Specification

A Channel Calibration shall be made of the power level monitoring channels by the calorimetric method annually but at intervals not to exceed 14 months.

Basis

The power level channel calibration will assure that the reactor will be operated at the proper power levels.

4.2.2 Pulse Mode Operation

Applicability

This specification applies to the surveillance requirements for operation of the reactor in the pulse mode.

Objective

The objective is to verify that operation of the reactor in the pulse mode is proper and safe and to determine if any significant changes in fuel characteristics have occurred.

Specification

The reactor shall be pulsed semiannually to compare fuel temperature measurements and core pulse energy with those of previous pulses of the same reactivity value or the reactor shall not be declared operational for pulsing until such pulse measurements are performed.

Basis

The reactor is pulsed at suitable intervals to make a comparison with previous similar pulses and to determine if changes in fuel or core characteristics are taking place.

4.2.3 Shutdown Margin

Applicability

This specification applies to the surveillance requirement of control rod calibrations and shutdown margin.

Objective

The objective is to verify that the requirements for shutdown margins are met for operational cores.

Specification

The reactivity worth of each control rod and the shutdown margin shall be determined annually but at intervals not to exceed 14 months.

Basis

The reactivity worth of the control rods is measured to assure that the required shutdown margin is available and to provide an accurate means for determining the reactivity worths of experiments inserted in the core. Past experience with TRIGA reactors gives assurance that measurement of the reactivity worth on an annual basis is adequate to insure no significant changes in the shutdown margin.

4.2.4 Reactor Fuel Elements

Applicability

This specification applies to the surveillance requirements for the fuel elements.

Objective

The objective is to verify the continuing integrity of the fuel element cladding and to ensure that no fuel damage has occured.

Specification

a. The following fuel elements shall be inspected visually for damage or deterioration and measured for length and bend annually, not to exceed 15 months.
   (1) At least four fuel elements which occupy the highest pulse temperature positions in the core.
   (2) At least one-fifth of the fuel elements used in operation of the reactor over the previous inspection year.
   (3) The four elements in (1) above may be included in the inspection of fuel elements of (2) above.

b. If any element is found to be damaged, the entire core will be inspected.

c. The reactor shall not be operated knowingly with damaged fuel.

d. A fuel element shall be considered damaged and must be removed from the core if:

   (1) In measuring the transverse bend, the bend exceeds 0.125 inch over the length of the cladding.

   (2) In measuring the elongation, its length exceeds its original length by 0.125 inch, or

   (3) A clad defect exists as indicated by release of fission products.

Basis

The frequency of inspection and measurement schedule is based on the parameters most likely to affect the fuel cladding of a pulsing reactor operated at moderate pulsing levels and utilizing fuel elements whose characteristics are well known. Experience has shown that temperature is the major contributor to fuel damages. Inspection of the four fuel elements which occupy the highest pulse temperature positions in the core provides surveillance for detection of the most probable fuel element damage should it occur. Inspection of one-fifth of elements used in operation of the reactor provides surveillance of the lower temperature elements and over a five-year period provides for inspection of all elements.

The limit of transverse bend has been shown to result in no difficulty in disassembling fuel bundles. Analysis of the removal of heat from touching fuel elements shows that there will be no hot spots resulting in damage to the fuel caused by this touching. Experience with TRIGA reactors has shown that fuel element bowing that could result in touching has occurred without deleterious effects. The elongation limit has been specified to assure that the cladding material will not be subjected to stresses that could cause a loss of integrity in the fuel containment and to assure adequate coolant flow.

4.3 REACTOR CONTROL AND SAFETY SYSTEMS

4.3.1 Reactor Control Systems

Applicability

These specifications apply to the surveillance requirements for reactor control systems.

Specification

A Channel Calibration shall be made of the power level monitoring channels by the calorimetric method annually but at intervals not to exceed 14 months.

Basis

The power level channel calibration will assure that the reactor will be operated at the proper power levels.

4.2.2 Pulse Mode Operation

Applicability

This specification applies to the surveillance requirements for operation of the reactor in the pulse mode.

Objective

The objective is to verify that operation of the reactor in the pulse mode is proper and safe and to determine if any significant changes in fuel characteristics have occurred.

Specification

to be changed

The reactor shall be pulsed semiannually to compare fuel temperature measurements and peak power levels with those of previous pulses of the same reactivity value or the reactor shall not be declared operational for pulsing until such ~~comparative~~ pulse measurements are performed.

to be deleted

Basis

The reactor is pulsed at suitable intervals to make a comparison with previous similar pulses and to determine if changes in fuel or core characteristics are taking place.

4.2.3 Shutdown Margin

Applicability

This specification applies to the surveillance requirement of control rod calibrations and shutdown margin.

Objective

The objective is to verify that the requirements for shutdown margins are met for operational cores.

Specification

The reactivity worth of each control rod and the shutdown margin shall be determined annually but at intervals not to exceed 14 months.

Basis

The reactivity worth of the control rods is measured to assure that the required shutdown margin is available and to provide an accurate means for determining the reactivity worths of experiments inserted in the core. Past experience with TRIGA reactors gives assurance that measurement of the reactivity worth on an annual basis is adequate to insure no significant changes in the shutdown margin.

4.2.4 Reactor Fuel Elements

Applicability

This specification applies to the surveillance requirements for the fuel elements.

Objective

The objective is to verify the continuing integrity of the fuel element cladding and to ensure that no fuel damage has occured.

Specification

to be changed

At least four fuel elements, which occupy the highest specific power density positions in the core shall be inspected visually for damage or deterioration and measured for length and bend annually, not to exceed 15 months. If any element is found to be damaged, the entire core will be inspected. The reactor shall not be operated with damaged fuel. A fuel element shall be considered damaged and must be removed from the core if:

a. In measuring the transverse bend, the bend exceeds 0.125 inch over the length of the cladding.

b. In measuring the elongation, its length exceeds its original length by 0.125 inch, or

c. A clad defect exists as indicated by release of fission products.

Basis

The frequency of inspection and measurement schedule is based on the parameters most likely to affect the fuel cladding of a pulsing reactor operated at moderate pulsing levels and utilizing fuel elements whose characteristics are well known. Experience has shown that temperature is the major contributor to fuel damages. By examining the 4 "lead" elements, the remainder of the fuel does not require inspection due to operation at substantially lower temperatures.

to be changed

The limit of transverse bend has been shown to result in no difficulty in disassembling fuel bundles. Analysis of the removal of heat from touching fuel elements shows that there will be no hot spots resulting in damage to the fuel caused by this touching. Experience with TRIGA reactors has shown that fuel element bowing that could result in touching has occurred without deleterious effects. The elongation limit has been specified to assure that the cladding material will not be subjected to stresses that could cause a loss of integrity in the fuel containment and to assure adequate coolant flow.

4.3 REACTOR CONTROL AND SAFETY SYSTEMS

4.3.1 Reactor Control Systems

Applicability

These specifications apply to the surveillance requirements for reactor control systems.