Draft Scope Book

The draft Scope Book will consist of six sections:

- Section A will include a general description of the Units.
- Section B will include a detailed technical description of the SSCs of the Units.
- Section C will include a detailed description of documentation.
- Section D will include a Site layout plan and description of the Facility.
- Section E will include a description of the nuclear fuel design.
- Section F will include a data table of the SSCs of the Units.

The information provided by a Respondent should not be limited to technical data for a standard plant. The level of detail provided should be consistent with Parts 1 & 2 of a Safety Report as prepared for the CNSC. For reference the safety report Volume 1 & 2 for Darlington Nuclear Generating Station is available in the data room.

Section A: General Description of the Units

This section should provide a summary description of the principal characteristics of the Site and a concise description of the Units. The Unit description should include a brief discussion of the:

- principal design criteria,
- operating characteristics,
- safety considerations for the plant, safety systems, and provisions for Severe Accident Management;
- nuclear steam supply systems;
- instrumentation, control, and electrical systems;
- balance of plant systems, including the turbine-generator systems;
- fuel handling and storage systems;
- cooling water and other auxiliary systems; and
- radioactive waste management system.

The general arrangement of major structures and equipment should also be indicated by the use of plan and elevation drawings in sufficient number and detail to provide a reasonable understanding of the general layout of the Facility.

In addition to the foregoing general description, each of the following five areas should be addressed:

1. Design Approach:

Respondents should provide information on design criteria and design approaches that have been incorporated in the proposed Facility. The following items should be covered:

- Design evolution and improvements based on operational feedback;
- Provenness of Design of SSCs;
- Selection of materials for major systems and components;
- Use of standardized materials, equipment and components;
- Approach to 60-year design life;
- Ability to inspect, access and maintain SSCs
- Ability to test important operational and safety systems during Unit operation;
- Human factors considerations (including man-machine interface);
- Extent of use of digital Instrumentation and Control (I&C); the quality assurance standards used for I&C, and how future obsolescence of digital I&C is addressed;
- Measures to address common cause failures, such as diversification, physical separation and segregation of safety related equipment, components and systems;
- Equipment Environmental Qualification (EQ);
- Application of leak before break (LBB) criteria, single failure criterion, fail-safe design, defense in depth, reliability, and redundancy;
- ALARA and radiation zoning criteria;

- Fire protection; and
- Protection against natural and human-induced external events.

2. Construction and Commissioning Approach

Respondents should summarize the construction and commissioning approaches for the proposed Facility.

For construction, the following items should be covered:

- Equipment and installations at the Site;
- Operations on and off the Site;
- Project Co. Personnel required for these Project Operations;
- Site infrastructure during construction and erection;
- Method and approach for using modular construction methods for the Facility;
- Physical descriptions of the existing and planned module assembly facilities;
- Location and current construction status of the off-site module assembly facilities (including potential dependencies on other plant orders to get them up and running);
- Location and current status of the manufacturing facilities for major components (including potential dependencies on other plant orders); and
- Procedures to be applied for storing and protecting equipment.

For commissioning, Project Co should summarize the major steps and tests (e.g. preoperational tests, SSCs tests, acceptance tests, and validation of operating and test procedures, as applicable). Examples of commissioning milestones to be addressed include:

- Hot functional tests;
- Core loading;
- Initial criticality;
- Low power tests;
- Startup and power tests; and
- Trial operation and acceptance of the Units.

3. Operation and Maintenance Approach

Respondents should outline the Unit operation and response for the following:

- Steady-state power operation;
- Load changes;
- Startup operation;
- Shutdown operation;
- Reactor and turbine trips and load rejection;
- Emergency conditions; and
- Severe Accident Management.

Respondents should outline maintenance considerations (on-line and outages) incorporated in the design including the following:

- Optimization of manpower;
- Minimization of radiation exposure (i.e., ALARA);
- Features to isolate equipment for maintenance;
- Features to facilitate maintenance (e.g. hoisting provisions, laydown space, equipment access);
- Features to facilitate inspection; and
- Additional features to minimize the duration of outages.

