Enclosures 1 and 4 Contain Proprietary Information –
Withhold in Accordance with 10 CFR 2.390

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Attn: Document Control Desk
U. S. Nuclear Regulatory Commission
Washington, DC 20555-0001

10 CFR 50.90

SUSQUEHANNA STEAM ELECTRIC STATION SUBMITTAL OF UNIT 2 CYCLE 21 RELOAD LICENSING DOCUMENTS TO SUPPORT LICENSE AMENDMENT REQUESTING APPLICATION OF ADVANCED FRAMATOME METHODOLOGIES
PLA-7861

Docket No. 50-387 and 50-388

Reference: 1) Susquehanna letter to NRC, "Proposed Amendment to Licenses NPF-14 and NPF-22: Application of Advanced Framatome Methodologies and TSTF-535 (PLA-7783)," dated July 15, 2019 (ADAMS Accession No. ML19196A270).

Pursuant to 10 CFR 50.90, Susquehanna Nuclear, LLC (Susquehanna), submitted, in Reference 1, a request for an amendment to the Technical Specifications (TS) for the Susquehanna Steam Electric Station (SSES), Units 1 and 2, Facility Operating License numbers NPF-14 and NPF-22. The proposed amendment would revise TS 5.6.5.b to allow application of Advanced Framatome Methodologies for determining core operating limits in support of loading Framatome fuel type ATRIUM 11, revise the low pressure safety limit in TS 2.1.1.1 and TS 2.1.1.2, and remove the neutronic methods penalties on Oscillation Power Range Monitor amplitude setpoint and the pin power distribution uncertainty and bundle power correlation coefficient.

In Enclosure 7 to Reference 1, Susquehanna committed to provide certain re-load licensing documents related to Unit 2, Cycle 21 (i.e., the first cycle expected to be loaded with ATRIUM 11 fuel), within 15 days of their approval. This letter provides the first two reports: Enclosure 1 provides the Unit 2, Cycle 21 Nuclear Fuel Design Report; and Enclosure 4 provides the Unit 2, Cycle 21 Fuel Cycle Design Report. Both reports are submitted for information only to aid in the NRC's review of the license amendment requested in Reference 1.

Information provided in Enclosures 1 and 4 is considered proprietary to Framatome. The proprietary information has been denoted therein by brackets. As owners of the proprietary information, Framatome has executed affidavits for the documents which identify the information as proprietary, is customarily held in confidence, and should be withheld from public disclosure in accordance with 10 CFR 2.390. Enclosures 2 and 5 provide non-proprietary versions of Enclosures 1 and 4, respectively. The Framatome affidavits are included as Enclosures 3 and 6.

There are no new or revised regulatory commitments contained in this submittal. This submittal satisfies Regulatory Commitments 7783-1 and 7783-2, as documented in Enclosure 7 to Reference 1.

Should you have any questions regarding this submittal, please contact Ms. Melisa Krick, Manager – Nuclear Regulatory Affairs, at (570) 542-1818.

I declare under penalty of perjury that the foregoing is true and correct.

Executed on: 4/9/20

K. Cimorelli

Enclosures:

1. Framatome Topical Report ANP-3825P, "Susquehanna Unit 2 Cycle 21 ATRIUM 11 Fuel Nuclear Fuel Design Report" **[Proprietary Information – Withhold from Public Disclosure in accordance with 10 CFR 2.390]**
2. Framatome Topical Report ANP-3825NP, "Susquehanna Unit 2 Cycle 21 ATRIUM 11 Fuel Nuclear Fuel Design Report" (Non-Proprietary Version)
3. Framatome Affidavit for ANP-3825P, "Susquehanna Unit 2 Cycle 21 ATRIUM 11 Fuel Nuclear Fuel Design Report"
4. Framatome Topical Report ANP-3826P, "Susquehanna Unit 2 Cycle 21 Fuel Cycle Design Report" **[Proprietary Information – Withhold from Public Disclosure in accordance with 10 CFR 2.390]**
5. Framatome Topical Report ANP-3826NP, "Susquehanna Unit 2 Cycle 21 Fuel Cycle

Design Report" (Non-Proprietary Version)

6. Framatome Affidavit for ANP-3826P, "Susquehanna Unit 2 Cycle 21 Fuel Cycle Design Report"

Copy: NRC Region I
Ms. L. Micewski, NRC Sr. Resident Inspector
Ms. S. Goetz, NRC Project Manager
Mr. M. Shields, PA DEP/BRP (w/out Enclosures 1 and 4)

Enclosure 2 of PLA-7861

Framatome Topical Report
ANP-3825NP

Susquehanna Unit 2 Cycle 21 ATRIUM 11 Fuel
Nuclear Fuel Design Report

(Non-Proprietary Version)

framatome

Susquehanna Unit 2 Cycle 21 ATRIUM 11 Fuel Nuclear Fuel Design Report

ANP-3825NP
Revision 0

March 2020

Nature of Changes

Item	Section(s) or Page(s)	Description and Justification
1	All	Initial Issue

Contents

List of Tables

List of Figures

Nomenclature

Acronym	Definition
BOL	beginning of life
BWR	boiling water reactor
EVC	plenum region in a fuel pin modeled as an evacuated section
GWd/MTU	gigawatt days per metric ton of initial uranium
kg/MTU	kilograms per metric ton of initial uranium
LHGR	linear heat generation rate
LPF	local peaking factor
MCPR	minimum critical power ratio
MWd/MTU	megawatt days per metric ton of initial uranium
NRC	(United States) Nuclear Regulatory Commission

1.0 INTRODUCTION

This report provides results of the neutronic design analyses performed by Framatome Inc. for the Susquehanna Unit 2 reload batch SUS2-21 ATRIUM 11 boiling water reactor (BWR) fuel assemblies scheduled to be loaded in Cycle 21.

Applicable neutronic design criteria are provided in the approved topical report ANF-89-98(P)(A) Revision 1 and Supplement 1 (Reference 1). Neutronic design analysis methodology used to determine conformance to design criteria has been reviewed and approved by the NRC in the topical report EMF-2158(P)(A) (Reference 2).

The fuel design includes Framatome Inc. **[**

] . Mechanical design criteria applicable to the design of these channels have been reviewed and approved by the NRC.

The neutronic design for the fabrication batch includes axially-varying enrichment and gadolinia designs with natural UO_2 blankets at the top and bottom of the assembly. The fabrication batch consists of the following fuel assemblies:

- **[ ]**
- **[ ]**
- **[ ]**

Pertinent fuel and reactor core design information associated with this fabrication batch is given in Section 2.0 and in Appendices A through D.

