A.11 FUEL TO BE STORED -- ADMINISTRATIVE AND TECHNICAL CONTROLS

A.11.1 INTRODUCTION

Administrative control of the k_∞ limits for fuel to be stored at the Morris facility depends primarily on correctly identifying the fuel bundles by number and on assuring that the pre-irradiation k_∞, cold, is less than the limits set by design criterion b[1]. The value for k_∞ is determined principally by the initial U-235 enrichment and to a much smaller degree by the pellet diameter (±0.25%) and the water/fuel volume ratio (±1.3%).

Figures A.11-1 and A.11-2 are used to evaluate the k_∞ value. They were prepared from data provided by Battelle Pacific Northwest Laboratories (BPNL). The form of these charts was designed to avoid the necessity for interpolation and to minimize potential for error in use of the data. When using these charts, the correction factors for variation in water-to-fuel ratio are slightly more conservative (approximately 0.12%) at the higher water-to-fuel ratio than the average value that would be obtained from calculations.

In addition to fuel evaluated as described above, other LWR fuel may be accepted for storage after specific analysis of nuclear characteristics and regulatory approval. For example, fuel from the LaCrosse BWR has been approved for storage after evaluation for storage in the fuel storage system (Figure A.11-1), and for rod lattice k_∞ (Figure A.11-2). Special storage authorizations are included in Chapter 10.

A.11.2 GENERAL PRACTICES

Prior to any transfer of fuel from a reactor site to Morris Operation (GE-MO), a utility transmits sufficient data on the fuel to be stored to calculate the rod lattice k_∞. The validity of this transmitted data is certified by two qualified individuals from that utility, one being from that organization's quality assurance component. General Electric Company determines the acceptability of that fuel in accordance with Materials License No. SNM-2500 as amended.

A separate confirmation of the fuel identity and initial enrichment is provided by documents required by government regulations. Current NRC policy requires that all transfers of nuclear material be documented on a NRC-741 form, which is initiated by the shipper and completed by the receiver. Copies of the completed NRC-741 form are transmitted to the shipper and appropriate NRC branch within 10 days of receipt, thus verifying the transfer of the material. In order to provide a separate verification of the initial enrichment of each fuel bundle, copies of NRC-741 forms covering shipment of the fuel from the fabricator to the utility will be provided to GE by the utility concurrently with transmittal of the Data for Storage Compliance (Fig. A.11-3).

