HITACHI

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***Proprietary & Security-Related Information Notice***
*This letter forwards sensitive proprietary and security-related information which is to be withheld from public disclosure in accordance with 10CFR2.390 and RIS 2005-31. When separated from the enclosure, this letter is non-sensitive.*

MFN 11-223

October 14, 2011

Attn: Document Control Desk
Brian Smith, Chief
Uranium Enrichment Branch
Fuel Facility Licensing Directorate
Division of Fuel Cycle Safety & Safeguards
Office of Nuclear Materials Safety & Safeguards
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001

Subject: **REVISED DOCUMENTS RELATED TO SEPTEMBER 15, 2011 RESPONSE TO NRC REQUEST FOR ADDITIONAL INFORMATION**

Dear Mr. Smith:

By letter dated September 15, 2011, GE-Hitachi Global Laser Enrichment LLC (GLE) submitted responses to an NRC Request for Additional Information (RAI) dated September 1, 2011. In that letter, GLE indicated that revised documents related to the RAI response would be submitted to the NRC at a later date to allow adequate time for subject matter expert and management reviews. The revisions to the GLE Quality Assurance Program Description were provided by letter dated September 21, 2011. Enclosures 1 thru 3 provide the remaining revised documents associated with the September 15, 2011 RAI response. Enclosure 4 provides the responses to NRC comments on GLE's September 15, 2011 RAI submittal. These comments were discussed during a telephone conference on September 30, 2011.

On October 13, 2011, during an additional telephone conference to discuss GLE's September 15, 2011 RAI response, GLE committed to including or designating certain portions or attributes of the Operations Building, where licensed material is contained, to be an Item Relied on for Safety (IROFS) in accordance with 10 CFR Part 70. The critical characteristics

NMSS22

and safety function of these portions or attributes of the Operations Building are considered a Sole IROFS, designated as a QL-1 level IROFS, and will require that the design and construction apply the GLE Quality Assurance Program Description (NEDE-33451) process modeled after the 18 elements of ANSI/ASME NQA-1, *Quality Assurance Program Requirements for Nuclear Facilities*, American National Standards Institute/American Society of Mechanical Engineers Standard, New York, NY, 1994. As such, any changes to the portions or attributes of the Operations Building included or designated as an IROFS will be submitted to NRC for approval in accordance with 10 CFR Part 70.

Enclosures 2, 3, and 4 of this letter contain sensitive Proprietary and Security-Related Information and should be withheld from public disclosure. When separated from the enclosures, this letter is non-sensitive.

If there are any questions regarding this letter and its contents, please do not hesitate to contact me at 910-819-4799 or at Julie.Olivier@ge.com.

Sincerely,

Julie Olivier
GLE Licensing Manager

Enclosures:
1. GLE License Application Front Matter, Chapter 1, and Chapter 3 - Public Versions.
2. GLE License Application Front Matter, Chapter 1, and Chapter 3 – Non-Public Versions (contain sensitive Proprietary and Security-Related Information).
3. Integrated Safety Analysis Summary Front Matter, Chapter 1, 2, 4.12, 4.16, Appendix B, and Appendix C.
4. Responses to NRC Comments on GLE's September 15, 2011 RAI Submittal Received During a September 30, 2011 Telephone Conference.

Cc (without enclosures):
Brian Smith (NRC)
Tim Johnson (NRC)
Jerry Head (GEH)
Ken Givens (GLE)
Julie Olivier (GLE)
Julius Bryant (GLE)
Tom Owens (GLE)
Lon Paulson (GLE)
Steve Long (GLE)

# Enclosure 1

# GLE License Application Front Matter, Chapter 1, and Chapter 3 - Public Versions

# GE-HITACHI GLOBAL LASER ENRICHMENT LLC COMMERCIAL FACILITY

## WILMINGTON, NORTH CAROLINA

## LICENSE APPLICATION

## October 2011

Docket No. 70-7016

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# LIST OF EFFECTIVE PAGES

| Chapter | Revision No | Date of Revision | Revision Description |
|---|---|---|---|
| **Front Matter** | 4 | 10/14/2011 | Changes to Chapters 1, 3, and Definitions. |
| **Chapter 1** | 6 | 10/14/2011 | Revised Section 1.2.5.6 to change "Dedication Process" to "Dedication" to be consistent with the definition in 10 CFR 21.<br>Revised Section 1.2.5.6 to correct a typo in the "Dedication" definition.<br>Revised Section 1.3.3.3.6 to revise basis for tornado probability of "Highly Unlikely".<br>Revised Section 1.3.5.2 to incorporate information related to the August 23, 2011 earthquake in Virginia.<br>Various non-intent revisions to information for clarity. |
| **Chapter 2** | 4 | 03/30/2011 | Added bullet to Fire Safety Manager's responsibilities. |
| **Chapter 3** | 6 | 10/14/2011 | Revised Section 3.2.4.4.10 to incorporate specific electrical and instrumentation and control commitments.<br>Updated Section 3.2.8 to include addition of a sole IROFS.<br>Revised Table 3-7 to remove "Credible" designation from table entries and to update footnote.<br>Added Table 3-11. |
| **Chapter 4** | 2 | 10/29/2010 | Incorporate RAI from NRC letter dated Oct. 5, 2010, added commitments in Section 4.7.1 related to transportation requirements. |

## LIST OF EFFECTIVE PAGES

| Chapter | Revision No | Date of Revision | Revision Description |
|---|---|---|---|
| **Chapter 5** | 5 | 08/01/2011 | Added detail regarding likelihood of cylinder damage due to forklift breach followed by rain accumulation. Changed "activities with the potential to result in inadvertent nuclear criticality" to "fissile materials operations". Replaced minimum margin of subcriticality MMS) with margin of subcriticality (MoS) throughout chapter to align with supporting validation report terminology and ANSI/ANS-8.24 (2007) national consensus standard guidance. Revised Section 5.4.4.2 to add clarity about crediting neutron absorbers. Revised Section 5.4.4.8 to add clarity about crediting neutron absorbers. Updated revision of reference 5-12. |
| **Chapter 6** | 0 | 04/30/2009 | Initial Application Submittal |
| **Chapter 7** | 2 | 06/30/2010 | Revised International Building Code Occupancy Classifications and added Solid Waste Storage Buildings discussion. |
| **Chapter 8** | 1 | 03/30/2011 | Revised to include commitment to 10 CFR 70.32 for changes to the RC&EP. |
| **Chapter 9** | 1 | 10/29/2010 | Incorporated RAI responses. Added description of cylinder pad stormwater monitoring. Added text and table describing mitigation measures. |
| **Chapter 10** | 1 | 03/31/2010 | Incorporate RAIs responses submitted to the NRC via MFN-09-802 dated 12/28/2009 and MFN-10-056 dated 02/10/2010. |
| **Chapter 11** | 4 | 03/30/2011 | Added language to clarify the application of the graded approach to applying management measures to IROFS.<br><br>Replaced reference to deleted section of this |

| Chapter | Revision No | Date of Revision | Revision Description |
|---|---|---|---|
| | | | chapter with GLE QAPD.<br><br>Revised Section 11.1.4 to indicate that procedurescontrol changes during design, construction and operations.<br><br>Replaced the term "as built" with "as constructed". |

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## FIGURES

## ACRONYMS

| | |
|---|---|
| A/E | Architect/Engineering |
| ACP | American Centrifuge Plant |
| AEC | Active Engineered Control |
| AEGL | Acute Exposure Guideline Levels |
| AEP | Annual Exceedance Probability |
| ALARA | As Low As Reasonably Achievable |
| ALI | Annual Limit on Intake |
| ANS | American Nuclear Society |
| ANSI | American National Standards Institute |
| APF | Assigned Protection Factor |
| ASCE | American Society of Civil Engineers |
| AST | Autoclave Surge Tank |
| ASTM | American Society for Testing and Materials |
| | |
| BDC | Baseline Design Criteria |
| BOD | Biochemical Oxygen Demand |
| | |
| CAA | Controlled Access Area |
| CAAS | Criticality Accident Alarm System |
| CAP | Corrective Action Plan |
| CBA | Cost-Benefit Analysis |
| CDE | Committed Dose Equivalent |
| CEDE | Committed Effective Dose Equivalent |
| CEO | Chief Executive Officer |
| CFPM | Commercial Facility Project Manager |
| CFR | Code of Federal Regulations |
| CJHA | Chemical Job Hazards Analysis |
| CM | Configuration Management |
| CSA | Criticality Safety Analysis |
| CTPS | Cold Trap Purification System |
| CY | Calendar Year |
| | |
| DAC | Derived Air Concentration |
| DFP | Decommissioning Funding Plan |
| DOE | U.S. Department of Energy |
| DOT | U.S. Department of Transportation |
| DP | Decommissioning Plan |
| | |
| ECC | Emergency Control Center |
| ECF | Entry Control Facility |
| EDMS | Electronic Document Management System |
| EHS | Environmental, Health, and Safety |
| EMT | Emergency Medical Technician |
| EPA | U.S. Environmental Protection Agency |
| EPCRA | Emergency Planning and Community Right-to-Know Act |
| ER | Environmental Report |

## ACRONYMS

| | |
|---|---|
| ERO | Emergency Response Organization |
| ERT | Emergency Response Team |
| ETA | Event Tree Analysis |
| FCS | Facility Control System |
| FHA | Fire Hazards Analysis |
| FMO | Fuel Manufacturing Operation |
| FNMCP | Fundamental Nuclear Material Control Plan |
| FOCI | Foreign Ownership, Control, Influence |
| FPLTF | Final Process Lagoon Treatment Facility |
| FSRC | Facility Safety Review Committee |
| FTA | Fault Tree Analysis |
| FVC | Feed Vaporization Chamber |
| GE | General Electric Company |
| GEH | GE-Hitachi Nuclear Energy Americans LLC |
| GEMER | Geometry Enhanced MERIT |
| GET | General Employee Training |
| GLE | GE-Hitachi Global Laser Enrichment LLC |
| GNF-A | Global Nuclear Fuel – Americas, LLC |
| HAZOP | Hazards and Operability Analysis |
| HEGA | High-Efficiency Gas Absorption |
| HEPA | High-Efficiency Particulate Air |
| HEU | High-Enriched Uranium |
| HFCVB | Heated Flow Control Valve Box |
| HVAC | Heating, Ventilation, and Air Conditioning |
| IBC | International Building Code |
| ICEA | Industry Cabling Engineers Association, Inc. |
| ICRP | International Commission on Radiological Protection |
| IEEE | Institute of Electrical and Electronics Engineers |
| IFC | International Fire Code |
| IROFS | Items Relied on for Safety |
| ISA | Integrated Safety Analysis |
| ISAS | Integrated Safety Analysis Summary |
| ITM | Inspection, Testing, and Maintenance |
| JHA | Job Hazards Analysis |
| LA | License Application |
| LEL | Lower Explosive Limit |
| LES | Louisiana Energy Services, L.P. |
| LEU | Low Enriched Uranium |
| LLMW | Low-Level Mixed Waste |
| LLRW | Low-Level Radioactive Waste |

| | |
|---|---|
| LTTS | Low Temperature Take-off Station |
| M&TE | Measuring and Test Equipment |
| MC&A | Material Control and Accounting |
| MCA | Moderation Controlled Area |
| MDC | Minimum Detectable Concentration |
| MCES | Monitored Central Exhaust System |
| MMS | Minimum Margin of Subcriticality |
| MOU | Memorandum of Understanding |
| MRA | Moderation Restricted Area |
| MSDS | Material Safety Data Sheet |
| MSW | Municipal Solid Waste |
| NC DAQ | North Carolina Division of Air Quality |
| NC DWQ | North Carolina Division of Water Quality |
| NCS | Nuclear Criticality Safety |
| NEF | National Enrichment Facility |
| NELAC | National Environmental Laboratory Accreditation Conference |
| NEPA | National Environmental Policy Act |
| NFPA | National Fire Protection Association |
| NIOSH | National Institute for Occupational Safety and Health |
| NIST | National Institute of Standards and Technology |
| NMSS | Nuclear Material Safety and Safeguards |
| NPDES | National Pollutant Discharge Elimination System |
| NPH | Natural Phenomena Hazard |
| NRC | U.S. Nuclear Regulatory Commission |
| NSI | Nuclear Safety Instruction |
| NSSL | National Severe Storms Laboratory |
| NUREG | NRC Publication |
| NVLAP | National Voluntary Laboratory Accreditation Program |
| OJT | On-the-Job Training |
| OSHA | Occupational Safety and Health Administration |
| OSTV | Onsite Transfer Vehicle |
| P&ID | Piping and Instrumentation Diagram |
| PHA | Process Hazards Analysis |
| PLC | Programmable Logic Controllers |
| PM | Preventive Maintenance |
| PMT | Post-Maintenance Testing |
| PNC | Potential Noncompliance |
| PPE | Personal Protective Equipment |
| PRA | Probabilistic Risk Assessment |
| PSP | Physical Security Plan |

## ACRONYMS

| | |
|---|---|
| QA | Quality Assurance |
| QAPD | Quality Assurance Program Description |
| QL | Quality Level |
| QRA | Quantitative Risk Assessment |
| RA | Response Agreements |
| RASCAL | Radiological Assessment System for Consequence Analysis |
| RC&EP | Radiological Contingency and Emergency Plan |
| RCA | Radiological Controlled Area |
| RCRA | Resource Conservation and Recovery Act |
| RD | Restricted Data |
| RLETS | Radiological Liquid Effluent Treatment System |
| RM | Records Management |
| RP | Radiation Protection |
| RSA | Radiological Safety Assessments |
| RSC | Radiation Safety Committee |
| RWP | Radiation Work Permit |
| SCA | Sample Containment Autoclave |
| SEM | Standard Error of Measurements |
| SFS | Solid Feed Station |
| SNM | Special Nuclear Material |
| SPPP | Standard Practice Procedures Plan |
| SRD | Secret Restricted Data |
| SSC | System, Structure, and Component |
| SSLCB | Single-Sided Lower Confidence Band |
| SSLTB | Single-Sided Lower Tolerance Band |
| SSLTL | Single-Sided Lower Tolerance Limit |
| SWU | Separative Work Unit |
| TEDE | Total Effective Dose Equivalent |
| TLD | Thermo Luminescent Dosimeters |
| TSDF | Treatment, Storage, and Disposal Facility |
| UBC | Uniform Building Code |
| UIR | Unusual Incident Report |
| UL | Underwriters Laboratory |
| UNC-W | University of North Carolina – Wilmington |
| U.S. | United States |
| USEC | United States Enrichment Corporation, Inc. |
| USGS | U.S. Geological Survey |
| USL | Upper Subcritical Limit |
| VRCT | Volume Reducing Compressor Train |

## ACRONYMS

| | |
|---|---|
| WFPP | Wilmington Fire Protection Program |
| WWTF | Waste Water Treatment Facility |

## CHEMICALS AND UNITS OF MEASURE

| | |
|---|---|
| $^{40}K$ | potassium-40 |
| $^{99}Tc$ | technetium-99 |
| $^{222}Rn$ | radon-222 |
| $^{226}Ra$ | radium-226 |
| $^{232}Th$ | thorium-232 |
| $^{235}U$ | uranium-235 |
| $^{238}U$ | uranium-238 (depleted $^{235}U$) |
| °F | Fahrenheit |
| ADU | ammonium diuranate |
| bgs | below ground surface |
| Bq | Becquerel |
| cc | cubic centimeters |
| CFC | chlorofluorocarbon |
| Ci | curie |
| cm | centimeter |
| $cm^2$ | square centimeters |
| CO | carbon monoxide |
| $CO_2$ | carbon dioxide |
| cP | continental polar |
| dBa | a-weighted decibels |
| DCE | cis-1,2 dichloroethylene |
| dpm | disintegrations per minute |
| ft | foot |
| $ft^2$ | square foot |
| g | gram |
| gal | gallon |
| gpd | gallons per day |
| gpm | gallons per minute |
| GWe | gigawatt electrical |
| ha | hectare |
| HF | hydrogen fluoride |

## CHEMICALS AND UNITS OF MEASURE

| | |
|---|---|
| hz | hertz |
| in | inches |
| kg | kilogram |
| km | kilometers |
| kts | knots |
| lb | pound |
| $L_{DN}$ | day-night average sound levels |
| Lpd | liters per day |
| m | meter |
| $m^2$ | square meter |
| Mg | megagram |
| mg | milligram |
| mm | millimeter |
| mph | miles per hour |
| mrem | millirem |
| mrem/yr | millirem per year |
| msl | mean sea level |
| mSv | millisievert |
| mSv/yr | millisievert per year |
| mT | maritime tropical |
| MWe | megawatt electrical |
| $NO_2$ | nitrous oxide |
| $O_3$ | ozone |
| Pb | lead |
| pCi | picocurie |
| PM | particulate matter |
| $PM_{10}$ | particulate matter with aerodynamic diameter of 10 μm or less |
| $PM_{25}$ | particulate matter with aerodynamic diameter of 2.5 μm or less |
| ppm | parts per million |
| psi | pound per square inch |
| PU | Plutonium |

## CHEMICALS AND UNITS OF MEASURE

| | |
|---|---|
| scfph | standard cubic feet per hour |
| sL/m | standard liters per minute |
| $SO_2$ | sulfur dioxide |
| Sv | sieverts |
| TCE | trichloroethylene |
| TSP | total suspended particulates |
| TSS | total suspended solids |
| $U_3O_8$ | triuranium octaoxide |
| $UF_4$ | uranium tetrafluoride |
| $UF_6$ | uranium hexafluoride |
| $UO_2$ | uranium dioxide |
| $UO_2F_2$ | uranyl fluoride |
| µCi | micocuries |
| µm | micrometer |
| VC | vinyl chloride |
| wt | weight |
| $yd^3$ | cubic yard |
| yr | year |

## GLOSSARY OF DEFINITIONS

**100-Year Flood** – A flood elevation (for a given area) that has a 1 percent chance of being equaled or exceeded each year. Thus, the 100-year flood could occur more than once in a relatively short period of time. The 100-year flood, which is the standard used by most federal and state agencies, is used by the National Flood Insurance Program (NFIP) as the standard for floodplain management and to determine the need for flood insurance. The term 100-year flood is synonymous with the one percent annual chance flood. [FEMA]

**500-Year Flood** – Refers to the flood elevation for a given area that has a 0.2 percent chance of being equaled or exceeded each year. This term is synonymous with the 0.2 percent annual chance of flood. [FEMA]

**Absorbed Dose** – The energy imparted by ionizing radiation per unit mass of irradiated material. [10 CFR 20.1003]

**Accident Sequence** – An unintended sequence of events that, given the failure of certain items relied on for safety (IROFS) identified in the sequence, would result in environmental contamination, radiation exposure, release of radioactive material, inadvertent nuclear criticality, or exposure to hazardous chemicals (provided that the chemicals are produced from licensed radioactive material). The term "accident" may be used interchangeably with "accident sequence." [NUREG-1520]

**Act** – The Atomic Energy Act of 1954 (68 Stat 919), including any amendments thereto. [10 CFR 70.4]

**Active Engineered Control (AEC)** – A physical device that uses active sensors, electrical components, or moving parts to maintain safe process conditions without any required human action. [NUREG-1520]

**Administrative Control** – Either an augmented administrative control or a simple administrative control. [NUREG-1520]

**Airborne Radioactive Material** – Radioactive material dispersed in the air in the form of dusts, fumes, particulates, mists, vapors, or gases. [10 CFR 20.1003]

**Airborne Radioactivity Area** – A room, enclosure, or area in which airborne radioactive materials, composed wholly or partly of licensed material, exist in concentrations in excess of the derived air concentrations (DACs) specified in 10 CFR 20.1001 through 20.2401, Appendix B; or to such a degree that an individual present in the area without respiratory protective equipment could exceed, during the hours an individual is present in a week, an intake of 0.6 percent of the annual limit on intake (ALI) or 12 DAC-hours. [10 CFR 20.1003]

**Alert** – Events may occur, are in progress, or have occurred that could lead to a release of radioactive material(s) but that the release is not expected to require a response by an offsite response organization to protect persons offsite. [10 CFR 70.4]

## GLOSSARY OF DEFINITIONS

**Annual Limit on Intake (ALI)** – The derived limit for the amount of radioactive material taken into the body of an adult worker by inhalation or ingestion in a year. ALI is the smaller value of intake of a given radionuclide in a year by the reference man that would result in a committed effective dose equivalent of five rems (0.05 Sv) or a committed dose equivalent of 50 rems (0.5 Sv) to any individual organ or tissue. (ALI values for intake by ingestion or inhalation of selected radionuclides are given in 10 CFR 20.1001 through 10 CFR 20-2401, Appendix B, Table 1, Columns 1 and 2. [10 CFR 20.1003]

**Area Manager** – Individual responsible for implementation of nuclear safety requirements in an assigned area. The generic title "Area Manager" does not necessarily refer to the title of any specific position in the GLE organization or position nomenclature.

