September 2, 2005

Mr. Charlie F. Holman, Manager
Environmental, Health, Safety
and Licensing
Framatome ANP, Inc.
1724 Mount Athos Road
P.O. Box 11646
Lynchburg, VA 24506-1646

SUBJECT: AMENDMENT 5 - FRAMATOME ANP, INC. (LYNCHBURG), APPLIED ADMINISTRATIVE MARGIN FOR FINISHED FUEL ASSEMBLIES AT TWO WORKSTATIONS (TAC L31886)

Dear Mr. Holman:

This letter refers to your application dated April 11, 2005, as supplemented May 13, 2005, June 22, 2005, and August 2, 2005, in which you requested a license amendment in order to accommodate a change in the types of fuel to be used in two workstations. Our review determined that the changes are acceptable. Pursuant to Part 70 of Title 10 of the Code of Federal Regulations, Materials License SNM-1168 is hereby amended. Accordingly, Safety Condition S-1 has been revised as follows:

S-1 Authorized use: For use in accordance with statements, representations, and conditions of the licensee's application dated March 28, 2002; and supplements dated November 8, 2002, July 18, July 30, August 4, and December 18, 2003; March 10, May 27, August 17, and November 10, 2004; and April 11, May 13, June 22, and August 2, 2005.

In addition, as a result of this review, Safety Condition S-4 will be revised to read:

S-4: Notwithstanding Section 5.2d of the licensee's application, when determining subcriticality based on computer calculations, the k_{eff} of a system or process shall not exceed 0.87 for normal conditions or 0.95 for credible off-normal conditions, including bias and uncertainty, with the exception of a finished (undamaged) fuel assembly in the drag gauge or air cleaning station under credible abnormal (fully flooded) conditions, which shall not exceed 0.98, including bias and uncertainty. This limit shall apply provided the fuel assembly has been analyzed to be within the area of applicability defined in Column 4 of Table 5-2 of the April 11, 2005, submittal.

Prior to modifying the nuclear criticality safety validation methodology (as defined in the July 18, 2003, submittal), Framatome must perform an analysis to determine if the proposed methodology is more or less conservative than described in the July 18, 2003, submittal. If the analysis shows that the new methodology is more, or equally, conservative, then Framatome must submit a detailed description of the new methodology, and a justification for the conservatism, 60 days prior to implementation. If the analysis determines the methodology to be less conservative, then Framatome must obtain a license amendment before implementation.

With the exceptions of S-1 and SG-1.3, discussed below, all other license conditions remain the same. The Nuclear Regulatory Commission (NRC) noted that, in License Amendment 4, dated August 4, 2005, two errors were made in Safety Conditions S-1 and SG-1.3. Safety Condition S-1 included a date of November 24, 2004, instead of the correct date of November 10, 2004. In addition, the NRC noted that in Amendment 4, Safeguards Condition SG-1.3, had an incorrect expiration date of October 7, 2005. The correct date reflects the 60 day extension from the date of the last of the six discussed shipments. The correct expiration date is November 5, 2005. This amendment corrects these errors in S-1 and SG-1.3.

Enclosed are copies of the revised Materials License SNM-1168 and the Safety Evaluation Report which includes the Categorical Exclusion from performing an environmental impact statement or environmental assessment as described in 10 CFR Parts 51.20 and 51.21.

If you have any questions regarding this letter, please contact Billy Gleaves of my staff at (301) 415-5848 or via e-mail to bcg@nrc.gov.

In accordance with 10 CFR 2.390 of the NRC's "Rules of Practice," a copy of this letter and Enclosure 1 will be available electronically for public inspection in the NRC Public Document Room or from the Publicly Available Records (PARS) component of NRC's document system (ADAMS). ADAMS is accessible from the NRC Web site at http://www.nrc.gov/NRC/reading-rm/adams.html.

