operating environment of the experiment, or by forces that can arise as a result of credible malfunctions.

Fuel Assembly: A fuel assembly is a cluster of three or four fuel rods fastened together in a square array by a top handle and bottom grid plate adapter. A fuel assembly is also sometimes referred to as a fuel bundle.

Fuel Rod: A fuel rod is a single TRIGA-type fuel rod of either Standard TRIGA or 30/20 TRIGA fuel.

Irradiation Facilities: Any in-pool experimental facility which is not a normal part of the core and which is used to irradiate devices and materials.

Instrumented Fuel Rod: An instrumented fuel rod is a fuel rod in which thermocouples have been embedded for the purpose of measuring the fuel temperature during reactor operation. The Instrumented Fuel Rod or Instrumented Fuel Element is sometimes referred to by the acronyms "IFR" or "IFE."

License: The written authorization, by the responsible authority, for an individual or organization to carry out the duties and responsibilities associated with a personnel position, material or facility requiring licensing.

Licensed Area: The licensed area is the part of the Dodgen Research Facility building which is subject to the requirements of the WSU license R-76. This area includes:

(1) the reactor pool room (also known as Room 201) and adjacent rooms that allow direct unrestricted access to the pool room

(2) the beam room (also known as Room 2) and adjacent rooms that allow direct unrestricted access to the beam room.

Licensee: An individual or organization holding a license.

Limiting Safety Systems Setting: Limiting safety systems settings are the settings for automatic protective devices related to those variables having significant safety functions.

Measured Value: The measured value is the value of a parameter as it appears on the output of a measuring channel.

Measuring Channel: A measuring channel is the combination of sensor, interconnecting cables or lines, amplifiers, and output devices that are connected for the purpose of measuring the value of a parameter.

Mixed Core: A mixed core is a core arrangement containing Standard and 30/20 TRIGA fuels.

Monthly: Monthly shall mean a time interval of 30 days, not to exceed 45 days.

3.3 Primary Coolant Conditions

Applicability: This specification applies to the quality and quantity of the primary coolant in contact with the fuel cladding.

Objectives: The objectives of this specification are to:

(1) minimize the possibility for corrosion of the cladding on the fuel rods and to minimize neutron activation of dissolved materials;

(2) limit the upper temperature of the primary coolant for operation of the reactor;

(3) limit the radionuclide content of the primary coolant;

(4) maintain the appropriate pressure of the reactor coolant.

Specifications:

(1) Conductivity of the primary coolant shall be no higher than 5×10^{-6} mhos/cm.

(2) The bulk primary coolant temperature shall not exceed 50 °C.

(3) The radionuclide content of the primary coolant shall not exceed 10 CFR 20 effluent release limits.

(4) The reactor shall not be operated with less than 16 feet of water above the top of the core.

Basis:

Specification (1) limits the primary coolant conductivity to limit the rate of corrosion that occurs in a water-metal system and to control the neutron activation of dissolved minerals in the primary coolant. A water purification system is used to control primary coolant conductivity to limit the corrosion rate and thereby extend the longevity and integrity of the fuel cladding and to minimize the radioactivity of neutron activation products, which is consistent with the ALARA principle, and tends to decrease the inventory of radionuclides in the entire coolant system, which will decrease personnel exposures during maintenance and operations. Due to the relationship between conductivity and pH, a periodic measurement of conductivity with an acceptable limit of 5×10^{-6} mhos/cm will also limit the pH of the primary coolant. Experience with water quality control at many reactor facilities has shown that maintenance of water conductivity within the specified limits provides acceptable control.

Specification (2) limits the primary coolant temperature to 50 °C because safety analysis for conversion of the WSU reactor from HEU to LEU fuel was carried out for a maximum pool water temperature of 50 °C and found to provide an acceptable level of cooling for the reactor.

Specification (3) stipulates that the radioactive content of the reactor pool water shall remain below 10 CFR 20 release limits, which ensures that a pool water leak cannot under any condition exceed 10 CFR 20 effluent release limits. At this limit the entire pool could be emptied into the WSU sewage system without taking advantage of the dilution factor associated with the discharge volume of the WSU sewage system.

Specification (4) ensures that the appropriate pressure exists for the reactor coolant.

3.4 Ventilation System

Applicability: This specification applies to the operation of the facility ventilation system.

Objective: The objective is to ensure that the ventilation system is operable to mitigate the consequences of the possible release of radioactive materials resulting from reactor operation.