2.0 NEUTRONIC DESIGN

The results of the Susquehanna Unit 2 fabrication batch SUS2-21 ATRIUM 11 neutronic design analyses are presented in this section. The fuel was designed to meet applicable design criteria, as well as reactivity and control requirements. Reactor core loading patterns and the number of assemblies to be loaded will depend upon final cycle energy requirements as specified by the utility. Applicable neutronic design criteria outlined in Reference 1 are summarized below:

- **Power Distribution.** The local power distribution in the fuel assembly combined with the core power distribution shall result in Linear Heat Generation Rate (LHGR) and Minimum Critical Power Ratio (MCPR) values that are within the limits established for each fuel design.
- **Kinetics Parameters.** The moderator void reactivity coefficient due to boiling in the active channels and the Doppler fuel temperature reactivity coefficient shall be negative. The negative void and Doppler reactivity coefficients ensure a negative power coefficient during reactor operation. Additional calculations were performed to show that the assembly average Doppler and void reactivity coefficients remain negative for the life of the assembly. These results demonstrate that the Reference 1 kinetics criteria are met on a bundle average basis.
- **Control Blade Reactivity.** The design of the fuel assembly and the reactor core loading shall be such that the technical specification shutdown margin requirement is met for all reactor conditions.

2.1 *Neutronic Design Description*

The neutronic design parameters for fabrication batch SUS2-21 are presented in Table 2.1.

The key ATRIUM 11 reload assembly nuclear design characteristics are summarized below:

- The fuel assembly contains **[** **]**
- Each fuel assembly has top and bottom natural uranium blankets.
- The enrichments are designed to yield a local power distribution which results in a balanced design relative to MCPR, LHGR, and other reactor operating requirements, e.g., power peaking.
- Gadolinia (Gd_2O_3 blended with UO_2) rods are designed to control assembly reactivity in order to meet reactivity control requirements in the reactor, e.g. cold shutdown margin.
- The reload batch **[** **]** designs which vary axially in enrichment and/or gadolinia. The axial distributions of the lattices in the assemblies are shown in

Figures 2.1, 2.2, and 2.3. The fuel rod distribution and axial descriptions are presented in Figures 2.4 through 2.8. The enrichment and gadolinia distribution maps for each of the reload assembly lattices are displayed in Appendix D.

- The fuel assembly incorporates the Framatome Inc. advanced fuel channel which improves uranium utilization.

2.2 *Lattice Control Blade Worths and Kinetics Parameters*

Beginning of life (BOL) lattice reactivities (k_∞) have been calculated for moderator and fuel conditions ranging from cold to hot operating conditions. From these reactivities, BOL control blade worths and kinetics parameters have been determined based on GE Duralife 160, GE Marathon, GE Original Equipment, and Westinghouse 99 control blades.

Kinetics parameters are calculated for fuel temperature (Doppler), moderator void, and moderator temperature. **[**

] The results of these calculations are presented in Tables 2.2 through 2.127.

2.3 *Enriched Lattice Uncontrolled Reactivities and Isotopic Data*

The enriched lattice exposure-dependent uncontrolled reactivities **[** **]** are presented graphically in Appendix A, and in tabular format in Appendix B. The enriched lattice exposure-dependent isotopic data **[** **]** are presented in Appendix C.

2.4 *Criticality Compliance*

The Susquehanna Unit 2 fabrication batch SUS2-21 ATRIUM 11 fuel assemblies satisfy the fuel design critical safety limits established for new and spent fuel storage at the Susquehanna Unit 2 facility per References 3 and 4. Additionally, these reload assemblies conform to the nuclear criticality requirements as provided to the NRC for the Reference 5 shipping container.

Table 2.1 Neutronic Design Parameters

Table 2.1 Neutronic Design Parameters (Continued)

Table 2.1 Neutronic Design Parameters (Continued)

Table 2.1 Neutronic Design Parameters (Continued)

Table 2.1 Neutronic Design Parameters (Continued)

Table 2.1 Neutronic Design Parameters (Continued)

Table 2.2 Lattice [ ] Control Blade Worths at BOL for Control Blade Type GE Duralife 160

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Table 2.3 Lattice [ ] Control Blade Worths at BOL for Control Blade Type GE Marathon

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Table 2.4 Lattice [ ] Control Blade Worths at BOL for Control Blade Type GE Marathon Lower

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Table 2.5 Lattice [ ] Control Blade Worths at BOL for Control Blade Type GE Original Equipment

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Table 2.6 Lattice [ ] Control Blade Worths at BOL for Control Blade Type Westinghouse 99 Top

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Table 2.7 Lattice [ ] Control Blade Worths at BOL for Control Blade Type Westinghouse 99 Main

Table 2.8 Lattice [ ] Kinetics Parameters at BOL

Table 2.9 Lattice [ ] Control Blade Worths at BOL for Control Blade Type GE Duralife 160

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Table 2.10 Lattice [ ] Control Blade Worths at BOL for Control Blade Type GE Marathon

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Table 2.11 Lattice [ ] Control Blade Worths at BOL for Control Blade Type GE Marathon Lower

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Table 2.12 Lattice [ ] Control Blade Worths at BOL for Control Blade Type GE Original Equipment

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Table 2.13 Lattice [ ] Control Blade Worths at BOL for Control Blade Type Westinghouse 99 Top

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Table 2.14 Lattice [ ] Control Blade Worths at BOL for Control Blade Type Westinghouse 99 Main

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Table 2.15 Lattice [ ] Kinetics Parameters at BOL

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Table 2.16 Lattice [ ] Control Blade Worths at BOL for Control Blade Type GE Duralife 160

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Table 2.17 Lattice [ ] Control Blade Worths at BOL for Control Blade Type GE Marathon

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Table 2.18 Lattice [ ] Control Blade Worths at BOL for Control Blade Type GE Marathon Lower

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Table 2.19 Lattice [ ] Control Blade Worths at BOL for Control Blade Type GE Original Equipment

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Table 2.20 Lattice [ ] Control Blade Worths at BOL for Control Blade Type Westinghouse 99 Top

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Table 2.21 Lattice [ ] Control Blade Worths at BOL for Control Blade Type Westinghouse 99 Main

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Table 2.22 Lattice [ ] Kinetics Parameters at BOL

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Table 2.23 Lattice [ ] Control Blade Worths at BOL for Control Blade Type GE Duralife 160

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Table 2.24 Lattice [ ] Control Blade Worths at BOL for Control Blade Type GE Marathon

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Table 2.25 Lattice [ ] Control Blade Worths at BOL for Control Blade Type GE Marathon Lower

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Table 2.26 Lattice [ ] Control Blade Worths at BOL for Control Blade Type GE Original Equipment

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Table 2.27 Lattice [ ] Control Blade Worths at BOL for Control Blade Type Westinghouse 99 Top