4. Nuclear Safety Approach

Respondents should provide information on nuclear safety approach that have been incorporated in the proposed Unit. The following items should be described:

- Definition of the Safe Operating Envelope;
- Preventing incidents and accidents ;
- Mitigating incidents and accidents;
- Emergency response to incidents and accidents; and
- Severe Accident Management.

Respondents should also outline how safety culture expectations in item 3.8 of the Client Requirements will be met during the design, construction, and Commissioning of the Facility.

5. Document Management Approach

Respondents should provide information on the document management approach that will be used for the proposed Facility. The following items should be outlined:

- Scope, hierarchy and interrelation of documents;
- Process followed to ensure documentation meets quality requirements;
- Systems and technology in place to manage documents;
- Configuration management during design, construction and Commissioning; and
- Access to documentation by the Client.

Section B: Detailed Technical Description of the SSCs of the Units

Respondents are requested to include information on the functional and physical characteristics of provided structures, systems, and components (SSCs). Appendix A provides a list of typical SSCs to use as a guide. For each SSC, the following items should be described:

- Design basis;
- Design data, including design limits and margins;
- Design features;
- Functional description; and
- Simplified system-level Process & Instrumentation Diagram (P&ID).

The following additional information should be included with the SSC descriptions above or included separately:

- Heat balance diagrams for rated power; and
- Control room(s) layout arrangement drawings.

Section C: Detailed Description of Documentation

Respondents are requested to provide a list of the types of Facility documentation which they will produce during Project Operations, and describe the scope of each type of documentation. This list should include all procedures, manuals, drawings, calculations, analysis, processes, and other documents required to design, license, construct, Commission, operate, maintain, and repair the Facility. Respondents should conceptually describe which of the documents will be submitted to the Client for information and/or review and the documented format, e.g. electronic document or database.

Section D: Site Layout and Description of the Facility

Respondents are requested to provide a Site layout plan for the Site that includes:

- Site preparation, facilities, infrastructure;
- Land reclamation, clearing and grading;
- Access roads, sidewalks, access roads connected with public roads;
- Railway access;
- Sanitary installations, yard drainage;
- Storm sewer systems, waterfront structures;
- Harbour and cranes, waterway improvements;
- Fences, gateways, security provisions;
- Identification of all plant external interfaces;
- Security Protected Area;
- Identify the land needed for the exclusion zone, and specifically any additional lands that will need to be controlled to fulfill the exclusion boundary requirements;
- Other ancillary Site facilities required to meet the Client Requirements; and
- Other infrastructure details.

The Site layout plan should demonstrate how the layout of the Facility:

- makes best and most efficient use of the available space at the Site for the operation, maintenance, and repair of the Facility over the 60-year operating life;
- allows the completion all of the Project Operations in a manner that would permit Client to construct, install, commission, operate, maintain and decommission up to 4,800 MW of generation capacity on the Site using the same technology as Unit 1 and Unit 2; and
- accommodates an area at the Site to permit construction of a dry storage facility with capacity to store irradiated nuclear fuel discharged over the Facility design life from units with an aggregate capacity (together with Units 1 and 2) of 4800MW; and
- accommodates the option of cooling tower installation in place of the baseline option of once through cooling.

Respondents are requested to provide a description of the functionally complete ancillary buildings, structures, infrastructure and systems (other than the Units) that are necessary for the safe and proper operation of the Facility. This description should include:

- Functional capacity (e.g. in the case of storage facilities, their size; in the case of administrative facilities, the number and type of staff housed);
- Special technologies utilized (e.g. in the case of the water treatment plant, the type of water treatment technology);
- Location, relationship and proximity to other related buildings (e.g. inside or outside the Protected Area);
- Application of the silver standard of the Leadership in Energy and Environmental Design (LEED) Canada initiative to administration building(s), training centre, and in-processing security facilities;

- Layout;
- Special features (e.g. Meeting rooms, printers, classrooms, debrief rooms, secure examination rooms);
- Allowance for future expansion;
- Interior and exterior finish;
- Access and egress;
- Washroom and shower facilities;
- Furnishings and equipment; and
- Users of the facility (e.g. in the case of administration buildings, the type of personnel housed, such as operations, contractors, maintenance, supervisors, outage workers, regulatory personnel, visitors).