Specifications:

(1) The reactor shall not be operated unless the facility ventilation system is operable and operating, except for periods of time not to exceed 48 hours to permit repair or testing of the ventilation system. The ventilation system is operable when flow rates, dampers and fans are functioning normally. The normal, dilute and isolation modes shall be operable for the ventilation system to be considered operable.

   (a) The exhaust flow rate of the ventilation system in the normal mode, from the reactor pool room, shall be not less than 4000 cfm.

   (b) The exhaust flow rate of the ventilation system in the dilute mode, from the reactor pool room, shall be 300 cfm.

(2) The reactor pool room atmospheric pressure shall be maintained negative with respect to the areas outside the pool room when the ventilation system is in the normal or dilute mode.

(3) The ventilation system shall automatically switch to dilute mode upon a high activity alarm from the Continuous Air Monitor.

(4) The ventilation system shall be switched to the isolate mode upon initiation of a reactor scram.

(5) The dilute mode air filter shall be changed whenever the pressure drop across the filter increases by 1 in. of water above the initial level.

Specifications:

(1) The conductivity of the primary coolant water shall be measured at least once every two weeks.

(2) The radionuclide content of the reactor pool water shall be monitored monthly. Steps shall be taken to isolate the source of the radioactivity and to mitigate the problem if the radionuclide content of the pool water in the reactor pool exceeds one-third (1/3) of the 10 CFR 20 Appendix B, Table 3 value.

Basis: These surveillance requirements ensure that primary coolant water quality is not permitted to deteriorate over extended periods of time even if the reactor does not operate.

Specification (1) provides for monitoring of primary coolant water conductivity to provide timely information of possible changes in primary coolant water chemistry. The primary coolant water purification system and buffering of water pH due to atmospheric carbon dioxide act to stabilize primary coolant chemistry against sudden changes, and as a result the surveillance interval has been shown to provide assurance that primary coolant chemistry lies within the acceptable ranges.

Specification (2) provides for monthly monitoring of the radionuclide content in the pool water to provide information as a means to detect, in a timely fashion, a leak of radioactive fission products from fuel or a leak of a sealed source. Leakage of the primary coolant from the reactor pool is an analyzed event in terms of the potential impact of a pool water leak on effluent release limits. As long as the radionuclide content of the pool water remains below 10 CFR 20 effluent release limits it would be possible to release the entire contents of the pool directly into the sewer system, without dilution, and not violate the 10 CFR 20 release limits. As a result, the specification limiting radionuclide content of the pool water is intended to prevent the possibility of exceeding the 10 CFR 20 release limits under any circumstances or condition of operation.

4.4 Ventilation System

Applicability: This specification applies to surveillance requirements for the pool room ventilation system.

Objective: The objective is to ensure the proper operation of the pool room ventilation system in all operational modes.

Specifications:

(1) The operation of the pool room ventilation system shall be checked monthly by cycling the system from the "normal" to the "isolate" and "dilution" modes of operation. The positions of the associated dampers, indicator display, and fan operation shall be visually checked to ensure correspondence between the device performance and selected mode of operation.

5 DESIGN FEATURES

5.1 Site and Facility Description

Applicability: This specification applies to the Washington State University research reactor site location and facility description. The research reactor is located within the Dodgen Research Facility, which is a concrete building located approximately one mile east of the main portion of the WSU campus.

Objective: The objective is to specify the site and the facility of the Washington State University research reactor.

Specifications:

(1) The site is that area bound by the perimeter that encloses the Nuclear Science Center building, (also known as the Dodgen Research Facility), the fenced area immediately outside the east pool room loading dock door and the fenced area immediately outside the beam room west loading dock door.

(2) The Washington State University research reactor shall be located in the licensed area of the Dodgen Research Facility.

(3) The facility shall be the following:

   (a) the room in which the WSU research reactor is located, also known as Room 201, the reactor control room which is within Room 201, the pump room, primary coolant water purification room, primary coolant and makeup water valve manifold room;

   (b) the research reactor beam room, also known as Room 2.

(4) The facility shall be a restricted area.

Basis:

Descriptions of the Nuclear Science Center, Dodgen Research Facility, reactor building, and site are provided in detail in the Washington State University Safety Analysis Report.

Specification (1) provides a description of the site.

Specifications (2) and (3) provide a description of the location of the research reactor and the licensed area, and that the location of the research reactor shall be within the licensed area of the Dodgen Research Facility.