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Table 2.28 Lattice [ ] Control Blade Worths at BOL for Control Blade Type Westinghouse 99 Main

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Table 2.29 Lattice [ ] Kinetics Parameters at BOL

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Table 2.30 Lattice [ ] Control Blade Worths at BOL for Control Blade Type GE Duralife 160

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Table 2.31 Lattice [ ] Control Blade Worths at BOL for Control Blade Type GE Marathon

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Table 2.32 Lattice [ ] Control Blade Worths at BOL for Control Blade Type GE Marathon Lower

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Table 2.33 Lattice [ ] Control Blade Worths at BOL for Control Blade Type GE Original Equipment

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Table 2.34 Lattice [ ] Control Blade Worths at BOL for Control Blade Type Westinghouse 99 Top

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Table 2.35 Lattice [ ] Control Blade Worths at BOL for Control Blade Type Westinghouse 99 Main

Table 2.36 Lattice [ ] Kinetics Parameters at BOL

Table 2.37 Lattice [ ] Control Blade Worths at BOL for Control Blade Type GE Duralife 160

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Table 2.38 Lattice [ ] Control Blade Worths at BOL for Control Blade Type GE Marathon

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Table 2.39 Lattice [ ] Control Blade Worths at BOL for Control Blade Type GE Marathon Lower

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Table 2.40 Lattice [ ] Control Blade Worths at BOL for Control Blade Type GE Original Equipment

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Table 2.41 Lattice [ ] Control Blade Worths at BOL for Control Blade Type Westinghouse 99 Top

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Table 2.42 Lattice [ ] Control Blade Worths at BOL for Control Blade Type Westinghouse 99 Main

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Table 2.43 Lattice [ ] Kinetics Parameters at BOL

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Table 2.44 Lattice [ ] Control Blade Worths at BOL for Control Blade Type GE Duralife 160

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Table 2.45 Lattice [ ] Control Blade Worths at BOL for Control Blade Type GE Marathon

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Table 2.46 Lattice [ ] Control Blade Worths at BOL for Control Blade Type GE Marathon Lower

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Table 2.47 Lattice [ ] Control Blade Worths at BOL for Control Blade Type GE Original Equipment

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Table 2.48 Lattice [ ] Control Blade Worths at BOL for Control Blade Type Westinghouse 99 Top

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Table 2.49 Lattice [ ] Control Blade Worths at BOL for Control Blade Type Westinghouse 99 Main

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Table 2.50 Lattice [ ] Kinetics Parameters at BOL

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Table 2.51 Lattice [ ] Control Blade Worths at BOL for Control Blade Type GE Duralife 160

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Table 2.52 Lattice [ ] Control Blade Worths at BOL for Control Blade Type GE Marathon

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Table 2.53 Lattice [ ] Control Blade Worths at BOL for Control Blade Type GE Marathon Lower

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Table 2.54 Lattice [ ] Control Blade Worths at BOL for Control Blade Type GE Original Equipment

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Table 2.55 Lattice [ ] Control Blade Worths at BOL for Control Blade Type Westinghouse 99 Top

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Table 2.56 Lattice [ ] Control Blade Worths at BOL for Control Blade Type Westinghouse 99 Main

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Table 2.57 Lattice [ ] Kinetics Parameters at BOL

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Table 2.58 Lattice [ ] Control Blade Worths at BOL for Control Blade Type GE Duralife 160

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Table 2.59 Lattice [ ] Control Blade Worths at BOL for Control Blade Type GE Marathon

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Table 2.60 Lattice [ ] Control Blade Worths at BOL for Control Blade Type GE Marathon Lower

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Table 2.61 Lattice [ ] Control Blade Worths at BOL for Control Blade Type GE Original Equipment

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Table 2.62 Lattice [ ] Control Blade Worths at BOL for Control Blade Type Westinghouse 99 Top

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Table 2.63 Lattice [ ] Control Blade Worths at BOL for Control Blade Type Westinghouse 99 Main

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Table 2.64 Lattice [ ] Kinetics Parameters at BOL

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Table 2.65 Lattice [ ] Control Blade Worths at BOL for Control Blade Type GE Duralife 160

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Table 2.66 Lattice [ ] Control Blade Worths at BOL for Control Blade Type GE Marathon

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Table 2.67 Lattice [ ] Control Blade Worths at BOL for Control Blade Type GE Marathon Lower

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Table 2.68 Lattice [ ] Control Blade Worths at BOL for Control Blade Type GE Original Equipment

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Table 2.69 Lattice [ ] Control Blade Worths at BOL for Control Blade Type Westinghouse 99 Top

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Table 2.70 Lattice [ ] Control Blade Worths at BOL for Control Blade Type Westinghouse 99 Main

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Table 2.71 Lattice [ ] Kinetics Parameters at BOL

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Table 2.72 Lattice [ ] Control Blade Worths at BOL for Control Blade Type GE Duralife 160

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Table 2.73 Lattice [ ] Control Blade Worths at BOL for Control Blade Type GE Marathon

Table 2.74 Lattice [ ] Control Blade Worths at BOL for Control Blade Type GE Marathon Lower

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Table 2.75 Lattice [ ] Control Blade Worths at BOL for Control Blade Type GE Original Equipment

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Table 2.76 Lattice [ ] Control Blade Worths at BOL for Control Blade Type Westinghouse 99 Top

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Table 2.77 Lattice [ ] Control Blade Worths at BOL for Control Blade Type Westinghouse 99 Main

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Table 2.78 Lattice [ ] Kinetics Parameters at BOL

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Table 2.79 Lattice [ ] Control Blade Worths at BOL for Control Blade Type GE Duralife 160

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Table 2.80 Lattice [ ] Control Blade Worths at BOL for Control Blade Type GE Marathon

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Table 2.81 Lattice [ ] Control Blade Worths at BOL for Control Blade Type GE Marathon Lower

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Table 2.82 Lattice [ ] Control Blade Worths at BOL for Control Blade Type GE Original Equipment

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Table 2.83 Lattice [ ] Control Blade Worths at BOL for Control Blade Type Westinghouse 99 Top

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Table 2.84 Lattice [ ] Control Blade Worths at BOL for Control Blade Type Westinghouse 99 Main

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Table 2.85 Lattice [ ] Kinetics Parameters at BOL

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Table 2.86 Lattice [ ] Control Blade Worths at BOL for Control Blade Type GE Duralife 160

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Table 2.87 Lattice [ ] Control Blade Worths at BOL for Control Blade Type GE Marathon

Table 2.88 Lattice [ ] Control Blade Worths at BOL for Control Blade Type GE Marathon Lower

