THE OHIO STATE UNIVERSITY

Engineering Experiment Station

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October 7, 1987

Dr. Thomas E. Murley, Director
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington DC 20555

Dear Dr. Murley:

This letter accompanies submission of a revised Safety Analysis Report and Technical Specifications for The Ohio State University Research Reactor, License No. R-75, Docket No. 50-150. This facility is currently undergoing conversion to low-enriched uranium (LEU) fuel, in accordance with recently passed NRC regulations, and a change in operating power. This work is funded in part by Department of Energy Grant No. DE-FG02-85ER75201. The documents being submitted cover both fuel and power change.

We have been advised by our project manager, Mr. Ted Michaels, that the fuel conversion will likely be addressed by an NRC-issued directive to perform the fuel conversion, while the power change would be handled through license amendments. We would request that the order covering fuel conversion contain provisions to allow simultaneous possession of both low and high-enrichment uranium (HEU) fuel on a temporary basis. The HEU fuel elements would be stored in a designated, secure area of the facility while the LEU core is loaded and tested. We would commit to shipment of the HEU fuel elements upon successful completion of the LEU core loading and startup tests.

Please send any official communications concerning the status of this submission to my attention at this office, with copies to Dr. Don Miller, Director of the Nuclear Reactor Laboratory, Mr. Joseph Talnagi, Senior Research Associate, and Mr. Richard Myser, Associate Director of the Nuclear Reactor Laboratory. The address of the Nuclear Reactor Laboratory is 1298 Kinnear Road, Columbus, OH 43212 (phone 614/292-6755). Questions on the technical content of the Safety Analysis Report should be directed to Mr. Talnagi.

Thank you for your attention to this matter.

Sincerely,

Robert F. Redmond

Robert F. Redmond
Director, EES

RFR/sh
enclosure
c: T. Michaels, NRC
D. Miller
J. Talnagi
R. Myser

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Preface

to the

Safety Analysis Report

and

Technical Specifications

for

The Ohio State University Research Reactor

License No. R-75

Docket No. 50-150

September, 1987

1.0 Introduction

1.1 Purpose

The Safety Analysis Report (SAR) for The Ohio State University Research Reactor (OSURR), completed in September of 1987, contains a significant amount of information related to the operation and safety of the facility when operated with low-enrichment uranium (LEU) fuel at a steady-state thermal power level of 500 kilowatts. This mode of operation represents a change from the initial operating characteristics of 10 kilowatts steady-state thermal power utilizing high-enrichment uranium (HEU) fuel. The purpose of this Preface document is to cite those sections related specifically to the change from HEU to LEU fuel, those portions related only to the change in operating power, those parts related to both changes, and those sections related to neither the power nor fuel change, but simply reflect non-safety-related changes to the facility or the original safety analysis (e.g., updates to the reactor instrumentation, more current information on the facility site, etc.).

1.2 Background and Licensing Approach

In the early stages of the program undertaken at the OSURR facility to convert the fuel of the reactor and change its operating power, it was clear that the SAR for the facility would have to be significantly enhanced to reflect those changes. The decision to produce a single, unified set of updated Technical Specifications and a Safety Analysis Report covering all aspects of the proposed facility modifications was based on the following considerations:

1. A single report would allow analysis of the OSURR in a single step, and allow the documents discussing these changes to be written only once,

2. If only the fuel conversion were discussed, many of the analyses would have to be duplicated for the operating power change. For example, the fuel conversion planned for the OSURR involves a change in the fuel geometry from that presently used. Such a change requires a thermal hydraulic analysis of the core. For the analytical phase, it is more logical to do this analysis once at a higher power, than to duplicate the analysis for both low and higher power operation.

3. From a licensing viewpoint, it seems logical that if the SAR can demonstrate safe operation of the OSURR at 500 kilowatts steady-state thermal power, the Commission would have the option of addressing the fuel conversion and power change in separate licensing actions. For example, it would be possible to address the fuel change through a Commission order, while handling the power change request through the usual license amendment process.

Thus, the submission of unified documents covering both aspects of the OSURR conversion allows the Commission flexibility in addressing these proposed changes. An initial order could be issued to address the fuel conversion, while other changes could be addressed in subsequent Commission actions through the license amendment process. Such an approach has advantages for both the Commission and the licensee.

1.3 Document Organization

The following sections of this document will review the SAR on a chapter-by-chapter basis. Within each section, a brief overview of each chapter will be presented, and those sections relevant to the fuel conversion, power change, both conversion and power change, and neither conversion nor power change will be cited. Where elaboration is necessary on the classification of the citations, it is given as a supplement to the citation.