The ancillary facilities include, but are not limited to the following (if not covered in Section B):

- administration building(s);
- chemical and oil storage;
- new fuel storage
- radioactive waste storage;
- water treatment plant(s) and demineralized water storage/supply;
- screenhouse(s);
- warehouse(s) including main warehouse(s) outside the protected area;
- maintenance shops, laydown areas and mock-ups;
- change room facilities;
- cafeteria(s);
- records facilities;
- compressed gas storage;
- vehicle fuel storage;
- maintenance facilities (inside and outside the protected area);
- store(s);
- radiation support /decontamination facility;
- transportation and work equipment maintenance and storage facility;
  - inside the protected area including the provisions for contaminated equipment,
  - outside the protected area for Site maintenance equipment, such as snow removal, lawn and road maintenance equipment, salt and sand sheds, and
  - Indoor storage space, located outside the Protected Area but in proximity to the Protected Area security access point to be used for emergency response vehicles.
- inspection services and radiography facility;
- chemistry laboratories (including specialized lab equipment);
- heavy water management/upgrading facility (if applicable);

- hazardous materials facilities;
- health physics laboratory/facilities;
- laundry facilities for uncontaminated materials;
- contaminated laundry facilities;
- coffee shop(s);
- first aid and medical facilities;
- training centre;
- training simulator, including desktop simulators;
- emergency response centers;
    - one near the control room; and
    - one on site outside the Protected Area
- security systems, fencing, signage and facilities;
- internal roads, driveways, walkways, parking facilities with appropriate markings and lighting; and
- Chemical Waste Ponds – Lagoons; and
- monitoring Equipment and systems such as environmental, site, radiological and seismic

Section E: Nuclear fuel design

Respondents are requested to include a technical description of the functional and physical characteristics of the nuclear fuel. The technical description should include the following items:

- Fuel pellets;
- Fuel cladding;
- Fuel rods and assemblies;
- Fuel performance;
- In-core fuel inventories;
- Stretchout capability, where applicable;
- Reactivity control characteristics;
- Different cycle lengths, where applicable;
- Use of burnable poison;
- Reactivity coefficients;
- Neutron fluxes;
- Core thermohydraulic characteristics;
- References for design of the offered fuel assemblies;
- Fuel burnup; and
- Safety design aspects.

Section F: Data table of the SSCs of the Units

Respondents are requested to complete the following table by filling out the "Data" column, where applicable.

Item	*Unit*	*Data*
Reactor core		————
Core diameter	*mm*	
Fuel enrichment	*%*	
Number of fuel assemblies in the core	*—*	
Fuel uranium weight, total	*kgU*	
Core flow, total	*m^3/s*	
Subcooling margin at the core inlet	*°C*	
Core coolant pressure drop	*kPa*	
Core coolant temperatures		————
– *Inlet*	*°C*	
– *Outlet*	*°C*	
Number of fuel rods per assembly or fuel bundle, as applicable	*—*	
Fuel cladding material	*—*	
Range of reactivity coefficients		————
– *moderator temperature*	*mk/°C*	
– *fuel temperature*	*mk/°C*	
– *coolant temperature*	*mk/°C*	
– *coolant void*	*mk*	
– *soluble poison*	*mk/ppm*	
Average number of fuel assemblies to be replaced during refueling outages or average number of fuel bundles to be replaced per full power day, as applicable	*—*	
Duration between fueling outages, as applicable	*days*	
Neutron sources, *if applicable*		————
— lifetime years	*years*	
Control rods, including shutoff rods, and rod drives		
Include separate data for each type of rod if more than one type is used in the design		
Number of rods	*—*	
Absorber material	*—*	
Lifetime of rods, average	*year*	
Total reactivity worth of all rods	*mk*	