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Table 2.89 Lattice [ ] Control Blade Worths at BOL for Control Blade Type GE Original Equipment

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Table 2.90 Lattice [ ] Control Blade Worths at BOL for Control Blade Type Westinghouse 99 Top

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Table 2.91 Lattice [ ] Control Blade Worths at BOL for Control Blade Type Westinghouse 99 Main

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Table 2.92 Lattice [ ] Kinetics Parameters at BOL

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Table 2.93 Lattice [ ] Control Blade Worths at BOL for Control Blade Type GE Duralife 160

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Table 2.94 Lattice [ ] Control Blade Worths at BOL for Control Blade Type GE Marathon

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Table 2.95 Lattice [ ] Control Blade Worths at BOL for Control Blade Type GE Marathon Lower

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Table 2.96 Lattice [ ] Control Blade Worths at BOL for Control Blade Type GE Original Equipment

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Table 2.97 Lattice [ ] Control Blade Worths at BOL for Control Blade Type Westinghouse 99 Top

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Table 2.98 Lattice [ ] Control Blade Worths at BOL for Control Blade Type Westinghouse 99 Main

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Table 2.99 Lattice [ ] Kinetics Parameters at BOL

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Table 2.100 Lattice [ ] Control Blade Worths at BOL for Control Blade Type GE Duralife 160

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Table 2.101 Lattice [ ] Control Blade Worths at BOL for Control Blade Type GE Marathon

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Table 2.102 Lattice [ ] Control Blade Worths at BOL for Control Blade Type GE Marathon Lower

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Table 2.103 Lattice [ ] Control Blade Worths at BOL for Control Blade Type GE Original Equipment

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Table 2.104 Lattice [ ] Control Blade Worths at BOL for Control Blade Type Westinghouse 99 Top

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Table 2.105 Lattice [ ] Control Blade Worths at BOL for Control Blade Type Westinghouse 99 Main

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Table 2.106 Lattice [ ] Kinetics Parameters at BOL

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Table 2.107 Lattice [ ] Control Blade Worths at BOL for Control Blade Type GE Duralife 160

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Table 2.108 Lattice [ ] Control Blade Worths at BOL for Control Blade Type GE Marathon

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Table 2.109 Lattice [ ] Control Blade Worths at BOL for Control Blade Type GE Marathon Lower

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Table 2.110 Lattice [ ] Control Blade Worths at BOL for Control Blade Type GE Original Equipment

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Table 2.111 Lattice [ ] Control Blade Worths at BOL for Control Blade Type Westinghouse 99 Top

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Table 2.112 Lattice [ ] Control Blade Worths at BOL for Control Blade Type Westinghouse 99 Main

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Table 2.113 Lattice [ ] Kinetics Parameters at BOL

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Table 2.114 Lattice [ ] Control Blade Worths at BOL for Control Blade Type GE Duralife 160

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Table 2.115 Lattice [ ] Control Blade Worths at BOL for Control Blade Type GE Marathon

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Table 2.116 Lattice [ ] Control Blade Worths at BOL for Control Blade Type GE Marathon Lower

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Table 2.117 Lattice [ ] Control Blade Worths at BOL for Control Blade Type GE Original Equipment

Table 2.118 Lattice [ ] Control Blade Worths at BOL for Control Blade Type Westinghouse 99 Top

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Table 2.119 Lattice [ ] Control Blade Worths at BOL for Control Blade Type Westinghouse 99 Main

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Table 2.120 Lattice [ ] Kinetics Parameters at BOL

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Table 2.121 Lattice [ ] Control Blade Worths at BOL for Control Blade Type GE Duralife 160

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Table 2.122 Lattice [ ] Control Blade Worths at BOL for Control Blade Type GE Marathon

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Table 2.123 Lattice [ ] Control Blade Worths at BOL for Control Blade Type GE Marathon Lower

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Table 2.124 Lattice [ ] Control Blade Worths at BOL for Control Blade Type GE Original Equipment

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Table 2.125 Lattice [ ] Control Blade Worths at BOL for Control Blade Type Westinghouse 99 Top

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Table 2.126 Lattice [ ] Control Blade Worths at BOL for Control Blade Type Westinghouse 99 Main

Table 2.127 Lattice [ ] Kinetics Parameters at BOL

Figure 2.1 Assembly Map

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Figure 2.2 Assembly Map

Figure 2.3 Assembly Map

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Figure 2.4 Fuel Rod Distribution

Figure 2.5 Fuel Rod Distribution

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Figure 2.6 Fuel Rod Distribution

Figure 2.7 Fuel Rod Axial Description

Figure 2.8 Fuel Rod Axial Description

3.0 REFERENCES

1. ANF-89-98(P)(A) Revision 1 and Supplement 1, *Generic Mechanical Design Criteria for BWR Fuel Designs*, Advanced Nuclear Fuels Corporation, May 1995.

2. EMF-2158(P)(A), Revision 0, *Siemens Power Corporation Methodology for Boiling Water Reactors: Evaluation and Validation of CASMO-4/MICROBURN-B2*, Siemens Power Corporation, October 1999.

3. ANP-3764P, Revision 0, *Susquehanna Steam Electric Station New Fuel Storage Vault Criticality Safety Analysis for ATRIUM 11*

4. ANP-3765P, Revision 0, *Susquehanna Steam Electric Station Spent Fuel Storage Pool Criticality Safety Analysis for ATRIUM 11*

5. “Certificate of Compliance for Radioactive Material Packages”, Certificate Number 9372 Revision 2, NRC Docket Number 71-9372, Package Identification Number USA/9372/B(U)F-96

Appendix A Enriched Lattice Hot Uncontrolled Reactivity and LPF Plots

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Figure A.1 [ ] Hot Uncontrolled k_∞

Figure A.2 [ ] Hot Uncontrolled LPF

Figure A.3 [ ] Hot Uncontrolled k_∞

Figure A.4 [ ] Hot Uncontrolled LPF

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Figure A.5 [ ] Hot Uncontrolled k_{∞}

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Figure A.6 [ ] Hot Uncontrolled LPF

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Figure A.7 [ ] Hot Uncontrolled k_∞

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Figure A.8 [ ] Hot Uncontrolled LPF

Figure A.9 [ ] Hot Uncontrolled k_∞

Figure A.10 [ ] Hot Uncontrolled LPF

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Figure A.11 [ ] Hot Uncontrolled k_∞

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Figure A.12 [ ] Hot Uncontrolled LPF

Figure A.13 [ ] Hot Uncontrolled k_∞

Figure A.14 [ ] Hot Uncontrolled LPF

Figure A.15 [ ] Hot Uncontrolled k_∞

Figure A.16 [ ] Hot Uncontrolled LPF

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Figure A.17 [ ] Hot Uncontrolled k_∞