2.0 SAR Review and Classification

2.1 SAR Chapter 1

2.1.1 Chapter 1 Overview

Chapter 1 is a largely narrative section which introduces the SAR and gives general information about the OSURR facility. There are some portions of this chapter which discuss, in limited detail, both the reactor fuel and operating power. This section is noted below. Other information is general and relates to neither the fuel conversion nor power change.

2.1.2 Fuel Conversion and Power Change

The following sections are relevant:

1.2: General Facility Description

2.1.3 Neither Fuel Conversion Nor Power Change

All other sections of Chapter 1.

2.2 SAR Chapter 2

2.2.1 Chapter 2 Overview

Chapter 2 of the SAR contains a general discussion of the facility site and characterizes the important features of the area. The entire chapter is not specifically directed to either the fuel conversion of power change, but does provide updated information on the topics discussed. Thus, this entire chapter need not be reviewed for either aspect of the overall facility modifications.

2.3 SAR Chapter 3

2.3.1 Chapter 3 Overview

This chapter presents a detailed discussion of the reactor system and related facilities. Some sections of this chapter describe the systems associated with or affected by the fuel conversion and power change. These sections are noted below.

2.3.2 Fuel Conversion Only

Section 3.1.1.2 (Fuel Description)
Section 3.1.1.3 (Core Arrangements)

2.3.3 Power Change Only

Section 3.1.4.5 (Temperature Sensors and Locations)
Section 3.1.4.6 (Water Level Sensors and Locations)
Section 3.2.1 (General Features of the Cooling System)
Section 3.2.2 (Cooling System Description)
Section 3.4 (Cooling System Controls)
Section 3.6.3 (Scram Functions and Setpoints)
Section 3.7.2 (ARM Detectors and Locations)

2.3.4 Neither Fuel Conversion Nor Power Change

All other sections of Chapter 3.

2.4 SAR Chapter 4

2.4.1 Chapter 4 Overview

The operating characteristics of the OSURR under normal conditions are analyzed in Chapter 4. The entire chapter deals with aspects of the fuel conversion and/or power change.

Aside from the power change, the fuel conversion for the OSURR would require a thermal hydraulic analysis of the core. This is required since the geometry of the LEU fuel assemblies differs from that of the HEU fuel elements. The LEU fuel assemblies contain more fuel plates than do the HEU assemblies, but the fuel plates are thinner. The overall length of the plates does not change, nor does the "outline" of the fuel "meat" within each plates. However, because there are more (but thinner) plates in each fuel element, and because the outside dimensions of the HEU and LEU fuel elements are identical, the gap between each fuel plate, through which the cooling (and moderator) water flows, is thinner than those for the HEU elements.

The fuel element geometry change also requires analysis of core neutronics. A neutronics analysis is also necessitated by the higher loading of the LEU fuel plates, and the use of "dummy" aluminum plates in each fuel element (which helps keep core size reasonable).

The need for a complete analysis of core neutronics and thermal hydraulics goes considerably beyond the scope of the somewhat simple analysis of these topics given in the original SAR for the OSURR

operated at 10 kilowatts with HEU fuel. Thus, Chapter 4 presents information required by both the fuel conversion and power change.

2.4.2 Fuel Change Only

Section 4.1 (Core Loading and Critical Mass)
Section 4.4.1 (Control Rod System)
Section 4.4.3 (Control Rod Worths)
Section 4.5 (Temperature and Void Coefficients of Reactivity)
Section 4.6 (Neutronics)
Section 4.7 (Effects of Core Geometry)

2.4.3 Power Change Only

Section 4.4.2 (Cooling System Control)

2.4.4 Both Fuel Conversion and Power Change

Section 4.2 (Reactivity Requirements)
Section 4.3 (Neutron and Gamma Environments)
Section 4.8 (Heat Transfer Characteristics)
Section 4.9 (Fluid Dynamics)

2.5 SAR Chapter 5

2.5.1 Chapter 5 Overview

Chapter 5 is a short descriptive chapter describing the auxiliary systems of the OSURR facility. As such, the contents of Chapter 5 as not specifically related to either the fuel conversion or power change.

2.6 SAR Chapter 6

2.6.1 Chapter 6 Overview

This chapter discusses the radioactive waste production and management at the OSURR facility. All calculations in Chapter 6 have been done assuming a 500 kilowatts power level. In this sense, all of Chapter 6 can be considered as related only to the power change. If the OSURR is operated at its present 10 kilowatt power level, the production of radioactive effluents would be greatly reduced and would likely be negligible. The results shown in this chapter could probably be reduced by a factor of 50 and yield a reasonable approximation to the effluent production at 10 kilowatts.