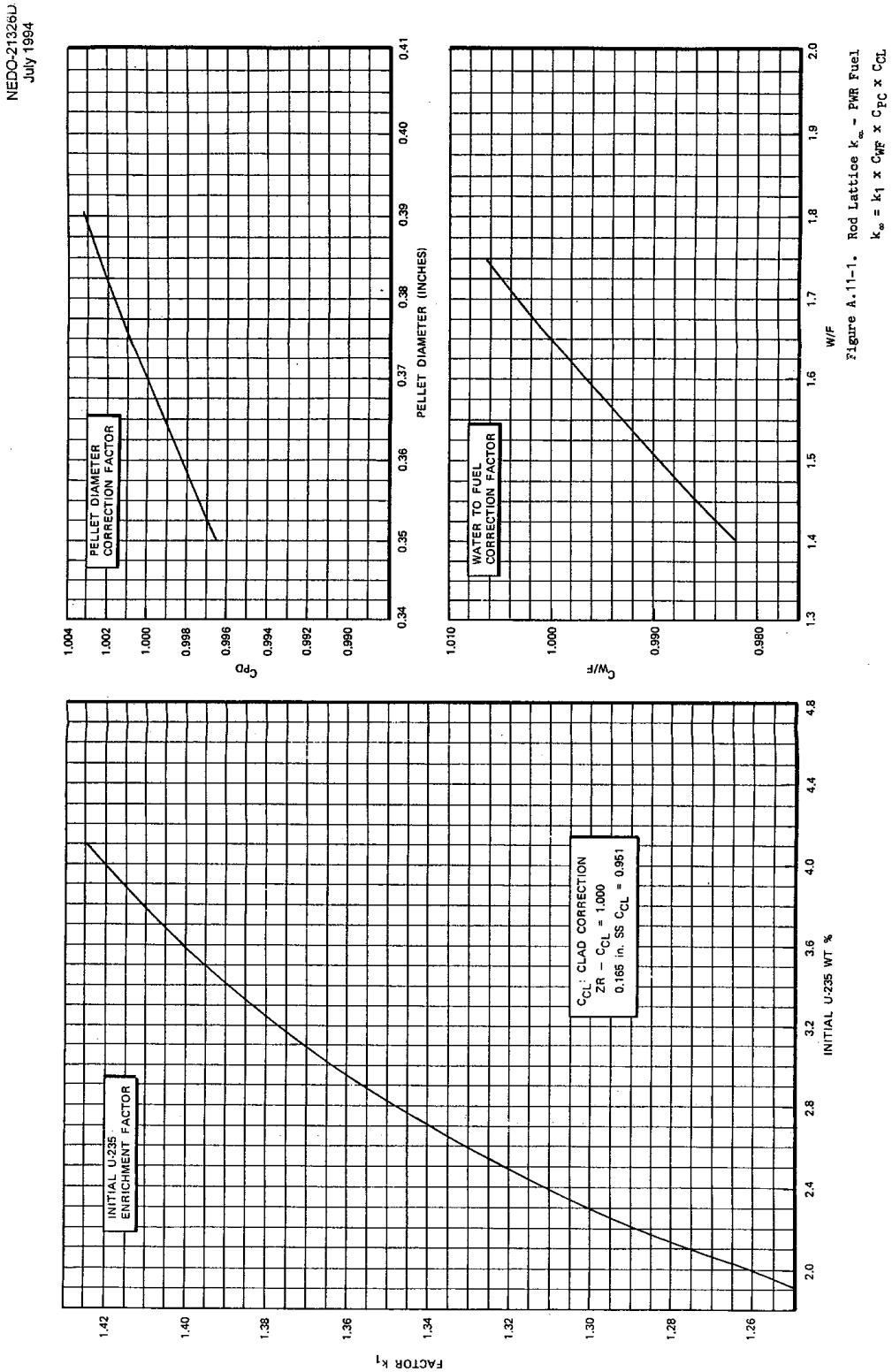

Figure A.11-1. Rod Lattice k_∞ - PWR Fuel
$k_\infty = k_1 \times C_{WF} \times C_{PC} \times C_{CL}$