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Figure A.18 [ ] Hot Uncontrolled LPF

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Figure A.19 [ ] Hot Uncontrolled k_∞

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Figure A.20 [ ] Hot Uncontrolled LPF

Figure A.21 [ ] Hot Uncontrolled k_{∞}

Figure A.22 [ ] Hot Uncontrolled LPF

Figure A.23 [ ] Hot Uncontrolled k_∞

Figure A.24 [ ] Hot Uncontrolled LPF

Figure A.25 [ ] Hot Uncontrolled k_∞

Figure A.26 [ ] Hot Uncontrolled LPF

Figure A.27 [ ] Hot Uncontrolled k_∞

Figure A.28 [ ] Hot Uncontrolled LPF

Figure A.29 [ ] Hot Uncontrolled k$_\infty$

Figure A.30 [ ] Hot Uncontrolled LPF

Appendix B Enriched Lattice Hot Uncontrolled Reactivity and LPF Tables

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Table B.1 [ ] Hot Uncontrolled k_∞

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Table B.2 [ ] Hot Uncontrolled LPF

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Table B.3 [ ] Hot Uncontrolled k_∞

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Table B.4 [ ] Hot Uncontrolled LPF

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Table B.5 [ ] Hot Uncontrolled k_∞

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Table B.6 [ ] Hot Uncontrolled LPF

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Table B.7 [ ] Hot Uncontrolled k_∞

Table B.8 [ ] Hot Uncontrolled LPF

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Table B.9 [ ] Hot Uncontrolled k_∞

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Table B.10 [ ] Hot Uncontrolled LPF

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Table B.11 [ ] Hot Uncontrolled k_∞

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Table B.12 [ ] Hot Uncontrolled LPF

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Table B.13 [ ] Hot Uncontrolled k_∞

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Table B.14 [ ] Hot Uncontrolled LPF

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Table B.15 [ ] Hot Uncontrolled k_∞

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Table B.16 [ ] Hot Uncontrolled LPF

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Table B.17 [ ] Hot Uncontrolled k_∞

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Table B.18 [ ] Hot Uncontrolled LPF

Table B.19 [ ] Hot Uncontrolled k_∞

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Table B.20 [ ] Hot Uncontrolled LPF

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Table B.21 [ ] Hot Uncontrolled k_∞

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Table B.22 [ ] Hot Uncontrolled LPF

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Table B.23 [ ] Hot Uncontrolled k_∞

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Table B.24 [ ] Hot Uncontrolled LPF

Table B.25 [ ] Hot Uncontrolled k_∞

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Table B.26 [ ] Hot Uncontrolled LPF

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Table B.27 [ ] Hot Uncontrolled k_∞

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Table B.28 [ ] Hot Uncontrolled LPF

Table B.29 [ ] Hot Uncontrolled k_∞

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Table B.30 [ ] Hot Uncontrolled LPF

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Appendix C Enriched Lattice Isotopic Data Tables

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Appendix D Lattice Enrichment Distribution Maps

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Figure D.1 [ ] Enrichment Distribution

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Figure D.2 [ ] Enrichment Distribution

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Figure D.3 [ ] Enrichment Distribution

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Figure D.4 [ ] Enrichment Distribution

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Figure D.5 [ ] Enrichment Distribution

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Figure D.6 [ ] Enrichment Distribution

Figure D.7 [ ] Enrichment Distribution

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Figure D.9 [ ] Enrichment Distribution

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Figure D.10 [ ] Enrichment Distribution

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Figure D.11 [ ] Enrichment Distribution

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Figure D.12 [ ] Enrichment Distribution

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Figure D.13 [ ] Enrichment Distribution

Figure D.14 [ ] Enrichment Distribution

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Figure D.15 [ ] Enrichment Distribution

Figure D.16 [ ] Enrichment Distribution

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Figure D.17 [ ] Enrichment Distribution

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Figure D.18 [ ] Enrichment Distribution

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Figure D.19 [ ] Enrichment Distribution

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Figure D.20 [ ] Enrichment Distribution

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Figure D.21 [ ] Enrichment Distribution

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Figure D.22 [ ] Enrichment Distribution

Figure D.23 [ ] Enrichment Distribution

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Figure D.24 [ ] Enrichment Distribution

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Figure D.25 [ ] Enrichment Distribution

Figure D.26 [ ] Enrichment Distribution

Figure D.27 [ ] Enrichment Distribution

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Figure D.28 [ ] Enrichment Distribution

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Figure D.29 [ ] Enrichment Distribution

Enclosure 3 of PLA-7861

Framatome Affidavit for ANP-3825P, "Susquehanna Unit 2 Cycle 21 ATRIUM 11 Fuel Nuclear Fuel Design Report"

AFFIDAVIT

1. My name is Alan B. Meginnis. I am Manager, Product Licensing, for Framatome Inc. and as such I am authorized to execute this Affidavit.

2. I am familiar with the criteria applied by Framatome to determine whether certain Framatome information is proprietary. I am familiar with the policies established by Framatome to ensure the proper application of these criteria.

3. I am familiar with the Framatome information contained in the report ANP-3825P, Revision 0, "Susquehanna Unit 2 Cycle 21 ATRIUM 11 Fuel Nuclear Fuel Design Report," dated March 2020 and referred to herein as "Document." Information contained in this Document has been classified by Framatome as proprietary in accordance with the policies established by Framatome for the control and protection of proprietary and confidential information.

4. This Document contains information of a proprietary and confidential nature and is of the type customarily held in confidence by Framatome and not made available to the public. Based on my experience, I am aware that other companies regard information of the kind contained in this Document as proprietary and confidential.

5. This Document has been made available to the U.S. Nuclear Regulatory Commission in confidence with the request that the information contained in this Document be withheld from public disclosure. The request for withholding of proprietary information is made in accordance with 10 CFR 2.390. The information for which withholding from disclosure is requested qualifies under 10 CFR 2.390(a)(4) "Trade secrets and commercial or financial information."

6. The following criteria are customarily applied by Framatome to determine whether information should be classified as proprietary:

(a) The information reveals details of Framatome's research and development plans and programs or their results.

(b) Use of the information by a competitor would permit the competitor to significantly reduce its expenditures, in time or resources, to design, produce, or market a similar product or service.

(c) The information includes test data or analytical techniques concerning a process, methodology, or component, the application of which results in a competitive advantage for Framatome.

(d) The information reveals certain distinguishing aspects of a process, methodology, or component, the exclusive use of which provides a competitive advantage for Framatome in product optimization or marketability.

(e) The information is vital to a competitive advantage held by Framatome, would be helpful to competitors to Framatome, and would likely cause substantial harm to the competitive position of Framatome.

