INSPECTION PROCEDURE 69005

CLASS I RESEARCH AND TEST REACTOR EXPERIMENTS

PROGRAM APPLICABILITY: 2545

69005-01 INSPECTION OBJECTIVE

To determine whether the licensee conducted experiments in accordance with regulatory requirements and licensee commitments, since the last inspection.

69005-02 INSPECTION REQUIREMENTS

02.01 Scope of Experiments. Determine whether the scope of experiments conducted at the facility were consistent with regulatory requirements and licensee commitments.

02.02 Procedure Review. Determine whether the licensee's procedures for the control and conduct of experiments are consistent with regulatory requirements and licensee commitments.

02.03 Program Implementation

a. Experiment Review and Approval. Determine whether the licensee reviewed and approved experiments performed at the facility, and any subsequent changes made to the experiments, in accordance with Technical Specification (TS) requirements and the licensee's procedural requirements.

b. 10 CFR 50.59 Evaluation. Determine whether the licensee reviewed experiments for TS changes or compliance to 10 CFR 50.59.

c. Potential Hazards Identification. In accordance with the licensee's procedures, determine whether the licensee identified hazards associated with the experiments conducted since the last inspection and took appropriate remedial action.

d. Reactivity Assessment

1. Determine whether the licensee predicted the approximate reactivity effect on the reactor before conducting the experiment.

2. Determine whether the licensee confirmed the reactivity effect as required by the TS.

e. Control of Irradiated Items. Determine whether the licensee accounted for irradiated items until disposing of them or until they decayed to an acceptable level, in accordance with regulatory requirements and applicable licensee procedures.

f. Constraint. Determine whether the licensee's experiments are constrained as required by the TS.

g. Compliance with Procedures. Determine whether researchers adhered to the licensees procedural controls when loading experiments into the test facilities and removing them from the test facilities.

h. Reactivity Control. Determine whether the experiments reduced the operator's ability to control reactivity manipulations or the protective system's ability to shut down the reactor if needed.

i. Engineered Radiation Controls and Posting. Determine whether engineered radiation safety controls were used during experiments and posting was accomplished as required.

69005-03 INSPECTION GUIDANCE

General Guidance

This inspection procedure is for the inspection of facilities and materials licensed under 10 CFR Part 50. It is not to be used for the inspection of facilities and materials governed by other types of licenses. It should be noted that naturally occurring radioactive materials or those produced by an accelerator are not licensed by the NRC.

General guidance may be found in the ANSI/ANS Standards listed in Appendix B to Inspection Procedure 69001, "Class II Research and Test Reactors." Additional general guidance may be found in the Division 2 Regulatory Guides, and the "Other Regulatory Guides of Possible Interest to Division 2 Recipients" listed in the Division 2 Regulatory Guides Table of Contents. Reference to this guidance is to aid the inspector in technical evaluation of licensee programs and is not to be used as requirements unless the licensee has committed in writing to use the specific guidance document.

New experiments and changes to the licensee's experiments and related programs since the last inspection are to be examined. The sample sizes recommended in this inspection procedure are provided for broad planning purposes and to define the typical depth of the inspection. They are not intended to be rigid requirements on the inspector.

Specific Guidance

03.01 Scope of Experiments. The review of 50 percent of the new experiments or changes to experiments, since the last inspection, is an acceptable sample for this inspection requirement. The inspector is not to review experiments or changes to experiments that have been previously reviewed by NRC personnel. The facility's Annual Report or experiment logs normally provide a list of experiments that are to be compared to respective license conditions, TS, Safety Analysis Report (SAR), Safety Evaluation Report (SER), and supporting documentation. Other sources of information are the minutes of the safety review committee meetings or experiment proposals. If this documentation is already available at the office, it is to be reviewed prior to the onsite inspection.

03.02 Procedure Review. If practical, the licensee's procedures for the control and conduct of experiments are to be reviewed prior to the onsite inspection. The procedures for experiments are governed by the TS, license conditions and the licensee's administrative controls. Generally, procedures that cover routine experiments are well established. Specific procedures are required to be developed for each non-routine experiment. These procedures normally include actions that are to be taken in the event of an emergency. These emergency actions may also be specified in the experiment proposal package or safety review committee meeting minutes, and operating log orders.

03.03 Program Implementation. Direct observation of 50 percent of the new experiments, or changes to experiments, since the last inspection is an acceptable sample for this inspection requirement. If direct observation is not practical, the review of records and discussions with cognizant personnel for the above sample size is acceptable.

a. Experiment Classification, Review and Approval. The TS and the licensee's administrative procedures provide the review and approval requirements for experiments. The SAR may provide more definitions of experiments, experimental facilities, and tests. The approval process is often complicated because not all experiments must be completely reviewed each time before they are performed. To determine whether an experiment has been reviewed and approved in accordance with licensee's TS and procedural requirements, review the information available to the operator that authorizes the conduct of a particular experiment. This information may be a proposal with signatures, an experiment review form, or entries in the operating log.