Shutoff rod/control rod drop time, as applicable	*s*	
Reactor pressure vessel (PWR only)		———
Design pressure	*kPa*	
Design temperature	*°C*	
Operating pressure	*kPa*	
Vessel material	*—*	
Cladding material	*—*	
Maximum nil ductility transition temperature after 60 years of operation at 90% load factor	*°C*	
Heat Transport System (PHWR only)		———
Design pressure	*kPa*	
Design temperature	*°C*	
Operating pressure	*kPa*	
Maximum nil ductility transition temperature after 60 years of operation at 90% load factor	*°C*	
Pressure Tubes		———
– *thickness*	*mm*	
– *material*	*—*	
– *lifetime at 90% load factor*	*years*	
Feeders		———
– *material*	*—*	
– *lifetime at 90% load factor*	*years*	
Calandria		———
Overall vessel length	*mm*	
Material of Calandria tubes	*—*	
Lifetime of Calandria tubes at 90% load factor	*years*	
Thickness of Calandria tubes	*mm*	
Steam generators		———
Number of steam generators	*—*	
Type	*—*	
Heat transfer capacity per generator	*MW*	
Active heat transfer surface per generator	*m^2*	
Plugging margin	*%*	
Mass of water (full load)	*Mg*	
Mass of water (hot stand-by)	*Mg*	
Number of tubes per generator	*—*	
Minimum tube bend radius	*mm*	
Materials		———
– *tubes*	*—*	

– *vessel body*	—	
– *cladding of primary coolant chambers*	—	
– *tube sheet plate*	—	
– *tube support sheet*	—	
– *steam dryer equipment*	—	
Primary coolant side		————
Primary coolant flow	*m^3/s*	
Pressure drop at full load	*kPa*	
Steam side		————
Design pressure	*kPa*	
Design temperature	*°C*	
Steam flow (full load)	*kg/s*	
Steam pressure at outlet nozzle	*kPa*	
Steam temperature at outlet nozzle	*°C*	
Steam moisture at full load	*wt%*	
Feedwater temperature at inlet nozzle	*°C*	
Internal preheaters included?	—	
Reactor coolant pumps		————
Number	—	
Type	—	
Design temperature	*°C*	
Delivery head	*m*	
Flow rate in normal operation	*m^3/s*	
Required power at the coupling (hot/cold)	*kW*	
Speed	*rev/min*	
Type of seal	—	
Seal water flow rate (if any)	*m^3/s*	
Total inertia of rotating parts	*kg-m^2*	
Materials		————
– *casing*	—	
– *shaft*	—	
– *impeller*	—	
– *seal*	—	
Electric motor type	—	
Pressurizer		————
Pressure, design/operating	*kPa*	
Temperature, design/operating	*°C*	
Total volume	*m^3*	
Water volume at full power	*m^3*	

Steam volume at full power	*m^3*	
Installed heater power, total	*kW*	
Number of heaters	*—*	
Base material	*—*	
Cladding material	*—*	
Reactor coolant safety/relief valves		———
– *Type*	*—*	
– *Number*	*—*	
– *Design pressure*	*kPa*	
– *Design temperature*	*°C*	
– *Blowdown flow*	*m^3/s*	
– *Lift-up set points*	*kPa*	
Pressurizer spray valves		———
– *Type*	*—*	
– *Number*	*—*	
Reactor coolant circulation piping		———
Base material	*—*	
Cladding thickness, if applicable	*mm*	
Cladding material, if applicable	*—*	
Emergency core cooling system		———
Number of trains	*—*	
Containment		———
Type	*—*	
Dimensions (diameter, height)	*m*	
Design pressure	*kPa*	
Design temperature	*°C*	
Design leakage rate	*kg/hr or % volume/hr*	
Secondary containment included?	*—*	
Means of containment cooling – active or passive	*—*	
Means of containment venting, if applicable	*—*	
Gaseous waste treatment system		———
Type of system	*—*	
Design maximum/normal off-gas rate	*Bq/a (Ci/a)*	
Solid waste treatment system		———
Capacity of waste treatment system	*—*	
– *spent resins*	*m^3/a*	
– *concentrates*	*m^3/a*	
– *chemical wastes*	*m^3/a*	