Specification (4) requires that the facility be a restricted area.

6 ADMINISTRATIVE CONTROL

6.1 Responsibility and Organization

(1) The Washington State University research reactor shall be operated by the Nuclear Science Center of Washington State University. The organization of the research reactor facility management and operation shall be as shown in Figure 6.1. The responsibilities and authority of the Level 2, Level 3, and Level 4 operating staff shall be defined in writing in these Technical Specifications.

(2) The following organizational levels and responsibilities shall exist:

(a) Vice President for Research (Level 1): The Vice President for Research is the head of the WSU Office of Research.

(b) Director of the Nuclear Science Center (Level 2): The Director of the Nuclear Science Center shall report to the Vice President for Research. The Director is responsible for ensuring that regulatory requirements and implementation are in accordance with requirements of the U.S. Nuclear Regulatory Commission, the Code of Federal Regulations, the State of Washington, and Washington State University regulations and the requirements of the WSU Reactor Safeguards Committee.

(c) Reactor Supervisor (Level 3):

(i) The Reactor Supervisor shall report to the Director of the Nuclear Science Center and is responsible for guidance, oversight, and technical support of reactor operations.

(ii) The Reactor Supervisor shall report to the Director of the Nuclear Science Center and to the Reactor Safeguards Committee in matters of radiation protection.

(d) Reactor Operating Staff (Level 4): The reactor operating staff shall report to the Reactor Supervisor. Reactor operating staff shall include one or more licensed Senior Reactor Operator, Reactor Operator or Reactor Operator trainee.

(e) Radiation Protection

(i) Radiation protection activities shall be carried out by Level 3 or Level 4, with supervisory function performed by the Level 3, Reactor Supervisor.

(ii) The Reactor Safeguards Committee shall perform the review and audit function over the radiation protection activities within the facility.

(iii) The University Radiation Safety Officer, as an ex-officio member of the Reactor Safeguards Committee, shall provide communication regarding radiation safety to the Director of the Nuclear Science Center.

(iv) The University Radiation Safety Officer shall have oversight, through the Reactor Safeguards Committee, of activities utilizing radioactive material.

(3) Responsibilities of one level may be assumed by higher levels or by alternates designated by a higher level, conditional upon meeting all requirements for the position.