The information in the Document is considered proprietary for the reasons set forth in paragraphs 6(b), 6(d) and 6(e) above.

7. In accordance with Framatome's policies governing the protection and control of information, proprietary information contained in this Document have been made available, on a limited basis, to others outside Framatome only as required and under suitable agreement providing for nondisclosure and limited use of the information.

8. Framatome policy requires that proprietary information be kept in a secured file or area and distributed on a need-to-know basis.

9. The foregoing statements are true and correct to the best of my knowledge, information, and belief.

Alan Meginnis

STATE OF WASHINGTON)
) ss.
COUNTY OF BENTON)

SUBSCRIBED before me this 26th day of March, 2020.

Katherine Kerr
NOTARY PUBLIC, STATE OF WASHINGTON
MY COMMISSION EXPIRES: 9/12/2022

KATHERINE KERR
MY COMM. EXP. 09/12/2022
NOTARY PUBLIC
COMM. NO. 205026
STATE OF WASHINGTON

Enclosure 5 of PLA-7861

Framatome Topical Report
ANP-3826NP

Susquehanna Unit 2 Cycle 21
Fuel Cycle Design Report

(Non-Proprietary Version)

framatome

Susquehanna Unit 2 Cycle 21

ANP-3826NP
Revision 0

Fuel Cycle Design Report

March 2020

Nature of Changes

Item	Section(s) or Page(s)	Description and Justification
1	All	Initial Issue

Contents

List of Tables

List of Figures

Nomenclature

Acronym	Definition
ACE	Framatome critical power correlation
ARO	all rods out
BOC	beginning of cycle
BWR	boiling water reactor
CSDM	cold shutdown margin
EOC	end of cycle
EOFP	end of full power capability
GWd/MTU	gigawatt days per metric ton of initial uranium
HEXR	hot excess reactivity
LHGR	linear heat generation rate
MCPR	minimum critical power ratio
MICROBURN-B2	Framatome Inc. advanced BWR core simulator methodology with PPR capability
MWd/MTU	megawatt days per metric ton of initial uranium
PPR	Pin Power Reconstruction. The PPR methodology accounts for variation in local rod power distributions due to neighboring assemblies and control state. The local rod power distributions are reconstructed based on the actual flux solution for each statepoint.
R Value	the larger of zero or the shutdown margin at BOC minus the minimum calculated shutdown margin in the cycle
SLC	standby liquid control
SPCB	Framatome Inc. (formerly Siemens Power Corporation) critical power correlation

1.0 INTRODUCTION

This report documents the Framatome Inc. fuel cycle design and fuel management calculations for the Cycle 21 operation of the Susquehanna Unit 2 BWR. This design analysis utilizes the ATRIUM 10 and ATRIUM 11 fuel design and has been performed with the approved Framatome Inc. neutronics methodology (References 1, 4 and 5). The CASMO-4 lattice depletion code was used to generate nuclear data including cross sections and local power peaking factors. The MICROBURN-B2 three dimensional core simulator code, combined with the application of the applicable critical power correlation, was used to model the core. The following MICROBURN-B2 version 2 modeling features were also used in the analyses supporting this report:

- Pin power reconstruction (PPR) to determine thermal margins
- **[ ]**
- **[ ]**
- **[ ]**
- **[ ]**

Design results for the Cycle 21 reactor core loading including projected control rod patterns and evaluations of thermal and reactivity margins are presented. The Cycle 21 results are based on Cycle 20 core operational history as summarized in Table 2.1

2.0 SUMMARY

The Cycle 21 fresh batch size [ ] and batch average enrichment [ ] were determined to meet the energy requirements provided by Talen Energy (Reference 3). For a complete description of the fresh reload assemblies, see Reference 2. The loading of the Cycle 21 fuel as described in this report results in a projected Cycle 21 full power energy capability of [ ]. Beyond the full power capability, the cycle has been designed to achieve [ ] additional energy via power coastdown at constant core dome pressure operation.

In order to obtain optimum operating flexibility, the projected control rod patterns for Cycle 21 were developed to be consistent with a conservative margin to thermal limits (References 6, 7, 8, and 9). The cycle design calculations also demonstrate adequate hot excess reactivity and cold shutdown margin throughout the cycle. Key results from the design analysis are summarized in Table 2.1. Table 3.1 summarizes the core composition and the assembly description for Cycle 21 by nuclear fuel type batch. Tables 3.2, 3.3 and 3.4 contain the assumed thermal limits for both the ATRIUM 10 and ATRIUM 11 fuel in the design.

Table 2.1 Energy and Key Results Summary

3.0 CYCLE 21 FUEL CYCLE DESIGN

3.1 *General Description*

The assembly design for the Cycle 21 SUS2-21 fresh reload fuel for Susquehanna Unit 2 is described in detail in Reference 2. Elevation views of the fresh reload fuel design axial enrichment and gadolinia distributions are shown in Appendix B, Figures B.1 through B.3. [

]. This loading in conjunction with the control rod patterns presented in Appendix A shows acceptable power peaking and associated margins to limits for projected Cycle 21 operation. The analyses supporting this fuel cycle design were based on the core parameters shown in Table 3.1. Figures 3.1 and 3.2 along with Table 3.1 define the reference loading pattern used in the fuel cycle design. The specific core location of the fresh assemblies in Cycle 21 is provided in Appendix C. Key results for the cycle are summarized in Table 2.1.

3.2 *Control Rod Patterns and Thermal Limits*

Projected control rod patterns for Cycle 21 and resultant key operating parameters including thermal margins are shown in Appendix A. The thermal margins presented in this report were determined using the MICROBURN-B2 3D core simulator PPR model to provide adequate margin to thermal limits from References 6, 7 and 8. A detailed summary of the core parameters resulting from the step-through projection analysis is provided in Tables A.1 and A.2. Limiting results from the step-through are summarized in Table 2.1. The hot operating target k-eff versus cycle exposure which was determined to be appropriate for Cycle 21 is shown in Table 3.5. The k-eff values presented in Appendix A are not bias corrected. Selected exposure and radial power distributions from the design step-through are presented in Appendix D.

3.3 *Hot Excess Reactivity and Cold Shutdown Margin*

The cycle design calculations demonstrate adequate hot excess reactivity, SLC shutdown margin, and cold shutdown margin throughout the cycle. Key shutdown margin and R-Value results are presented in Table 2.1. The shutdown margin for Cycle 21 is in conformance with the Technical Specification limit of R + 0.38 %Δk/k at BOC. The shutdown margin was calculated at **[** **]** The cold target k-eff versus exposure determined to be appropriate for calculation of cold shutdown margin in Cycle 21 is shown in Table 3.6. **[** **]**. Table 3.7 summarizes the Cycle 21 reactivity margins versus cycle exposure, including the SLC shutdown margin for the cycle.