   A proposal which contains the details of the experiment is normally submitted to the safety review committee for Class 2, 3, and 4 experiments. Class 3 and 4 experiments generally undergo an extensive 10 CFR 50.59 review. A copy of the proposals is ordinarily kept in a location specified in the licensee's procedures. This is usually near the reactor console where the copies of the proposals are readily available for the operators while they conduct the experiment.

   Particular attention is to be given to experiments that contain special nuclear material (fueled experiments) or explosives. The failure of such experiments may result in a significant radioactive release and may be the maximum hypothetical accident at some reactors.

Below are examples of acceptable ways for classifying experiments and the level of review and approval required for the classifications.

1. Routine experiments such as gold foil irradiation can be readily approved by the reactor supervisor, a licensed senior reactor operator (SRO), or the radiation control officer based on the safety review committee's previous review and approval of this type of experiment.

2. Routine experiments need to be individually documented for each new group of experimenters, or whenever the experiment has not been performed for one calendar year or more by the original experimenter. These experiments must pose no hazard to the reactor, the personnel, or the public and can be approved by the reactor supervisor, an SRO, or the radiation control officer. These approvals verify that the hazard assumptions are as stated above.

3. Experiments that could pose a hazard to the safety of the reactor, personnel, or the public must be approved by the safety review committee, which could also recommend devices to minimize any hazards. These experiments are also to be approved by the reactor supervisor, an SRO (if the reactor supervisor is not an SRO), and the radiation control officer. It is important for the operating personnel to verify that all expressed conditions are met before the experiment is conducted.

4. Experiments that have a significant potential for posing a hazard to the reactor, personnel, or the public must be approved by the safety review committee. These experiments are also to be approved by the reactor supervisor, an SRO (if the reactor supervisor is not an SRO), and the radiation control officer. Such experiments are to be inserted, disassembled, or removed from the reactor under the direct supervision of the reactor supervisor, or a duly authorized SRO (if the reactor supervisor is not an SRO). A written description of reactor operations (from insertion until removal) approved by the safety review committee is required before an experiment is inserted in the reactor.

b. 10 CFR 50.59 Evaluation. Requirements are specified in 10 CFR 50.59. Guidance is also provided in NRC Inspection Manual Chapter 10 CFR Guidance "10 CFR 50.59 - Changes, Tests and Experiments."

In the June 23, 1971 letter from D. J. Skovholt, Division of Reactor Licensing (DRL), NRR, the holders of research and test reactor licenses were informed that the use of explosives within a reactor facility is considered to require NRC review and approval. The irradiation of explosives continues to require NRC review and approval by the Office of Nuclear Reactor Regulation (NRR) and such usage is written into the facility TS. Explosives as indicated in the DRL letter are materials that constitute Class A, Class B, and Class C explosives as described in Title 49, Parts 172 and 173 of the Code of Federal Regulations. If the irradiation of explosives is authorized, the limits for the explosives that NRR has approved can be found in the TS.

c. Hazards Identification. Experiments are to be conducted in accordance with the licensee's administrative control procedures and contain guidance or cautions for the operator and experimenter, including those established by the safety review committee. It is important that the operators and experimenters understand the hazards associated with an experiment and the methods to identify and respond to them (see 10 CFR 19.12).

An example of a non-routine hazard is a radioactive gas leak in an experiment. The operator or experimenter might detect this condition by observing a loss of vacuum in an evacuated experimental tube that contains the primary capsule. If the capsule has ruptured, the opening of the experiment tube could be radiologically hazardous or cause a reactivity transient. It is important that the operators or experimenters monitor and understand the meaning of gauges that measure pressures, including vacuum conditions, where appropriate to the experimental setup. Were items such as these gauges listed in experiment proposals before the experiment was begun and were remedial actions planned in accordance with the licensee's administrative control procedures?

d. Reactivity Assessment. Did the licensee verify that the applicable TS limits for reactivity, such as shutdown margin, excess reactivity, and individual and total worth of experiments were not exceeded?

1. The licensee's calculations will vary in complexity with that of the experiment. Requirements are specified in the TS and the licensee's procedures.

2. If the regulating rod does not change position substantially with the experiment insertion, this is an adequate reactivity check for most near zero worth experiments. In most cases, an experiment with a worth of 0.001 delta K/K or less need not be measured because it poses no safety problem. Xenon or temperature differences would mask a worth of this order. It is important for the operator to be able to detect any large change in reactivity during an experiment. For example, a conservative cut off point is normally established by the licensee, so that if a regulating rod is changed by that amount, the operator will stop the experiment and calculate the value to assure compliance with constraint limits and shutdown margin limits.

e. Control of Irradiated Items. The verification of the location and the status of three past experiments, performed under the license since the last inspection, is an acceptable sample to verify this inspection requirement. The requirements for the control of irradiated materials are specified in 10 CFR Part 20 and the licensee's procedures for the control of radioactive materials. Guidance is provided in ANSI/ANS-15.11, "Radiological Controls at Research Reactors," 1993 and IE Information Notice No. 85-92, "Surveys of Wastes Before Disposal from Nuclear Reactor Facilities," December 2, 1985 (Accession No. 8511270325). Until final disposal, irradiated articles are to be controlled by the licensee in accordance with 10 CFR Part 20. Final disposal shall be made in accordance with Subpart K of 10 CFR Part 20.

