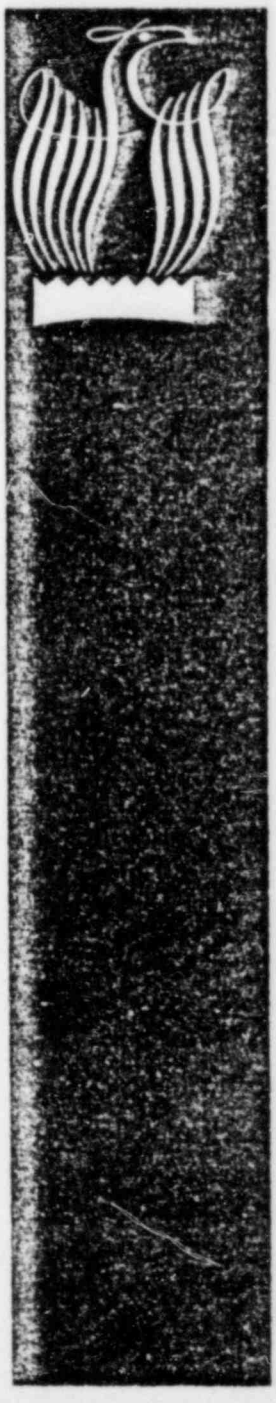
MICHIGAN MEMORIAL PHOENIX PROJECT
THE UNIVERSITY OF MICHIGAN

QUALITY ASSURANCE PROGRAM



FORD NUCLEAR REACTOR

The University of Michigan
Ann Arbor

May, 1978

ANN ARBOR MICHIGAN

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REVIEW

This program will be reviewed, revised as required, signed by the Reactor Manager, and dated annually and whenever revisions are made. Revisions will be noted in the right hand column. Revised procedures will be issued to procedure holders at the time of revision.

Reactor Manager	Date	Revised Sections
Fred R Brune	5/3/79	Annual Review.

1. INTRODUCTION

1.1 Purpose

The purpose of this program is to provide requirements for managing, conducting, and auditing the quality assurance program for the design, construction, testing, modification, and maintenance of safety related items and experiments associated with the Ford Nuclear Reactor (FNR).

1.2 Applicability

The quality assurance program applies to replacements of and modifications to safety related items subsequent to the date of implementation. Quality assurance documentation is not required for the facility as-built and for safety related changes made prior to program implementation.

1.3 Safety Related Items

Safety related items associated with the FNR are the reactor pool, the primary coolant system, and the instrumentation systems listed in Technical Specifications, Tables 3.1 and 3.2.

1.4 References

1.4.1 American National Standards Institute (ANSI) N402-1976, Quality Assurance Program Requirements for Research Reactors.

2. PROGRAM REQUIREMENTS

2.1 Quality Assurance Organization

The FNR Quality Assurance Committee is responsible for the implementation of quality assurance requirements on a project basis (Described in Sections 3 - 11). Permanent committee members include the Reactor Manager (Chairman), Assistant Reactor Manager, and Supervisor of Reactor Operations. Ad hoc project members include a design engineer and a quality engineer. These functions may not be combined, but may be filled by one of the permanent committee members.

The FNR Safety Review Committee serves to provide technical advice and must grant final approval of project safety analysis and design prior to implementation.

2.2 Responsibilities

2.2.1 Reactor Manager. The Reactor Manager is responsible for:

a. Assigning ad hoc Quality Assurance Committee members.

b. Scheduling and chairing project reviews.

c. Assigning drawing and document numbers as required.

d. Submitting safety analysis and project design to the FNR Safety Review Committee for approval.

e. Submitting License and Technical Specification amendments to the NRC as required.

2.2.2 Supervisor of Reactor Operations. The Supervisor of Reactor Operations is responsible for:

a. Maintaining a project file which contains copies of all records associated with the project.

b. Maintaining measuring and test equipment properly calibrated.

2.2.3 Design Engineer. The design engineer is responsible for:

a. Performing a safety analysis including Technical Specification and standards requirements.

b. Developing the required design.

c. Preparing information required for procurement documents.

d. Controlling procured material upon arrival at the facility.

e. Preparing procedures for installation and tests.

f. Completing drawings, system descriptions, procedures, regulations, and changes to the Technical Specifications and License as required.

g. Maintaining a complete file with the Supervisor of Reactor Operations of all work related to the modification.

2.2.4 Quality Engineer. The quality engineer is responsible for:

a. Verification of design adequacy.

b. Disposition of non-conforming materials and parts.

c. Performing inspections.

d. Verification of tests.