Other sections of Chapter 6 deal with more general topics. For example, sections 6.4 through 6.6 are of a general enough nature to apply to OSURR operation at either 10 or 500 kilowatts.

There is no part of Chapter 6 which deals with aspects related only to fuel conversion.

2.7 SAR Chapter 7

2.7.1 Chapter 7 Overview

This chapter is similar to the preceding chapter in that calculations have been done assuming a 500 kilowatt power level. Again, the results of this analysis could probably be reduced linearly with operating power and give reasonable results for lower power operation. Thus, the entire chapter could be considered related only to the change in reactor power, and not to the conversion of the reactor fuel.

Several sections of Chapter 7 are of a general nature and would apply to either low of higher-powered operation. These include sections 7.2 and 7.3. Again, there is no part of Chapter 7 that relates only to fuel conversion.

2.8 SAR Chapter 8

2.8.1 Chapter 8 Overview

Chapter 8 presents the safety analysis for the OSURR under abnormal conditions. The analysis presented is considerably more detailed than that presented in the original SAR for the OSURR.

The analyses presented in Chapter 8 require certain input parameters. Some of these input data are the result of the fuel conversion (e.g., control rod worths, step reactivity input, etc.), and some result from the power change (e.g., operating power at the time of reactivity insertion). Thus, this chapter contains information related to fuel conversion and power change. The specific sections are noted below.

2.8.2 Fuel Conversion Only

Section 8.4.3.1 (Reactivity Insertion Mechanisms)
Section 8.4.3.2 (Design Basis Accident)

2.8.3 Power Change Only

Section 8.4.4 (Damaged Fuel Plate)

2.8.4 Both Fuel Conversion and Power Change

Section 8.2 (Scenario Construction)
Section 8.3 (Analytical Methods and Tools)
Section 8.4.1 (Loss of Heat Sink)
Section 8.4.3 (Reactivity Insertion)

2.8.5 Neither Fuel Conversion Nor Power Change

Section 8.5 (Natural Phenomena)
Section 8.6 (Man-Made Phenomena)

2.9 SAR Chapter 9

2.9.1 Chapter 9 Overview

This is a largely descriptive chapter dealing with facility administration and administrative controls. There are no sections of this chapter specifically dealing with either fuel conversion or power change as issues in themselves. The discussion includes updated information on facility management and quality control.

2.10 SAR Appendix A

2.10.1 Appendix A Overview

The Technical Specifications for the OSURR are contained in Appendix A of the Safety Analysis Report. This document differs somewhat from the main body of the SAR. Revision of the Technical Specifications required consideration of facility changes resulting from the fuel conversion and power change, and also formatting of the Technical Specifications according to guidelines set forth in the standard document denoted ANSI/ANS 15.1-1982. Also, revisions in the Technical Specifications contain changes resulting from updating of non-safety related information in the original Technical Specifications, which may or may not have been required by the guidelines of ANSI/ANS 15.1-1982.

Because of the varied nature of the content of the Technical Specifications and the revisions to them, the document containing the revised specifications was written and reviewed separately from the main sections of the SAR, and later incorporated into the SAR as Appendix A. On the following pages, the revisions to the Technical Specifications are cited and discussed.

Below is an outline followed by a brief description of the various sections of the Technical Specifications. Each number refers to a specific section of the Technical Specifications. The letter beside each number is an explanation as to how or why the specifications were changed.

A. The change relates to the required fuel change only.

B. The change relates to the requested power level change only.

C. The change relates to both fuel change and power level change.

D. The change relates to neither the fuel change nor the power level change. Often it is simply an addition or a change to the old Technical Specifications, perhaps required by ANSI/ANS 15.1-1982.