Table 3.1 Cycle 21 Core Composition and Design Parameters

Table 3.2 ATRIUM 10 and ATRIUM 11 Assumed MCPR Operating Limit

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Table 3.3 ATRIUM 10 and ATRIUM 11 Assumed LHGR Limit

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Table 3.4 ATRIUM 10 and ATRIUM 11 Assumed MAPLHGR Limit

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Table 3.5 Hot Operating Target k-eff Versus Cycle Exposure

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Table 3.6 Cold Critical Target k-eff Versus Cycle Exposure

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Table 3.7 Reactivity Margin Summary

Table 3.7 Reactivity Margin Summary (continued)

Table 3.7 Reactivity Margin Summary (continued)

Table 3.7 Reactivity Margin Summary (continued)

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Figure 3.1 Reference Loading Pattern

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Figure 3.1 Reference Loading Pattern (Continued)

Figure 3.2 Lower Right Quarter Core Layout by Fuel Type

4.0 REFERENCES

1. EMF-2158(P)(A) Revision 0, Siemens Power Corporation Methodology for Boiling Water Reactors: Evaluation and Validation of CASMO-4/MICROBURN-B2, Siemens Power Corporation

2. ANP-3825P, Revision 0, Susquehanna Unit 2 Cycle 21 ATRIUM 11 Fuel Nuclear Fuel Design Report

3. Letter, I. Brisson (Susquehanna) to R. Follett (Framatome), “Susquehanna Unit 2 Cycle 21 Reload Design Plan,” EML 01384, November 6, 2019. (FS1-0047729 Revision 1.0, “Susquehanna Unit 2 Cycle 21 Reload Design Plan,” Framatome Inc., January 2, 2020.)

4. EMF-2209(P)(A) Revision 3, SPCB Critical Power Correlation, AREVA

5. ANP-10335P-A, Revision 0, ACE/ATRIUM 11 Critical Power Correlation

6. EMF-3243(P), Revision 0, Susquehanna LOCA MALPHGR Analysis for ATRIUM-10 Fuel and Extended Power Uprate

7. ANP-3416P, Revision 2, Mechanical Design Report for Susquehanna Units 1 and 2 ATRIUM-10 Fuel Assemblies Licensing Report

8. ANP-3784P, Revision 0, Susquehanna Units 1 and 2 LOCA Analysis for ATRIUM 11 Fuel

9. ANP-3745P, Revision 0, ATRIUM 11 Fuel Rod Thermal-Mechanical Evaluation for Susquehanna LAR

Appendix A Susquehanna Unit 2 Cycle 21 Step-through Depletion Summary, Control Rod Patterns and Core Average Axial Power and Exposure Distributions

Table A.1 Design Depletion Summary

Table A.1 Design Depletion Summary (continued)

Table A.2 Design Depletion Thermal Margin Summary

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Table A.2 Design Depletion Thermal Margin Summary (continued)

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Figure A.1 Control Rod Pattern and Axial Distributions at [ ]

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Figure A.2 Control Rod Pattern and Axial Distributions at [ ]

Figure A.3 Control Rod Pattern and Axial Distributions at [ ]

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Figure A.4 Control Rod Pattern and Axial Distributions at [ ]

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Figure A.5 Control Rod Pattern and Axial Distributions at [ ]

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Figure A.6 Control Rod Pattern and Axial Distributions at [ ]

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Figure A.7 Control Rod Pattern and Axial Distributions at [ ]

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Figure A.8 Control Rod Pattern and Axial Distributions at [ ]

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Figure A.9 Control Rod Pattern and Axial Distributions at [ ]

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Figure A.10 Control Rod Pattern and Axial Distributions at [ ]

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Figure A.11 Control Rod Pattern and Axial Distributions at [ ]

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Figure A.12 Control Rod Pattern and Axial Distributions at [ ]

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Figure A.13 Control Rod Pattern and Axial Distributions at [ ]

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Figure A.14 Control Rod Pattern and Axial Distributions at [ ]

Figure A.15 Control Rod Pattern and Axial Distributions at [ ]

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Figure A.16 Control Rod Pattern and Axial Distributions at [ ]

Figure A.17 Control Rod Pattern and Axial Distributions at [ ]

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Figure A.18 Control Rod Pattern and Axial Distributions at [ ]

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Figure A.19 Control Rod Pattern and Axial Distributions at [ ]

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Figure A.20 Control Rod Pattern and Axial Distributions at [ ]

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Figure A.21 Control Rod Pattern and Axial Distributions at [ ]

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Figure A.22 Control Rod Pattern and Axial Distributions at [ ]

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Figure A.23 Control Rod Pattern and Axial Distributions at [ ]

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Figure A.24 Control Rod Pattern and Axial Distributions at [ ]

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Figure A.25 Control Rod Pattern and Axial Distributions at [ ]

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Figure A.26 Control Rod Pattern and Axial Distributions at [ ]

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Figure A.27 Control Rod Pattern and Axial Distributions at [ ]

Figure A.28 Control Rod Pattern and Axial Distributions at [ ]

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Figure A.29 Control Rod Pattern and Axial Distributions at [ ]

Figure A.30 Control Rod Pattern and Axial Distributions at [ ]

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Figure A.31 Control Rod Pattern and Axial Distributions at [ ]

Figure A.32 Control Rod Pattern and Axial Distributions at [ ]

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Figure A.33 Control Rod Pattern and Axial Distributions at [ ]

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Figure A.34 Control Rod Pattern and Axial Distributions at [ ]

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Figure A.35 Control Rod Pattern and Axial Distributions at [ ]

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Figure A.36 Control Rod Pattern and Axial Distributions at [ ]

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Figure A.37 Control Rod Pattern and Axial Distributions at [ ]

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Figure A.38 Control Rod Pattern and Axial Distributions at [ ]

Figure A.39 Control Rod Pattern and Axial Distributions at [ ]

Figure A.40 Control Rod Pattern and Axial Distributions at [ ]

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Figure A.41 Control Rod Pattern and Axial Distributions at [ ]

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Figure A.42 Control Rod Pattern and Axial Distributions at [ ]

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Figure A.43 Control Rod Pattern and Axial Distributions at [ ]

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Figure A.44 Control Rod Pattern and Axial Distributions at [ ]

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Figure A.45 Control Rod Pattern and Axial Distributions at [ ]

Figure A.46 Control Rod Pattern and Axial Distributions at [ ]

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Figure A.47 Control Rod Pattern and Axial Distributions at [ ]

Figure A.48 Control Rod Pattern and Axial Distributions at [ ]