**Area of Environmental Concern** – Designated by the North Costal Resources Commission within 20 North Carolina counties as areas of natural importance that may be easily destroyed by erosion or floodwater or may have environmental, social, economic, or aesthetic values to the state. [GLE ER]

**As Low As Reasonably Achievable (ALARA)** – Making every reasonable effort to maintain exposures to radiation as far below the dose limits in 10 CFR 20 as is practical, consistent with the purpose for which the licensed activity is undertaken, taking into account the state of technology, the economics of improvements in relation to state of technology, the economics of improvements in relation to benefits to the public health and safety, and other societal and socioeconomic considerations, and in relation to utilization of nuclear energy and licensed materials in the public interest. [10 CFR 20.1003]

**Assessments** – An assessment is used to determine the effectiveness of activities in achieving applicant-specified objectives that provide reasonable assurance of the continued availability and reliability of IROFS. [NUREG-1520]

**Assigned Protection Factor (APF)** – The expected workplace level of respiratory protection that would be provided by a properly functioning respirator or a class of respirators to properly fitted and trained users. Operationally, the inhaled concentration can be estimated by dividing the ambient airborne concentration by the APF. [10 CFR 20.1003]

**Audits** – An audit is used to monitor compliance with regulatory requirements and license commitments. [NUREG-1520] A planned and documented activity performed to determine by investigation, examination, or evaluation of objective evidence the adequacy of and compliance with established procedures, instructions, drawings, and other applicable documents, and the effectiveness of implementation. An audit should not be confused with self-assessment, surveillance, and inspection activities performed for the purpose of process control or product acceptance. [ANSI NQA-1-1989]

**Augmented Administrative Control** – A procedurally required or prohibited human action, combined with a physical device that alerts the operator that the action is needed to maintain safe process conditions, or otherwise adds substantial assurance of the required human performance. [NUREG-1520]

## GLOSSARY OF DEFINITIONS

**Available and Reliable to Perform Their Function When Needed** – Based on the analyzed, credible conditions in the integrated safety analysis (ISA), items relied on for safety (IROFS) will perform their intended safety function when needed, and management measures will be implemented that ensure compliance with the performance requirements of 10 CFR 70.61, considering factors such as necessary maintenance, operating limits, common-cause failures, and the likelihood and consequences of failure or degradation of the times and measures. [10 CFR 70.4]

**Background Radiation** – Radiation from cosmic sources; naturally occurring radioactive material, including radon (except as a decay product of source or special nuclear material; and global fallout as it exists in the environment from the testing of nuclear explosive devices or from past nuclear accidents such as Chernobyl, that contribute to background radiation and are not under the control of the licensee. "Background Radiation" does not included radiation from source, byproduct, or special nuclear materials regulated by the U.S. Nuclear Regulatory Commission. [10 CFR 20.1003]

**Baseline Design Criteria** – A set of criteria specifying design features and management measures that are required and acceptable under certain conditions for new processes or facilities specified in 10 CFR 70.64. In general, these criteria are the acceptance criteria that apply to safety design for new facilities and new processes. [NUREG-1520]

**Basic Component** – A structure, system, or component (SSC), or part thereof, designated as an item relied on for safety (IROFS) identified as QL-1 or QL-2, that affects the IROFS function, that is directly procured by the licensee of a facility or activity subject to the regulations in 10 CFR 70 and in which a defect or failure to comply with any applicable regulation in 10 CFR 70, order, or license issued by the U.S. Nuclear Regulatory Commission (NRC) could create a substantial safety hazard (i.e., exceed the performance requirements of 10 CFR 70.61). Basic components include QL-1 and QL-2 identified IROFS-related design, analysis, inspection, testing, fabrication, replacement of parts, or consulting services that are associated with the component hardware, whether these services are performed by the component supplier or others.

When applied to IROFS identified as QL-NFPA, a basic component is a SSC, or part thereof, that affects the safety function of the IROFS that is directly procured by the licensee or a facility or activity subject to the requirements of the National Fire Protection Administration (NFPA) Code of Record, and in which a defect or failure to comply with requirements of the NFPA Code of Record could create a substantial safety hazard that cannot be addressed by compensatory measures as allowed by the NFPA Code of Record. Basic component includes QL-NFPA identified IROFS-related design, analysis, inspection, testing, fabrication, replacement of parts, or consulting services that are associated with the component hardware, whether these services are performed by the component supplier or others, to the extent required by the NFPA Code of Record.

**Bias** – The systematic difference between calculated results and experimentally measured values of $k_{eff}$ for a fissile system.

## GLOSSARY OF DEFINITIONS

**Bias Uncertainty** – The integrated uncertainty in experimental data, calculational methods, and models, estimated by a valid statistical analysis of calculated $k_{eff}$ values for critical experiments.

**Bioassay (Radiobioassay)** – The determination of kinds, quantities or concentrations, and in some cases, the locations of radioactive material in the human body, whether by direct measurement (in vivo counting) or by analysis and evaluation of materials excreted or removed from the human body. [10 CFR 20.1003]

**Closed Security Area** – Designated Controlled Access Areas that are established to safeguard classified material. Typically the classified material in these areas, because of its size, nature, and operational necessity, cannot be adequately protected during work hours by normal safeguards or stored during non-working hours.

**Collective Dose** – The sum of the individual doses received in a given period of time by a specified population from exposure to a specified source of radiation. [10 CFR 20.1003]

**Commencement of Construction** – Any clearing of land, excavation, or other substantial action that would adversely affect the natural environment of a site but does not include changes desirable for the temporary use of the land for public recreational uses, necessary borings to determine site characteristics or other preconstruction monitoring to establish background information related to the suitability of a site or to the protection of environmental values. [10 CFR 70.4]

**Commercial-Grade Item** – A structure, system, or component (SSC), or part thereof that affects its QL-1 and/or QL-2 identified IROFS function, which is not designed and manufactured as a Basic Component. Commercial-grade items do not include items where the design and manufacturing process require in-process inspections and verifications to ensure that defect or failures to comply are identified and corrected (i.e., one or more critical characteristics of the item cannot be verified.)

When applied to items identified as QL-NFPA (being items in facilities and activities licensed pursuant to 10 CFR 70), commercial grade item means an item that is (1) not subject to design or specification requirements that are unique to facilities or activities; (2) used in applications other than those facilities and activities; and (3) to be ordered from the manufacturer/supplier on the basis of specifications set forth in the manufacture's published product description.

**Configuration Management (CM)** – A management measure that provides oversight and control of design information, safety information, and records of modifications (both temporary and permanent) that might impact the ability of items relied on for safety to perform their functions when needed. [10 CFR 70.4]

**Consequence** – Any result of interest caused by an event or sequence of events. In this context, "adverse consequence" refers to adverse health or safety effects on either workers, the public, or the environment. [NUREG-1520]

**Constraint** – A value above which specified licensee actions are required. [10 CFR 20.1003]

## GLOSSARY OF DEFINITIONS

**Contractor Personnel** – All persons who are not GLE/GEH/GNF employees, active pensioners, or variable workers. Contract Workers have been contracted to provide a service or activity for GE.

**Controlled Area** – An area, outside of a restricted area but inside the site boundary, access to which can be limited by the licensee for any reason. [10 CFR 20.1003]

**Controlled Parameter** – A measurable parameter that is maintained within a specified range by one or more specific controls to ensure the safety of an operation. [NUREG-1520]

**Corrective Action** – A measure taken to rectify significant conditions adverse to quality and to preclude repetition. [ANSI/ASME NQA-1]

**Critical Characteristics** – Those important to design, material, and performance characteristics of a commercial-grade item that, once verified, will provide reasonable assurance that the item will perform its intended QL-1 and/or QL-2 identified IROFS function.

When applied to items identified as QL-NFPA, critical characteristics are those important to design, material, and performance characteristics of a commercial grade item that will provide reasonable assurance that the item will perform its intended QL-NFPA identified IROFS function.

**Critical Mass of Special Nuclear Material** – Special nuclear material in a quantity exceeding 700 grams of contained $^{235}U$; 520 grams of $^{233}U$; 450 grams of plutonium; 1500 grams of contained $^{235}U$; if no uranium enriched to more than four percent by weight of $^{235}U$ is present; 450 grams of any combination thereof; or one-half such quantities if massive moderators or reflectors made of graphite, heavy water, or beryllium may be present. [10 CFR 70.4]

**Declared Pregnant Woman** – A woman who has voluntarily informed the licensee, in writing, of her pregnancy and the estimated date of conception. The declaration remains in effect until the declared pregnant woman withdraws the declaration in writing or is no longer pregnant. [10 CFR 20.1003]

**Decommission** – To remove a facility or site safety from service and reduce residual radioactivity to a level that permits: (1) release of the property for unrestricted use and termination of the license; or (2) release of the property under restricted conditions and termination of the license. [10 CFR 70.4]

**Dedication** – An acceptance process undertaken to provide reasonable assurance that a commercial-grade item to be used as a basic component will perform its intended QL-1 and/or QL-2 item relied on for safety (IROFS) function and, in this respect, is deemed equivalent to an item designed and manufactured under QL-1 or QL-2 requirements in accordance with the GLE QAPD. This assurance is achieved by identifying the critical characteristics of the item and verifying their acceptability by inspections, tests, or analyses performed by the purchaser or third-party dedicating entity after delivery, supplemented as necessary by one or more of the following: commercial grade surveys; product inspections or witness at holdpoints at the manufacturer's facility, and analysis of historical records for acceptable performance. In all cases, the dedication process must be conducted in accordance with the applicable provisions of the GLE QAPD. The process is considered complete when the item is designated for use as a basic component applicable to QL-1 and/or QL-2 IROFS.

When applied to items identified as QL-NFPA (being items in facilities and activities licensed pursuant to 10 CFR 70), the dedication process is applied to commercial-grade items to be used as basic components to provide reasonable assurance that they will perform their intended QL-NFPA identified IROFS function and are deemed equivalent to an item designed and manufactured under QL-NFPA requirements in accordance with the GLE QAPD. This assurance is achieved by confirming that the commercial-grade item is manufactured to established, acceptable national codes or standards that include one or more independent product endorsement based on qualification testing or periodic testing of selected characteristics of the item except in cases where such listing/approval is not required by codes and standards. In all cases, the applicable provisions of the GLE QAPD will be used to conduct the dedication process. The process is considered complete when the commercial-grade item is designated as a basic component.

**Dedicating Entity** – The organization that performs the dedication process for QL-1 and QL-2 identified IROFS. Dedication may be performed by the manufacturer of the item, a third-party dedicating entity, or the licensee itself. The dedicating entity, pursuant to 10 CFR 21.21(c), *Notification of Failure to Comply or Existence of a Defect and its Evaluation,* is responsible for identifying and evaluating deviations, reporting defects and failure to comply for the dedicated item, and maintaining auditable records of the dedication process. In cases where the Licensee applies the commercial-grade item procurement strategy and performs the dedication process, the Licensee would assume full responsibility as the dedicating entity.

When applied to items identified as QL-NFPA (being items in facilities and activities licensed pursuant to 10 CFR 70), the dedicating entity is the licensee. The licensee, pursuant to 10 CFR 21.21(c), is responsible for reporting defects and failure to comply for the dedicated item, maintaining auditable records of the dedication process, and assumes full responsibility as the dedicating entity.

**Derived Air Concentration (DAC)** – The concentration of a given radionuclide in air which, if breathed by the reference man for a working year of 2,000 hours under conditions of light work (inhalation Rate 1.2 cubic meters of air per hour), results in an intake of one ALI. DAC values are given in 10 CFR 20.1001 through 20.2401, Appendix B, Table 1, Column 3. [10 CFR 20.1003]

**Derived Air Concentration-Hour (DAC-Hour)** – The product of the concentration of radioactive material in air (expressed as a fraction or multiple of the DAC for each radionuclide) and the time of exposure to that radionuclide, in hours. A licensee may take 2,000 DAC-hours to represent one ALI, equivalent to a committed effective dose equivalent of five rems (0.05 Sv). [10 CFR 20.1003]

**Double Contingency Principle** – Process designs should incorporate sufficient factors of safety to require at least two unlikely, independent, and concurrent changes in process conditions before a criticality accident is possible. [10 CFR 70.4]

## GLOSSARY OF DEFINITIONS

**Double Contingency Protection** – A characteristic or attribute of a process that has incorporated sufficient safety factors to that at least two unlikely, independent, and concurrent changes in process conditions are required before a nuclear criticality accident is possible. [NUREG-1520]

**Effective Dose Equivalent** – The sum of the products of the dose equivalent to the body organ or tissue and the weighting factors applicable to each of the body organs or tissues that are irradiated. Weighting factors are: 0.25 for gonads; 0.15 for breast; 0.12 for red bone marrow; 0.12 for lungs, 0.03 for thyroid; 0.03 for bone surface, and 0.06 for each of the other five organs receiving the highest dose equivalent. [10 CFR 70.4]

**Effective Kilograms of Special Nuclear Material** – (1) For plutonium and $^{233}U$, their weight in kilograms; (2) For uranium with an enrichment in the isotope $^{235}U$ of 0.01 (one percent) and above, its element weight in kilograms multiplied by the square of its enrichment expressed as a decimal weight fraction; and (3) For uranium with an enrichment in the isotope $^{235}U$ below 0.01 (one percent), by its element weight in kilograms multiplied by 0.0001. [10 CFR 70.4]

**Engineered Control** – See active engineered control or a passive engineered control. [NUREG-1520]

**Entrance or Access Point** – Any location through which an individual could gain access to radiation areas or to radioactive materials. This includes entry or exit portals of sufficient size to permit human entry, irrespective of their intended use. [10 CFR 20.1003]

**Exposure** – Being exposed to ionizing radiation or to radioactive materials. [10 CFR 20.1003]

**External Dose** – The portion of the dose equivalent received from radiation sources outside the body. [10 CFR 20.1003]

**External Event** – An event for which the likelihood cannot be altered by changes to the regulated facility or its operation. This would include all natural phenomena events, plus airplane crashes, explosions, toxic releases, fires, etc., occurring near or on the plant site. [NUREG-1520]

**GLE Commercial Facility** – The structures, systems, and components that comprise the GLE Site infrastructure established to support the enrichment processing and support operations. The GLE Commercial Facility includes the Operations Building, multiple administrative and support buildings or areas, a parking lot, retention basins, cylinder storage pads, and connecting roadways. A cleared security buffer surrounds the entire GLE Commercial Facility and defines both the Restricted Area and the Protected Area of the facility.

**GLE Site** – The approximate 100 acres of land upon which the GLE Commercial Facility is built.

**GLE Study Area** – The area of the Wilmington Site evaluated in the GLE Environmental Report which includes the GLE Site as well as additional land surrounding the GLE Site.