Sincerely,

/RA/

Gary S. Janosko, Chief
Fuel Cycle Facilities Branch
Division of Fuel Cycle Safety
and Safeguards
Office of Nuclear Material Safety
and Safeguards

Docket No: 70-1201
License No: SNM-1168

Enclosures: 1. Materials License SNM-1168
2. Safety Evaluation Report

Prior to modifying the nuclear criticality safety validation methodology (as defined in the July 18, 2003, submittal), Framatome must perform an analysis to determine if the proposed methodology is more or less conservative than described in the July 18, 2003, submittal. If the analysis shows that the new methodology is more, or equally, conservative, then Framatome must submit a detailed description of the new methodology, and a justification for the conservatism, 60 days prior to implementation. If the analysis determines the methodology to be less conservative, then Framatome must obtain a license amendment before implementation.

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CLOSES TAC L31886

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DOCKET NO: 70-1201

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Lynchburg, VA

SUBJECT: SAFETY EVALUATION REPORT - APPLIED ADMINISTRATIVE MARGIN FOR FINISHED FUEL ASSEMBLIES AT TWO WORKSTATIONS, FOR THE FRAMATOME ANP, INC. LYNCHBURG FACILITY (TAC L31886)

1.0 BACKGROUND

On April 11, 2005, Framatome ANP (FANP) submitted an amendment request to decrease the minimum margin of subcriticality for safety (also known as the administrative margin) at the Mount Athos Road (MAR) facility in Lynchburg, Virginia to 0.02 for finished fuel assemblies under off-normal conditions. Currently, FANP-Lynchburg has a maximum allowable k_{eff} limit of 0.87 for normal conditions and 0.95 for off-normal conditions. The amendment involves adding the following text to Section 5.2d (page 5-8) of the license application:

> Applications involving finished (undamaged) fuel assemblies in the air cleaning and drag gauge stations under off-normal conditions will have a 0.02 administrative margin applied using the methodology detailed in the “MAR Single Fuel Assembly Criticality Code Validation.”

The stated reason for the request was that the air cleaning and drag gauge stations are below grade and require operation of a sump pump to remain dry. Flooding of the stations, therefore, is a credible off-normal condition. These operations will not rely on fixed neutron absorber plates in the pits, as has been done in the past at the facility. Without credit for these absorbers, the most reactive fuel assemblies would not meet the existing 0.95 criterion under fully-flooded conditions.

As part of its amendment request, FANP submitted the above-referenced validation report, Rev. 0, dated April 2005. The Nuclear Regulatory Commission (NRC) provided the licensee with a request for additional information (RAI) on May 5, 2005. The licensee responded on May 13, 2005. Following a series of phone calls, the licensee submitted packages of supplemental information on June 22, 2005, and August 3, 2005.

This Safety Evaluation Report (SER) documents the staff’s review of the license application change, validation report, and RAI responses and other supplemental information.

2.0 DISCUSSION

2.1 Licensee's Submittal

The validation report consisted of a validation of the SCALE 4.4a code with the 44-group cross section library from ENDF/B-V. The licensee selected a total of 83 benchmark experiments consisting of lattices of UO_2 fuel rods in water, with various moderator-to-fuel ratios (v^m/v^f) and enrichments. Additionally, 19 benchmarks having enrichments of 7.41 and 9.83 wt% ^{235}U were evaluated to demonstrate the lack of a trend in the bias for enrichments greater than 5 wt% ^{235}U, but these were not used in the determination of the upper subcritical limit (USL) or the determination of the validated area of applicability (AOA). The licensee analyzed these benchmarks using the statistical methodology in NUREG/CR-6698, "Guide for Validation of Nuclear Criticality Safety Methodology." The licensee verified that the data was normally distributed using the chi-squared (χ^2) test from the USLSTATS data analysis code, as well as the Anderson-Darling and Kolmogorov-Smirnov tests. The calculated k_{eff} values were trended as a function of the energy of average lethargy causing fission (EALF), moderator-to-fuel (H/X) ratio, and enrichment. The moderator-to-fuel volumetric ratio v^m/v^f applicable to heterogeneous systems was converted to an equivalent H/X value using a formula derived in the RAI response dated May 13, 2005. The USL of 0.9646 was taken from the parameter trend giving the lowest calculated k_{eff}. The validation report also contained several sections devoted specifically to justifying the 0.02 minimum margin of subcriticality. The various arguments contained in the validation report are summarized below (section numbers refer to sections of the validation report).