Figure A.49 Control Rod Pattern and Axial Distributions at [ ]

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Figure A.50 Control Rod Pattern and Axial Distributions at [ ]

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Figure A.51 Control Rod Pattern and Axial Distributions at [ ]

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Figure A.52 Control Rod Pattern and Axial Distributions at [ ]

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Figure A.53 Control Rod Pattern and Axial Distributions at [ ]

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Figure A.54 Control Rod Pattern and Axial Distributions at [ ]

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Figure A.55 Control Rod Pattern and Axial Distributions at [ ]

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Figure A.56 Control Rod Pattern and Axial Distributions at [ ]

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Figure A.57 Control Rod Pattern and Axial Distributions at [ ]

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Figure A.58 Control Rod Pattern and Axial Distributions at [ ]

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Figure A.59 Control Rod Pattern and Axial Distributions at [ ]

Figure A.60 Control Rod Pattern and Axial Distributions at [ ]

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Figure A.61 Control Rod Pattern and Axial Distributions at [ ]

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Figure A.62 Control Rod Pattern and Axial Distributions at [ ]

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Figure A.63 Control Rod Pattern and Axial Distributions at [ ]

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Figure A.64 Control Rod Pattern and Axial Distributions at [ ]

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Figure A.65 Control Rod Pattern and Axial Distributions at [ ]

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Figure A.66 Control Rod Pattern and Axial Distributions at [ ]

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Figure A.67 Control Rod Pattern and Axial Distributions at [ ]

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Figure A.68 Control Rod Pattern and Axial Distributions at [ ]

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Figure A.69 Control Rod Pattern and Axial Distributions at [ ]

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Figure A.70 Control Rod Pattern and Axial Distributions at [ ]

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Figure A.71 Control Rod Pattern and Axial Distributions at [ ]

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Figure A.72 Control Rod Pattern and Axial Distributions at [ ]

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Figure A.73 Control Rod Pattern and Axial Distributions at [ ]

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Figure A.74 Control Rod Pattern and Axial Distributions at [ ]

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Figure A.75 Control Rod Pattern and Axial Distributions at [ ]

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Figure A.76 Control Rod Pattern and Axial Distributions at [ ]

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Figure A.77 Control Rod Pattern and Axial Distributions at [ ]

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Figure A.78 Control Rod Pattern and Axial Distributions at [ ]

Figure A.79 Control Rod Pattern and Axial Distributions at [ ]

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Figure A.80 Control Rod Pattern and Axial Distributions at [ ]

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Figure A.81 Control Rod Pattern and Axial Distributions at [ ]

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Figure A.82 Control Rod Pattern and Axial Distributions at [ ]

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Figure A.83 Control Rod Pattern and Axial Distributions at [ ]

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Figure A.84 Control Rod Pattern and Axial Distributions at [ ]

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Figure A.85 Control Rod Pattern and Axial Distributions at [ ]

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Figure A.86 Control Rod Pattern and Axial Distributions at [ ]

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Figure A.87 Control Rod Pattern and Axial Distributions at [ ]

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Figure A.88 Control Rod Pattern and Axial Distributions at [ ]

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Figure A.89 Control Rod Pattern and Axial Distributions at [ ]

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Figure A.90 Control Rod Pattern and Axial Distributions at [ ]

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Figure A.91 Control Rod Pattern and Axial Distributions at [ ]

Figure A.92 Control Rod Pattern and Axial Distributions at [ ]

Figure A.93 Control Rod Pattern and Axial Distributions at [ ]

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Figure A.94 Control Rod Pattern and Axial Distributions at [ ]

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Figure A.95 Control Rod Pattern and Axial Distributions at [ ]

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Figure A.96 Control Rod Pattern and Axial Distributions at [ ]

Figure A.97 Control Rod Pattern and Axial Distributions at [ ]

Figure A.98 Control Rod Pattern and Axial Distributions at [ ]

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Figure A.99 Control Rod Pattern and Axial Distributions at [ ]

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Figure A.100 Control Rod Pattern and Axial Distributions at [ ]

Figure A.101 Control Rod Pattern and Axial Distributions at [ ]

Figure A.102 Control Rod Pattern and Axial Distributions at [ ]

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Figure A.103 Control Rod Pattern and Axial Distributions at [ ]

Figure A.104 Control Rod Pattern and Axial Distributions at [ ]

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Figure A.105 Control Rod Pattern and Axial Distributions at [ ]

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Figure A.106 Control Rod Pattern and Axial Distributions at [ ]

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Figure A.107 Control Rod Pattern and Axial Distributions at [ ]

Appendix B Elevation Views of the Susquehanna Unit 2 Cycle 21 Fresh Reload Batch Fuel Assemblies

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Figure B.1 Elevation View for the Fresh Fuel Reload Batch SUS2-21
[ ] Fuel Assembly Design

Figure B.2 Elevation View for the Fresh Fuel Reload Batch SUS2-21
[ ] Fuel Assembly Design

Figure B.3 Elevation View for the Fresh Fuel Reload Batch SUS2-21
[ ] Fuel Assembly Design

Appendix C Susquehanna Unit 2 Cycle 21 Fresh Fuel Locations

Table C.1 Reload Fuel Identification and Locations [ ]

[ ]

Table C.2 Reload Fuel Identification and Locations [ ]

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Table C.3 Reload Fuel Identification and Locations [ ]

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Appendix D Susquehanna Unit 2 Cycle 21 Radial Exposure and Power Distributions

Figure D.1 BOC Exposure Distribution [ ]

Figure D.2 EOC Exposure Distribution [ ]

Figure D.3 Radial Power Distribution at [ ]

Figure D.4 Radial Power Distribution at [ ]

Appendix E Susquehanna Unit 2 Cycle 20 EOC Projection Control Rod Patterns and Core Average Axial Power and Exposure Distributions

Figure E.1 Cycle 20 Control Rod Pattern and Axial Distributions at [ ]

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Figure E.2 Cycle 20 Control Rod Pattern and Axial Distributions at
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Figure E.3 Cycle 20 Control Rod Pattern and Axial Distributions at
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Enclosure 6 of PLA-7861

Framatome Affidavit for ANP-3826P, “Susquehanna Unit 2 Cycle 21 Fuel Cycle Design Report”

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Alan Meginnis

STATE OF WASHINGTON)
) ss.
COUNTY OF BENTON)

SUBSCRIBED before me this 26th day of March, 2020.

Katherine Kerr

Katherine Kerr
NOTARY PUBLIC, STATE OF WASHINGTON
MY COMMISSION EXPIRES: 9/12/2022

KATHERINE KERR
MY COMM. EXP. 09/12/2022
NOTARY PUBLIC
STATE OF WASHINGTON