system, the river is regulated in the same manner as site streams (table A–4).

Drinking Water

The federal Safe Drinking Water Act—enacted in 1974 to protect public drinking water supplies—was amended in 1977, 1979, 1980, 1986, and 1996.

SRS drinking water systems are tested routinely by SRS and SCDHEC to ensure compliance with SCDHEC State Primary Drinking Water Regulations (R61–58) and EPA National Primary Drinking Water Regulations (40 CFR 141).

SRS drinking water is supplied by 17 separate systems, all of which utilize groundwater sources. The A-Area, D-Area, and K-Area systems are actively regulated by SCDHEC, while the remaining 14 site water systems receive a reduced level of regulatory oversight.

D-Area and K-Area were sampled in 2006 for lead and copper, and neither system exceeded the lead and copper action levels. The A-Area system will be resampled for lead and copper in 2007.

DWS for specific radionuclides and contaminants can be found on the Internet at http://www.epa.gov/safewater/standards.html.

Although the B-Area Bottled Water Facility is not listed by SCDHEC as a public water system, SCDHEC's Division of Food Protection will continue to conduct periodic inspections of this facility. Results

Table A–4
South Carolina Water Quality Standards for Freshwaters[a]

Parameters	Standards
Fecal coliform	Not to exceed a geometric mean of 200/100 mL, based on five consecutive samples during any 30-day period; nor shall more than 10 percent of the total samples during any 30-day period exceed 400/100 mL
pH	Range between 6.0 and 8.5
Temperature	Generally, shall not be increased more than 5°F (2.8°C) above natural temperature conditions or be permitted to exceed a maximum of 90°F (32.2°C) as a result of the discharge of heated liquids; for more details, see E.12, Regulation 61–68, "Water Classifications and Standards" (June 25, 2004)
Dissolved oxygen	Daily average not less than 5.0 mg/L, with a low of 4.0 mg/L
Garbage, cinders, ashes, sludge, or other refuse	None allowed
Treated wastes, toxic wastes, deleterious substances, colored or other wastes, except in the parameter immediately above	None alone or in combination with other substances of wastes in sufficient amounts to make the waters unsafe or unsuitable for primary-contact recreation or to impair the waters for any other best usage as determined for the specific waters assigned to this class
Toxic pollutants listed in South Carolina Regulation 61–68, "Water Classifications and Standards"	See Appendix: Water Quality Numeric Criteria for the Protection of Aquatic Life and Human Health, Regulation 61–68, "Water Classifications and Standards" (June 25, 2004)

[a] This is a partial list of water quality standards for freshwaters.

SOURCE: SCDHEC, 2004

from quarterly bacteriological and annual complete chemical analyses performed in 2006 met SCDHEC and FDA water quality standards.

Groundwater

Groundwater is a valuable resource and is the subject of both protection and cleanup programs at SRS. More than 1,000 wells are monitored each year at the site for a wide range of constituents. Monitoring in the groundwater protection program is performed to detect new or unknown contamination across the site, and monitoring in the groundwater cleanup program is performed to meet the requirements of state and federal laws and regulations. Most of the monitoring in the cleanup program is governed by SCDHEC's administration of RCRA regulations.

The analytical results of samples taken from SRS monitoring wells are compared to various standards. The most common are final federal primary DWS—or other standards if DWS do not exist. The DWS are considered first because groundwater aquifers are defined

as potential drinking water sources by the South Carolina Pollution Control Act. DWS can be found at http://www.epa.gov/safewater/standards.html on the Internet. Other standards sometimes are applied by regulatory agencies to the SRS waste units under their jurisdiction. For example, standards under RCRA can include DWS, groundwater protection standards, background levels, or alternate concentration limits.

SRS responses to groundwater analytical results require careful evaluation of the data and relevant standards. Results from two constituents having DWS—dichloromethane and bis (2–ethylhexyl) phthalate—are evaluated more closely than other constituents and are commonly dismissed. Both are common laboratory contaminants and are reported in groundwater samples with little or no reproducibility. Both are reported, with appropriate flags and qualifiers, in detailed groundwater monitoring results that can be obtained by contacting the manager of the Washington Savannah River Company (WSRC) Environmental Permitting and Monitoring (EPM) group at 803–952–6931. Also, the SCDHEC standard used for lead is 50 µg/L. The federal standard of 15 µg/L is a treatment standard for drinking water at the consumer's tap.

The regulatory standards for radionuclide discharges from industrial and governmental facilities are set under the Clean Water Act and under Nuclear Regulatory Commission and DOE regulations. In addition, radionuclide cleanup levels are included in the site RCRA permit under the authority of the South Carolina Pollution Control Act. The proposed drinking water maximum contaminant levels (MCLs) discussed in this report are only an adjunct to these release restrictions and are not used to regulate SRS groundwater.