Section 1.4.2 stated that fuel assemblies are "well-defined" systems, in that they are subjected to exacting tolerance requirements and quality assurance testing, that conservative modeling practices ensure that the models bound allowed variations in physical characteristics, and that there is an extensive history of reactor performance to confirm their acceptability. Details of the quality assurance practices are provided in Section 1.4.2.1, along with historical data from the 2004 production year showing the average deviation of pellet enrichment for each lot of pellets produced. The supplemental information received on June 22, 2005, contained additional data on actual measured deviations of parameters and the effect of these deviations on calculated k_{eff}. Section 1.4.2.2 addresses the extensive analysis and reactor experience associated with well-thermalized fuel assemblies and draws a connection between being "well-defined" and having a reduced margin of subcriticality by stating: "Fissile systems which are known to be subcritical with a high degree of confidence (well-defined systems) do not warrant application of the traditional administrative margin of 0.05 for systems where subcriticality is less certain." Section 1.4.2.3 contains a short list of conservative modeling assumptions to show that the as-modeled configuration of fuel assemblies bounds any variation within manufacturing tolerances.

Section 6.1.5 contains a statistical justification for the reduced margin of subcriticality based on: (1) the presence of an adequate number of representative benchmark experiments analyzed that cover the AOA applicable to fully-flooded fuel assemblies; (2) a comparison of two different statistical methods for determining the USL (the "USL-2 analysis"); and (3) a conservative method of determining the final USL from the results of the various trending analyses.

Section 6.1.6.1 contains a more detailed list of conservative modeling assumptions and states that they result in a net conservatism $^{a}k_{eff}$ of ~3-4%. Section 6.1.6.2 repeats the justification that fuel assemblies are well-defined systems.

Section 7.1.1 contains a slightly different statistical justification than that in Section 6.1.5. In addition to the arguments presented in Section 6.1.5, Section 7.1.1 states that the statistical confidence criteria exceed the recommended minimum criteria in NUREG/CR-6698, which produces an added margin of 1-2%.

Section 7.1.2 repeats the argument that the minimum margin of subcriticality of 0.02 is justified based on conservative modeling assumptions applied to well-defined systems.

The review of these aspects of the validation report is summarized below.

2.2 NRC Technical Review

The staff reviewed the scope of the amendment request to determine exactly what physical conditions were intended to be covered by the amendment request. While the language in the license application states that the decrease in margin is applied to "finished (undamaged) fuel assemblies" under "off-normal conditions," it was not immediately clear what these off-normal conditions are. However, the cover letter to the amendment request states that the request applies to "the bounding case off-normal condition of being fully flooded" and further clarifies that "damaged or partially loaded fuel assemblies are not placed in these locations." The submitted validation report also states that the validated AOA consists of "heterogeneous UO_2 applications involving single flooded fuel assemblies." Therefore, the staff concludes that it is only necessary to determine whether a finished, fully-flooded fuel assembly is subcritical with a minimum margin of subcriticality of 0.02. Because reactor fuel is designed with a negative void reactivity coefficient, fuel assemblies that are less than fully-flooded will have a lower calculated k_{eff}. Partially loaded fuel assemblies will likewise be less reactive than this bounding case.

The staff's technical review focused on four aspects of the physical systems and processes covered by the amendment request: (1) evaluation of the degree of similarity between the critical benchmarks and off-normal conditions being evaluated; (2) characterization of finished fuel assemblies as well-defined systems; (3) likelihood of attaining the abnormal condition; and (4) conservatism in modeling practices and the statistical methodology. The staff's review of these aspects is discussed in the following sections.