**Hazardous Chemicals Produced from Licensed Materials** – Substances having licensed material as precursor compound(s) or substances that physically or chemically interact with licensed materials; and that are toxic, explosive, flammable, corrosive, or reactive to the extent that they can endanger life or health if not adequately controlled. These include substances commingled with licensed material, and include substances such as hydrogen fluoride that is produced by the reactor of uranium hexafluoride and water, but do not include substances prior to process addition to licensed material or after process separation from licensed material. [10 CFR 70.4]

**High Radiation Area** – An area, accessible to individuals, in which radiation levels from radiation sources external to the body could result in an individual receiving a dose equivalent in excess of 0.1 rem (1 mSv) in one hour at 30 centimeters from the radiation source or 30 centimeters from any surface that the radiation penetrates. [10 CFR 20.1003]

**Individual Monitoring** – (1) The assessment of dose equivalent by the use of devices designed to be worn by an individual; (2) The assessment of committed effective dose equivalent by bioassay or by determination of the time-weighted air concentrations to which an individual has been exposed; or (3) The assessment of dose equivalent by the use of survey data. [10 CFR 20.1003]

**Individual Monitoring Devices** – Devices designed to be worn by a single individual for the assessment of dose equivalent such as film badges, thermo luminescence dosimeters (TLDs), pocket ionization chambers, and personal ("lapel") air sampling devices. [10 CFR 20.1003]

**Integrated Safety Analysis (ISA)** – A systematic analysis to identify facility and external hazards and their potential for initiating accident sequences, the potential accident sequences, their likelihood and consequences, and the IROFS. As used here, integrated means joint consideration of, and protection from, all relevant hazards, including radiological, nuclear criticality, fire, and chemical. However, with respect to compliance with the regulations of 10 CFR 70, the NRC requirement is limited to consideration of the effects of all relevant hazards on radiological safety, prevention of nuclear criticality accidents, or chemical hazards directly associated with NRC licensed radioactive material. An ISA can be performed process by process, but all processes must be integrated, and process interactions considered. [10 CFR 70.4]

**Integrated Safety Analysis (ISA) Summary** – A document or documents submitted with the license application, license amendment application, license renewal application, or pursuant to 10 CFR 70.62(c)(3)(ii) that provides a synopsis of the results of the integrated safety analysis and contains the information specified in 10 CFR 70.65(b). The ISA Summary can be submitted as one document for the entire facility, or as multiple documents that cover all portions and processes of the facility. [10 CFR 70.4]

**Internal Dose** – The portion of the dose equivalent received from radioactive material taken into the body. [10 CFR 20.1003]

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**Items Relied on for Safety (IROFS)** – Structures, systems, equipment, components, and activities of personnel that are relied on to prevent potential accidents at a facility that could exceed the performance requirements in 10 CFR 70.61 or to mitigate their potential consequences. This does not limit the licensee from identifying additional structures, systems, equipment, components, or activities of personnel (i.e., beyond those in the minimum set necessary for compliance with the performance requirements) as items relied on for safety. [10 CFR 70.4]

**IROFS Boundary Definition Package** – IROFS boundary definition packages are documents that contain the physical descriptions and parameters of SSCs which are used to meet the performance requirements of 10 CFR 70.61. IROFS Boundary Definition Packages are also prepared for administrative procedures or workers actions which are defined as IROFS. The boundary packages also identify the facility areas in which the IROFS is used, design and functional attributes, management measures, any open items, and supporting documentation (i.e. P&IDs, schematics, etc.). Open items that affect the reliability and/or effectiveness of the IROFS should be closed prior to the NRC Operational Readiness Review (ORR). The open items section should identify open items associated with the IROFS during the NRC License Review and describe how the open items were resolved. [NUREG-1520, Rev 1]

**ISA Baseline Documents** – Includes technical reports, Process Hazard Analyses, Quantitative Risk Analyses (QRAs), calculations, drawings, white papers, IROFS Boundary Definition Packages, and memos or notes to file that capture the ISA.

**Licensed Material** – Source material, special nuclear material, or byproduct material received, possessed, used, transferred, or disposed of under a general or specific license issued by the U.S. Nuclear Regulatory Commission. [10 CFR 20.1003]

**Licensee** – Holder of a license from the U.S. Nuclear Regulatory Commission. [10 CFR 20.1003]

**Limits** – The permissible upper bounds of radiation doses. [10 CFR 20.1003]

**Line Management** – Managers who are charged with the administration of a group of people having a common organizational function. Line Managers are responsible for the assigned organization's output.

**Management Measures** – The functions performed by the licensee, generally on a continuing basis, that are applied to items relied on for safety, to ensure the items are available and reliable to perform their functions when needed. Management measures include Configuration Management, Maintenance, Training and Qualifications, Procedures, Audits and Assessments, Incident Investigations, Records Management, and other Quality Assurance elements. [10 CFR 70.4]

**Member of the Public** – Any individual except when that individual is receiving an occupational dose. [10 CFR 20.1003]

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**Minimum Margin of Subcriticality (MMS)** – An allowance for any unknown (or difficult to identify or quantify) errors or uncertainties in the method of calculating $k_{eff}$, that may exist beyond those which have been accounted for explicitly in calculating bias and bias uncertainty.

**Mitigative Control** – A control intended to reduce the consequence of an accident sequence, not to prevent it. When a mitigative control works as intended, the results of the sequence are called the mitigated consequences. [NUREG-1520]

**Monitoring (Radiation Monitoring)** – The measurement of radiation levels, concentrations, surface area concentrations or quantities of radioactive material and the use of the results of these measurements to evaluate potential exposures and doses. [10 CFR 20.1003]

**Natural Phenomena Event** – Earthquakes, floods, tornadoes, tsunamis, hurricanes, and other events that occur in the natural environment and could adversely affect safety. Natural phenomena events may be credible or incredible, depending on their likelihood of occurrence. [NUREG-1520]

**Nuclear Criticality Safety (NCS) Control** – A fixed physical design feature, active device, or procedure that is implemented to maintain safe process conditions. NCS controls are preventive and may be passive engineered, active engineered, or administrative (procedural). The NCS controls that are necessary to maintain the system subcritical under normal and credible abnormal conditions and achieve an overall likelihood of less than or equal to $10^{-5}$ per year (per event), are declared as IROFS in the ISA Summary.

**New Processes at Existing Facilities** – Systems-level or facility-level design changes to processes equipment, process technology, facility layout, or types of licensed material possessed or used. Generally, this definition does not include component-level design changes or equipment replacement. [NUREG-1520]

**Occupational Dose** – The dose received by an individual in the course of employment in which the individual's assigned duties involve exposure to radiation or to radioactive material from licensed and unlicensed sources of radiation, whether in the possession of the licensee or other person. Occupational dose does not include doses received from background radiation, from any medical administration the individual has received, from exposure to the individuals administered radioactive material and released under 10 CFR 35.75, from voluntary participation in medical research programs, or as a member of the public. [10 CFR 20.1003]

**Out-of-Specification Cylinder** – A cylinder that contains material that is outside of a design specification parameter or cylinder design parameters (capacity, volume, enrichment, wall thickness, etc.)

**Over-Filled Cylinder** – A cylinder that contains more than the design capacity/volume of material.

**Passive Engineered Control** – A device that uses only fixed physical design features to maintain safe process conditions without any required human action. Assurance is maintained through specific periodic inspections or verification measurement(s), as appropriate. [NUREG-1520]

**Plutonium Processing and Fuel Fabrication Plant** – A plant in which the following operations or activities are conducted: (1) Operations for manufacture of reactor fuel containing plutonium including any of the following: (i) preparation of fuel material; (ii) formation of fuel material into desired shapes; (iii) application of protective cladding; (iv) recovery of scrap material; and (v) storage associated with such operations; or (2) Research and development activities involving any of the operations described in Paragraph (1) of this definition except for research and development activities utilizing unsubstantial amounts of plutonium. [10 CFR 70.4]

**Preventive Control** – A control intended to prevent an accident (such as, any of the radiological or chemical consequences described in 10 CFR 70.61. [NUREG-1520]

**Procedure** – A document that specifies or describes how an activity is to be performed.

**Protected Area** – An area encompassed by physical barriers and to which access is controlled. For GLE, this includes the GLE Site surrounded by the vehicle barrier, physical barrier, and fencing systems with controlled access points at Entry Control Facilities. [10 CFR 73.2]

**Public Dose** – The dose received by a member of the public from exposure to radiation or to radioactive material released by a licensee, or to any other source of radiation under the control of a licensee. Public dose does not include occupational dose or doses received from background radiation, from any medical administration the individual has received, from exposure to individuals administered radioactive material and released under 10 CFR 35.75, or from voluntary participation in medical research programs. [10 CFR 20.1003]

**Qualitative Fit Test (QLFT)** – A pass/fail fit test to assess the adequacy of respirator fit that relies on the individual's response to the test agent. [10 CFR 20.1003]

**Quantitative Fit Test (QNFT)** – An assessment of the adequacy of respirator fit by numerically measuring the amount of leakage into the respirator. [10 CFR 20.1003]

**Radiation (Ionizing Radiation)** – Alpha particles, beta particles, gamma rays, x-rays, neutrons, high-speed electronics, high-speed protons, and other particles capable of producing ions. Radiation does not include non-ionizing radiation, such as radio-waves or microwaves, or visible, infrared, or ultraviolet light. [10 CFR 20.1003]

**Radiation Area** – An area, accessible to individuals, in which radiation levels could result in an individual receiving a dose equivalent in excess of 0.005 rem (0.05 mSv) in one hour at 30 centimeters from the radiation source or from any surface that the radiation penetrates. [10 CFR 20.1003]

**Radiological Controlled Area (RCA)** – An area to which access is limited by the licensee for the purpose of protecting individuals against undue risks from exposure to radiation and radioactive materials. For regulatory purposes, a radiological controlled area is equivalent to a restricted area, as defined in 10 CFR 20.1003.

**Research and Development** – (1) Theoretical analysis, exploration, or experimentation; or (2) The extension of investigative finding and theories of a scientific or technical nature into practical application for experimental and demonstration purposes, including the experimental production and testing of models, devices, equipment, materials, and processes. [10 CFR 70.4]

**Residual Radioactivity** – Radioactivity in structure, materials, soils, groundwater, and other media at a site resulting from activities under the licensee's control. This includes radioactivity from all licensed and unlicensed sources used by the licensee, but excludes background radiation. It also includes radioactive materials remaining at the site as a result of routine or accident releases of radioactive material at the site and previous burials at the site, even if those burials were made in accordance with the provisions of 10 CFR 20. [10 CFR 20.1003]

**Respiratory Protective Device** – An apparatus, such as a respirator, used to reduce the individual's intake of airborne radioactive materials. [10 CFR 20.1003]

**Restricted Area** – An area, access to which is limited by the licensee for the purpose of protecting individuals against undue risks from exposure to radiation and radioactive materials. Restricted area does not include areas used as residential quarters, but separate rooms in a residential building may be set apart as a restricted area. [10 CFR 20.1003]

**Restricted Data** – All data concerning (1) design, manufacture, or utilization of atomic weapons; (2) the production of special nuclear material; or (3) the use of special nuclear material in the production of energy, but shall not include data declassified or removed from the Restricted Data category pursuant to Section 142 of the Act. [10 CFR 70.4]

**Restricted Security Area** – Designated Controlled Access Areas that are established to safeguard classified material. Typically classified material in these areas, which due to its size or nature, cannot be adequately protected during working hours by usual safeguards measures but is capable of being stored during non-working hours in an approved repository or secured by other approved methods.

**Safety Control (Safeguard)** – A system, device, or procedure that is intended to regulate a device, process, or human activity to maintain a safe state. Controls may be engineered controls or administrative (procedural) controls, and may be either preventive or mitigative.

**Sanitary Sewerage** – A system of public sewers for carrying off waste water and refuse, but excluding sewage treatment facilities, septic tanks, and leach fields owned or operated by the licensee. [10 CFR 20.1003]

**Sealed Source** – Any special nuclear material that is encased in a capsule designed to prevent leakage or escape of the special nuclear material. [10 CFR 70.4]

**Simple Administrative Control** – A procedural human action that is prohibited or required to maintain safe process conditions. [NUREG-1520]

**Single-Sided Lower Confidence Band (SSLCB)**: Estimates bias uncertainty to ensure, at a 95% level of confidence, a future calculation of $k_{eff}$ for a critical system or process is actually above the lower confidence limit. The SSLCB may be used when there is a clear trend in the calculated critical benchmark results.

**Single-Sided Lower Tolerance Band (SSLTB)**: Estimates the bias uncertainty to ensure, at a 95% level of confidence, at least 95% of future calculations of $k_{eff}$ for critical systems or processes are actually above the lower tolerance limit. The SSLTB may be used when there is a clear trend in the calculated critical benchmark results.

**Single-Sided Lower Tolerance Limit (SSLTL)**: Estimates the bias uncertainty to ensure, at a 95% level of confidence, at least 95% of future calculations of $k_{eff}$ for critical systems or processes are actually above the lower tolerance limit. The SSLTL is used when there are no trends apparent in the calculated critical benchmark results.

**Site Area Emergency** – Events may occur, are in progress, or have occurred that could lead to a significant release of radioactive material and that could require a response by offsite response organization to protect persons offsite. [10 CFR 70.4]

**Site Boundary** – The line beyond which the land or property is not owned, leased, or otherwise controlled by the licensee. [10 CFR 20.1003] For the GLE Commercial Facility, the Site Boundary is coincident with the Wilmington Site boundary.

**Source Material** – (1) Uranium or thorium or any combination of uranium and thorium in any physical or chemical form; or (2) Ores that contain, by weight, one-twentieth of one percent (0.05 percent), or more, of uranium, thorium, or any combination of uranium and thorium. Source material does not include special nuclear material. [10 CFR 20.1003]

**Special Nuclear Material (SNM)** – (1) Plutonium, $^{233}U$, uranium enriched in the Isotope 233 or in the Isotope 235, and any other material which the Commission, pursuant to the provisions of Section 51 of the Atomic Energy Act, determines to be special nuclear material, but does not include source material; or (2) Any material artificially enriched by any of the foregoing but does not include source material. [10 CFR 70.4]

**Special Nuclear Material of Low Strategic Significance** – (1) Less than an amount of special nuclear material of moderate strategic significance as defined in Paragraph (1) of the definition of strategic nuclear material of moderate strategic significance, but more than 15 grams of $^{235}U$ (contained in uranium enriched to 20 percent or more in $^{235}U$ isotope) or 15 grams of $^{233}U$ or 15 grams of plutonium or the combination of 15 grams when computed by the equation, grams = (grams contained $^{235}U$) + (grams plutonium) + (grams $^{233}U$); or (2) Less than 10,000 grams but more than 1,000 grams of $^{235}U$ (contained in uranium enriched to 10 percent or more but less than 20 percent in the $^{235}U$ isotope); or (3) 10,000 grams or more of $^{235}U$ (contained in uranium enriched above natural but less than 10 percent in the $^{235}U$ isotope). This class of material is sometimes referred to as a Category III quantity of material. [10 CFR 70.4]

**Special Nuclear Material of Moderate Strategic Significance** – (1) Less than a formula quantity of strategic special nuclear material but more than 1,000 grams of $^{235}U$ (contained in uranium enriched to 20 percent or more in the $^{235}U$ isotope) or more than 500 grams of $^{233}U$ or plutonium, or in a combined quantity of more than 1,000 grams when computed by the equation, grams = (grams contained $^{235}U$) + 2 (grams $^{233}U$ + grams plutonium); or (2) 10,000 grams or more of $^{235}U$ (contained in uranium enriched to 20 percent or more in the $^{235}U$ isotope), $^{233}U$, or plutonium. This class of material is sometimes referred to as a Category II quantity of material. [10 CFR 70.4]

**Special Nuclear Material Scrap** – The various forms of special nuclear material generated during chemical and mechanical processing, other than recycle material and normal process intermediates, which are unsuitable for use in their present form, but all or part of which will be used after further processing. [10 CFR 70.4]

**Strategic Special Nuclear Material** – $^{235}U$ (contained in uranium enriched to 20 percent or more in $^{235}U$ isotope), $^{233}U$, or plutonium. [10 CFR 70.4]

**Survey (Radiological)** – An evaluation of the radiological conditions and potential hazards incident to the production, use, transfer, release, disposal, or presence of radioactive material or their sources of radiation, When appropriate, such an evaluation includes a physical survey of the location of radioactive material and measurements or calculations of levels of radiation, or concentrations or quantities of radioactive material present. [10 CFR 20.1003]

**Tail Cylinder** – A 48-inch, $UF_6$ cylinder that contains less than 0.72 percent weight $^{235}U$ material.

**Total Effective Dose Equivalent** – Means the sum of the effective dose equivalent (for external exposures) and the committed effective dose equivalent (for internal exposures). [10 CFR 20.1003]

**Unacceptable Performance Deficiencies** – Deficiencies in the items relied on for safety or the management measures that need to be corrected to ensure an adequate level of protection as defined in 10 CFR 70.61(b), (c), or (d). [10 CFR 70.4]

**Unmitigated Initial Condition** – The unmitigated initial conditions are those initial conditions of the designed process or SSC that define how the process works, the physical conditions/constraints under which the material is handled, confined, or processed, and/or specifications of the SSC that define the normal operating characteristics of the process from which a deviation is postulated and its impacts are judged. For SSCs these initial conditions are defined based on application of the applicable Codes and Standards used in good engineering practices as they would be applied to non-regulated material (for example, in processing an HF gas stream in the chemical industry). These conditions do not include reliance on safety devices or abnormal or emergency procedures that mitigate abnormal deviations from the normal conditions (even when required by Codes and Standards). (For example, the unmitigated initial condition of a pressure vessel includes the vessel's location; materials normally processed; reaction rates, flow, pressure, and temperature ratings; materials of manufacture; etc. During the PHA process, deviations to these initial conditions are postulated and unmitigated event sequences are postulated based on the response of the process, system, structure, or component as defined by these parameters without relying on such items as pressure relief devices or abnormal operating procedures.)

**Unmitigated Event Sequences** – Unmitigated event sequences are those unintentional sequences of events that occur as a response of a process or SSC to a process deviation. The response is postulated based on the magnitude or effect of the process deviation on the unmitigated initial condition(s) defined by the designed process or SSC. The unmitigated initial conditions are defined by the process description, procedures, design documents, codes and standards, etc., that are used for defining the process or SSC. These unmitigated event sequences describe the process upset without the application of IROFS, and present the unmitigated likelihood of their occurrences, the unmitigated consequences that result, and an indication of the unmitigated risk. When the unmitigated risks are identified, they can be determined to be either acceptable or unacceptable. When unacceptable risks are identified for an unmitigated event sequence (that is, the risks exceed the performance requirements of 10 CFR 70.61), it is required that IROFS be identified to either prevent and/or mitigate the risk to the point that it becomes acceptable. The new sequences, including IROFS, are defined as an accident sequences. (For example, a credible path for a reactant not normally used in a pressure vessel functioning as a reaction vessel is introduced as a process deviation. If the resulting pressure of the reaction can credibly result in exceeding the pressure or temperature ratings of the vessel then the vessel is assumed to rupture. The likelihood of the deviation is estimated and, based on the materials involved, the severity of the release is identified. The unmitigated event sequence includes the introduction of the reactant - the deviation-, the response to the deviation - the rupture and release of the contents at the respective rate consistent with the deviation-, and does not include the presence of a relief device that may prevent the rupture and direct the released pressure to a safe location. The unmitigated event sequence becomes an accident sequence of concern if the likelihood category and the severity category result in unacceptable risk.)

**Unmitigated Consequence/Likelihood** - Unmitigated consequence/likelihood is the consequence/likelihood of the unmitigated event sequence before IROFS are identified and applied.

**Unmitigated Risk** - Unmitigated risk is the product of the unmitigated likelihood category (a number from 1 to 3) and the unmitigated consequence category (a number from 1 to 3). Unacceptable unmitigated risk carries a value of 6 or 9 (exceeds a value of 4).