– *compressible wastes (compacted)*	*V*	
– *number of radioactive filters*	*number per year*	
– *other wastes to be solidified*	*m^3/a*	
Type of encapsulation, if applicable	*m^3*	
Number of drums expected	*number per year*	
Volume of drums	—	
Number of drums which can be stored:		———
– *within the nuclear building complex*	—	
– *in separate storage buildings*	—	
Liquid waste treatment system		———
Type of system	—	
Capacity of waste treatment system	*m^3/a*	
Turbine-generator		———
Rated output at generator terminals	*MW*	
Heat rate at full power	*kJ/kW-h*	
Steam pressure at turbine stop valves	*kPa*	
Steam temperature at turbine stop valves	*°C*	
Main steam flow at rated output	*kg/s*	
Condenser pressure at rated output	*kPa*	
Nominal cooling water inlet temperature	*°C*	
Cooling water differential temperature at full power	*°C*	
Cooling water flow to main condenser	*m^3/s*	
Operation		———
Startup time to full load after cold shutdown	*min*	
Startup time to full load after hot shutdown	*min*	
Permissible ramp load change	*%/min*	
Permissible step load change	*%*	
Minimum continuous load	*MW*	
Continuous permissible frequency range	*min/max Hz*	
Maximum output with one section of condenser isolated	*MW*	
Maximum output with one-half of condenser out of service	*MW*	
Maximum output with one train of LP feed heaters out of service	*MW*	
Maximum output with one train of HP feed heaters out of service	*MW*	
Maximum output with all HP heaters out of service	*MW*	
Condenser pressure at which turbine is tripped	*kPa*	
Condenser pressure at which bypass is tripped	*kPa*	

Main steam lines		———
Number	—	
Main steam flow rate	*kg/s*	
Moisture in steam		———
– *at steam generator outlet*	*wt%*	
– *at turbine inlet valve*	*wt%*	
Materials	—	
Safety valves		———
Type	—	
Number	—	
Actuation point	*kPa*	
Feedwater lines		———
Number	—	
Flow rate, total	*kg/s*	
Materials	—	
Turbine bypass, if applicable		———
Type of system	—	
Capacity	*% of reactor thermal power*	
Bypass valves		———
– *number, type*	—	
– *capacity*	*kg/s*	
Turbine		———
Speed	*rev/min*	
Number of LP cylinders	—	
Length of last-stage LP blades	*mm*	
Type of erosion protection of LP blades	—	
Total LP exhaust area	m^2	
Critical speeds in, or close to, operating range		———
– *HP rotor*	*rev/min*	
– *LP 1 rotor*	*rev/min*	
– *LP 2 rotor*	*rev/min*	
– *LP 3 rotor*	*rev/min*	
– *Generator*	*rev/min*	
Moisture separator reheaters (MS/RH)		———
Number of units	—	
Type of units	—	
Type of moisture separating elements	—	
Degree of moisture separation	—	

Number of reheating stages	—	
Number of reheater bundles per stage	—	
Materials		———
– *Shell*	—	
– *moisture separating elements*	—	
– *reheater tubes*	—	
– *tube sheets*	—	
Drain pumps		———
– *number and duty*	*%*	
– *capacity*	*L/s*	
– *motor rating*	*kW*	
Turbine-generator lubrication oil system		———
Type of oil used	—	
Main oil pump		———
– *type*	—	
– *drive*	—	
– *speed*	*rev/min*	
– *capacity*	*L/s*	
DC motor driven emergency oil pump		———
– *type*	—	
– *capacity*	*L/s*	
– *motor rating*	*kW*	
AC motor driven auxiliary oil pump		———
– *type*	—	
– *capacity*	*L/s*	
– *motor rating*	*kW*	
Jacking oil pumps		———
– *number*	—	
– *type*	—	
Coolers		———
– *type*	—	
– *number*	—	
– *duty*	*%*	
Materials		———
– *Shell*	—	
– *tubes*	—	
– *tube sheets*	—	
Oil purifier		———
– *type*	—	