2.2.1 Similarity of Critical Benchmarks to Off-Normal Case

The staff did not perform a comprehensive review of all aspects of the validation report, but only those aspects that the staff judged pertinent to justifying the minimum margin of subcriticality in relation to this application. Besides the specific sections containing technical justifications for the reduced margin, the staff reviewed the description of benchmark experiments and compared the experiments to the off-normal case of a fully-flooded fuel assembly. Because the actual k_{eff} value of a physical system (in this case, the fully-flooded fuel assembly) is not precisely known, the usual practice of selecting critical benchmark experiments, which have k_{eff} values equal to or very close to 1, was followed. Benchmark experiments having similar physical characteristics (i.e., geometric forms, material compositions, and neutron spectra) to the cases being validated must be chosen, to provide assurance that the bias associated with these experiments is representative of that associated with the cases being validated. Thus, the greater the similarity of the experiments to the cases being validated, the greater the confidence that one has accounted for all sources of bias and uncertainty. In such cases, a reduced minimum margin of subcriticality may be acceptable.

The staff determined, based on its review, that the 83 critical benchmark experiments bound the range of parameters encountered by the narrowly-defined case of a fully-flooded fuel assembly. The table below compares the parameters corresponding to this case to those of the 83 benchmark experiments.

Parameter	**Fully-Flooded Fuel Assembly***	**Range of Benchmarks**
Material Form	UO_2 pellets	UO_2 pellets
Geometrical Shape	rectangular fuel lattices	rectangular fuel lattices
Absorbers/Reflectors	water, concrete, zirconium alloys, stainless steel	water, concrete, zirconium alloys, aluminum, stainless steel, polyethylene
EALF (eV)	0.19 - 0.25	0.11 - 2.48
H/X	89 - 100	17.4 - 255.9
Enrichment (wt% ^{235}U)	5.1	2.45 - 4.74

*Based on the model of the most reactive fuel assembly

Based on this, the fully-flooded fuel assembly model falls well within the range of parameters of the benchmark experiments, with the exception of enrichment. The range of materials covered by the benchmarks includes the range of materials in the fully-flooded fuel assembly as a subset, and therefore bounds the fuel assembly. In addition, the inclusion of aluminum is not expected to have a significant effect on the bias because the cross sections of aluminum are much lower than those of the other included materials. The inclusion of polyethylene is also not expected to have a significant effect on the bias because this is a low-density hydrogenous moderator very similar in moderating and reflecting properties to water.

In addition, the staff reviewed the distribution of benchmark experiments within the entire range to determine whether there were sufficient benchmarks with parameters close to the much narrower range covered by fully-flooded fuel assemblies. The range in H/X covered by fully-flooded fuel assemblies falls in the middle of the range covered by the benchmark experiments. While there are no benchmarks within the much narrower range covered by fully-flooded fuel assemblies, the majority of the data have EALF values very close to that of fully-flooded fuel assemblies. Because the EALF is a more direct measure of the degree of thermalization than H/X, the staff has reasonable assurance that the majority of benchmarks have very similar spectra to that of a fully-flooded fuel assembly. The enrichment that is used in the calculations of 5.1wt% ^{235}U exceeds that of any of the benchmark experiments. There is a sizeable cluster of experiments with the highest enrichment of 4.74wt% ^{235}U. To determine the possible impact of this difference, the staff consulted Table 2.3 of NUREG/CR-6698, "Guide to Radiation of Nuclear Criticality Safety Calculational Methodology." This table contains parametric criteria for benchmark selection that is widely accepted as being the conservative result of expert judgement, which is also used as "typical extrapolation ranges" for extending the validated AOA. Table 2.3 indicates that the extrapolation range for enrichments between 2 and 5 wt% ^{235}U is ±1.5 wt%. This would mean that extrapolation would be permissible from 4.74 to 6.24 wt% ^{235}U. This greatly exceeds the gap between the data and the fuel assembly model. Based on the staff's observation of the trend in Figure 6-2 (calculated k_{eff} vs. enrichment), it is clear that extending the trend will have only a minor effect on the USL. The data tested normal using the chi-squared and Kolmogorov-Smirnov normality tests. The 83 benchmarks passed the Anderson-Darling test only if one of the data points was removed as an outlier. No physical justification was provided for discarding this outlier. The data point that was discarded, however, had a higher calculated k_{eff} than any of the other benchmarks, and its removal has only a negligible effect on the bias and bias uncertainty.