**Unrestricted Area** – An area, access to which is neither limited nor controlled by the licensee. [10 CFR 20.1003]

**Uranium Enrichment Facility** – (1) Any facility used for separating the isotopes of uranium or enriching uranium in the Isotope 235, except laboratory scale facilities designed or used for experimental or analytical purposes only; (2) Any equipment or device, or important component part especially designed for such equipment or device, capable of separating the isotopes or uranium or enriching uranium in the Isotope 235. [10 CFR 70.4]

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**Very High Radiation Area** – An area, accessible to individuals, in which radiation levels from radiation sources external to the body could result in an individual receiving an absorbed dose in excess of 500 rads (five grays) in one hour at one meter from a radiation source or one meter from any surface that the radiation penetrates. [10 CFR 20.1003]

**Waste** – Those low-level radioactive wastes containing source, special nuclear, or byproduct material that are acceptable for disposal in a land disposal facility. For the purposes of this definition, low-level radioactive waste means radioactive waste not classified as high-level radioactive waste, transuranic waste, spent nuclear fuel, or byproduct material. [10 CFR 20.1003]

**Wilmington Site** – The approximately 1600 acre GE property located in Wilmington, NC, where various nuclear and non-nuclear industrial facilities are located, including the GLE Commercial Facility.

**Worker** – An individual who receives an occupational dose as defined in 10 CFR 20.1003. [10 CFR 70.4]

# CHAPTER 1
# REVISION LOG

| Rev. | Effective Date | Affected Pages | Revision Description |
|---|---|---|---|
| 0 | 04/30/2009 | ALL | Initial Application Submittal. |
| 1 | 03/31/2010 | 8-9, 17, 19-29, 41, 43-45, 47, 55, 59, 61 | Incorporate RAI responses submitted to the NRC via MFN-09-578 dated 09/04/2009 and MFN-09-801 dated 12/28/2009. |
| 2 | 06/18/2010 | 14-18, 22, 26, 30, 22, 34, 38-41, 47, 49, 63 | Revised Section 1.2.2.4 regarding nuclear liability insurance. Revised Section 1.1.3.1 regarding the transition period between construction and operations. Incorporated the latest natural phenomena information and updated the figures. |
| 3 | 12/17/2010 | 23-25, 29, 32 | Incorporate RAI responses from NRC letters dated October 5, 2010 and October 14, 2010.<br>Revised Section 1.2.2.2 to update schedule for operations.<br>Changed name President and CEO.<br>Updated company assets to 2009 information<br>Clarified that insurer determined amount of nuclear liability insurance<br>Revised Section 1.2.5.6 to clarify definition of "basic component".<br>Added description of procedure for inclement weather |
| 4 | 03/30/2011 | 39, 48, 49 | Changed two erroneous tornado "F3" references to "F2".<br>Added revision number for referenced Reg Guide 1.76.<br>Added revision number for referenced Reg Guide 1.198. |
| 5 | 08/12/2011 | 30-32 | Revised Section 1.2.5.6 to update the definitions of Basic Component, Critical Characteristics, Dedication Process, Dedicating Entity to be consistent with the GLE QAPD. |

| Rev. | Effective Date | Affected Pages | Revision Description |
|---|---|---|---|
| | | 32<br><br>38-46 | Revised Section 1.2.6 to clarify that the Facility Clearance has been granted to GLE (previously granted to GNFA).<br>Revised portions of Section 1.3 to be consistent with the GLE ISA Summary. |
| 6 | 10/14/2011 | 31, 33, 34, 39, 40, 43, 45, 46 | Revised Section 1.2.5.6 to change "Dedication Process" to "Dedication" to be consistent with the definition in 10 CFR 21.<br>Revised Section 1.2.5.6 to correct a typo in the "Dedication" definition.<br>Revised Section 1.3.3.3.6 to correct information revise basis for tornado probability of "Highly Unlikely".<br>Revised Section 1.3.5.2 to incorporate information related to the August 23, 2011 earthquake in Virginia.<br>Various non-intent revisions to information for clarity. |
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# 1. GENERAL INFORMATION

This application requests a license from the U.S. Nuclear Regulatory Commission (NRC) to possess and use source material, special nuclear material (SNM), and byproduct material to construct and operate a commercial uranium enrichment facility. This application is filed by the GE-Hitachi Global Laser Enrichment LLC (GLE). GLE is requesting a license for a period of 40 years.

This chapter provides an overview of the GLE Commercial Facility. The facility enriches uranium for use in the manufacturing of nuclear fuel used in commercial power plants. This chapter provides a description of the facility and enrichment process along with a description of the GLE Site. Institutional information is provided to identify the applicant, describe the applicant's financial qualifications, and describe the proposed licensed activities.

This License Application (LA) is being submitted pursuant to the following:

- Atomic Energy Act of 1954, as amended *(Ref. 1-1)*,
- 10 CFR 70, *Domestic Licensing of Special Nuclear Material (Ref. 1-2)*,
- 10 CFR 40, *Domestic Licensing of Source Material (Ref. 1-3)*, and
- 10 CFR 30, *Rules of General Applicability to Domestic Licensing of Byproduct Material (Ref. 1-4)*.

## 1.1 FACILITY AND PROCESS DESCRIPTION

This section provides an overview of the GLE Site, the GLE Commercial Facility layout, and a summary of the GLE enrichment process.

### 1.1.1 Facility Location

The GLE Commercial Facility is located on an existing General Electric Company (GE) industrial site in Wilmington, North Carolina (herein referred to as the Wilmington Site). The Wilmington Site is a 1621-acre tract of land, located west of North Carolina Highway 133 (also known as Castle Hayne Road). The Wilmington Site lies between latitudes (North) 34° 19' 4.0"and 34° 20' 28.9" and longitudes (West) 77° 58' 16.4" and 77° 55' 19.8", and is approximately six (6) miles north of the City of Wilmington in New Hanover County, North Carolina (see Figure 1-1, *Wilmington Site and County Location*, and Figure 1-2, *Wilmington Site, New Hanover County, and Other Adjacent Counties*). The Wilmington Site is also the GLE "controlled area" (or "owner controlled area") for the purpose of meeting the requirements of 10 CFR 70.61(f), *Performance Requirements (Ref. 1-5)*.

The GLE Commercial Facility is located on approximately 100 acres of the Wilmington Site. In addition to the GLE Commercial Facility, the Wilmington Site contains the following GE facilities (see Figure 1-3, *Wilmington Site*):

- Global Nuclear Fuel – Americas, LLC (GNF-A) Fuel Manufacturing Operations (FMO) facility operated under the NRC SNM License-1097 *(Ref. 1-6)*;
- Wilmington Field Service Center (WFSC) in which used reactor control rod drive mechanisms are decontaminated, refurbished, and temporarily stored;
- GE Aircraft Engines (AE) facility which is not involved in nuclear fuel manufacturing operations;
- GE Services Components Operation (SCO) facility in which non-radioactive reactor components are manufactured;
- Fuel Components Operation (FCO) facility in which non-radioactive components for reactor fuel assemblies are manufactured; and
- Miscellaneous administrative and support buildings and site infrastructure, such as roads and parking lots.

To the east of the Wilmington Site border is North Carolina Highway 133 and some commercially and residentially developed properties. Located to the east of North Carolina Highway 133, is a GE-owned 24-acre parcel that is undeveloped, except for a GE employee park and a leased portion of property used as a transportation terminal. To the southwest of the Wilmington Site border is the Northeast Cape Fear River.

The majority of the north, northwest, and south perimeters are undeveloped forestlands. A small segment (approximately 1,000-feet of the north property line) borders the Wooden Shoe residential subdivision. A portion of the south property line is bordered by Interstate Highway 140 (otherwise known as the Wilmington Bypass). Residential properties are located directly south of the Wilmington Bypass.

The surrounding terrain is typical of coastal North Carolina with an elevation averaging less than 40 feet above mean sea level (msl). The terrain is characterized as gently rolling terrain consisting of forest, rivers, creeks, and swamps/marshlands.

### 1.1.2 Facility Description

The GLE Commercial Facility is shown on Figure 1-4, *GLE Commercial Facility Site Plan*. The GLE Commercial Facility includes the Operations Building where the enrichment processing systems and enrichment processing support systems are contained, several administrative and support buildings, a parking lot, retention basins, uranium hexafluoride ($UF_6$) cylinder pads, and connecting roadways. A cleared security buffer surrounds the entire GLE Commercial Facility and defines both the Restricted Area and the Protected Area of the facility. The major structures and areas of the facility are described below.

#### 1.1.2.1 GLE Operations Building

The overall layout of the Operations Building is shown in Figure 1-4. The Operations Building includes the following process and support areas:

- Cylinder Shipping and Receiving Area,
- $UF_6$ Feed and Vaporization Area,
- Product Withdrawal Area,
- Tails Withdrawal Area,
- Cascade/Gas Handling Area,
- Blending Area,
- Sampling Area,
- Radioactive Waste Area,
- Heating, Ventilation, and Air Conditioning (HVAC) Equipment Area,
- Decontamination/Maintenance Area,
- Laboratory Area, and
- Laser Area.

The main process and support areas of the Operations Building and the associated operations are described below.

##### 1.1.2.1.1 Cylinder Shipping and Receiving Area

The Cylinder Shipping and Receiving Area contains the necessary equipment to perform the following functions:

- Receive 30- and 48-inch cylinders from offsite;
- Weigh cylinders and perform other material control and radiological functions during receiving and when preparing for storage or offsite shipment;
- Provide interim storage of cylinders inside the Operations Building;
- Prepare cylinders and transfer them to onsite transfer vehicles (OSTVs) for transfer between the Operations Building and the $UF_6$ Cylinder Pads;
- Provide interim storage of product, feed, and sample/blend cylinders;

- Prepare cylinders and transfer them to OSTVs for transfer to other process areas within the Operations Building;

- Prepare product cylinders for offsite shipment and intra-site transfer; and

- Prepare 48-inch tails and heel cylinders for offsite shipment.

$UF_6$ feed is received at the GLE Commercial Facility in American National Standards Institute (ANSI) N14.1-compliant $UF_6$ cylinders on semi-trailer trucks, typically with one full 48-inch cylinder per shipping trailer. A compliant 48-inch feed cylinder contains a maximum of 12,501 kg of $UF_6$ *(Ref: 1-7)*.

When $UF_6$ cylinders are received at the GLE Commercial Facility, the cylinders are inspected, verified, and processed per approved written Operations, Security, and Radiation Protection (RP) procedures. Empty 30- and 48-inch cylinders are also received at the GLE Commercial Facility.

At the Cylinder Shipping and Receiving Area, cylinders are offloaded and transferred to an adjacent weighing and scanning area. After acceptance, feed cylinders are moved to an interim cylinder storage area inside the Cylinder Shipping and Receiving Area. From the interim cylinder storage area, feed cylinders may be moved to a feed station to begin processing, or to the In-Process Pad. An overhead bridge crane and transfer cart are used to handle the $UF_6$ cylinders.

Source material and SNM are used in this area.

### *1.1.2.1.2 $UF_6$ Feed and Vaporization Area*

The $UF_6$ Feed and Vaporization Area contains the necessary equipment to perform the following operations:

- Receive $UF_6$ feed cylinders from the Cylinder Shipping and Receiving Area;

- Purge the light gases contained within the feed cylinders;

- Capture the light gases for disposal;

- Vaporize the $UF_6$ contained within the feed cylinders;

- Feed the vaporized $UF_6$ to the feed header between the Vaporization Area and the Cascade/Gas Handling Area within the Operations Building;

- Maintain design basis $UF_6$ feed rates to the feed header within the design basis temperature and pressure range; and

- Recover residual $UF_6$ from the feed cylinders to meet U.S. Department of Transportation (DOT) offsite cylinder shipping requirements for empty cylinders.

The $UF_6$ Feed and Vaporization Area is divided into feed vaporization chambers (FVCs). Each of the FVCs typically contains: solid feed stations (SFS) to vaporize the $UF_6$ feed; a cold trap purification station (CTPS) to remove light gases from the feed stream; a low temperature take-off station (LTTS) to remove feed cylinder $UF_6$ down to heel quantities; and a heated flow control valve box (HFCVB) for each SFS that contains the valves and pipe connections from each SFS.

Source material is used in this area.

#### *1.1.2.1.3 Product Withdrawal Area*

The Product Withdrawal Area contains the necessary equipment to perform the following functions:

- Receive empty 48 GLE $UF_6$ cylinders from interim storage within the Cylinder Shipping and Receipt Area;
- Maintain design basis $UF_6$ product withdrawal rates from the Cascade main discharge header;
- Separate the light gases from the $UF_6$ for disposal; and
- Provide filled 48 GLE cylinders with ≤ 8.00 wt% $^{235}U$ for interim storage and later disposition.

The Product Withdrawal Area contains: volume reducing compressor trains (VRCTs) that move $UF_6$ product material from the Cascade/Gas Handling System to the product Withdrawal Stations; LTTSs to collect the $UF_6$ product material; a CTPS to remove non-condensable light gases from the product stream; and a HFCVB for each LTTS that contains the valves and pipe connections from each LTTS.

SNM is used in this area.

#### *1.1.2.1.4 Tail Withdrawal Area*

The Tail Withdrawal Area contains the necessary equipment to perform the following functions:

- Receive empty $UF_6$ cylinders from interim storage within the Cylinder Shipping and Storage Area;
- Maintain design-basis $UF_6$ tails withdrawal rates from the enrichment system main discharge header;
- Separate the light gases from the $UF_6$ for disposal; and
- Provide filled $UF_6$ cylinders with ≤ 0.72 wt% $^{235}U$ for interim storage and later disposition.

The Tail Withdrawal Area contains: VRCTs that move $UF_6$ tails from the Cascade/Gas Handling System to the Tail Withdrawal Stations; LTTSs to collect the $UF_6$ tails material; a CTPS to remove non-condensable light gases from the tails stream; and a HFCVB for each LTTS that contains the valves and pipe connections from each LTTS.

Source material is used in this area.

#### *1.1.2.1.5 Cascade/Gas Handling Area*

The Cascade/Gas Handling Area contains the equipment necessary to perform the laser-based enrichment process. The $UF_6$ gas is exposed to laser-emitted light and two process streams are generated; one enriched in $^{235}U$ and one depleted in $^{235}U$.

Technical details of the GLE laser-based enrichment process are proprietary, subject to export control by U.S. laws and regulations, and in many cases may also fall into the categories of security-related, safeguards, or classified information, access to which is further limited per U.S. laws and regulations.

Source material and SNM are used in this area.

#### *1.1.2.1.6 Blending Area*

The Blending Area contains the necessary equipment to perform the following functions:

- Receive 30- or 48-inch donor cylinders from interim storage within the Cylinder Shipping and Receiving Area;
- Purge the light gases contained within the cylinders;
- Capture the light gases for disposal;
- Vaporize the $UF_6$ contained within the donor cylinders;
- Feed the vaporized $UF_6$ to receiver cylinders;
- Recover residual $UF_6$ from the donor cylinders to meet DOT cylinder shipping requirements for empty cylinders; and
- Provide empty donor cylinders and filled receiver cylinders for interim storage.

The Blending Area contains blending donor stations (which are similar to the SFS) and blending receiver stations (which are similar to the product withdrawal LTTS) described under the Product Withdrawal Area above.

SNM is used in this area.

### 1.1.2.1.7 Sampling Area

The Sampling Area contains the necessary equipment to perform the following functions:

- Receive filled $UF_6$ cylinders from interim storage within the Cylinder Shipping and Receipt Area;
- Purge the light gases contained within the cylinders;
- Capture the reactive light gases for disposal and vent the nonreactive light gases;
- Homogenize and sample the $UF_6$ contained within the cylinders; and
- Maintain design basis $UF_6$ cylinder rates to support a six (6) million separative work unit (SWU) facility.

The function of the product liquid sampling system is to obtain an assay sample from filled product cylinders. The sample is used to validate the enrichment level of $UF_6$ in the filled product cylinders before the cylinders are sent to the fuel processor. This is the only system in the GLE Commercial Facility that converts solid $UF_6$ to liquid $UF_6$.

The Sampling Area contains: sample containment autoclaves (SCAs) to support liquefaction, sampling, and solidification of $UF_6$ in the cylinders; CTPS to remove light gases vented from the cylinders being sampled; LTTSs to capture $UF_6$ vented from the cylinders during sampling; HFCVB for each SCA that contains the valves and pipe connections between units within the sampling area; an autoclave surge tank (AST) that provides $UF_6$ surge capacity if an autoclave relief device actuates.

Source material and SNM are used in this area.

### 1.1.2.1.8 Liquid and Solid Radioactive Waste Areas

Quantities of radiologically contaminated, potentially contaminated, and non-contaminated aqueous liquid effluents are generated in a variety of the GLE Commercial Facility operations and processes. Aqueous liquid effluents are collected in tanks located in the Radioactive Liquid Effluent Collection and Treatment Room. The collected effluent is sampled and analyzed to determine if treatment is required before release.

Operation of the GLE Commercial Facility also generates refuse and other hazardous and nonhazardous solid wastes. These wastes may be designated as Resource Conservation and Recovery Act (RCRA) hazardous wastes, low-level radioactive waste (LLRW), high-activity waste, or low-level mixed waste (LLMW). Solid-waste systems are designed to process both wet and dry low-level radioactive solid waste. Solid radioactive waste material is accumulated, monitored for criticality control and other regulatory requirements, stored in temporary accumulation areas, and then transferred to one of the solid-waste storage buildings located on the GLE Site for storage pending eventual offsite shipment/disposition.

#### 1.1.2.1.9 HVAC Equipment Areas

Various ventilation systems are used to condition the environment inside the buildings and areas to meet requirements for personnel, process equipment, and supporting systems and utilities. The HVAC systems also control the room pressure in different areas or zones of the buildings relative to adjacent areas and relative to the outdoors as part of the radioactive or hazardous material containment function.

The ventilation system requirements of each area are dependent on the process performed, and on variables such as the indoor air temperature, relative humidity, relative room pressure, and safety requirements.

Ventilation systems that have the potential to exhaust radioactive or hazardous materials interface with the Monitored Central Exhaust System (MCES). The MCES functions to remove uranium particulates as well as $UF_6$ and HF gas from process gas streams and room air during normal and abnormal events. The system maintains areas under negative pressure relative to ambient and adjacent areas. This prevents the release of radioactive or hazardous materials, which protects workers and the public. The MCES discharges through a monitored exhaust stack located in the Operations Building.