Byproduct materials or irradiated materials produced under a reactor license may also be transferred to other licensees, in areas outside the reactor facility, for use at their laboratories by other authorized users. Transfer may be to another reactor licensee, but it is usually from the reactor facility to the holder of an NRC materials license or an Agreement State license. The transfer of byproduct material produced or used under the reactor (10 CFR Part 50) license, to the holder of a materials (10 CFR Part 30) license, is required to be done in accordance with 10 CFR 30.41. The reactor licensee transferring such material is required to verify that the recipient is licensed to possess the type, form and quantity of material to be transferred. Further guidance is provided in NRC Inspection Manual Chapter 9900, "Byproduct Material Produced in Non-Power Reactors."

f. Constraint. The need for constraints will depend on the type of reactor, and will be specifically stated in the TS. The TS require various degrees of constraint for experiments depending on reactivity values. Physical constraints may be based on a number of experimental conditions, such as the reactivity worth of an experiment and the ability of the reactor to handle the transients.

An experiment can be considered constrained if it has a large mass or heavy shielding that minimize potential movement. Secure arrangements should be established so that a single movement does not pulse a non-pulsing reactor, or exceed TS requirements or safety analysis assumptions. The following examples provide guidance relative to selected constraints:

An example of the type of problem that could occur from inadequate physical constraints is an experiment in a pool-type reactor that escapes its constraints and floats to the surface of the pool, causing potential reactivity and exposure problems.

Another example is for a reactor with Materials Test Reactor (MTR)-type fuel and experiments with a worth of 0.002 delta K/K or less, which may not require constraints on movements while critical if the control system can compensate for the change in reactivity for any movement without significantly deviating from normal parameters. If the experiment has a reactivity worth of between 0.002 and around 0.006 delta K/K, it would normally be mildly constrained, for instance, by resting the experiment on a support instead of dangling it from a string or wire that could break. Experiments (samples) with a worth of less than 0.002 delta K/K can be inserted or removed with a rabbit system or by hand while the reactor is critical, if the expected radiation field for the personnel does not present an exposure problem. If the worth of the experiment is approaching beta, that is greater than 0.006 delta K/K, it should normally be fixed in place such that a simple movement cannot not change the position of the experiment. Note that reactivity limits are given in the TS as absolute values. Experiments, that are of negative reactivity on insertion into the reactor core, are positive on withdraw and are must meet TS requirements.

g. Compliance with Procedures. Experimental activities are required to be consistent with the licensee's approved administrative controls and procedures for experiments. When an experiment is being removed from the reactor, it is

assumed to be contaminated and highly radioactive until proven otherwise. If removal of an experiment from the reactor cannot be directly observed, discuss the methods of handling experiments and examine the process for consistency with the licensee's administrative controls and procedures (see 10 CFR Part 19.12).

h. Reactivity Control. 10 CFR 50.54 (j) requires that apparatus and mechanisms other than controls, the operation of which may affect the reactivity or power level of a reactor be manipulated only with the knowledge and consent of a licensed operator or SRO. How does the licensee assure that experiments do not cause reactivity anomalies that cannot be controlled by the operator or control system? Consider (1) the operator's control over rabbit insertions and removals, (2) experiments that shadow the nuclear detectors and cause the indicated power level to be lower than the actual power level on a safety channel by more than the allowed instrument error, and (3) experiments that may interfere with the movement of a control rod or blade.

i. Engineered Radiation Control and Posting . Consistent with the principle of as low a reasonably achievable (LARA), has the licensee considered the use of engineered safety features such as remote handling devices, time, distance and shielding in the planning and conduct of experiments? If correctly used, engineered safety controls for experiments can effectively limit occupational exposures to the levels required by 10 CFR Part 20, and the licensee's administrative limits. Access to areas where radiation is present are required to be posted in accordance with the 10 CFR Parts 20.1902 and 20.1903 and are to be limited as required by licensee's radiation protection program.

69005-04 RESOURCE ESTIMATE

For planning purposes, the direct onsite inspection effort to complete this inspection procedure is estimated to be six hours. Actual inspection at any facility may require more or less effort depending on past inspection history, conditions at the facility, and safety significance of the inspection findings.

69005-05 REFERENCES

Regulatory Guide 2.2, "Development of Technical Specifications for Experiments in Research Reactors," November 1973.

Regulatory Guide 2.4 "Review of Experiments for Research Reactors," May 1977.

ANSI/ANS-15.1, "Development of Technical Specifications for Research Reactors," 1982.

ANSI/ANS-15.6, "Review of Experiments for Research Reactors," 1974.

ANSI/ANS-15.11, "Radiation Protection at Research Reactor Facilities," 1993.

ANSI-N328, "Control of Radioactive Surface Contamination on Materials, Equipment, and Facilities to be Released for Uncontrolled Use," 1978.

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