Based on this review, the staff concludes that there is a large number of critical benchmark experiments with physical characteristics nearly identical to those of fully-flooded fuel assemblies and that the range of parameters covered by the benchmark experiments bounds the much narrower range corresponding to the fully-flooded fuel assembly. As was discussed at the beginning of this section, the benchmark experiments in this validation report qualitatively represent a much closer similarity to the well-defined fuel assembly system than is typically seen for other fuel cycle facilities. Therefore, the staff concludes that the high degree of benchmark similarity supports the use of a reduced margin of subcriticality of 0.02.

As stated at the beginning of this section, this review does not represent wholesale approval of the validation for finished fuel assemblies.

2.2.2 Fuel Assemblies as "Well-defined Systems"

The following table summarizes the nominal values, manufacturing tolerances, historically measured deviations, and bounding model values (i.e., those used in criticality calculations, for physical parameters associated with the most reactive fuel type currently manufactured at the MAR facility). The source of this data was the RAI response dated May 13, 2005, combined with the supplemental information submitted on June 22, 2005.

Parameter (dimension)	Nominal Value/ Manufacturing Tolerance	Historically Measured Deviation[3]	Bounding Model Value
Pellet OD (in)	0.3615 ± 0.0007		0.3622

Clad ID (in)	0.368 ± 0.002		0.37
Clad OD (in)	0.416 ± 0.002	5.68×10^{-4}	0.414
Guide Tube OD (in)	0.53 ± 0.002		0.528
Guide Tube ID (in)	0.498 ± 0.002		0.5
Inst. Tube OD (in)	0.441 ± 0.002		0.491
Inst. Tube ID (in)	0.441 ± 0.002		0.443
Pitch (in)	0.568[1]		0.568
Active length (in)	144[1]		150
Density (% theoretical)	96 ± 1.5	0.23	97.5
Enrichment (wt%)	4.25[2] ± 0.05	0.0063	5.1

[1]Manufacturing tolerance not given
[2]Typical value (varies)
[3]No historical data was provided for the grayed-out entries

The applicant analyzed the sensitivity of the system k_{eff} to the parameters in the table and concluded that only the clad outer diameter, fuel pellet density, and enrichment had a significant effect (greater than 0.1% Î k_{eff}). Based on this, the staff requested that historical data be provided on the deviation of these parameters to demonstrate that the deviations associated with other parameters will have a negligible effect on system k_{eff}.

Based on its review, the staff agrees that finished fuel assemblies can be characterized as “well-defined” based on tight manufacturing tolerances ensured by strict quality assurance practices. The air cleaning and drag gauge stations are near the end of the fuel manufacturing process; prior to this, the individual pellets and rods, as well as the finished assembly, are subject to multiple quality assurance tests to ensure that their physical characteristics are within specified tolerances. Therefore, the staff finds it almost certain that significantly damaged fuel would be removed from the production line before reaching the air cleaning and drag gauge stations. This is evidenced by the table, which shows that the licensee has demonstrated an ability to maintain dimensions well within the stated tolerances, in accordance with its strict quality assurance practices.

The fact that the finished fuel assembly may be considered to be a “well-defined” system is relevant to the choice of the minimum margin of subcriticality because it demonstrates that the fuel assembly, as constructed, has a fixed configuration whose neutron physics is well-known. Fuel specifications must be tightly controlled if the fuel is to be usable in a reactor. The performance (including reactivity) of in-core reactor fuel has been studied extensively and requires strict manufacturing tolerances. The licensee has stated that it will not place damaged fuel assemblies in either of these test stations. The staff has reasonable assurance that this will be the case because these stations are near the end of the production line and are only used to ensure that fuel meets the required product specifications. Damaged fuel is not usable in a reactor environment and thus there is no motive for placing obviously damaged fuel into these stations. Fuel whose damage is not obvious could be placed into these stations, but such a minimal deformation of the fuel would have only a negligible effect on the calculated k_{eff}. Moreover, due to the proposed wording in the license application, fuel that is damaged is limited to a maximum k_{eff} of 0.95 under off-normal conditions.