The ventilation and MCES equipment serving the Operations Building is located in various locations throughout the Operations Building.

#### 1.1.2.1.10 Decontamination/Maintenance Area

The Decontamination/Maintenance Area provides a place for personnel to remove contamination from, and make repairs to, equipment and process components used in $UF_6$ systems, waste handling systems, and other areas of the facility.

Source material and SNM are contained in this area.

#### 1.1.2.1.11 Laboratory Area

The Laboratory Area is located just north of the Cylinder Shipping and Receiving Area, on the east side of the Operations Building. Within the Laboratory Area there are areas for mass spectroscopy equipment, wet chemistry activities, safety and regulatory testing and analysis, standard analytical laboratory equipment, and fume collection and exhaust hoods.

Source material and SNM are used in this area.

#### 1.1.2.1.12 Laser Area

The Laser Area contains the necessary equipment to operate the laser systems that are part of the GLE laser-based enrichment technology; and produce the specific wavelength of light required to affect the uranium isotope necessary for the enrichment process.

The Laser Area contains: lasers to generate the required wavelength of light needed for the enrichment process, and a laser repair shop located adjacent to the Laser Area to perform maintenance on the laser systems, including calibration, repair, and preventive maintenance.

No source material or SNM is used in this area.

#### *1.1.2.2 $UF_6$ Cylinder Pads*

The $UF_6$ Cylinder Pads include three outdoor cylinder pads each serving a different function. The three pads are described below. See Figure 1-4 for the location of the $UF_6$ Cylinder Pads.

##### *1.1.2.2.1 Product Pad*

The Product Pad is used to store product in 30-inch cylinders. The Product Pad is approximately 48,000 square feet and constructed similar to the other storage pads to provide for rainwater drainage. Saddles are used to store the cylinders and the cylinders are not typically stacked.

SNM is contained in this area.

##### *1.1.2.2.2 In-Process Pad*

The In-Process Pad is used to store feed material, as well as any cylinders containing heels and empty cylinders. It is approximately 130,000 square feet and constructed similar to the other pads to provide for rainwater drainage. Saddles are used to store the cylinders and the cylinders are not typically stacked.

Source material is contained in this area.

##### *1.1.2.2.3 Tails Pad*

The Tails Pad is designed to provide storage for 48-inch cylinders containing less than or equal to 0.72 percent weight $^{235}U$. The Tails Pad is sized to accommodate the cylinders resulting from ten (10) years of facility operation.

The Tails Pad occupies approximately 465,000 square feet. The pad is sloped to provide drainage to the edges of the pad. The surrounding site is graded to provide collection and drainage of rainwater to an onsite retention basin. The cylinders may be stacked two high and are stored using saddles.

Source material is contained in this area.

### *1.1.2.3 Other Facility Buildings and Supporting Infrastructure*

See Figure 1-4 for the location of the following buildings and supporting infrastructure.

There are three (3) administrative buildings. Two of the administrative buildings primarily contain office space for the GLE support staff and conference rooms. The third administrative building, the Operations Support Center, contains the personnel Entry Control Facility (ECF) and is located at the entrance to the Protected Area. Personnel requiring access to the Protected Area must pass through the ECF. The ECF is designed to facilitate and control the passage of authorized facility personnel and visitors. General parking is located outside of the Protected Area.

Waste storage buildings are used to store solid LLRW. The waste is packaged in transportation containers and surveyed prior to being stored in the warehouse.

An electrical substation and diesel generators provide electrical power to the GLE Commercial Facility. The diesel generators are used during short-term power losses to support an orderly shutdown of the enrichment processes upon loss of power or until normal electrical service is restored. A loss of GLE Site electrical power does not have any public safety implications.

Potable and process water supply lines run to the GLE Commercial Facility from the existing Wilmington Site water supply infrastructure. Sanitary waste, process wastewater, and treated liquid radiological wastewater are routed from the GLE Commercial Facility via underground lines to lift stations. The lift stations deliver the respective wastewaters to the existing Wilmington Site Sanitary Waste Water Treatment Facility (WWTF) and Final Process Lagoon Treatment Facility (FPLTF) through underground pipes.

Two retention basins receive stormwater runoff from the GLE Commercial Facility. The majority of the runoff from the GLE Commercial Facility, including the Operations Building, drains to a collection basin on the Wilmington Site. The remaining runoff, including runoff from the $UF_6$ Cylinder Pads, drains to a GLE Site retention basin.

There is a water tower, a firewater retention basin, and associated pumps and piping located on the GLE Site. The water in the tower is designated for process water, but has a reserved level for fire fighting. The firewater retention basin and associated diesel powered firewater pumps are designed as a backup source for fire protection systems.

The road leading to the entrance of the GLE Commercial Facility is located off of Castle Hayne Road (see Figure 1-3). There is also a road exiting the GLE Commercial Facility leading to the GNF-A FMO Facility. Both of these roads are located on the Wilmington Site and are maintained by GE.

### 1.1.3 Process Description

This section provides an overview of the GLE laser-based enrichment process. A more detailed description of the process is provided in the Integrated Safety Analysis (ISA) Summary. The ISA Summary also contains a description of the other systems supporting the GLE Commercial Facility including the utility systems; HVAC systems, process water system, and the various cylinder-handling systems used to move $UF_6$ cylinders.

#### *1.1.3.1 Process Overview*

The GLE Commercial Facility is a uranium enrichment facility that utilizes laser-based enrichment technology. The GLE Commercial Facility is designed to separate a feed stream containing the naturally occurring proportions of uranium isotopes into a product stream (enriched in the $^{235}U$ isotope) and a tails stream (depleted in the $^{235}U$ isotope).

The GLE Commercial Facility utilizes industry standard $UF_6$ containers and processes for material handling aspects of enrichment facility operations similar to those utilized at other uranium enrichment facilities. These similar $UF_6$ handling processes include the movement of uranium feed stock from its solid $UF_6$ form in cylinders to gaseous form used in the enrichment cascade via vaporization techniques, the filling of $UF_6$ cylinders with $UF_6$ gas condensed into solid $UF_6$ form after the enrichment process, and the blending of $UF_6$ gas of different enrichments to create specific desired product enrichments.

The GLE Commercial Facility uses the laser-based enrichment technology within an area of the facility known as the Cascade/Gas Handling Area. The process enriches natural $UF_6$, containing approximately 0.72 weight percent $^{235}U$, to a $UF_6$ product containing $^{235}U$ enriched up to 8 weight percent. The nominal capacity of the facility is six (6) million SWU per year.

The uranium enrichment process utilized by the GLE Commercial Facility utilizes lasers tuned to specific frequencies to selectively excite $UF_6$ gas molecules to enable separation of the $^{235}U$ isotope in $UF_6$ feed stock. The result is a $UF_6$ product stream enriched in the $^{235}U$ isotope and a $UF_6$ tails stream in which the fraction of $^{235}U$ isotope is reduced or depleted. Technical details of the GLE laser-based enrichment technology are proprietary, subject to export controls by U.S. laws and regulations, and in many cases also fall into the categories of security-related, safeguards, or classified information, access to which is further limited per U.S. laws and regulations.

The phases of construction/initial operations include Early Construction, Phase 1 Construction (Initial Construction of one MSWU facility), Phase 2 Construction (Construction and Component Installation to Ramp up to six MSWU), and Full Operations at six MSWU. The facility described in this License Application assumes that the facility is operating at six MSWU. However, the facility will be operating at approximately one MSWU during the first year, two MSWU during the second year, three MSWU during the third year, four MSWU during the fourth year, five MSWU during the fifth year, and six MSWU during the sixth year and every year thereafter. The initial construction plan includes building the Operations Building in its entirety, and equipping it with the necessary equipment to generate one MSWU. During the first year, while the facility is operating at one MSWU, equipment/component installation will be occurring simultaneously. Similarly, for the second, third, fourth, and fifth years, operations and equipment/component installation will occur simultaneously.

During Early Construction (prior to receipt of an NRC license), the following activities will occur:

- Clearing 100 acres on the GLE Site,
- Site grading and erosion control,
- Installation of stormwater retention system,
- Construction of main access roadways,
- Placement of utilities (electricity, potable water, process water, water for fire suppression, sanitary sewer, natural gas), and
- Construction of parking lots and minor roadways.

During Phase 1 Construction, the following activities will occur:

- Construction of the Operations Building,
- Construction of the $UF_6$ Cylinder Pads,
- Construction of the guardhouses,
- Construction of ancillary buildings (includes waste storage facilities, vehicle maintenance facilities, warehouses, storage yards, utility buildings, etc.),
- Installation of security systems,
- Construction of the Administrative buildings,
- Installation of the fire protection and other safety systems, and
- Installation of components within Operations Building to support one MSWU production.

**{{{Proprietary Information withheld from disclosure per 10 CFR 2.390}}}**

During full operations at six MSWU, there is not anticipated to be further facility construction or component installation, with the exception of maintenance and repair activities. Any unanticipated construction/component installation will be evaluated per the 10 CFR 70.72 *Facility Changes and Change Process (Ref. 1-8)* to determine if an amendment to the license is required prior to initiating the activities.

### 1.1.3.2 *Process System Descriptions*

The GLE Commercial Facility enrichment process consists of the following four (4) major systems and two enrichment support systems:

<u>Major Enrichment Process Systems</u>

1. $UF_6$ Feed and Vaporization
2. Cascade/Gas Handling
3. Product Withdrawal
4. Tail Withdrawal

<u>Enrichment Support Systems</u>

1. Blending
2. Sampling

An overview of each process system or support system is provided below.

#### 1.1.3.2.1 *$UF_6$ Feed and Vaporization System*

The major function of the $UF_6$ Feed Vaporization System is to provide a continuous supply of gaseous $UF_6$ from the feed cylinders to the Cascades. The nominal $UF_6$ feed flow rate is based on a six (6) million SWU/year facility capacity. Approximately 900 48-inch cylinders are processed annually.

The major equipment used in the $UF_6$ Feed Vaporization Process are the SFSs. Feed cylinders are loaded into SFSs; vented for removal of light gases, primarily air and hydrogen fluoride, and heated to sublime the $UF_6$. The light gases and $UF_6$ gas generated during feed purification are routed to the Feed Purification Subsystem where the $UF_6$ is de-sublimed. The Feed Purification Subsystem consists of $UF_6$ cold traps, a vacuum pump/chemical trap set, and a LTTS. The Feed Purification Subsystem removes any light gases such as air and hydrogen fluoride from $UF_6$ prior to introduction into the Cascade/Gas Handling Area. The $UF_6$ is captured in $UF_6$ cold traps and ultimately recycled as feed, while hydrogen fluoride is captured on chemical traps.

#### 1.1.3.2.2 *Cascade/Gas Handling System*

After purification, $UF_6$ from the SFS is routed to the Cascade/Gas Handling Area. The gas is exposed to laser-emitted light, and the $UF_6$ gas is separated into two streams, one enriched in $^{235}U$ and one depleted in $^{235}U$.

#### 1.1.3.2.3 *Product Withdrawal System*

Enriched $UF_6$ from the Cascade/Gas Handling Area is de-sublimed in the Product Withdrawal LTTS. Pumps and compressors transport the $UF_6$ from the Cascade/Gas Handling Area to the Product Withdrawal LTTS. The heat of de-sublimation of the $UF_6$ is removed by cooling air routed through the LTTS. Filling of the product cylinders is monitored with a load cell system, and filled cylinders are transferred to the Product Cylinder Sampling System for sampling.

#### *1.1.3.2.4 Tail Withdrawal System*

Depleted $UF_6$ from the Cascade/Gas Handling Area is de-sublimed in the Tail Withdrawal LTTS. Pumps and compressors transport the $UF_6$ from the Cascade/Gas Handling Area to the Product LTTS. The heat of de-sublimation of the $UF_6$ is removed by cooling air routed through the LTTS. Filling of the tail cylinders is monitored with a load cell system, and filled cylinders are transferred to the Tails Pad.

#### *1.1.3.2.5 Blending System*

The primary function of the Blending System is to blend $UF_6$ donor cylinders with differing enrichments into a receiver cylinder. The assay in the receiver cylinder is one that meets customer specifications as well as transportation standards.

#### *1.1.3.2.6 Sampling System*

$UF_6$ sampling operations are performed in the Sampling Area. Current American Society for Testing and Materials (ASTM) International standards require that $UF_6$ samples be taken from homogenized $UF_6$. Therefore, the design criteria require liquefaction of $UF_6$ during sampling operations. In addition, sampling of a statistical basis set of feed and tails cylinders is required to support Material Control and Accounting (MC&A) requirements.

Autoclaves with heating and cooling capability are used to liquefy $UF_6$ in the cylinders, homogenize the liquefied material, obtain a representative sample of the contents of the cylinders, and then solidify the $UF_6$ in the cylinders before they are removed from the autoclave. The cylinders may be any approved $UF_6$ cylinder, per ANSI N14.1, *Nuclear Materials – Uranium Hexafluoride – Packaging for Transport (Ref. 1-9)*, which meets nuclear criticality safety (NCS) requirements. The autoclaves are designed to contain a $UF_6$ release in the autoclave. Electrically heated air is the heating medium and cold air is used for cooling.

### 1.1.4 Waste Management

#### *1.1.4.1 Solid Wastes*

Operation of the GLE Commercial Facility generates refuse and other nonhazardous solid waste, wastes designated as RCRA hazardous wastes, and LLRWs. No high-level radioactive wastes are generated by GLE Commercial Facility operations. GLE does not intend to generate mixed wastes. Low-level waste is expected to be Class A waste. The types, sources, and estimated quantities of solid wastes generated by GLE Commercial Facility operations are summarized in Table 1-1, *Typical Types, Sources, Quantities of Solid Wastes Generated by GLE Commercial Facility Operations*, and Table 1-2, *Management of Solid Wastes*.

GLE Commercial Facility operations generate an estimated 380 tons of municipal solid waste (MSW) per year. This waste is collected and placed in roll-off type containers. A commercial refuse collection service regularly collects the filled containers and transports the waste to a RCRA permitted Subtitle D landfill for disposal.

In addition to MSW, an estimated 107 tons of non-hazardous solid wastes are generated per year as a result of equipment maintenance for GLE Commercial Facility operations. Examples of these wastes are spent coolant and used filter media. These wastes are collected and temporarily stored in containers appropriate for the waste type. Depending on the composition of the non-hazardous waste, these materials are either shipped directly to a permitted RCRA Subpart D landfill for treatment and burial, or routed to other approved facilities for reuse, reclamation, or treatment.

The GLE Commercial Facility generates approximately 12 tons of RCRA hazardous waste per year. This waste is collected, packaged in DOT-approved shipping containers, and temporarily stored onsite for shipment to a RCRA-permitted Subtitle C treatment, storage, and disposal facility.

The sources and typical quantities of LLRW generated by GLE Commercial Facility operations are summarized in Table 1-1. LLRW is collected in containers appropriate for the waste form and shipped by truck to an approved disposal facility as indicated in Table 1-2.

### *1.1.4.2 Liquid Wastes*

The sources and estimated quantities of wastewater generated by GLE Commercial Facility operations are summarized in Table 1-3, *Typical Types, Sources, and Quantities of Wastewater Generated by GLE Commercial Facility Operations*, and Table 1-4, *Management of Wastewater Generated by GLE Commercial Facility Operations*.

The liquid radioactive wastes generated in the Operations Building are collected in closed drain systems that discharge to an accumulator tank. The liquid is treated to remove uranium through precipitation; the liquid is then treated to remove fluoride through evaporation. The resulting solids are dried and disposed of as LLRW.

The treated wastewaters from the Radiological Liquid Effluent Treatment System (RLETS) are discharged to the existing Wilmington Site Sanitary WWTF and FPLTF. The FPLTF receives Wilmington Site process wastewater, including the treated effluent from the GNF-A Radiological Waste Treatment System. The treated effluent from the FPLTF is discharged via National Pollutant Discharge Elimination System (NPDES)-permitted Outfall 001 to the Wilmington Site effluent channel where it is combined with stormwater, discharging groundwater, and treated sanitary wastewater effluent. The effluent channel flows to the unnamed Tributary No. 1 to the Northeast Cape Fear River.

The cooling tower for the GLE Commercial Facility is a closed loop system that does not contact any uranium materials or uranium-contaminated wastewater streams. To minimize the amount of dissolved solids and other impurities in the circulating water, standard operating practice is to regularly remove a portion of the circulating water from the cooling tower loop and discharge the water to an evaporation pond (adding fresh water to the cooling tower loop to make up for corresponding water loss). Approximately 30,000 gallons per day (gpd) is removed and pumped directly to the existing Wilmington Site FPLTF.

Operation of the GLE Commercial Facility generates approximately 10,500 gpd of sanitary waste. The sanitary wastes are collected in a sewer system connected to the existing Wilmington Site Sanitary WWTF. This facility uses an Activated Sludge Aeration Process. The treated effluent from the Wilmington Site Sanitary WWTF is reused as process water.

Stormwater runoff from outdoor impervious surfaces within the GLE Commercial Facility is collected in drainage conduits and channels flowing into retention basins used for collection of runoff. The retention basins are routed to the unnamed Tributary No. 1, which flows into the Northeast Cape Fear River.

### 1.1.5 Depleted Uranium Management

Depleted uranium (also referred to as $UF_6$ tails) from GLE Commercial Facility operations is temporarily stored at the GLE Commercial Facility in 48-inch cylinders before being shipped offsite to a depleted uranium conversion facility. There is no onsite disposal of the $UF_6$ tails at the Wilmington Site. Section 3113 of the United States Enrichment Corporation (USEC) Privatization Act *(Ref. 1-10)* directs the U.S. Department of Energy (DOE) to "accept for disposal" depleted uranium, such as the $UF_6$ tails generated by the GLE Commercial Facility.

The Tails Pad is designed to provide storage capacity for approximately 9,000 48-inch cylinders, which is equivalent to ten years of facility operation. It is anticipated that DOE will have begun accepting possession of the $UF_6$ tails before the storage pad capacity is reached. The pad design layout permits double stacking of the 48-inch cylinders and allows the cylinders to be moved with gantry cranes and flatbed trucks. The storage pad occupies approximately 465,000 square feet. To provide stormwater drainage, the pad is sloped at the edges. The terrain surrounding the storage pad is graded to provide collection and drainage of stormwater to a retention basin.