Many potential radionuclide contaminants are beta emitters. The standard used for gross beta is a screening standard; when public drinking water exceeds this standard, the supplier is expected to analyze for individual beta and gamma emitters. A gross beta result above the standard is an indication that one or more radioisotopes are present in quantities that would exceed the EPA annual dose equivalent for persons consuming 2 liters daily. Thus, for the individual beta and gamma radioisotopes (other than strontium-90 and tritium), the standard considered is the activity per liter that would, if only that isotope were present, exceed the dose equivalent. Similarly, the standards for alpha emitters are calculated to present the same risk at the same rate of ingestion.

The element radium has several isotopes of concern in groundwater monitoring. Although radium has a DWS of 5 pCi/L for the sum of radium-226 and radium-228, the isotopes have to be measured separately, and the combined numbers may not be representative of the total. Radium-226, an alpha emitter, and radium-228, a beta emitter, cannot be analyzed by a single method. Analyses for total alpha-emitting radium, which consists of radium-223, radium-224, and radium-226, are compared to the standard for radium-226.

Four other constituents without DWS are commonly used as indicators of potential contamination in wells.

These constituents are

- specific conductance at values equal to or greater than 100 µS/cm
- alkalinity (as CaCO3) at values equal to or greater than 120 mg/L
- total dissolved solids (TDS) at values equal to or greater than 500 mg/L
- pH at values equal to or less than 6.5 or equal to or greater than 8.5

The selection of these values as standards for comparison is somewhat arbitrary; however, the values exceed levels usually found in background wells at SRS. The occurrence of elevated alkalinity (as CaCO3), specific conductance, pH, and TDS within a single well also may indicate leaching of the grouting material used in well construction, rather than degradation of the groundwater.

Potential Dose

The radiation protection standards followed by SRS are outlined in DOE Order 5400.5 and include EPA regulations on the potential doses from airborne releases and treated drinking water.

The following radiation dose standards for protection of the public in the SRS vicinity are specified in DOE Order 5400.5:

Drinking Water Pathway.....4 mrem per year
Airborne Pathway.....10 mrem per year
All Pathways .....100 mrem per year

The EPA annual dose standard of 10 mrem (0.1 mSv) for the atmospheric pathway, which is contained in 40 CFR 61, Subpart H, is adopted in DOE Order 5400.5.

These dose standards are based on recommendations of the ICRP and the National Council on Radiation Protection and Measurements.

The DOE dose standard enforced at SRS for drinking water is consistent with the criteria contained in "National Interim Primary Drinking Water Regulations, 40 CFR Part 141." Under these regulations, persons consuming drinking water shall not receive an annual total body or organ dose—DOE Order 5400.5 interprets this dose as committed effective dose equivalent—of more than 4 mrem (0.04 mSv).

In 2000, EPA promulgated 40 CFR, Parts 9, 141, and 142, "National Primary Drinking Water Regulations; Radionuclides; Final Rule." This rule, which is applicable only to community drinking water systems, finalized MCLs for radionuclides, including uranium. In essence, it reestablishes the MCLs from EPA's original 1976 rule. Most of these MCLs are derived from dose conversion factors that are based on early ICRP–2 methods.

However, when calculating dose, SRS must use the more current ICRP–30-based dose conversion factors provided by DOE. Because they are based on different methods, most EPA and DOE radionuclide dose conversion factors differ. Therefore, a direct comparison of the drinking water doses calculated for showing compliance with DOE Order 5400.5 to the EPA drinking water MCLs cannot be made.

Comparisons of Average Concentrations in Airborne Emissions to DOE Derived Concentration Guides

Average concentrations of radionuclides in airborne emissions are calculated by dividing the yearly release total of each radionuclide from each stack by the yearly stack flow quantities. These average concentrations then can be compared to the DOE DCGs, which are found in DOE Order 5400.5 for each radionuclide.

DCGs are used as reference concentrations for conducting environmental protection programs at all DOE sites. DCGs, which are based on a 100-mrem exposure, are applicable at the point of discharge (prior to dilution or dispersion) under conditions of continuous exposure (assumed to be an average inhalation rate of 8,400 cubic meters per year). This means that the DOE DCGs are based on the highly conservative assumption that a member of the public has direct access to, and continuously breathes (or is immersed in), the actual air effluent 24 hours a day, 365 days a year. However, because of the large distance between most SRS operating facilities and the site boundary, this scenario is improbable.

Average annual radionuclide concentrations in SRS air effluent can be referenced to DOE DCGs as a screening method to determine if existing effluent treatment systems are proper and effective.