In addition, the configuration of the fuel assemblies is unlikely to change once they have been placed in the test stations, which consist of immovable pits in which the assemblies are placed for testing. In its RAI response dated May 13, 2005, the licensee stated that the Integrated Safety Analysis (ISA) process did not identify any accident sequences in which fuel assemblies would be damaged while in the test stations. Because the fuel assemblies consist of well-defined systems, there is very little uncertainty as to its exact physical configuration. The range of parameters covered by the fuel assemblies is therefore very narrow and was shown to be well within the AOA in the validation report. The licensee's analysis showed that variation within tightly controlled tolerances has a negligible effect on the system k_{eff}. Also, no credible off-normal conditions have been identified that could result in a more reactive or less-understood configuration than the fully-flooded bounding case. A larger margin of subcriticality will be appropriate for the general case than for a single specific system whose neutron physics has been extensively studied and is well known. Therefore, the staff concludes that the extensive knowledge of the neutron physics of this well-defined system supports the use of a reduced margin of subcriticality of 0.02.

2.2.3 Likelihood of the Abnormal Condition

Besides the justification for the 0.02 minimum margin of subcriticality as discussed above, and as specifically provided in the validation report, there are other considerations that ensure that the risk of inadvertent criticality with a fully-flooded fuel assembly evaluated at a k_{eff} of 0.98 is very low.

The most important factor providing assurance that a fully-flooded fuel assembly is subcritical is the fact that it must be designed to be subcritical, or else it would not be possible to load it into the reactor core. Fuel designers have a long history of designing fuel assemblies with similar configurations to the assemblies to be loaded into these test stations. Under fully-flooded conditions, the neutron spectra are well-thermalized, and both the in-core behavior of these assemblies and the thermal neutron cross sections have been studied and measured extensively. The configuration of a finished fuel assembly loaded into the test stations is essentially the same as a fuel assembly that is shipped to reactors, stored at the reactor site, and then loaded into the reactor core. While the water in the reactor cavity is borated, the fuel must be evaluated to be subcritical under unborated and fully-flooded conditions, in accordance with the requirements of 10 CFR 50.68. In accordance with this regulation, there must be a high degree of confidence that such systems will be safely subcritical under fully-flooded and optimum moderation conditions.

In addition, the staff noted that there are approximately 15 different types of fuel assemblies that will need to be loaded into the two test stations. The criticality analysis was performed using the most reactive fuel type, so that not every fuel assembly would have the maximum k_{eff}. As indicated in the August 3, 2005, submittal, only 6 of the approximately 15 different types of fuel assemblies will exceed a k_{eff} of 0.95 under fully-flooded conditions. While this feature of plant operations is not controlled, it constitutes additional margin for all but the most reactive fuel types.

Moreover, occurrence of the off-normal condition is very unlikely due to a number of factors. Fuel assemblies are not intended to be stored in the test stations, but will be present in the station for a short period. During this time, they will be actively subjected to tests, such that plant personnel will be present during most of the time that the fuel assemblies are in the test stations. Therefore, there is expected to be a very narrow window of vulnerability during which fuel would be present in the below-grade pit without an operator being immediately present. Flooding requires failure of redundant sump pumps, which are equipped with stand-by power. In addition, redundant level controls provide a high-level alarm to alert operators to accumulation of water in the pit. The operators are required to remove the assembly from the pit upon a high-level alarm; this action is credited as an item relied on for safety (IROFS) in the ISA Summary. Even if the pumps and level alarm were to fail, it is very unlikely that plant personnel, who would be actively performing tests on the assembly, would not notice the pit flooding. It is therefore the staff's judgement that it is very unlikely that the pit would flood to a sufficient depth to cause the system k_{eff} to approach that of the analyzed off-normal condition. (It is not actually necessary to flood the entire 12-foot length of the fuel assembly to approach the fully-flooded case k_{eff} . It is the staff's experience that it would likely require flooding of the lower several feet of the assembly.) The following sequence of events would have to occur before the off-normal condition could be approached: (1) placement of one of the most reactive fuel assemblies in the pit; (2) failure of the redundant sump pumps; (3) failure of operators to respond to a high level alarm (caused by failure of the alarm and/or level control, or failure of operators to respond to an alarm); and (4) failure of operators to be present or to notice the flooding before a depth of several feet is reached. Therefore, the staff concludes that the remote likelihood of attaining the fully-flooded condition supports the use of a reduced margin of subcriticality of 0.02.