– *capacity*	*L/s*	
– *motor rating*	*kW*	
Gland sealing system		———
Gland steam condensers		———
– *number*	—	
– *duty*	*%*	
– *type*	—	
– *materials*		———
– *shell*	—	
– *tubes*	—	
– *tube sheet*	—	
Turbine control and protection system		———
Type	—	
Control fluid pumps		———
– *number*	—	
– *duty*	*%*	
– *motor rating*	*kW*	
Control fluid coolers		———
– *number*	—	
– *duty*	*%*	
– *materials*		
– *shell*	—	
– *tubes*	—	
– *tube sheets*	—	
Mechanical governor		———
– *type*	—	
– *deadband*	*±%*	
– *droop*	*%*	
– *droop adjustment range*	*±%*	
Overspeed protection		———
– *method*	—	
– *tripping speed*	*rev/min*	
Turning gear		———
Type	—	
Generator		———
Rated apparent output	*MV A*	
Rated active output	*MW*	
Rated voltage and variation	*kV and ±%*	
Rated frequency and variation	*Hz and ±%*	

Rated power factor	—	
Rated hydrogen pressure	*kPa*	
Maximum permissible continuous output		———
– *at rated power factor*	*MW*	
– *at 1.0 power factor*	*MW*	
– *at 0.95 leading power factor*	*MW*	
Stator cooling water system		———
Type	—	
Stator cooling water pumps		———
– *number*	—	
– *duty*	*%*	
Seal oil system		———
Type	—	
Seal oil pumps		———
– *number*	—	
– *duty*	*%*	
Hydrogen cooling system		———
Type	—	
Hydrogen coolers		———
– *number*	—	
– *duty*	*%*	
Excitation and voltage control system		———
Type of excitation system	—	
Voltage control system sensitivity	*%*	
Condensate system		———
Heat removed at rated output	*MW*	
Condenser pressure at rated output and nominal cooling water inlet temperature	*kPa*	
Condensate temperature	*°C*	
Oxygen content of condensate at condenser pump discharge	*ppb*	
Condenser		———
Type	—	
Number of sections	—	
Number of passes	—	
Total tube surface	m^2	
Plugging margin	*%*	
Total number of tubes	—	
Number of tubes in air cooling section	—	

Hot-well storage capacity (if applicable)	m^3	
Materials		———
– *condenser shell*	—	
– *tubes in condensing zone*	—	
– *tubes in air removal zone*	—	
– *tube sheets*	—	
– *tube support plates*	—	
– *water box protection*	—	
Evacuating equipment		———
Main air ejectors		———
– *type*	—	
– *number of units*	—	
Startup ejectors or vacuum pump		———
– *type*	—	
– *number of units*	—	
Condensate pumps		———
Type	—	
Number	—	
Number operating at rated output	—	
Materials		———
– *casing*	—	
– *impeller*	—	
– *shaft*	—	
Feedwater heating system		———
Feed heaters		———
Number of feed heating stages		———
– *LP*	—	
– *Deaerating*	—	
– *HP*	—	
Number of feed heater banks		———
– *LP*	—	
– *HP*	—	
Total tube surface	m^2	
Plugging margin	*%*	
Materials		———
– *shell*	—	
– *water box*	—	
– *tubes*	—	
– *tube sheet*	—	