Comparison of Average Concentrations in Liquid Releases to DOE Derived Concentration Guides

In addition to dose standards, DOE Order 5400.5 imposes other control considerations on liquid releases. These considerations are applicable to direct discharges but not to seepage basin and Solid Waste Disposal Facility migration discharges. The DOE order lists DCG values for most radionuclides. DCGs are used as reference concentrations for conducting environmental protection programs at all DOE sites. These DCG values are not release limits but screening values for best-available-technology investigations and for determining whether existing effluent treatment systems are proper and effective.

Per DOE Order 5400.5, exceedance of the DCGs at any discharge point may require an investigation of best-available-technology waste treatment for the liquid effluents. Tritium in liquid effluents is specifically excluded from best available technology requirements; however, it is not excluded from other ALARA considerations. DOE DCG compliance is demonstrated when the sum of the fractional DCG values for all radionuclides detectable in the effluent is less than 1.00, based on consecutive 12-month average concentrations.

DCGs, based on a 100-mrem exposure, are applicable at the point of discharge from the effluent conduit to the environment (prior to dilution or dispersion). They are based on the highly conservative assumption that a member of the public has continuous direct access to the actual liquid effluents and consumes 2 liters of the effluents every day, 365 days a year. Because of security controls and the considerable distances between most SRS operating facilities and the site boundary, this scenario is highly improbable, if not impossible.

For each SRS facility that releases radioactivity, the site's Environmental Permitting and Monitoring group compares the monthly liquid effluent concentrations and 12-month average concentrations against the DOE DCGs.

Environmental Management

SRS began its cleanup program in 1981. Two major federal statutes provide guidance for the site's environmental restoration and waste management activities—RCRA and CERCLA. RCRA addresses the management of hazardous waste and requires that permits be obtained for facilities that treat, store, or dispose of hazardous or mixed waste. It also requires that DOE facilities perform appropriate corrective action to address contaminants in the environment. CERCLA (also known as Superfund) addresses the uncontrolled release of hazardous substances and the cleanup of inactive waste sites. This act established

a National Priority List of sites targeted for assessment and, if necessary, corrective/remedial action. SRS was placed on this list December 21, 1989 [Fact Sheet, 2000]. In August 1993, SRS entered into the Federal Facility Agreement (FFA) with EPA Region IV and SCDHEC. This agreement governs the corrective/remedial action process from site investigation through site remediation. It also describes procedures for setting annual work priorities, including schedules and deadlines, for that process [FFA under section 120 of CERCLA and sections 3008(h) and 6001 of RCRA].

Additionally, DOE is complying with Federal Facility Compliance Act requirements for mixed waste management—including high-level waste, most transuranic waste, and low-level waste with hazardous constituents. This act requires that DOE develop and submit site treatment plans to the EPA or state regulators for approval.

The disposition of facilities after they are declared excess to the government's mission is managed by Site Decommissioning and Demolition (D&D)—formerly Facilities Disposition Projects. The facility disposition process is conducted in accordance with DOE Order 430.1B, "Real Property Asset Management," and its associated guidance documents. The major emphases are reducing risks to workers and the public and minimizing real property asset lifecycle costs.

Quality Assurance/Quality Control

DOE Order 414.1C, "Quality Assurance," sets requirements and guidelines for departmental quality assurance (QA) practices. To ensure compliance with regulations and to provide overall quality requirements for site programs, WSRC developed its Quality Assurance Management Plan, Rev. 17 (WSRC–RP–92–225). The plan's requirements are implemented by the WSRC Quality Assurance Manual (WSRC 1Q).

The SRS Environmental Monitoring Section Quality Assurance Plan (WSRC–3Q1–2, Volume 3, Section 8000), was written to apply the QA requirements of WSRC 1Q to the environmental monitoring and surveillance program. The WSRC–3Q1 series includes procedures on sampling, radiochemistry, and water quality that emphasize the quality control requirements for EPM.

QA requirements for monitoring radiological air emissions are specified in 40 CFR 61, "National Emission Standards for Hazardous Air Pollutants." For radiological air emissions at SRS, the responsibilities and lines of communication are detailed in National Emission Standards for Hazardous Air Pollutants Quality Assurance Project Plan for Radionuclides (U) (WSRC–IM–91–60).

To ensure valid and defensible monitoring data, the records and data generated by the monitoring program are maintained according to the requirements of DOE Guide 1324.5B, "Implementation Guide for Use with 36 CFR Chapter XII – Subchapter B Records Management," and of WSRC 1Q. QA records include sampling and analytical procedure manuals, logbooks, chain-of-custody forms, calibration and training records, analytical notebooks, control charts, validated laboratory data, and environmental reports. These records are maintained and stored per the requirements of WSRC Retention Schedule Matrix (WSRC–EM–96–00023).