2.2.4 Conservatism in Modeling and Statistical Methodology

The applicant provided information intended to demonstrate a reliable and dependable amount of conservatism in the modeling of fuel assemblies in the drag gauge and air cleaning stations. While this is true for the most reactive assemblies considered in the submitted validation report, due to assuming an enrichment of 5.1wt% ^{235}U in the criticality calculations, this may not be the case for future assembly designs. The most reactive assembly is currently limited to 4.25wt% ^{235}U; modeling these assemblies at 5.1wt% ^{235}U provides a margin in k_{eff} of approximately 3%. Thus, an assembly with a calculated k_{eff} of 0.98 actually has a k_{eff} ~0.95, which is the currently approved abnormal condition license limit. However, future assemblies may be manufactured with enrichments up to 5wt% ^{235}U under the current license, which would erode most of this k_{eff} margin. Therefore, the margin provided by assuming a higher enrichment than that for current fuel types cannot be relied on to justify a reduction in the margin of subcriticality. The staff reviewed the supplemental information provided on August 3, 2005, and determined that the conservatism in other parameters also could not be relied on to justify a reduction in the margin of subcriticality. As shown in the table in Section 2.2.2 of this SER, the bounding case model takes into account the worst-case combination of manufacturing tolerances, but does not apply margin beyond the manufacturing tolerances. Although it is very unlikely that a fuel assembly would be manufactured with all tolerances combined in the most reactive manner, variation within the manufacturing tolerances is allowed by the quality assurance practices and cannot contribute to the margin of safety.

The applicant also stated that its statistical methodology justified use of a 0.02 minimum margin of subcriticality. The applicant used the USLSTATS data analysis code distributed by Oak Ridge National Laboratory, which computes USLs based on two statistical methods: (1) confidence band with administrative margin, and (2) lower tolerance band, also known as the single-sided uniform with closed interval approach. Method 1 requires the choice of an administrative margin, while Method 2 (which does not) is intended to be a more conservative statistical approach. The licensee stated that the difference between USLs calculated using Methods 1 and 2 (USL-1 and USL-2) indicates that 0.01208 is an adequate margin of subcriticality that is bounded by the 0.02 requested in the amendment. This is mathematically equivalent to the argument that is frequently made that as long as USL-1 (including the margin of 0.02) is less than USL-2, the choice of margin in Method 1 is adequate.

The NRC has taken the position that the comparison of USL-1 with USL-2 does not demonstrate the adequacy of the minimum margin of subcriticality. This condition that USL-1 is less than USL-2 is necessary, but not sufficient, to show that adequate margin as used in Method 1 has been provided. Method 1 and Method 2 are two different statistical treatments of the data, and a comparison between them can only demonstrate whether the margin is sufficient to bound statistical uncertainties included in Method 2 but not included in Method 1. There may also be other statistical or non-statistical errors in the calculation of k_{eff} that are not handled in the statistical treatments.

The applicant also stated that its statistical methodology was conservative compared to the statistical methodology in NUREG/CR-6698, "Guide for Validation of Nuclear Criticality Safety Calculational Methodology." Section 7.1.1 stated that the licensee used a 95/99.9 confidence criterion for determining the bias and bias uncertainty. This means that there is a 95% chance that 99.9% of all future calculations of critical systems will have calculated k_{eff} above the USL. This exceeds the minimum recommended 95/95 criterion from NUREG/CR-6698, which the licensee stated provides ~1% margin in k_{eff}. The staff, however, noted that the 99% population fraction is only used in USLSTATS Method 2 (the lower tolerance band method). Because the value of USL-1 must be less than USL-2, application of a different population fraction will not in most cases, change the final USL. It would only change the final USL if the change in USL-2 were sufficiently large to require additional subcritical margin to ensure that USL-1 remained lower than USL-2. The staff independently ran USLSTATS with the differing statistical criteria and determined that the difference was not sufficiently large to affect the final USL. Therefore, the staff concludes that this change in the population fraction does not result in conservatism in

k_{eff}. Therefore, the staff concludes that modeling and statistical conservatism cannot be relied on to support the use of a reduced margin of subcriticality of 0.02. However, the staff also concludes that the considerations discussed in the previous sections are sufficient to provide reasonable assurance of subcriticality with a margin of 0.02.