– *support plates*	—	
– *baffles*	—	
Deaerator heater and feedwater storage tank		———
Type	—	
Oxygen content of feedwater at storage tank outlet	*ppb*	
Total storage volume	m^3	
Storage volume with normal level	m^3	
Number and capacity of deaerator safety valves	*kg/s*	
Materials		———
– *deaerator shell*	—	
– *storage tank shell*	—	
Feedwater pumps and drives		———
Number of pumps	—	
Rated duty of pumps	*%*	
Type of drive	—	
Motor driven devices (such as pumps, compressors, fans, etc.) greater than 75 kW other than those listed above		
Include separate data for each device used in the design		
Type	—	
Number of units	—	
Number of units required for normal operation	—	
Operation characteristics		———
– *capacity*	*kg/s*	
– *power of electric motor*	*kW*	
Major heat exchangers other than those listed above		
Include separate data for each major heat exchanger used in the design, not already listed		
Type	—	
Number of units	—	
Number of units required for normal operation	—	
Materials		———
– *tubes*	—	
– *tube sheets*	—	
– *tube support sheets*	—	
– *shell*	—	
Major tanks other than those listed above		
Include separate data for each major tank used in the design, not already listed		
Type	—	
Number of units	—	
Volume per unit	m^3	

Design/operating pressure	*kPa*	
Design/operating temperature	*°C*	
Materials		———
– *shell and heads*	—	
– *lining or cladding*	—	
– *internals*	—	
Electrical Output and Distribution System		———
Main Output Transformer		———
– *rated voltage*	*V*	
– *capacity*	*MVA*	
Plant supply transformers		———
– *rated voltage*	*V*	
– *capacity*	*MVA*	
Standby/Emergency generator units		———
– *type*	—	
– *number supplied*	—	
– *number required for normal operation*	—	
– *voltage level*	*V*	
Minimum house load	*MW*	

Appendix A

LIST OF NUCLEAR POWER PLANT SYSTEMS

The following list and numbering system is provided as a guide to be completed as appropriate. Respondent should modify the list and numbering system to reflect their design and numbering system.

1. Buildings and Structures
   - 1.1 Reactor building
   - 1.2 Reactor auxiliary building(s)
   - 1.3 Turbine building
   - 1.4 Other buildings (as applicable)
     - Fuel storage building
     - Radioactive waste treatment and storage building(s)
     - Emergency diesel generator building
     - Electrical and switchgear buildings
     - Security building
     - Condenser cooling water and service water pumphouse(s)
     - Control buildings
     - Additional buildings housing nuclear power plant systems

2. Reactor Plant System
   - 2.1 Reactor equipment
     - 2.1.1 Reactor vessel or Calandria, including:
       - Reactor vessel and accessories
       - Closure head and attachments
       - Calandria tubes and fittings
       - Pressure tubes and fittings
       - End shield
     - 2.1.2 Reactor vessel or Calandria internals, including:
       - Core baffles, core shrouds, distributors, orifices, throttles and strainers
       - Upper core structure
       - Reactivity mechanisms deck
       - Control rod guide assemblies
       - Guides, channels, holders, etc. for irradiation specimen

2.1.3 Reactor control devices and other core installations, including:

- Control rods
- Reactivity control units
- In-core instrumentation
- Primary and secondary neutron sources
- Burnable poison
- Moderator liquid poison

2.1.4 Reactor shutdown devices, including:

- Moderator liquid injection shutdown system
- Control rods
- Shutoff rods
- In-core instrumentation
- Boron fast shutdown system

2.1.5 Moderator systems, including:

- Cover Gas System
- Moderator Purification System
- Moderator D_2O Collection System

2.2 Reactor Coolant System, including:

- Piping and headers
- Valves
- Feeders
- Main coolant circulating pumps
- Steam generators
- Pressurizer
- Residual heat removal system
- Long Term Cooling System

2.3 Reactor auxiliary systems, including:

- Volume control system
- Seal water supply system for main coolant pumps
- Pressure and inventory control system
- Pressure relief
- Chemical control system
- Coolant purification system
- Coolant degassing system
- Coolant storage and treatment system
- Nuclear component cooling system
- Leakage collection system