2.3 Project Review Meetings

The Quality Assurance Committee will meet to review project safety analysis, design, installation tests, and final documentation package. The means for implementing Sections 3 - 10 will be established on a project basis at the review meeting.

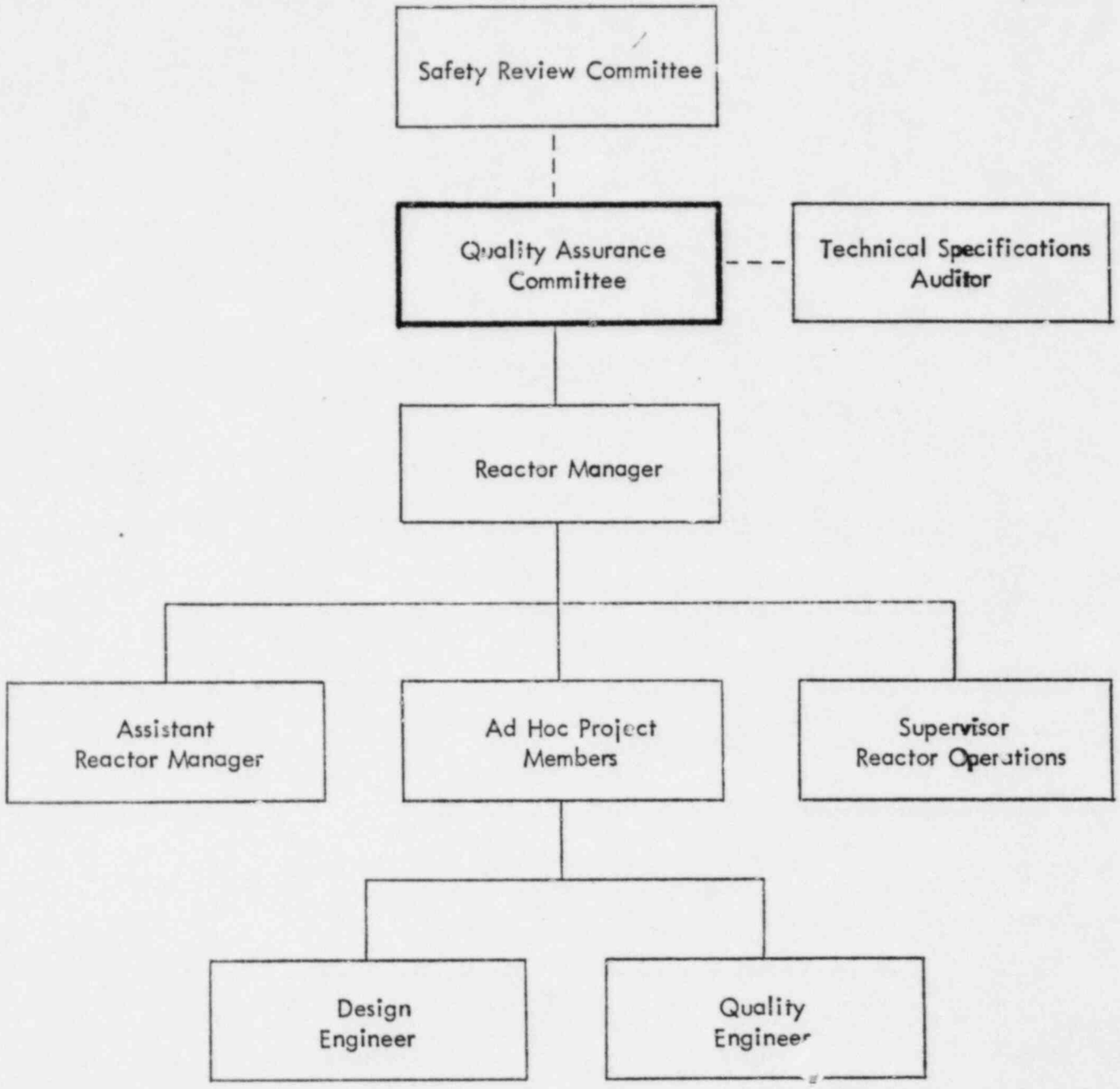

FIGURE 1

FORD NUCLEAR REACTOR QUALITY ASSURANCE ORGANIZATION

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2.3.1 Design Adequacy. Designs will be reviewed for reactor physics implications; thermal, hydraulic, and mechanical stress; accident analysis; material compatibility; accessibility for in-service inspection, maintenance, and repair; and interfaces with other systems.