3.0 CONCLUSION

The staff has reasonable assurance that a finished fuel assembly under fully-flooded conditions in the air cleaning and drag gauge stations would be subcritical when evaluated with a margin of subcriticality of 0.02. This is based on the following: (1) the area of applicability covered by fully-flooded fuel assemblies covers a very narrow range, for which there is a large number of applicable benchmark experiments; (2) the benchmark experiments in this range exhibit a very high degree of similarity (i.e., they have similar geometry, material, and spectral characteristics) to a fully-flooded assembly; (3) fuel assemblies are manufactured to strict quality assurance requirements, such that variation within manufacturing tolerances will have a negligible effect on the ability of the code to calculate k_{eff}; (4) the physical and neutronic characteristics of this narrowly-defined system configuration have been extensively studied to qualify it for in-core use; (5) there is ample additional evidence that a fully-flooded fuel assembly is subcritical; and (6) attainment of the off-normal condition is considered extremely unlikely.

Reducing the margin of subcriticality from 0.05 to 0.02 requires modification of current license condition S-4, which currently limits all plant operations under abnormal conditions to 0.05. In addition, should future fuel assemblies not fall within the area of applicability in the validation report reviewed, a separate validation would need to be performed. Conclusions regarding the similarity and number of benchmarks were only made in connection with the validation report submitted on April 11, 2005. Therefore, the basis for this approval is limited to fuel assemblies within the area of applicability of that submittal.

The revised condition S-4 will therefore read:

S-4: Notwithstanding Section 5.2d of the licensee's application, when determining subcriticality based on computer calculations, the k_{eff} of a system or process shall not exceed 0.87 for normal conditions or 0.95 for credible off-normal conditions, including bias and uncertainty, with the exception of a finished (undamaged) fuel assembly in the drag gauge or air cleaning station under credible abnormal (fully flooded) conditions, which shall not exceed 0.98, including bias and uncertainty. This limit shall apply provided the fuel assembly has been analyzed to be within the area of applicability defined in Column 4 of Table 5-2 of the April 11, 2005, submittal.

Prior to modifying the nuclear criticality safety validation methodology (as defined in the July 18, 2003, submittal), Framatome must perform an analysis to determine if the proposed methodology is more or less conservative than described in the July 18, 2003, submittal. If the analysis shows that the new methodology is more, or equally, conservative, then Framatome must submit a detailed description of the new methodology, and a justification for the conservatism, 60 days prior to implementation. If the analysis determines the methodology to be less conservative, then Framatome must obtain a license amendment before implementation.

With this condition, the staff has reasonable assurance of subcriticality with a margin of 0.02 for the specific application requested by the licensee.

4.0 ENVIRONMENTAL REVIEW

Authorization of the change in administrative margin for two stations constitutes a change in process operations and equipment and meets the following requirements:

(i) there is no significant change in the types or significant increase in the amounts of any effluents that may be released offsite,
(ii) there is no significant increase in individual or cumulative occupational radiation exposure,
(iii) there is no significant construction impact, and
(i) there is no significant increase in the potential for or consequences from radiological accidents.

Operation of the fuel in the two stations will not cause a change in the types or significant increase in the amounts of any effluents that may be released offsite. The process also has similar radiological characteristics as the current fuel process system currently authorized at the site. The authorization of this process will not result in any significant increase in individual or cumulative occupation radiation exposure. There will be no significant construction impact since the system is currently being used in an existing facility. No construction activities are required. There will be no significant increase in the potential for or consequences from radiological accidents as discussed in the safety evaluation.

Accordingly, NRC staff has determined that the criteria from 10 CFR 51.22(c)(11) for a categorical exclusion has been met. Therefore, neither an environmental assessment nor an environmental impact statement is warranted for this action.

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