Figure A.11-2

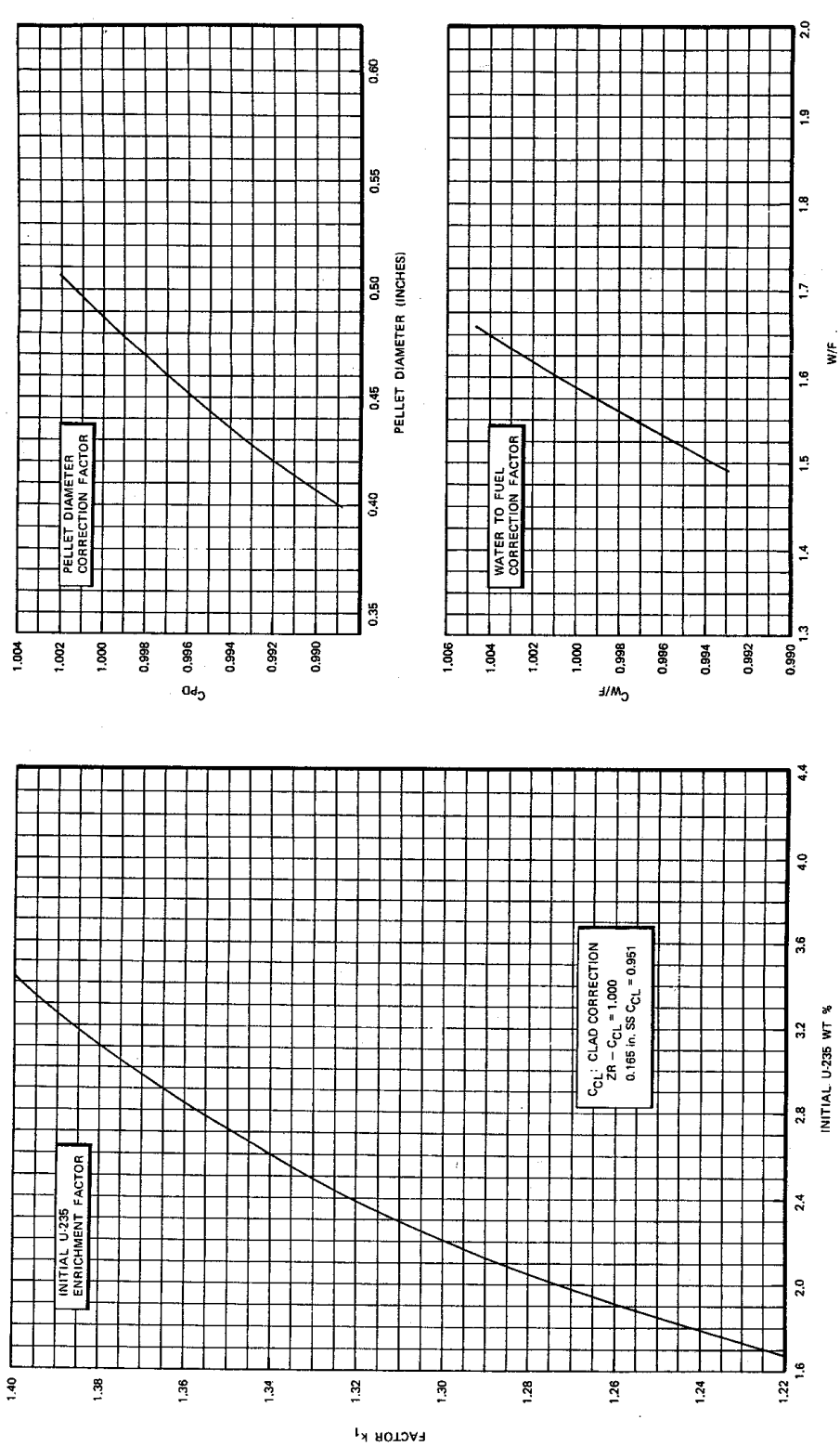

Figure A.11-2. Rod Lattice k_∞ - BWR Fuel
$k_\infty = k_1 \times C_{WF} \times C_{PC} \times C_{CL}$

Figure A.11-3

FIGURE A.11-3
DATA FOR FUEL STORAGE COMPLIANCE
MORRIS OPERATION

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Reactor: _____ Bundle Rod Array: _____ x _____
Batch Discharge #: _____ Bundle Dimension: _____ (in.)
Date of Discharge: _____ Cladding Material: _____
Nom. Cladding Thickness: _____ (in.)

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Bundle I.D. No.	Total U (kg)	Initial %U-235	Pellet O.D. (in.)	Rod O.D. (in.)	Rod Pitch (in.)	Average Burnup (GWD/MTU)	Final %U-235	Initial Cold, Clean k_{eff} (by Mfg.)	Final k_{eff} Cold, no Xe (if avail)

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Data Compiled by:
Signature: _____
Title: _____
Company: _____
Date: _____

Data Verified by QA:
Signature: _____
Title: _____
Company: _____
Date: _____

Prior to shipment, the Regulatory Compliance Manager (RCM), or designee, will determine the acceptability of each fuel bundle for storage. This determination will include, but not be limited to, the evaluation of k_∞, using Figures A.11-1 and A.11-2. The rod lattice k_∞ value determined

from this evaluation is compared with the bundle k_∞ value received from the contracting utility. The initial cold, clean k_∞ values determined from the evaluation must be less than or equal to the limit set by design criterion b[1] and in agreement with the k_∞ value from the shipper to within 2%. For BWR bundles, the calculated rod lattice k_∞ is compared to the bundle k_∞ from the shipper plus 0.052. For PWR bundles, the calculated rod lattice k_∞ is compared to the bundle k_∞ from the shipper since the rod lattice and bundle k_∞s are essentially the same.

Should General Electric's evaluation determine that the k_∞ of any fuel bundle differs from that value stated by the contracting utility by more than 2%, shipment of that fuel bundle shall be deferred until such time as the difference is resolved and its acceptability established in a manner equivalent to that outlined above. Upon determination that the fuel is acceptable, the General Electric Company will notify the contracting utility that the fuel bundle is acceptable and that it can be shipped.

At the time a fuel bundle is to be shipped to GE-MO, its identity is checked and verified against the approved list by two individuals of the contracting utility, and documented on the shipping release forms. A copy of this list is maintained in the permanent records at GE-MO.