E. The change is simply an original Technical Specification in the format of ANSI/ANS 15.1-1982.

Technical Specifications

1.1	(D)	3.3.2	(E)		(3) (D)	5.4	(E)
1.2	(D)						
1.3	(D)	3.3.3	(D)	4.2.2	(D)	6.0	(D)
2.1	(C)	3.3.4	(D)	4.3.1	(D)		
2.2	(C)	3.3.5	(B)	4.3.2	(B)		
3.1.1	(C)	3.4	(D)	4.4	(D)		
3.2.1	(E)	3.5	(E)	4.5	(D)		
3.2.2	(E)	3.6.1	(1) (D)	4.6.1	(D)		
			(2) (B)				
3.2.3.1	(B)		(3) (E)	4.6.2	(D)		
3.2.3.2	(B)		(4) (E)				
3.2.3.3	(E)		(5) (D)	4.6.3	(D)		
3.2.3.4	(B)						
3.2.3.5	(B)	3.6.2	(1) (D)	4.6.4	(D)		
3.2.3.6	(D)		(2) (D)				
3.2.3.7	(E)			5.1.1	(E)		
3.2.3.8	(D)	3.7.1	(E)				
3.2.3.9	(E)	3.7.2	(E)	5.1.2	(E)		
3.2.3.10	(D)						
3.2.3.11	(E)	4.1.1	(1) (E)	5.2.1	(B)		
3.2.3.12	(E)	4.1.1	(2) (D)				
3.2.3.13	(D)			5.2.2	(B)		
		4.2.1	(1) (D)				
3.3.1	(B)		(2) (D)	5.3	(A)		

Section 1.0 is basically an addition to the original Technical Specifications for the OSURR. For example, there were no definitions in our original specifications. Now, as required by ANSI/ANS 15.1, we can refer to numerous definitions when interpreting our specifications. This first section also serves as the introduction to the document.

Section 2.0 establishes both the safety limit and safety system settings to assure the safety limit is not exceeded. This is information not found in the original specifications but required by ANSI/ANS 15.1. This does, however, relate to both the fuel change and the power increase. Regardless of the type of fuel, we would have the same safety limit. Due to the power increase our safety system settings are established at higher levels.

There are various reasons for the Limiting Conditions for Operation in Section 3.0.

Due to the power increase and lower enriched fuel we will require a higher excess reactivity (3.1.1).

Rod drop requirements are the same as the original technical specifications (3.2.1) as are the reactivity insertion rates (3.2.2).

Most (9) of the specifications relating to scram channels (3.2.3) are original specifications put in the proper format or new specifications. The others, 3.2.3.1, 3.2.3.2, 3.2.3.4, and 3.2.3.5, are basically required because of the power increase. 3.2.3.1 and 3.2.3.2 would have been included even if power was not increased but the levels would have been different.

Since the coolant pumps would not be needed unless we were requesting a power increase, specification 3.3.1 is needed only because of this.

Although power is to be increased, the same minimum quantity of water (coolant and shielding) is required over and around the core. Therefore specification 3.3.2 is simply a format change.

Specification 3.3.3 deals with pool water conductivity. This value was changed from the original specifications.

The specification to detect the loss of primary coolant (3.3.4) is an addition to the original technical specifications.

3.3.5 relates directly to the power increase since there would be no secondary coolant unless the power were being upgraded.

In the original specifications, only the ventilation fan was required to be operable. In order to assure isolation capability, specification 3.4 was written which added the operability of doors and windows.

3.5 is an old specification in the new format. The fan capacity is additional information.

3.6.1 (1) is a change to allow operation of the effluent monitor in two modes. It does not relate to either power or fuel change.

3.6.1 (2) is an addition of a rabbit effluent monitor due to the power increase.

3.6.1 (3) is basically a reformat of the original specification. We will also monitor a location near the primary cooling system when operating.

3.6.1 (4) is a reformat of the original specification.

3.6.1 (5) is a change patterned after ANSI/ANS 15.1.

Specifications for liquid and gaseous radioactivity releases, 3.6.2.(1) and 3.6.2.(2) are additions based on ANSI/ANS 15.1.

Reactivity limits for experiments are the same as in the original specifications. 3.7.1 and 3.7.2 are, therefore, format changes only.

Sections 4.1.1 (1) and (2) are format changes and additions to the original specifications, respectively.

Specifications for the control rods, 4.2.1 (1, 2, 3) are changes and additions to the original specifications.

Section 4.2.2 includes additions and changes to the original specifications. Only 4.2.2 (5) a, c, and d relate to the power change.

4.3.1 is also an addition to the current specifications since the frequency of this surveillance is now specified.

4.3.2 is basically related to the power change although part of it is also a change in the original specifications.

The ANSI/ANS technical specification guide requires the surveillance found in Sections 4.4 and 4.5 as they relate to containment and ventilation.

Changes and additions to surveillance requirements in Section 4.6, Radiation Monitoring Systems and Radioactive Effluents, were based on ANSI/ANS 15.1. They needed updating whether or not fuel or power were changed.

Sections 5.1 and 5.4 contain information in the original specifications placed in the new format.

5.2, Reactor Coolant Systems, is included because of the power increase request and 5.3, Reactor Core and Fuel, is included because of the fuel change.

Section 6.0, Administrative Controls is also required to be included in the Technical Specifications by ANSI/ANS 15.1. Some of this information was in the original Hazards Summary Report for the OSURR.