Saddles are used to stack and store the cylinders above the Tails Pad surface. To transfer the $UF_6$ tails between the Cylinder Shipping and Receiving Area and the Tails Pad, dedicated diesel-powered flatbed trucks are used. At the Tails Pad, a diesel-powered, self-propelled gantry crane is used to unload the cylinder from the flatbed truck, move the cylinder to the appropriate storage location on the pad, and place the cylinder on its pad cradle. Work practices to manage the Tails Pad include periodic inspections and radiological surveys to ensure cylinder integrity. Operators are trained in safe cylinder handling and cylinder maintenance procedures.

### 1.1.6 Liquid and Air Effluents

#### *1.1.6.1 Process Wastewaters*

Uranium enrichment operations performed inside the Operations Building generate process wastewater from decontamination, cleaning wash water, and laboratory wastes. The waste streams contain small concentrations of uranium and are collectively referred herein as liquid radioactive waste. Liquid radioactive waste is treated to remove uranium and fluoride as described in Section 1.1.4, *Waste Management*.

The treated wastewaters from the RLETS are discharged to the existing Wilmington Site FPLTF. This facility currently receives Wilmington Site process wastewater, including the treated effluent from the GNF-A FMO Facility Radiological Waste Treatment System. The treated effluent from the FPLTF is discharged via NPDES-permitted Outfall 001 to the Wilmington Site effluent channel where it is combined with stormwater, discharging groundwater, and treated sanitary wastewater effluent. The effluent channel flows to the unnamed Tributary No. 1 to the Northeast Cape Fear River. The liquid leaving RLETS is monitored to ensure compliance with the 10 CFR 20, Appendix B, *Annual Limits on Intake (ALIs) and Derived Air Concentrations (DACs) of Radionuclides for Occupational Exposure; Effluent Concentrations; Concentrations for Release to Sewerage (Ref. 1-11),* limit. In addition, the liquid leaving the RLETS system is monitored to ensure compliance with the NDPES permit levels for fluoride, as well as other constituents specified in the permit. Other constituents may include total suspended solids, biological oxygen demand, oil and grease, total nitrogen, dissolved oxygen, and pH.

#### *1.1.6.2 Air Effluents*

The laser-based enrichment process is a closed process with no vents needed for routine venting of process gases. Some short-term gaseous releases occur inside the Operations Building during activities associated with operations such as the connection/ disconnection of $UF_6$ cylinders to process equipment and process equipment maintenance activities. These gaseous releases are routed through the building's ventilation system. The ventilation system air stream passes through a series of emissions-control devices consisting of high-efficiency particulate air (HEPA) filters and high-efficiency gas absorption (HEGA) filters. The exhaust air stream from these emission controls is vented to the atmosphere and monitored at the stack for uranium and fluoride. Table 1-5, *Typical GLE Air Emissions*, shows the typical air effluent concentrations from the Operations Building and the required regulatory limits. GLE shall comply with the requirements in 10 CFR 20, Appendix B, for uranium air effluents, and with the requirements specified in the North Carolina Department of Air Quality permit for monitoring of fluorides (as well as other operational controls/conditions specified in the permit).

### 1.1.7 Raw Materials, By-Products, Wastes, and Finished Products

The raw materials used in the laser-based enrichment process include $UF_6$ feed, gases used to support laser operation, oils used to support mechanical operations, process water, and solvents used in cleaning equipment. The by-product of the laser-based enrichment process is depleted uranium tails in the form of solid $UF_6$. The wastes from the laser-based enrichment process include solid wastes, process wastewaters, and air effluents. Further description of these wastes is contained in Section 1.1.4. The finished product from the laser-based enrichment process is solid $UF_6$ enriched in $^{235}U$. GLE will not use or possess any moderator or reflector with special characteristics, such as beryllium or graphite.

GLE utilizes commercial natural $UF_6$ feed stock meeting the requirements of ASTM C787-06, *Standard Specification for Uranium Hexafluoride for Enrichment (Ref. 1-12)*. At this time, GLE does not intend to use "reprocessed $UF_6$" as feed stock, and consistent with ASTM C787-06, GLE requires that suppliers possessing feed cylinders contaminated with reprocessed $UF_6$ feedstock provide additional evidence of uranium purity that is backed up by statistical sampling of feed stock at GLE. As such, impurities in the feed are expected to be consistent with, or less than, those quantities specified in this standard. GLE shall produce enriched uranium meeting the requirements of ASTM C996-04, *Standard Specification for Uranium Hexafluoride Enriched to Less than 5 % $^{235}U$ (Ref. 1-13)*, for enriched commercial grade $UF_6$ and any additional customer specifications.

## 1.2 INSTITUTIONAL INFORMATION

This section describes the corporate identity, financial qualifications, type of license, and the requested special authorizations and exemptions.

### 1.2.1 Corporate Identity

The applicant name and address, corporate structure and ownership control, and physical location of the facility are provided below.

#### *1.2.1.1 Applicant Name and Address*

This application for an NRC license is filed by GE-Hitachi Global Laser Enrichment LLC. GLE is headquartered in Wilmington, North Carolina.

The full address of the applicant is as follows:

Mailing Address:

Global Laser Enrichment
P.O. Box 780, Wilmington, North Carolina 28402

Physical Address:

Global Laser Enrichment
3901 Castle Hayne Road, Wilmington, North Carolina 28401

#### *1.2.1.2 Organization and Management of Applicant*

The corporate ownership structure is shown in Figure 1-5, *GLE Ownership*. GLE is a Delaware limited liability company and currently the only subsidiary of majority owner GE-Hitachi Nuclear Energy Americas LLC (GEH), a global supplier of nuclear energy-related equipment and services, and which is itself a Delaware limited liability company and a wholly-owned subsidiary of GE-Hitachi Nuclear Energy Holdings LLC (Holdings). Holdings, a Delaware limited liability company, is a subsidiary of majority owner GENE Holding LLC (GENE), which is a Delaware limited liability company wholly owned by General Electric Company (GE), a U.S. corporation organized under the laws of the State of New York, and of minority owner Hitachi

America, Ltd., which is a wholly owned subsidiary of Hitachi Ltd., a Japanese corporation. GLE also has two minority owners, Cameco Enrichment Holdings, LLC ("Cameco Enrichment"), with 24% ownership interest in GLE, and GENE, which owns 13.5% of GLE. Cameco Enrichment is a Delaware limited liability company wholly owned by Cameco US Holdings, Inc., a Nevada corporation, which is in turn wholly owned by Cameco Corporation, a Canadian corporation.

In this ownership structure, GE maintains an indirect majority, that is 51% ownership, controlling interest, and no foreign entity has the ability to exercise control over GLE operations and management or has access to, or use rights in, GLE's nonpublic enrichment technology, including classified information. GLE Governing Board resolutions and, as applicable, Governing Board member voting proxies are utilized to assure that only Governing Board members who are U.S. citizens with appropriate U.S. government clearances have access to, or exercise control over activities affecting the protection of, classified information. Foreign ownership, control, and influence (FOCI) information is initially submitted, and periodic updates thereto are provided, to the NRC in accordance with 10 CFR 95, *Facility Security Clearance and Safeguards of National Security Information and Restricted Data (Ref. 1-14)*.

The current principal officers of GLE and their citizenship are listed below:

- Chris Monetta, President and Chief Executive Officer — United States
- Craig M. Steven, Chief Financial Officer — United States
- Harold J. Neems, Secretary and General Counsel — United States

GLE's immediate parent, GEH, is the parent company of NRC licensees that are licensed under 10 CFR 50, *Domestic Licensing of Production and Utilization Facilities (Ref. 1-15)*, 10 CFR 70, and 10 CFR 72, *Licensing Requirements for the Independent Storage of Spent Nuclear Fuel, High-Level Radioactive Waste, and Reactor Related Greater Than Class C Waste (Ref. 1-16)*, at facilities in Sunol, California and Morris, Illinois. GLE's affiliate, GNF-A, also a controlled subsidiary of GE, is the current holder of an NRC license under 10 CFR 70 for an existing facility on the Wilmington Site.

#### *1.2.1.3 Address of Facility and Site Location Description*

The address of the facility is the same as the physical address of the applicant. A description of the facility site location is provided in Section 1.1.1, Facility Location.

### 1.2.2 Financial Qualifications

#### *1.2.2.1 Capital Cost Estimate*

GLE estimates that the total capital investment required to construct a six million SWU facility is approximately **{{{Proprietary Information withheld from disclosure per 10 CFR 2.390}}}** (in 2009 dollars), excluding capital depreciation, $UF_6$ tails disposition, decommissioning and any replacement equipment required during the life of the facility. The basis for the cost estimate is provided in Table 1-6, *GLE Commercial Facility Capital Cost Estimate*.

The cost estimate is based on a phased construction approach that is expected to take approximately eight (8) years from the time the license is issued to reach the full six (6) million SWU capacity. The first phase of the GLE Commercial Facility will be a one (1) million SWU facility, followed by incremental addition of 1 million SWU per year, starting one year after the initial 1 million SWU begins operating. GLE is expected to start production on the initial 1 million SWU facility approximately three (3) years from the issuance of the NRC license that GLE is seeking through this application. The ramp u phase (from 1 to 6 million SWU) is expected to leverage efficiencies gained from the initial deployments to expedite the construction process and increase the SWU capacity that can be deployed at one time..

#### *1.2.2.2 Funding Commitments*

Construction of the initial 1 million SWU facility shall not commence before funding is fully committed. Of this full funding (equity and/or debt), GLE will have: (1) minimum equity contributions of 30% of project costs from the parents and affiliates of the partners; and (2) firm commitments ensuring funds for the remaining project costs. The construction of the ramp up phase will have the same requirements listed for the first phase, except, that expected profits from sales may be used as a funding source.

GLE shall not proceed with the project unless it has in place long-term conditional enrichment contracts (that is, five (5) years or longer) with price expectations sufficient to cover operating costs (including facility depreciation and decommissioning), with a return on investment.

The foregoing funding commitments, which will be in place prior to GLE Commercial Facility construction and operation, as applicable, are consistent with the license condition approved by the NRC in previous uranium enrichment facility licensing proceedings. See CLI-97-15, 46 NRC 294, 309 (1997) (Claiborne Enrichment Center); CLI-04-3, 59 NRC 10, 23 (2004) (National Enrichment Facility); and CLI-04-30, 60 NRC 426, 437 (2004) (American Centrifuge Plant).

GLE LA Chapter 10, *Decommissioning,* describes how reasonable assurance is provided that funds will be available to decommission the facility as required by 10 CFR 70.22(a)(9), *Contents of Applications (Ref. 1-17)*, 10 CFR 70.25, *Financial Assurance and Recordkeeping for Decommissioning (Ref. 1-18)*, and 10 CFR 40.36, *Financial Assurance and Recordkeeping for Decommissioning (Ref. 1-19)*.

#### *1.2.2.3 Financial Resources*

GLE is currently funded by three parent companies, General Electric, Hitachi, and Cameco. The parent organizations have contributed cash and notes to fund the project through the design validation stage of the program and stand committed to provide additional funding pending the successful validation of the design concept. GLE currently expects to fund the construction costs through additional equity contributions provided by the parent companies. However, GLE may explore other funding options including, but not limited to additional equity owners (pending approval of the current parent companies) or long-term debt instruments.

A summary of the parent companies' total assets and net income for 2009 are provided below. All three of the parent organizations are publicly traded and additional information, including annual reports, are available on the companies' respective websites.

For the year ending December 31, 2009, GE had total assets (U.S. Dollars) of $781,818,000,000, with cash assets of $72,260,000,000. GE's net income in 2009 was $10,725,000,000.

For the year ending December 31, 2009, Hitachi had total assets (Japanese Yen) of JPY9,403,709,000,000, with cash assets of JPY807,926,000,000. Hitachi had a net loss in 2009 of JPY787,337,000,000.

For the year ending December 31, 2009, Cameco had total assets (Canadian Dollars) of C$7,342,102,000, with cash assets of C$1,101,229,000. Cameco's net income in 2009 was C$1,099,422,000.

#### *1.2.2.4 Liability Insurance*

GLE shall, in accordance with 10 CFR 140.13b, *Amount of Liability Insurance Required for Uranium Enrichment Facilities (Ref. 1-20)*, and prior to and throughout operation of the GLE Commercial Facility, have and maintain nuclear liability insurance in the amount of up to $200 million to cover liability claims arising out of any occurrence within the United States, causing, within or outside the United States, bodily injury, sickness, disease, or death, or loss of or damage to property, or loss of use of property arising out of or resulting from the radioactive, toxic, explosive, or other hazardous properties of chemical compounds containing source material or SNM. The amount of $200 million was determined by the insurer (American Nuclear Insurers).

The amounts of nuclear energy liability insurance required may be furnished and maintained in the form of:

- An effective facility form (non-indemnified facility) policy of nuclear energy liability insurance from nuclear facility underwriters;
- Such other type of nuclear energy liability insurance as the NRC may approve; or
- A combination of the foregoing.

GLE will provide proof of insurance to the NRC no later than October 15, 2010.

### 1.2.3 Type, Quantity, and Form of Licensed Material

GLE proposes to acquire, deliver, receive, possess, produce, use, transfer, and/or store source material and SNM meeting the criteria of SNM of low strategic significance as described in 10 CFR 70.4, *Definitions (Ref. 1-20)*. Details of the SNM are provided in Table 1-7, *Type, Quantity, and Form of Licensed Special Nuclear Material*. It is anticipated that other source and by-product materials will be used for instrument calibration purposes. These materials will be identified during subsequent design phases and the LA will be revised, as necessary.

GLE utilizes commercial natural $UF_6$ feed stock meeting the requirements of ASTM C787-06. At this time, GLE does not intend to use "reprocessed $UF_6$" as feed stock, and consistent with ASTM C787-06, GLE shall require that suppliers possessing feed cylinders contaminated with reprocessed $UF_6$ feed stock provide additional evidence of uranium purity that is backed up by statistical sampling of feed stock at GLE. As such, GLE expects to possess only trace amounts of other radionuclides consistent with the natural decay of uranium.

### 1.2.4 Requested Licenses and Authorized Uses

GLE is engaged in the production and sale of uranium enrichment services to electric utilities or fuel fabrication facilities for the purpose of manufacturing fuel to be used to produce electricity in commercial nuclear power plants. GLE also may purchase and enrich uranium for direct sale to fuel fabrication facilities. In addition, GLE may provide enrichment services for the U.S. government under certain contractual agreements.

This GLE LA is necessary for licenses issued under 10 CFR 30, 10 CFR 40, and 10 CFR 70 to construct, own, use, and operate facilities described herein as an integral part of the GLE Commercial Facility. This includes licenses for byproduct material, source material, and SNM. The license requested is for a 40 year period. See Section 1.1, *Facility and Process Description*, for a summary description of the GLE activities.

### 1.2.5 Special Authorizations and Exemptions

#### *1.2.5.1 Authorized Guidelines for Contamination-Free Articles*

GLE requests authorization to use the guidelines, contamination, and exposure rate limits developed by the NRC and included as Appendix A of this chapter titled *Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for Byproduct, Source, or Special Nuclear Material,* for decontamination and survey of surfaces or premises and equipment prior to abandonment or release for unrestricted use. These guidelines are included as a regulatory acceptance criterion in NUREG-1520, *Standard Review Plan for the Review of a License Application for a Fuel Cycle Facility (Ref. 1-22).*

#### *1.2.5.2 Exemption to Posting Requirements*

GLE requests authorization to post areas within Radiological Controlled Areas (RCAs) in which radioactive materials are processed, used, or stored with a sign stating "Every container in this area may contain radioactive material," in lieu of the labeling requirements in 10 CFR 20.1904, *Labeling Requirements (Ref. 1-23).*

The requested exemption is authorized by law because there is no statutory prohibition on the proposed posting of a single sign indicating that every container in the posted area has the potential for internal contamination. Indeed, to reduce unnecessary regulatory burden, the NRC issued a final rule in 2007 that, in part, modified 10 CFR 20.1905, *Exemptions to Labeling Requirements (Ref. 1-24)*, thereby exempting certain containers holding licensed material from the labeling requirements of 10 CFR 20.1904 if certain conditions are met. Although the 2007 rulemaking only applied to facilities licensed under 10 CFR 50 and 10 CFR 52, *Licenses, Certifications, and Approvals for Nuclear Power Plants (Ref. 1-25)*, the rationale underlying the rule supports the exemption request. Exempting GLE from this requirement will reduce licensee administrative and information collection burdens, but serve the same health and safety functions as the current labeling requirements. Therefore, the exemption does not affect the level of protection for either the health and safety of workers and the public or for the environment; nor does it endanger life or property or the common defense and security.

The NRC approved a similar exemption from 10 CFR 20.1904 requested by a prior uranium enrichment facility license applicant. In approving the exemption, the NRC concluded:

*"Under 10 CFR 20.2301, the Commission may grant exemptions from the requirements of the regulations, if it determines that the request will be authorized by law and will not result in undue hazard to life or property. Also, 10 CFR 20.1905(c) already exempts containers from 10 CFR 20.1904, if the containers are attended by an individual who takes the precautions necessary to prevent the exposure of individuals in excess of the limits established. The staff agrees that it would be impractical to label each and every container in restricted areas at this facility because of the large number of potential containers. Labeling each container may also reduce radiation safety by desensitizing the worker to radiation warning signs. Since there is no statutory provision prohibiting the granting of this exemption, the staff concludes that the request is authorized by law. Also, the exemption request is consistent with those approved previously at the gaseous diffusion plants and other fuel cycle facilities. Experience at facilities that have received the exemption from the labeling requirement demonstrates that the applicant's request will provide an equivalent amount of safety, and will not result in an undue hazard to individuals. Accordingly, the staff finds that the request will not be an undue hazard to life or property. Therefore, exemption to the requirements of 10 CFR 20.1904 is recommended." (Ref. 1-24)*

### 1.2.5.3 Exemption to Decommissioning Funding Requirements

The following proposed exemption from the requirements of 10 CFR 70.25(e) and 10 CFR 40.36(d) addressing the decommissioning funding requirements is identified in the Decommissioning Funding Plan (DFP) and GLE LA Chapter 10, *Decommissioning*.

10 CFR 70.25(e) and 10 CFR 40.36(d) require, in part, that *"The decommissioning funding plan must also contain a certification by the licensee that financial assurance for decommissioning has been provided in the amount of the cost estimate for decommissioning...".* In accordance with the DFP, GLE will incrementally fund that portion of its total decommissioning costs associated with the disposition of $UF_6$ tails generated by facility operation. Specifically, GLE will provide financial assurance for the disposition of $UF_6$ tails based on the expected amount of $UF_6$ tails to be generated annually, in a forward-looking manner. The NRC has previously approved the same incremental decommissioning financial assurance approach for USEC's American Centrifuge Project (ACP) and Louisiana Energy Services', L.P. (LES) National Enrichment Facility (NEF).