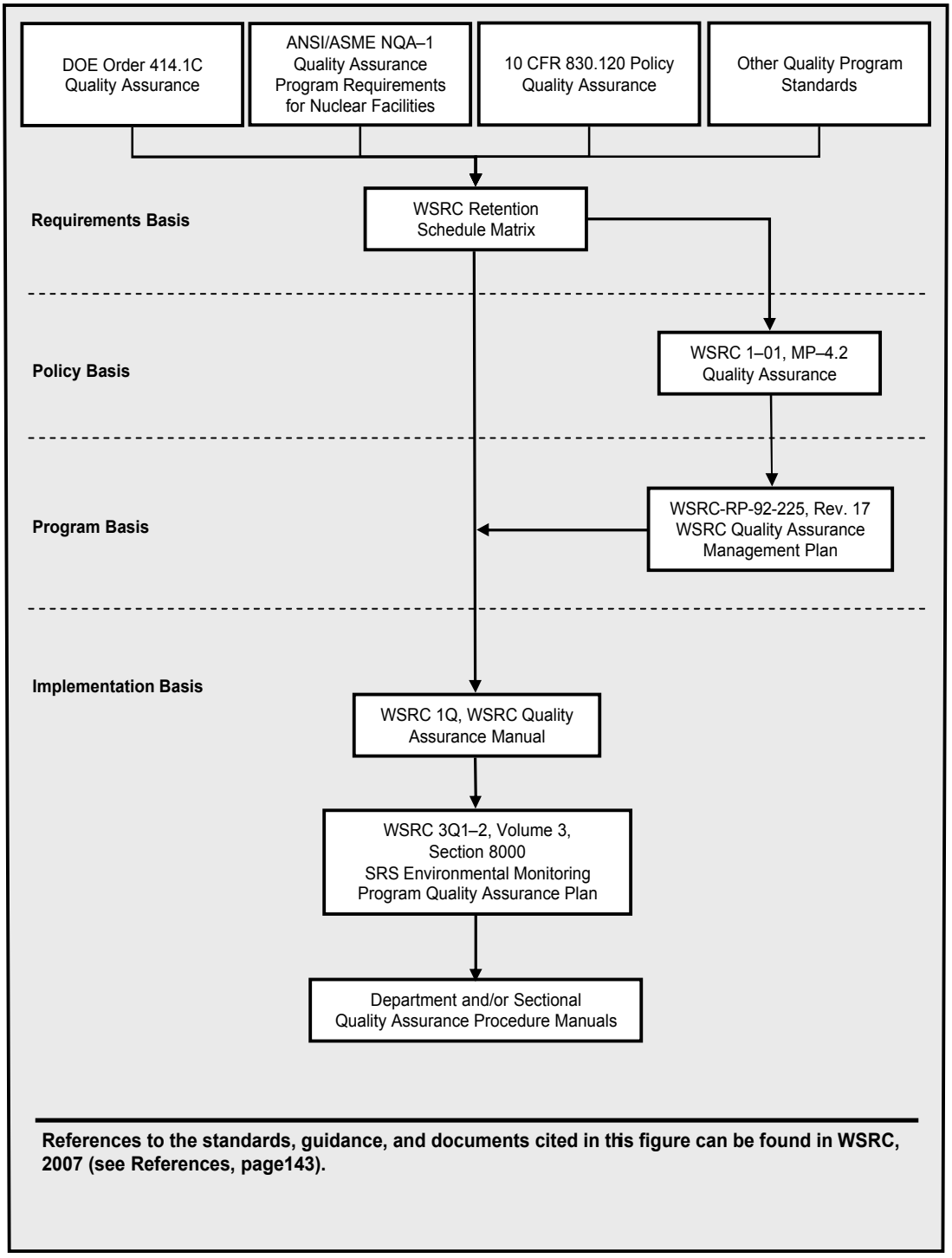

Figure A–1 SRS EM Program QA Document Hierarchy
This diagram depicts the hierarchy of relevant guidance and supporting documents for the SRS QA program.

EPM assessments are implemented according to the following documents:

- DOE Order 414.1C
- DOE/EH–0173T
- DOE Environmental Management Consolidated Audit Program (EMCAP)
- WSRC 1Q, Quality Assurance Manual
- WSRC 12Q, Assessment Manual

Reporting

DOE Orders 231.1A, "Environment, Safety and Health Reporting," and 5400.5, "Radiation Protection of the Public and Environment," require that SRS submit an annual environmental report.

This report, the *SRS Environmental Report for 2006*, is an overview of effluent monitoring and environmental surveillance activities conducted on and in the vicinity of SRS from January 1 through December 31, 2006.