- Leak detection system

2.4 Reactor ancillary systems, including:

- Radioactive liquid waste storage and processing system
- Radioactive gaseous waste processing system
- Radioactive solid waste processing system
- Nuclear component drain and vent systems
- Nuclear building drain system
- Nuclear sampling system

2.5 Nuclear fuel handling and storage systems, including:

- New fuel storage and inspection facilities
- Fuel changing system
- Irradiated fuel handling and storage facilities
- Irradiated fuel pool cleaning and cooling system
- IAEA Safeguards
- Criticality considerations

3. Safety Systems
   - 3.1 Shutdown system(s)
   - 3.2 Containment and containment cooling systems
   - 3.3 Emergency core cooling
   - 3.4 Emergency feedwater system
   - 3.5 Reactor protection system
4. Safety Support Systems
   - 4.1 Emergency power supply system
   - 4.2 Backup instrument air
   - 4.3 Emergency service and cooling water systems
   - 4.4 Emergency containment venting system
   - 4.5 Control room habitability systems

5. Turbine-Generator and Auxiliaries
   5.1 Turbine, including:
      - High pressure and low pressure turbines
      - Moisture separator/reheater system
      - Lubrication and control fluid system
      - Turbine governing and protection systems
   5.2 Generator, including:
      - Stator cooling system
      - H_2 cooling system
      - Lubrication system
      - Seal oil system
      - Excitation system
   5.3 Main steam system, including:
      - Safety valves
   5.4 Condensing System, including
      - Condenser
      - Condensate air extraction
      - Turbine gland sealing
      - Turbine bypass
      - Steam drains
   5.5 Condensate system, including:
      - Condensate cleaning system
      - Condensate make-up and rejection
      - Condensate extraction pumps
      - Low pressure feedheating
   5.6 Feedwater system, including:
      - Deaeration system
      - Boiler feed pumps
      - High pressure feedheating

6. Electrical and Instrumentation and Control Systems
   - 6.1 Off-site power system
   - 6.2 Main power output system, including:
     - Isolated phase bus
     - Generator breaker system
     - Main output transformer
     - Generator and station services protection, operation (synchronizing and changeover) and monitoring equipment
     - Grounding and lightning protection systems
     - Switchyard connections
   - 6.3 Unit service distribution, including:
     - Station service transformers
     - Medium voltage switchgear
     - Low voltage A.C. switchgear
     - D.C. distribution
     - Batteries and chargers
     - Converters and inverters
   - 6.4 Ancillary and communication systems, including:
     - Communication and telecommunications systems
     - Clock systems
     - Closed-circuit television
     - Information Technology (IT) systems
   - 6.5 Instrumentation and control systems, including:
     - Overall unit control
     - Reactor power control system
     - Steam generator pressure and level control system
     - Heat transport pressure and inventory control system
     - Turbine-Generator control system
     - Reactor core monitoring systems
     - Man-Machine interface
     - Control areas, including main and secondary control areas
     - Radiation monitoring system inside and outside plant
7. Water Systems
   - 7.1 Condenser cooling water system, including:
     - Single pass cooling
     - Cooling towers
   - 7.2 Service water system

7.3 Component cooling water system

7.4 Demineralized water system

7.5 Potable water system

8. Beyond Design Basis Accident and Severe Accident Management Provisions

9. Miscellaneous Plant Systems

9.1 Heating, ventilation and air-conditioning systems (HVAC), including:

- Auxiliary boiler or alternative supplementary heating system

9.2 Heavy Water Management, including

- Vapour recovery
- D_2O supply
- D_2O cleanup

9.3 Fire protection and fire fighting systems, including:

- Turbine-generator fire suppression system
- Dykes, liners, berms, and fire suppression for fuel storage area
- Alarm systems
- Sprinkler system
- Mobile installations
- Manually operated and hand fighting equipment
- Hose reels and cabinets

9.4 Air supply systems, including:

- Breathing air systems
- Instrument air systems
- Service air systems
- Isolation of air systems inside containment as required

9.5 End Shield Cooling

9.6 Annulus Gas