2.4 Experimental Equipment

The quality assurance program will provide controls over the fabrication and installation of experimental equipment to the extent that these relate to reactor safety.

2.5 Corrective Action

Significant conditions detrimental to the quality of safety-related items, such as failures, malfunctions, and deficiencies, will be promptly identified, the cause determined, and corrective action taken to preclude repetition.

3. SAFETY ANALYSIS

As a preliminary step in any safety related modification, a safety analysis will be performed. The safety analysis will analyze the safety implications of the modification. Verification must be provided that the probability of occurrence or consequences of an accident have not been increased, the possibility of an accident or malfunction of a different type has not been created, and the margin of safety in Technical Specifications has not decreased.

4. DESIGN CONTROL

Applicable codes, standards, and regulatory requirements will be incorporated into the design of safety related items and experiments.

Design adequacy will be verified by design review, alternate calculations, or a test program. Verification should include checks of such characteristics as compatibility of materials; suitability of application of materials, parts, and processes; accessibility for in-service inspection, maintenance and repair; proper interfacing of subsystems; and completeness of acceptance criteria.

5. PROCUREMENT CONTROL

Applicable codes, standards, and regulatory requirements will be included in safety related item procurement documents. To the extent determined by the safety requirements of the final system, procurement documents will require contractors or subcontractors to provide appropriate quality assurance controls, which may include, but are not limited to, functions such as inspections, tests, and controls over materials, processes and nonconformances.

Changes to procurement documents will be subject to controls commensurate with those for the original procurements.

Assurance will be provided that procured items or services conform to procurement documents by such measures as source evaluation, contractor furnished evidence, inspection at source, or inspection upon receipt, as appropriate.

6. MATERIAL CONTROL

Control of the identification, handling, storage, shipping, cleaning, and preservation of safety related material and equipment will be established as deemed necessary by the Quality Assurance Committee.

6.1 Nonconforming Material and Parts

Nonconforming materials and parts will be identified, segregated, and disposed of. Disposition will be accomplished after a review by the Quality Assurance Committee and will consist of acceptance, repair, rework, or rejection.

7. PROCESS CONTROL

Processing of materials for safety related items will be accomplished under controlled conditions in accordance with applicable codes, standards, and specifications. Controls will be applied to the extent appropriate, with particular emphasis on those for specific processes, such as crimping, soldering, welding, heat treating, cleaning and nondestructive examination. Procedures, equipment and qualifications of personnel will be defined for those special processes not covered by existing codes or standards.

8. INSPECTIONS

Inspection requirements apply to procurements, construction, modification, maintenance, and experiment equipment fabrication, and will include, to the applicable extent the following:

a. Inspection procedures, specifying the characteristics to be inspected, sampling plans, and acceptance criteria.

b. Description of process monitoring action for those situations in which inspection is impossible or disadvantageous.

c. Specification of mandatory inspection hold points.

d. Procedures for identifying inspection and test status, so that only items that have passed the required inspections and tests are used, installed, or operated. Nonconforming items will be clearly identified.

e. Procedures for required in-service inspection of completed systems, structures, and components.

9. TESTS

The test program will cover required tests, including prototype qualification tests, proof tests prior to installation, and functional tests.

Test procedures will specify appropriate prerequisite and monitoring requirements, equipment to be used, personnel training requirements, suitable environmental conditions, and provisions for data acquisition and documentation as applicable.

9.1 Measuring and Test Equipment

Tools, gages, instruments, and other measuring and testing devices used in activities affecting the quality of safety-related items will be available, properly controlled, properly calibrated, and adjusted at the required intervals.

10. DOCUMENTATION

All activities affecting safety-related items will be formally identified and documented. Documentation will include the applicable procedures, reviews, and other measures to be applied.

10.1 Design Documentation

Facility drawings, procedures, and regulations will be completed and updated as an integral part of a facility modification. All or part of the drawings and documents described below may be required as determined at the design review.

10.1.1 Facility Drawing Index. New drawings will be added to the facility drawing index as required to complete a modification. The Reactor Manager will assign drawing numbers at the project review meeting.

10.1.2 System Description. A brief but complete description of the modification stating its purposes, function, operation, and maintenance requirements.

10.1.3 Block Diagram. A basic logic block diagram that indicates the major mechanical or instrumentation components.

10.1.4 Detailed System of Circuit Schematic Diagrams. Mechanical or instrumentation diagrams in sufficient detail to perform maintenance and repair.

10.1.5 Design Notebook. A notebook kept by the design engineer containing assumptions, design basis, data, observations and sketches.