Upon receipt at GE-MO, the Operations Engineer (OE), or designee, verifies that the bundle listed on the Shipping Report form is one of the approved bundles for receipt. This verification is documented and maintained in permanent files at GE-MO. The cask is then released to the cask receiving area.

During cask unloading operations, the identity of the fuel is determined and verified by the OE or designee. The fuel bundles are then transferred to their assigned locations in the fuel storage basin. The identity and locations of the bundles in the basin are documented in a computer data base.

The procedures described above provide sufficient control to ensure fulfillment of the double contingency policy. Each action or transaction is verified by two competent representatives of the organization primarily responsible for that act. The independent review and analysis by General Electric personnel provides further checks on the validity of the data transmitted by the contracting utility and the ultimate acceptability of each fuel bundle. The bundle identity is verified by a minimum of four individuals and documented on at least three forms. As the General Electric Company's evaluation of rod lattice k_∞ is most sensitive to initial enrichment of the fuel bundle, copies of the NRC-741 forms, initiated by the fabricator, will be provided by the contracting utility to assure that the initial enrichment value used as a base for k_∞ is correct.

A.11.3 BWR AND PWR FUEL QUANTITIES

To permit some flexibility in the relative amounts of BWR and PWR fuel to be stored at the Morris facility, the fuel baskets are designed to have a common base and hold-down mechanism. The fuel basket designs accommodate either nine BWR bundles in 8 in. stainless steel pipe or four PWR bundles in 12 in. stainless steel pipe.

Preliminary calculations by BPNL showed that 15 x 15 PWR fuel having k_∞ of 1.35 would give an array k_{eff} of approximately 0.90. A k_∞ limit of 1.35 was used as the basis for the basket detailed design to allow some margin for dimensional tolerances and for any uncertainty in the final design calculations. The completed analysis showed that for k_∞ of 1.35, k_{eff} at the 95% confidence level would be 0.917. At k_∞ of 1.4008, k_{eff} would be 0.952 at the 95% confidence level. Thus the entire basin could therefore be used to store 15 x 15 PWR fuel limited to a k_∞ of 1.37 in an "unrestricted manner."

The k_∞ limits set by design criterion b[1] provide reasonable assurance of meeting near-term utility needs without restrictions other than reactivity. Should a need arise for storage of a limited amount of slightly more reactive fuel, it could be accommodated safely by requiring the fuel have undergone sufficient burnup to assure that k_∞ is below the limit set by design criterion b[1].

A.11.4 CRITICALITY PREVENTION

Protection against accidental criticality in the fuel storage system is provided by:

a. Administrative controls limiting the enrichment and reactivity of the fuel as fabricated.

b. comparison of fuel identity upon receipt to shipping data to ensure that it meets specified limits on enrichment and reactivity.

c. fuel basket design which assures safe spacing between fuel bundles and between fuel baskets even in the unlikely event that fuel basket should be dropped; and

d. moving fuel between the fuel unloading basin and the storage basins only in fuel storage baskets and by handling individual fuel bundles one at a time.

Before a fuel shipment is scheduled for shipment to the GE-MO facility, the serial number and initial or maximum reactivity (cold k_∞) for each fuel bundle will be stated and certified by the utility. These values will be reviewed and compared to correlations provided by BPNL. (See Section 5.3.5.6.)

PWR fuel having a cold, clean k_∞ in excess of the limits established by design criterion b[1] is classified as non-specification fuel in the standard fuel storage contract, which is the basis for establishing the conditions for fuel storage at the Morris Operation. Presently, there is no PWR fuel contemplated for storage which would have a k_∞ in excess of the specified limits. For such non-specification fuel to be included under the contractual arrangement for storage, it will be necessary to establish that the post-irradiation value for k_∞ is confirmed to be less than the limiting value set by design criterion b. The evaluation of pre-irradiation k_∞ will be made based on the BPNL correlation of enrichment versus k_∞ adjusted as appropriate for pellet diameter and water-to-fuel ratio. The amount of irradiation required to assure that the post-irradiation k_∞ is less than the limit set by design criterion b[1] will be ascertained using the pre-irradiation k_∞ and BPNL correlations.

A.11.5 REFERENCES

1. Refer to A.10.1, a through e.