This exemption is justified for the following reasons:

- It is authorized by law because there is no statutory prohibition on incremental funding of decommissioning costs.

- The requested exemption will not endanger life or property or the common defense and security because $UF_6$ tails are generated incrementally over the life of the plant. GLE will provide financial assurance for $UF_6$ tails already generated that require disposal and the projected $UF_6$ tails to be generated in the next year. As such, requiring financial assurance for the disposition of $UF_6$ tails to be generated over the full licensed operating life of the enrichment facility – at the time of initial license issuance – would impose an unnecessarily large financial burden on the licensee.

- Granting this exemption is in the public interest for the same reasons stated above. Moreover, by eliminating an unnecessarily large financial burden on the licensee, the exemption will facilitate the deployment of an advanced, next-generation enrichment technology in the United States, in furtherance of important national energy objectives.

Finally, providing financial assurance for $UF_6$ tails disposition on an incremental basis is justified in view of GLE's commitments to: (1) provide full financial assurance for facility decommissioning (assuming a six MSWU facility) at startup (startup refers to when GLE receives licensed material); (2) update its $UF_6$ tails dispositioning cost estimate annually, on a forward-looking basis, to ensure that the financial assurance reflects the current projected inventory of $UF_6$ tails at the facility (including any previously-generated tails still requiring disposition); and (3) adjust other decommissioning costs periodically, and no less frequently than every three years. This approach will allow GLE to consider available operating experience and other relevant information, including actual $UF_6$ tails inventory values and generation rates, and to ensure that sufficient decommissioning financial assurance is available at any point during the licensed operating life of the facility.

#### *1.2.5.4 Authorization to Use ICRP 68*

GLE requests authorization to use the derived air concentration (DAC) and annual limit on intake (ALI) values based on dose coefficients published in International Commission on Radiological Protection (ICRP) Publication No. 68, *Dose Coefficients for Intakes of Radionuclides by Workers (Ref. 1-26)*, in lieu of the values in Appendix B of 10 CFR 20, in accordance with approved written procedures.

The ICRP 68 guidance was promulgated after the 10 CFR 20, Appendix B criteria were established, and provides an updated and revised internal dosimetry model. Use of the ICRP 68 models provide more accurate dose estimates than the models used in 10 CFR 20, and allows GLE to implement an appropriate level of internal exposure protection. The NRC has established precedent for this exemption request from 10 CFR 20 in SECY-99-077.

#### *1.2.5.5 Authorization to Make Changes to License Commitments*

##### *1.2.5.5.1 Changes Requiring Prior Approval*

GLE shall not make changes to the License Application that decreases the effectiveness of commitments, without prior NRC approval. For these changes, GLE will submit to the NRC, for review and approval, an application to amend the license. Such changes shall not be implemented until approval is granted.

##### *1.2.5.5.2 Changes Not Requiring Prior Approval*

Upon documented completion of a change request for a facility or process, GLE may make changes in the facility or process as presented in the License Application, or conduct test or activities not presented in the License Application, without prior NRC approval, subject to the following conditions:

1. There is no degradation in the safety commitments in the License; and
2. The change, test, or activity does not conflict with any condition specifically stated in the License Application.

Records of such changes shall be maintained, including technical justification and management approval, in dedicated records to enable NRC inspection upon request at the facility. A report containing a description of each such change, and appropriate revised sections to the License Application, shall be submitted to the NRC within three (3) months of implementing the change.

#### *1.2.5.6 Exemption from 10 CFR 21.3 Definitions*

GLE requests authorization to replace the definitions of basic component, commercial-grade items, critical characteristics, dedication, and dedicating entity as they apply to facilities licensed pursuant to 10 CFR 70 with the following:

**Basic Component** – A structure, system, or component (SSC), or part thereof, designated as an IROFS identified as QL-1 or QL-2, that affects the IROFS function, that is directly procured by the licensee of a facility or activity subject to the regulations in 10 CFR 70 and in which a defect or failure to comply with any applicable regulation in 10 CFR 70, order, or license issued by the U.S. Nuclear Regulatory Commission (NRC) could create a substantial safety hazard (i.e., exceed the performance requirements of 10 CFR 70.61). Basic Components include QL-1 and QL-2 identified IROFS-related design, analysis, inspection, testing, fabrication, replacement of parts, or consulting services that are associated with the component hardware, whether these services are performed by the component supplier or others.

When applied to IROFS identified as QL-NFPA, a basic component is a SSC, or part thereof, that affects the safety function of the IROFS that is directly procured by the licensee or a facility or activity subject to the requirements of the National Fire Protection Administration (NFPA) Code of Record, and in which a defect or failure to comply with requirements of the NFPA Code of Record could create a substantial safety hazard. Basic component includes QL-NFPA identified IROFS-related design, analysis, inspection, testing, fabrication, replacement of parts, or consulting services that are associated with the component hardware, whether these services are performed by the component supplier or others, to the extent required by the NFPA Code of Record.

**Commercial-Grade Item** – A SSC, or part thereof, that affects its QL-1 and/or QL-2 identified IROFS function, which is not designed and manufactured as a Basic Component. Commercial-grade items do not include items where the design and manufacturing processes require in-process inspections and verifications to ensure that defect or failures to comply are identified and corrected (i.e., one or more critical characteristics of the item cannot be verified).

When applied to items identified as QL-NFPA (being items in facilities and activities licensed pursuant to 10 CFR 70), commercial grade item means an item that is (1) not subject to design or specification requirements that are unique to facilities or activities; (2) used in applications other than those facilities and activities; and (3) to be ordered from the manufacturer/supplier on the basis of specifications set forth in the manufacture's published product description.

**Critical Characteristics** – Those important to design, material, and performance characteristics of a commercial-grade item that, once verified, will provide reasonable assurance that the item will perform its intended QL-1 and/or QL-2 identified IROFS function.

When applied to items identified as QL-NFPA, critical characteristics are those important to design, material, and performance characteristics of a commercial grade item that will provide reasonable assurance that the item will perform its intended QL-NFPA identified IROFS function.

**Dedication** – An acceptance process undertaken to provide reasonable assurance that a commercial-grade item to be used as a Basic Component will perform its intended QL-1 and/or QL-2 IROFS function and, in this respect, is deemed equivalent to an item designed and manufactured under QL-1 or QL-2 requirements in accordance with the GLE QAPD. This assurance is achieved by identifying the critical characteristics of the item and verifying their acceptability by inspections, tests, or analyses performed by the purchaser or third-party dedicating entity after delivery, supplemented as necessary by one or more of the following: commercial grade surveys, product inspections or witness at holdpoints at the manufacturer's facility, and analysis of historical records for acceptable performance. In all cases, the dedication process must be conducted in accordance with the applicable provisions of the GLE QAPD. The process is considered complete when the item is designated for use as a basic component applicable to QL-1 and/or QL-2 IROFS.

When applied to items identified as QL-NFPA (being items in facilities and activities licensed pursuant to 10 CFR 70), the dedication process is applied to commercial-grade items to be used as basic components to provide reasonable assurance that they will perform their intended QL-NFPA identified IROFS function and are deemed equivalent to an item designed and manufactured under QL-NFPA requirements in accordance with the GLE QAPD. This assurance is achieved by confirming that the commercial-grade item is manufactured to established, acceptable national codes or standards that include one or more independent product endorsement based on qualification testing or periodic testing of selected characteristics of the item except in cases where such listing/approval is not required by codes and standards. In all cases, the applicable provisions of the GLE QAPD will be used to conduct the dedication process. The process is considered complete when the commercial-grade item is designated as a basic component.

**Dedicating Entity** – The organization that performs the dedication process for QL-1 and QL-2 identified IROFS. Dedication may be performed by the manufacturer of the item, a third-party dedicating entity, or the licensee itself. The dedicating entity, pursuant to 10 CFR 21.21(c), *Notification of Failure to Comply or Existence of a Defect and its Evaluation*, is responsible for identifying and evaluating deviations, reporting defects and failure to comply for the dedicated item, and maintaining auditable records of the dedication process. In cases where the Licensee applies the commercial-grade item procurement strategy and performs the dedication process, the licensee would assume full responsibility as the dedicating entity.

When applied to items identified as QL-NFPA (being items in facilities and activities licensed pursuant to 10 CFR 70), the dedicating entity is the licensee. The licensee, pursuant to 10 CFR 21.21(c), is responsible for reporting defects and failure to comply for the dedicated item, maintaining auditable records of the dedication process, and assumes full responsibility as the dedicating entity.

#### *1.2.5.7 CAAS Exemption on the Cylinder Storage Pads*

GLE requests exemption from the use of a Criticality Accident Alarm System (CAAS) to cover the $UF_6$ Cylinder Storage Pads (MPF-106, -107, and -108), Trailer Storage Area, and $UF_6$ Cylinder Staging Area. The exemption is based on the full discussion presented in GLE LA Section 5.3.5.1 and is summarized as follows:

In the $UF_6$ Cylinder Storage Yards, most of the storage is provided for source material, not special nuclear material (SNM). Only 30B model cylinder containing SNM at 5 wt% $^{235}U$, or less, is stored on the Product Pad. Storage of 30B model cylinders is short term and involves fewer cylinders than Tails or In-Process Storage thus further reducing the total likelihood for mishaps. Installation of CAAS to cover these storage yards will require detection clusters mounted high over the pads and require increased traffic into the storage yards for maintenance, functional testing, and calibration activities. This introduces additional hazards to the worker working at heights and presents an increased cylinder damage hazard from falling items and collapsing lift equipment.

### 1.2.6 Security of Classified Information

GLE has been granted a facility security clearance, in accordance with 10 CFR 95, in a separate submittal. The use, processing, storage, reproduction, transmission, transportation or handling of classified information necessary to support this license application is currently controlled under the NRC authorized GNF-A facility security clearance at the Secret Restricted Data (SRD) level. As a result, access to restricted data (RD) or national security information (NSI) for the GLE Commercial Facility shall continue to be controlled by GNF-A in accordance with 10 CFR 25, *Access Authorization (Ref. 1-28)*, 10 CFR 95, and any other requirements that the NRC imposes through the issuance of Orders, until such time NRC processes GLE for an approved facility security clearance at the SRD level. Classified information associated with this LA, but not part of the facility security clearance request has been transmitted in a separate submittal.

## 1.3 SITE DESCRIPTION

This section contains a summary description of the Wilmington Site and surrounding areas. The GLE Environmental Report (ER) *(Ref. 1-29)* contains more detailed information regarding the site and its environs.

### 1.3.1 Site Geography

This section contains information regarding the site location, including nearby highways, bodies of water, and other geographical features.

#### *1.3.1.1 Site Location Specifics*

The GLE Commercial Facility is located on an existing industrial site in Wilmington, North Carolina. The existing Wilmington Site is situated on a 1621-acre tract of land, located west of North Carolina Highway 133 (also known as Castle Hayne Road). The Wilmington Site lies between latitudes (North) 34° 19' 4.0"and 34° 20' 28.9" and longitudes (West) 77° 58' 16.4" and 77° 55' 19.8", and is approximately six (6) miles north of the City of Wilmington in New Hanover County, North Carolina (see Figure 1-1 and Figure 1-2). For further information, see Section 1.1.1.

The southeastern corner of the Wilmington Site is adjacent to the interchange of Interstate 140 with Castle Hayne Road. Current access to and from the Wilmington Site by trucks and other vehicle traffic is from Castle Hayne Road. Northbound Castle Hayne Road from the Interstate 140 interchange bordering the Wilmington Site is a four-lane road that continues for approximately one-half mile before narrowing to two lanes. The Wilmington Metropolitan Planning Organization designated Castle Hayne Road as an urban principal arterial south of Interstate 140 and as an urban minor arterial north of the Interstate 140 interchange.

#### *1.3.1.2 Features of Potential Impact to Accident Analysis*

The surrounding terrain is typical for coastal North Carolina. The terrain has an average elevation of less than 40 feet above msl and is characterized by gently rolling land, with rivers, creeks, swamps, and marshlands. Approximately 182 acres of the southwest portion of the Wilmington Site are classified as swamp forest. There are no mountain ranges nearby. The terrain of the GLE Site is very gently sloping (gradients less than 2 percent) with little relief; therefore, landslides are not identified as events of concern. There is no volcanic or glacial activity in the region or vicinity of the Wilmington Site.

The elevation of the GLE Site is above the 500-year coastal still water flood elevation (coastal still water elevations factor in potential impacts from storm surge, including tidal and wind setup effects). The GLE Commercial Facility is located outside both the 100- and 500-year flood plains and there are no dams in the vicinity that could contribute to a rapid flood event. The site may be subject to a probable maximum probable flood event resulting from combined river flooding of the Cape Fear and Northeast Cape Fear Rivers. This type of event would be very slow moving thus allowing ample warning for safe shutdown. GLE will have procedures for determining what actions to take in the event of inclement weather (i.e., whether to shut down operations). Additionally, the design of systems and components within the facility are evaluated for the flooding to ensure any accidents that could result in high consequencesare "Highly

Unlikely", and any accidents that could result in intermediate consequences are "Unlikely", thus meeting the performance requirements in 10 CFR 70.61.

Due to the curvature of the coastline in the area, the ocean lies approximately 10 miles east and 26.4 miles south of the Wilmington Site. The Federal Emergency Management Agency defines the geographic threshold for concern regarding a tsunami as one (1) mile inland from the coast with an elevation of 25 feet above msl. Given the distance of the Wilmington Site from the ocean, there are no direct threat effects of a potential tsunami. Because of the distance of the Wilmington Site upstream from the Atlantic Ocean (approximately 23 river miles) and the height of the GLE Site above the 500-year floodplain, the indirect effects of flooding from a tidal bore in the Northeast Cape Fear River induced by a tsunami are minimal.

The Mid-Atlantic Coastal Plain province counties in North Carolina are in a low potential zone for the presence of radon gas relative to other regions in the state.

Soil samples collected at the GLE Site typically do not have high amounts of natural organic material. In addition, no peat deposits that could be a potential source of methane gas have been identified at the GLE Site. There are no municipal landfills on or in the immediate vicinity of the Wilmington Site that could generate methane gas; therefore, methane gas buildup beneath the Wilmington Site is not identified as an event of concern.

The projected lowering of the potentiometric surface at the GLE Site, as a result of the groundwater withdrawals from the aquifer on and in the vicinity of the Wilmington Site, is minimal, and no greater than the historical seasonal fluctuations observed in groundwater levels. In addition, the absence of a thick or regionally continuous confining bed at the GLE Site further minimizes the potential for subsidence as a result of lowered groundwater levels; therefore, subsidence due to dewatering is not credible. Likewise, there are no active mines adjacent to the Wilmington Site or known economic deposits of minerals, stone, or fuel materials that could cause subsidence at the GLE Site.

### 1.3.2 Demographics

This section provides the current census results (calendar year [CY] 2000) for the area surrounding the Wilmington Site, to include specific information about populations, public facilities, and industrial facilities. Land use and nearby bodies of water are also described.

#### *1.3.2.1 Latest Census Results*

According to the U.S. Census Bureau's 2000 Decennial Census *(Ref. 1-30)*, a total of 321 census blocks fall within a five-mile radius of the Wilmington Site. The majority of these census blocks (261) is within New Hanover County and includes 12,997 persons and 4,953 households. A total of 57 Pender County census blocks are within the five-mile radius, with a combined population of 3,305 persons and 1,274 households. An examination of census block data from CY 2000 reveals a total of three census blocks in Brunswick County with some portion of the total area inside the five-mile radius. The total population of these three (3) census blocks is 36 persons in 17 households. Blocks with any portion of their area inside the five-mile radius were included in this population count. (See GLE ER Section 3.10.1 for additional information.)

### *1.3.2.2 Description, Distance, and Direction to Nearby Population Area*

The region around the site is lightly settled with large areas of heavily timbered tracts of land. Farms, single-family dwellings, and light commercial activities are located along North Carolina Highway 133. In the eastern and southern vicinities of the Wilmington Site, residential uses are dominant due to the presence of the Wrightsboro (south), Skippers Corner (east), and Castle Hayne (northeast) communities. Wrightsboro has a population of approximately 4500, Skippers Corner has a population of approximately 1200, and Castle Hayne has a population of approximately 1100. (See GLE ER Section 3.1 for additional information.)

### *1.3.2.3 Proximity to Public Facilities*

Figure 1-6, *Community Characteristics Near the Wilmington Site*, shows the location of schools and parks with respect to the five-mile Wilmington Site radius. There are a total of 90 public and private elementary, middle, and high schools in the three-county region. In addition to these primary and secondary schools, colleges such as the University of North Carolina at Wilmington (UNCW), Brunswick Community College, and Cape Fear Community College are located in the region. Out of the 90 schools in the region, one is within a four-mile radius of the GLE Site (Wrightsboro Elementary) and 21 schools are within an eight-mile radius of the GLE Site. The nearest hospital, New Hanover Regional Medical Center, is approximately six (6) miles from the Wilmington Site.

No state or federal parks are located within five (5) miles of the Wilmington Site. There are 18 parks, three trails, and three gardens maintained by New Hanover County. Four of the parks are located within a five-mile radius of the Wilmington Site.

### *1.3.2.4 Nearby Industrial Facilities*

The Northeast Cape Fear River borders the Wilmington Site to the west, and industrial land uses are dominant on the opposite (west) side of the river. The BASF Corporation, Elementis Chromium Facilities, and the L.V. Sutton coal-fired power plant operated by Progress Energy are examples of industrial operations located in this area. The industrial area sits between the Northeast Cape Fear River and the main branch of the Cape Fear River.

### *1.3.2.5 Land Use within a Five Mile Radius*

The land use in the vicinity of the Wilmington Site is discussed below and generally covers the five-mile radius around the Wilmington Site. The Wilmington Site is a 1,621-acre parcel, owned by the GE, located west of Castle Hayne Road (otherwise known as North Carolina Highway 133). The property is currently zoned I-2, which is described in the New Hanover County zoning code as intended for heavy industrial uses. No portion of the property is currently used for agricultural purposes.

Immediately north of the Wilmington Site is a large parcel of approximately 4,069 acres owned by Hilton Properties. The current zoning designation for this property is Rural Agricultural, which is designed for low-density residential development with an emphasis on farming and open-space preservation. This parcel is locally known as the Sledge Forest and is currently used for timber management and as a private hunting area. Access to the Sledge Forest is provided via a private, unpaved road that intersects with Castle Hayne Road and closely follows the northern property line of the Wilmington Site.