10.2 Document Issue and Change

10.2.1 Ford Nuclear Reactor Modification Request. A modification request may be requested by any staff member for changes to the physical facility, procedures, or regulations. The requester is responsible for completing the modification description and safety implications to the extent that he is aware of them.

All changes to drawings, procedures, and regulations will be made via modification requests. The reviewed modification request number will serve as the authorization for new drawings and making changes to existing drawings. The Reactor Manager will complete sections 5 and 6 as items are completed.

10.2.2 Drawing Title Block. Each facility drawing will contain a title block with the following information: A title block will be added to existing drawings if required.

LTR	Date	Mod Req Number	Issue Description	Draftsman	Design Engineer	Reactor Manager

10.3 Quality Assurance Records

The Quality Assurance Program includes documentation of activities affecting quality of safety related items. Records will be retained for

FIGURE 2

FORD NUCLEAR REACTOR MODIFICATION REQUEST NO. [ ]

1. Modification Description:

2. Requested By: _____ Date: _____

3. Safety Analysis:

	Yes	No	
3.1			Probability of occurrence or consequences of an accident for equipment important to safety increased.
3.2			Possibility of an accident or malfunction of different type created.
3.3			Margin of safety in Technical Specifications decreased.

4. Design Engineer: _____

Quality Engineer: _____

5. Project Record Requirements:

		Required		Completed		Comments:
		Yes	No	Date	Initial	
5.1	Safety Analysis					10CFR50.29(C)
5.2	Design Review					
5.3	Drawing Revision					
5.4	New Drawings					
5.5	Manual Change					
5.6	Procedure Change					
5.7	SRC Approval					Tech Spec 6.4, 10CFR50.59(C)
5.8	Tech Spec Change					
5.9	License Change					
5.10	NRC Approval					10CFR50.59(C)
5.11	Procurement Review					
5.12	Material Control Review					
5.13	Process Control Review					
5.14	Inspections					
5.15	Tests					
5.16	Non-Conforming Materials					
5.17	Failure Records					

6. Completed: _____ Date: _____

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the life of the system, equipment, or experiment and will be identified and retrievable throughout their retention period.

The Supervisor of Reactor Operations will maintain a project file for each safety related item which includes:

a. Modification Request. Each review item completed and dated when completed. Final review approved by the Reactor Manager.

b. Safety Analysis

c. Design Review

d. Procurement Review

e. Material Control Review

f. Process Control Review

g. Inspections

h. Tests

i. Non-conforming Materials

j. Failure Records

11. AUDITS

An audit will be performed annually of each safety related project begun, in progress, or completed during the year.

ADMINISTRATIVE PROCEDURE NO. 16

FORD NUCLEAR REACTOR
The University of Michigan
Ann Arbor, Michigan

1. TITLE SPENT FUEL SHIPMENT

2. EQUIPMENT COVERED

Not Applicable

3. PURPOSE

The purpose of this procedure is to provide a consistent and safe method for shipping spent reactor fuel elements from the FNR.

4. BACKGROUND AND SAFETY ANALYSIS

Rev. 3/79

The FNR contracts with an owner of a fuel shipping cask to transport spent fuel elements back to the U. S. Government for reprocessing. Planning, coordination and care are extremely important when handling reactor fuel which contains a large inventory of fission products.

Criticality checks on the cask and cask neutron shielding material are not required. The minumum critical mass for fresh 140 gm U235 Ford Nuclear Reactor (FNR) fuel is 2554 gm U235 based on the initial critical core of September 19, 1957. The core was fully reflected, water moderated, and consisted of 18 standard elements and 4 control rod elements. The maximum number of partially expended FNR fuel elements that can be placed in the BMI-1 cask is 12.

PROCEDURE REVIEW

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Reactor Manager	Date	Revised Sections

6. DEFINITIONS

Not Applicable.

7. REFERENCES

Rev 11/78 7.1 University of Michigan Quality Assurance Procedure.

Rev 11/78 7.2 Cask owner Quality Assurance Procedure.

8. EQUIPMENT REQUIRED

8.1 Shipping cask.

8.2 Building crane.

9. RESPONSIBILITIES

9.1 The Reactor Manager will assign personnel to implement this procedure.

10. PROCEDURE

10.1 Preliminary

10.1.1 Internal Processing

10.1.1.1 Issue University of Michigan purchase order for spent fuel shipment.

10.1.1.2 Verify cask owner's ability to fulfill contract commitments.

10.1.1.3 Set tentative date for shipment.

10.1.1.4 Schedule crane for loading and unloading cask. (Normally needed: 0800 - 1200 first day; 0800 - 1200 second day.)