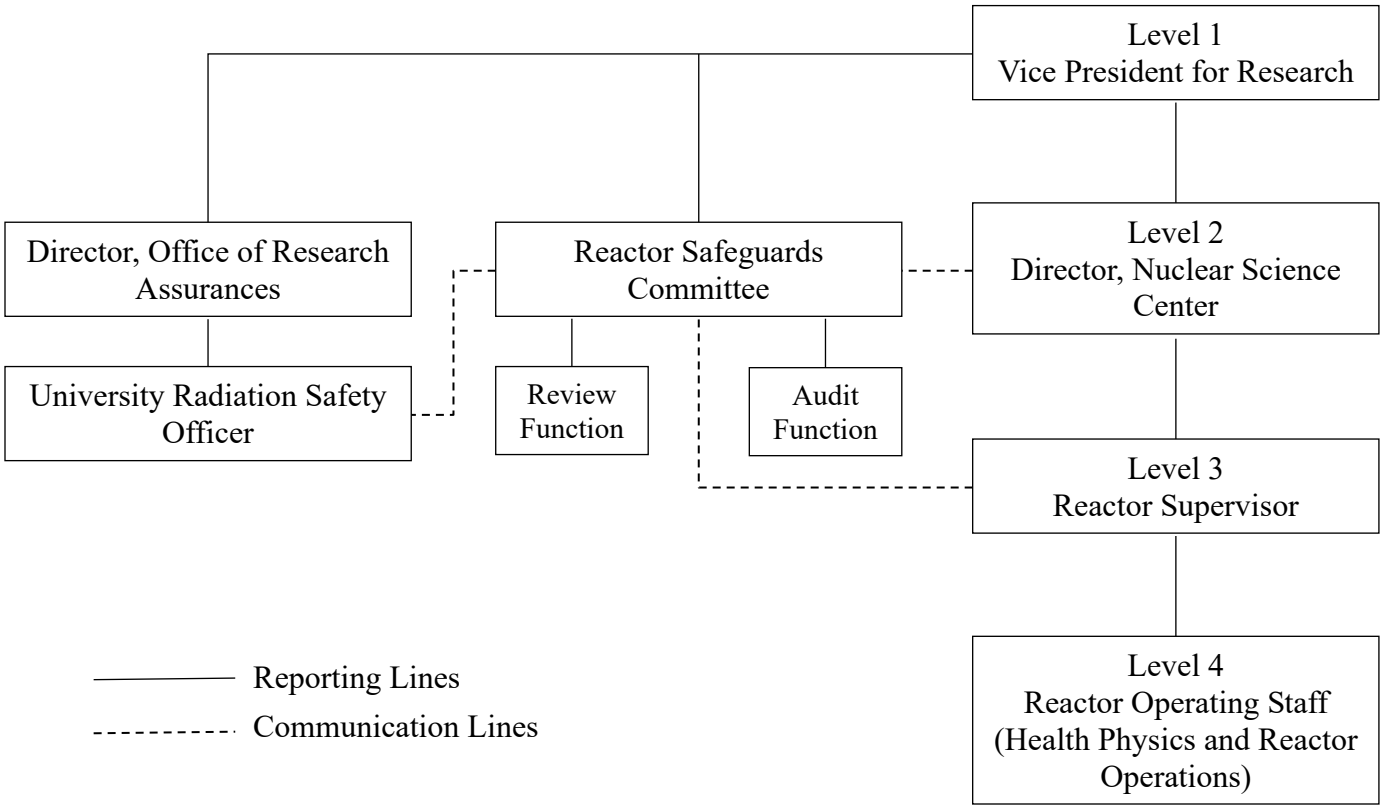

Figure 6.1 Facility organization

6.2 Staffing

6.2.1 Minimum Staffing Levels

(1) When the reactor is not secured, the minimum staffing level shall consist of:

(a) a licensed Reactor Operator or Senior Reactor Operator in the control room;

(6) Recovery from unplanned or unscheduled significant power reduction.

6.3 Selection and Training of Personnel

The selection, training and requalification of each member of operations personnel shall meet or exceed the requirements of ANSI/ANS 15.4 – 2007, "Standard for the Selection and Training of Personnel for Research Reactors," for comparable positions.

6.4 Reactor Safeguards Committee

6.4.1 Function

The Reactor Safeguards Committee shall function to provide an independent review and audit of the Nuclear Science Center activities including:

(1) reactor operations;

(2) radiological safety;

(3) general safety;

(4) testing and experiments;

(5) licensing and reports;

(6) quality assurance.

6.4.2 Composition and Qualifications

(1) The Reactor Safeguards Committee shall be composed of at least five members knowledgeable in fields that relate to nuclear reactor safety.

(2) The members of the Committee shall include:

(a) one Senior Reactor Operator who may be the Director of the Nuclear Science Center. The presence of Nuclear Science Center staff members shall not be counted to constitute a quorum. Nuclear Science Center staff members shall not be voting members of the Committee.

(b) WSU faculty and staff members designated to serve on the Committee in accordance with the procedures specified by the WSU committee manual.

(3) The University Radiation Safety Officer shall be an ex-officio member of the Committee.

(4) The Reactor Safeguards Committee is a WSU Presidential Committee which performs reviews and audits of the WSU Nuclear Science Center. The Reactor Safeguards Committee reports to the WSU Vice President for Research.

6.4.3 Reactor Safeguards Committee Operation

The Reactor Safeguards Committee shall operate in accordance with a written charter, including provisions for:

(1) semiannual meetings of the full committee;

(2) voting rules;

(3) quorums: the committee chair or a designate and two voting members;

(4) method of submission and content of presentations to the committee;

(5) use of subcommittees;

(6) review, approval and dissemination of minutes.

6.4.4 Reviews

The responsibilities of the Reactor Safeguards Committee or designated subcommittee shall include the following:

(1) review and approval of new experiments utilizing the research reactor;

(2) review and approval of proposed changes to the following:

    (i) the operating license (R-76) by amendment;

    (ii) Standard Operating Procedures;

    (iii) Technical Specifications.

(3) review of the operation and operational records of the Nuclear Science Center;

(4) review of operating abnormalities or deviations from normal and expected performance of equipment with safety significance;

(5) review in accordance with 10 CFR 50.59 whether proposed changes in equipment, systems, tests, experiments or Standard Operating Procedures would be allowed without prior authorization by the U.S. Nuclear Regulatory Commission.

(6) review of reportable occurrences and the reports filed with the U.S. Nuclear Regulatory Commission for reportable occurrences;