The Northeast Cape Fear River borders the Wilmington Site to the west, and industrial land uses are dominant on the opposite (west) side of the river. The BASF Corporation, Elementis Chromium facilities, and the L.V. Sutton coal-fired power plant operated by Progress Energy are examples of industrial operations located in this area. The industrial area sits between the Northeast Cape Fear River and the main branch of the Cape Fear River. In the eastern and southern vicinities of the Wilmington Site, residential uses are dominant due to the presence of the Wrightsboro (south), Skippers Corner (east), and Castle Hayne (northeast) communities.

Three (3) public schools are located within five (5) miles of the Wilmington Site: Wrightsboro Elementary School, Emma B. Trask Middle School, and Emsley A. Laney High School. Trask Middle School also serves as an emergency shelter for New Hanover County.

The Wilmington International Airport (ILM) is located approximately five (5) miles south-southeast from the Wilmington Site. The New Hanover County Landfill is located approximately four (4) miles southwest of the Wilmington Site.

### *1.3.2.6 Land Use Within One Mile of the Facility*

As described above, the Wilmington Site is bordered on the north by the Sledge Forest and on the west by the Northeast Cape Fear River. Castle Hayne Road borders the eastern portion of the site. Further north along Castle Hayne Road, are four (4) mobile homes located on the opposite side of the street from the Wilmington Site. Adjacent to the site on the northeast side is the Wooden Shoe residential subdivision. Located adjacent to the Wilmington Site's eastern boundary across Castle Hayne Road, are the North Carolina State University Horticultural Crops Research Station, a truck parking lot, and a small recreational park for use by Wilmington Site employees (owned by GE). Directly south of the site is the Interstate 140, and beyond the interstate is a small residential area.

### *1.3.2.7 Uses of Nearby Bodies of Water*

A portion of the Wilmington Site borders the Northeast Cape Fear River. Both commercial and recreational fishing occur on the Northeast Cape Fear River. Commercial fishing is more prevalent downstream of the Wilmington Site and in the Cape Fear River Estuary.

## 1.3.3 Meteorology

### *1.3.3.1 Primary Wind Directions and Average Wind Speeds*

On an annual basis, the wind direction (direction from where the wind is blowing) at Wilmington International Airport is predominantly southwesterly *(Ref. 1-31)*; thus, reflecting the general synoptic scale wind pattern. In contrast, the predominant wind direction during the fall and winter is often northerly, due largely to the influence of invading polar air masses and changes in global circulation *(Ref. 1-31*; *Ref. 1-32)*. Figure 1-7, *Wind Rose for Wilmington International Airport*, shows the overall wind rose for Wilmington International Airport. The annual prevailing wind speed at the airport is 10.4 mph (9 knots) *(Ref. 1-31)*.

### *1.3.3.2 Annual Precipitation – Amounts and Forms*

The mean annual precipitation in eastern North Carolina is heaviest in the southeast corner of the state and steadily decreases toward the north and west. The higher precipitation amounts are due to higher levels of moisture provided by the Atlantic Ocean. The area along the North Carolina coast experiences afternoon showers and thunderstorms often during the summer months. These storms form along a sea breeze front as it moves inland from the coast. The mean annual precipitation for the area around the GLE Commercial Facility is approximately 55.0 inches/year according to the 1948 to 1995 dataset *(Ref. 1-31)* and 57.1 inches/year according to the 1971 to 2000 dataset *(Ref. 1-33)*.

Due to the moderate climate, Wilmington receives very little snowfall, except on rare occasions. On average, only about 2.1 inches of snowfall occurs annually. December and January are expected to receive the most average snowfall, at 0.6 inches *(Ref. 1-33)*. Wilmington also receives only a small amount of sleet. The mean recurrence interval for measurable sleet in Wilmington, North Carolina, is approximately 4.6 years, or an annual probability about 22 percent. Sleet greater than 0.25 inches has a mean recurrence interval of only once every 46 years, or an annual probability of about 2 percent *(Ref. 1-34)*. Freezing rain usually poses a higher risk to power systems and trees than sleet. Freezing rain does not occur often in Wilmington, although it occurs more often than sleet *(Ref. 1-34)*. Measurable accumulations occur in Wilmington with a mean recurrence interval of about 1.5 years, or an annual probability of 67 percent. More significant accumulations of less than 0.25 inches occur with a mean recurrence interval of 7.7 years, or an annual probability of 13 percent. Accumulations of less than 0.5 inches, which are very likely to affect power lines and trees, are expected to occur in Wilmington at a mean recurrence interval of 46 years, or an annual probability of 2 percent.

### *1.3.3.3 Severe Weather*

#### *1.3.3.3.1 Extreme Temperature*

The highest recorded temperature at Wilmington International Airport for the period of record is 104.0°F, which occurred during June 1952 *(Ref. 1-33)*. The lowest recorded temperature of 0.0°F occurred in December 1989 *(Ref. 1-33)*. This shows that the maximum annual temperature range at the Wilmington Site is about 104.0°F.

### 1.3.3.3.2 *Extreme Precipitation*

Tropical storms and hurricanes occur in and around the southeastern United States, making Wilmington prone to high amounts of rainfall over a short time period. The highest recorded 24-hour rainfall amount of 13.38 inches at Wilmington International Airport occurred during September 1999 due to the effects of Hurricane Floyd making landfall on the North Carolina Coast *(Ref. 1-33)*. Rainfall totals recorded for the 49 year period starting in 1949 and ending in 2000, published by the NOAA, were reviewed. The heaviest rainfall amounts normally occur during the month of September with an average monthly total rainfall of 173 mm (6.79 in) which is the equivalent of a daily rainfall average of 5.8 mm (0.23 in) per day. The Extreme Environmental Rainfall is equivalent to the 24-hour all season extreme local precipitation (based on point precipitation frequency estimates from NOAA Atlas 14 for Wilmington, North Carolina, and is estimated to be 109 mm (4.29 in). The 24-hour rainfall estimate accounts for the peak 1-hour extreme local precipitation estimate of 49 mm (1.91 in). The maximum one time extreme rainfall event recorded for a 24 hour period was a value of 340 mm (13.38 in) (rainfall event resulting from Hurricane Floyd making landfall on the eastern coast on September 15, 1999).

The largest snow accumulation in the Wilmington, North Carolina Area was 38.9 cm (15.3 in) from December 22 to December 24, 1989. The amount of snowfall in a 24 hour period equaled the maximum amount of 13 inches. The roof loading from the maximum amount of snow in a 24 hour period or the largest snow accumulation are 17 and 20 psf, respectively, per the information in ASCE 7-05.

ASCE 7-05 provides a methodology for estimating mean recurrence periods for snowfalls beyond those presented in this document. Using this methodology, the $1 \times 10^{-5}$ snowfall is estimated to be about 17 to 25 psf. Based on the above the Design Basis Snow (DBS) is defined as 25 psf.

The roofs of the proposed facility are currently designed with a live load capacity of 30 psf. The roof design does not include any parapets so that there will be no drift snow loads over the majority of the roof. The exception to this is where the roof elevations change. Adjacent to locations where a lower roof abuts to walls for higher roof areas there is the potential for snow drifts to form. Following the guidelines in ASCE 7-05, the highest drift snow load is approximately 85 psf above the normal snow load of 10 psf, which exceeds the live load roof capacity. The additional drift snow load would be present for approximately 20 feet from the wall of the higher roof areas of the facility. For the roof decking in this area the snow drift load could cause the decking to first sag and eventually fail, allowing snow and water to enter the building. The main roof supports (e.g., steel girders and beams) are not expected to be overloaded because of the failure of the weaker roof decking, thus their failure is not postulated. Therefore, a complete roof failure due to any load, including snow drift loads, is determined to be "Highly Unlikely."

### 1.3.3.3.3 *Extreme Winds*

Extreme winds may occur at Wilmington International Airport due to localized events, such as thunderstorm downdrafts, microbursts, or tornadoes. In addition, the airport lies in a particularly vulnerable location for hurricane-force winds. As of 1995, the highest wind gust measured at the airport was approximately 78 mph (68 knots) *(Ref. 1-31)*; however, since that time, Wilmington has experienced Hurricanes Fran (1996), Floyd (1999), and Charley (2004).

Hurricane Fran had a peak gust of approximately 86 mph (75 knots) measured at the Wilmington International Airport. Hurricane Floyd similarly caused a wind gust of approximately 86 mph (75 knots) at the airport *(Ref. 1-37)*. Hurricane Charley had somewhat lower wind gusts of approximately 74 mph (64 knots) at the airport *(Ref. 1-38)*. The likelihood and consequences of design basis wind velocities are discussed further in Section 1.3.3.3.7.

### *1.3.3.3.4 Thunderstorms*

Rainfall in the region during the summer months comes primarily from thunderstorms. These storms occur on approximately 33 percent of days during June through August in the vicinity of the Wilmington Site and are scattered and uneven in coverage *(Ref. 1-31)*. Although the inland advance of the sea breeze front often causes summer thunderstorms, other primary causes of thunderstorms in the Wilmington area are tropical storms or hurricanes approaching from the south and southeast, and large-scale synoptic fronts approaching from the north and west. The latter two causes of thunderstorms also increase the chance of severe weather. For example, hail is observed in the Wilmington area on an average of about once per year *(Ref. 1-31)* and is most likely to be associated with synoptic frontal thunderstorms. Severe thunderstorms may produce damaging straight-line winds greater than 57 mph (50 knots). According to the National Severe Storms Laboratory (NSSL) *(Ref. 1-39)*, the area surrounding the Wilmington Site experiences approximately four days per year of damaging thunderstorm winds or winds less than 57 mph (50 knots) due to a thunderstorm.

### *1.3.3.3.5 Lightning*

Another hazard of thunderstorms is lightning, which can strike miles from a thunderstorm and often occurs without warning. Besides the obvious danger to personnel working outside, lightning can disrupt electrical circuits and cause fires. The region surrounding the Wilmington Site has experienced a lightning flash density ranging from 4 to 8 flashes/km$^2$/year over the period from 1996 through 2000.

### *1.3.3.3.6 Tornados*

Historical data indicates that 15 tornadoes (7 F0 and 8 F1) have occurred in New Hanover County, 21 tornadoes (13 F0, 7 F1, and 1 F2) have occurred in Brunswick County, and 26 tornadoes (14 F0, 8 F1, and 4 F2) have occurred in Pender County. The period of these records started January 1950 and has been verified through December 2010. Wind speeds associated with an F2 tornado are between 113 and 157 miles per hour (mph) for the fastest quadrant values. An F2 tornado can have 3-second gust wind speeds from 110 to 137 mph on the Enhanced Fujia Scale.

The base case evaluation considered any type of tornado (starting with F0 events, based on the Fujita or Enhanced Fujita Scales). This was done for various areas in proximity to the site of the proposed facility. The combined areas of the three counties were included. In all cases the probabilities that tornado strikes occur were below $1 \times 10^{-4}$/yr, which is within an order of magnitude of $1.0 \times 10^{-5}$/year and consistent with the definition of "Highly Unlikely" as presented in Chapter 3 of the License Application and the ISA Summary, Chapter 1. Also, the probabilities of tornadoes of sufficient strength to threaten residential structures that were conservatively assumed to threaten the proposed facility are near or less than $1 \times 10^{-5}$/yr.

NUREG/CR-4461, *Tornado Climatology of the Contiguous United States*, presents a $1 \times 10^{-5}$/year tornado event design basis wind speed of 3-second gust wind speed of 140 mph for the region of the United States that includes the proposed facility site (Region II). This is considered to be a "Highly Unlikely" event, as defined in Chapter 3 of the GLE License Application. NUREG/CR-4461 provides a refined value for the wind speed to be considered for those instances where detailed analysis is not warranted. The regions are further divided into 2-degree blocks. The 2-degree block that includes the proposed facility site (between North latitudes 33° and 35° and between West longitudes 78° and 76°) indicates that the probability of $1 \times 10^{-5}$/year tornado event is represented by a 3-second gust wind speed of 112 mph. This too, is considered to be a "Highly Unlikely" event. The magnitudes of these high speed wind events are bounded by the applicable codes and standards required 3-second gust wind speed of 160 mph for the proposed facility. Thus, it is appropriate to state that a "Highly Unlikely" tornado represents wind speeds substantially below the wind speeds required to be considered by the use of applicable codes and standards. The occurrence of tornadoes with these wind speeds are not expected to result in substantive damage to the process building structures. This conclusion is further supported when, utilizing historical data, adjustments to the characteristics of the NUREG/CR-4461 tornado events are applied to the area of the proposed facility.

#### *1.3.3.3.7 Tropical Storms and Hurricanes*

The area of New Hanover County along the coast could expect the following return periods for each category of hurricanes that have been in the indicated categories at some point along their track, passing within approximately 86 miles (75 nautical miles):

- Category 1, 6 to 10 years;
- Category 2, 23 to 30 years;
- Category 3, 33 to 44 years;
- Category 4, 79 to 120 years; and
- Category 5, 191 to 250 years (*Ref. 1-40*).

Because winds are stronger on the right side of the storm's eye, causing more wind damage and higher storm surges, the greatest meteorological threat to New Hanover County comes from hurricanes that strike land in the approximate area between the South Carolina border and the outlet of the Cape Fear River. In addition, the strongest bands of rain occur in front of a hurricane as it approaches, resulting in a great deal of heavy, flooding rain in New Hanover County when a storm approaches this area of coastline. Between 1954 and 2004, three hurricanes, ranging from Category 1 through Category 3, made landfall in the area. Two of the hurricanes, Hurricanes Hazel (1954) and Fran (1996), were Category 3 storms that made landfall with winds between 111 to 130 mph. Note that the indicated return periods are not an indication that a specific area would experience the wind speeds of the indicated category of hurricane. It indicates that at some point along the track of a hurricane that was at the indicted category the track may pass within the indicated distance from the coast.

The most severe documented wind for the area in proximity to the proposed site was 98 miles per hour (on the conservative assumption that the wind speed reported was a one minute average value, this equates to a 3-second gust wind speed of 107 mph). The highest recorded wind speeds were experienced as a result of a hurricane (Hazel, 1954). The most severe wind speed in the area is below the Category 3 hurricane range (lowest wind speed in Category 3 is 111 mph for the one minute average that equates to a 122 mph 3-second gust wind speed). Thus, for the area in proximity to the proposed site no hurricane winds associated with Category 3 strength events have occurred (the occurrence of hurricane Category 3 wind speeds in the area in proximity to the proposed site is considered to be the "Unlikely" event). Distinct from "Unlikely" events, a Category 4 hurricane, represented as an event with 3-second gust wind speeds of 157.5 mph, was selected as the deterministically identified "Highly Unlikely" DBW event. This is based on objective criteria, supported by the historical data.

According to the examination of NOAA storm surge data *(Ref. 1-44)*, most portions of the Wilmington Site at an elevation of 25 feet above msl, including the GLE Commercial Facility would not be directly affected by the highest storm surge. This is further supported by the storm surge potential from hurricanes being estimated at 21.94 feet as presented in Regulatory Guide 1.59, *Design Basis Floods for Nuclear Power Plants (Ref. 1-45).*

#### *1.3.3.3.8 Floods*

The GLE Site does not fall within 100-year or 500-year floodplains *(Ref. 1-46)*; however, some of the low-lying areas on the Wilmington Site contain swamp forest that borders the Northeast Cape Fear River. Much of this swamp forest is in the floodplain and may flood upstream during extreme rain events. As a result, the GLE site may be subject to a maximum probable flood event as discussed in Section 1.3.1.2.

## 1.3.4 Hydrology

The section contains descriptions of nearby water bodies, groundwater on and near the Wilmington Site, and design basis flood events.

### *1.3.4.1 Characteristics of Nearby Rivers, Streams, and Other Bodies of Water*

Bodies of water in the vicinity of the Wilmington Site are the Northeast Cape Fear River (which borders the Wilmington Site to the west) and its associated tributaries and creeks. The

Northeast Cape Fear River is a blackwater river with relatively low levels of dissolved oxygen and higher turbidity than the Cape Fear River. The Northeast Cape Fear River and its tributaries have a naturally low pH and are classified as swamp water by the North Carolina Department of Environment and Natural Resources Division of Water Quality. At the Wilmington Site, the river is tidally influenced. Salinity concentrations vary with the rate of freshwater input and the amount of tidal exchange.

On the Wilmington Site, there are three (3) streams that provide habitat to aquatic wildlife. Two of the streams, unnamed Tributaries No. 1 and No. 2 (located in the Swamp Forest community in the Western Site Sector), drain to the Northeast Cape Fear River. The remaining stream is located on the Eastern Site Sector and drains northward to Prince George Creek. The first two are unnamed tributaries to the Northeast Cape Fear River and are classified as freshwater streams, but their lower reaches are tidally influenced by the river. The third stream, the unnamed tributary to Prince George Creek, is a freshwater stream and is not tidally influenced within the Wilmington Site. All streams are capable of accommodating the aquatic species associated with the neighboring Northeast Cape Fear River. However, the tidal variations in dissolved oxygen and salinity may affect the suitability of the habitat for some species.

In addition, there are three (3) small ephemeral ponds in the Western Site Sector and North-Central Site Sector, along with wetland areas throughout the Site that provide habitat. These areas provide a water source for wildlife found on the Wilmington Site.

#### *1.3.4.2 Depth to the Groundwater Table*

On the Wilmington Site, the water table is generally located near the land surface averaging approximately nine (9) feet below ground surface (bgs) with a range from 0 to 20 feet bgs.

#### *1.3.4.3 Groundwater Hydrology*

The Wilmington Site is within the North Carolina Coastal Plain physiographic province, which extends from the Piedmont eastward to the North Carolina coast. The coastal aquifer system is an eastward-dipping and eastward-thickening wedge of depositional sediments and sedimentary rock underlain by a crystalline, eroded surface of igneous and metamorphic rock (Precambrian or Early Paleozoic age). Six (6) regional aquifers are present in the region surrounding the Wilmington Site, including the Surficial Aquifer, Castle Hayne Aquifer, Peedee Aquifer, Black Creek Aquifer, and the Upper and Lower Cape Fear Aquifers. The aquifers are water-yielding formations that are more permeable than the finer-grained formations (confining units) that are typically above and/or beneath these coastal aquifers. In most areas, a less-permeable confining unit, with the exception of the Surficial Aquifer, overlies each aquifer that is under water-table conditions. The aquifers and confining units consist of sands, conglomerates, silts, clays, shell hash, and fossiliferous limestones deposited in nearshore and deltaic to offshore marine environments *(Ref. 1-47)*.