10.1.2 Federal Regulations Compliance

Rev 11/78 10.1.2.1 Verify that University of Michigan is an Authorized Shipper of the cask being used.

Rev 11/78 10.1.2.2 Verify that proper Quality Assurance documentation for the cask is in effect from the supplier.

10.1.3 Send Necessary Shipment Data to Savannah River Operations, Aiken, South Carolina

10.1.3.1 Proposed shipping date.

10.1.3.2 Reference proper material description. Normally Appendix A, Modification 3.

10.1.3.3 Spent fuel element data sheet.

10.1.3.4 Indicate that shipment contains no stainless steel and whether or not fuel element nose cones are cut off.

10.1.3.5 All elements must have a minimum 90 days cooling time.

10.2 Procedure

10.2.1 Smear truck and cask. (Health Physicist) (Record)

10.2.2 Remove elevator top with crane.

10.2.3 Unbolt cask tiedowns.

10.2.4 Remove cask from truck to elevator with crane.

10.2.5 Lower cask with elevator (following with crane).

10.2.6 Roll cask into Reactor Building using fork truck and men.

10.2.7 Remove bolts from cask lid and remove lid. Health Physicist must be present.

10.2.8 Smear cask internals including lid and determine whether or not cask may be put into reactor pool.

10.2.9 Determine that proper basket is in cask.

10.2.10 Attach lifting yoke to cask and raise cask to pool floor. Position cask directly above the reactor south pool.

10.2.11 Wet down cask with demineralized water using hose provided.

10.2.12 Lower cask to bottom of pool. Carefully watch all clearances while lowering cask.

10.2.13 Remove lifting yoke from cask and store on pool floor.

10.2.14 Load fuel elements to be shipped into cask.

10.2.14.1 Verify each element serial number before loading.

10.2.14.2 Load elements into baskets keeping each element aligned with adjacent elements.

10.2.14.3 Document the location of each element as it is loaded.

10.2.15 Use building crane to install cask lid on the cask.

10.2.16 Use building crane to install lifting yoke on cask.

10.2.17 Carefully align crane for vertical lift and then lift cask.

10.2.18 As cask clears the pool surface wash it down thoroughly with demineralized water.

10.2.19 Health Physics must monitor radiation level of fuel cask.

10.2.20 As cask is being lifted out of pool, install all lid nuts finger tight.

DO NOT HOLD CASK ABOVE SOUTH POOL ANY LONGER THAN NECESSARY.

10.2.21 Lower cask to beam hole floor and set it on blotter paper.

10.2.22 Smear cask.

10.2.23 Drain cask into thermal column door trench. Collect a water sample from the cask for counting.

10.2.24 Tighten all cask lid nuts and install FNR seals.

10.2.25 Verify cask is not contaminated.

10.2.26 Move cask from the reactor building onto waiting truck.

11. REPORTS

11.1 Record and Report Form For a Shipment of Solid Irradiated Nuclear Fuels must be completed.

11.2 NRC #741 form must be completed and distributed.

SPENT FUEL SHIPMENT DATA SHEET

1. Preliminary contamination survey

   A. Cask _____ by _____
   B. Truck bed _____ by _____

2. Cask internal smear

   A. Underside lid _____ by _____
   B. Cask cavity _____ by _____

MUST BE COMPLETED AND SATISFACTORY BEFORE CASK CAN BE LOWERED INTO POOL

3. Proper basket in cask _____ by _____

4. Cask wet down _____ by _____

5. Fuel Elements loaded

Position	Fuel #	Position	Fuel #
1	_____	7	_____
2	_____	8	_____
3	_____	9	_____
4	_____	10	_____
5	_____	11	_____
6	_____	12	_____

by _____

6. Cask lid in place _____ by _____

MUST BE COMPLETED BEFORE RAISING CASK FROM BOTTOM OF POOL

7. Cask wash down _____ by _____

8. All cask lid nuts installed _____ by _____

MUST BE COMPLETED BEFORE LOWERING CASK TO BEAM PORT FLOOR

9. Final Cask contamination survey

   A. Lid _____ by _____
   B. Cask body _____ by _____
   C. Cask platform _____ by _____
   D. Floor area _____ by _____

10. Radiation level

   A. Cask sides _____ by _____
   B. Cask top _____ by _____

Data Sheet Complete _____ by _____ date _____
Reviewed _____ by _____ date _____

NRC #741 form completed _____ by _____