FRAMATOME ANP

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FRAMATOME ANP, Inc.

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Document Control Desk
ATTN: Chief, Planning, Program and Management Support Branch
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001

Response to Supplemental Question on BAW-10238(P), Revision 1, "MOX Fuel Design Report."

Ref.: 1. Letter, James F. Mallay (Framatome ANP) to Document Control Desk (NRC), "Request for Approval of BAW-10238(P), Revision 1, 'MOX Fuel Design Report'," NRC:03:037, May 30, 2003.

Framatome ANP requested the NRC's review and approval for referencing in licensing actions the topical report BAW-10238, Revision 1, "MOX Fuel Design Report" in Reference 1. During a conference call with the NRC on January 29, 2004, a final supplemental question on Reference 1 was discussed. Attached please find the response to this question.

Also included in the attachment are corrections to two tables from previously submitted material. These responses are provided in two attachments- one proprietary and one non-proprietary.

Framatome ANP considers some of the information contained in Attachment 1 to be proprietary. The affidavit provided with the original submittal of the topical report satisfies the requirements of 10 CFR 2.790(b) to support the withholding of this information from public disclosure.

Very truly yours,

James F. Mallay/sm

James F. Mallay, Director
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Enclosure

cc: M. C. Honcharik
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Response to Supplemental Question on Topical Report BAW-10238(P), MOX Fuel Design Report

Supplemental Question 5: *Please describe the schedule for all PIEs. Also, describe the hot cell examinations to be performed and the expected results.*

Supplemental Response 5: The hot cell examinations will include a set of inspections intended to confirm that the fuel is performing acceptably. The set of inspections is similar to what might be used with a new design for LEU fuel.

Plans for lead assembly irradiation have been clarified since BAW-10238 was written. The report states that "it may be necessary to limit the program to two (2) lead assemblies." That contingency now appears unlikely because plutonium polishing operations are proceeding smoothly. BAW-10238 likewise states that fuel rods will be extracted for hot cell examination "after the third cycle of operation." It is expected that only one or two of the four lead assemblies will be irradiated for a third cycle. Therefore, at least two of the four lead assemblies should be available to accommodate a hot cell examination after the second cycle. The current plan is to extract rods from these assemblies so that the results of the hot cell examinations will be available earlier. Table SQ5.1 summarizes the expected schedule for lead and batch irradiations. This schedule provides the results of the hot cell PIE early in the first irradiation cycle of batch assemblies.

Table SQ5.1. Expected Schedule for Lead and Batch Irradiation of MOX Fuel

Lead Assemblies	
Start first cycle irradiation	spring 2005
Perform first poolside PIE (basic)	fall 2006
Start second cycle irradiation	fall 2006
Perform second poolside PIE (basic)	spring 2008
Start third cycle irradiation	spring 2008
Perform second poolside PIE (extended)	summer 2008
Ship rods to hot cell for PIE	spring 2009
Finish third cycle irradiation	fall 2009
Perform third poolside PIE (basic + extended)	winter 2009-2010
Complete hot cell PIE on second cycle rods	summer 2010
Batch Assemblies	
Submit batch license amendment request	summer 2005
Receive license amendment approval	summer 2008
Start first batch irradiation	spring 2010

At least four rods will be selected for hot cell examination. Rod selection will reflect the following considerations: (1) High-burnup rods are generally preferable. (2) The rods should be chosen from more than one assembly. (3) The rods should represent all three zones of plutonium content. (4) The rods should be chosen from various types of locations (e.g., corner, interior).

The following sections describe the hot cell examinations. Each section provides an expected result. If the results of the inspections are inconsistent with the expected results, an evaluation will be performed to determine the cause and determine whether any corrective action is necessary.

Rod Puncture

This measurement is to confirm models for fission gas release. The plenum of each rod will be punctured, and the gas will be collected. The quantity and chemical composition of the gas will be determined. The void volume of the rod will be measured, and the end-of-life gas pressure will be calculated from the PIE measurements. The expected result is that the gas pressure will be less than that predicted by the COPERNIC upper-bound model. The COPERNIC prediction will reflect appropriate values of the design tolerances discussed in section 13.1.2 of Reference SQ5.1.

Metallography/Ceramography

Eight samples of cladding will be prepared and examined by optical metallography. The cladding will be examined for oxide thickness and for amount, orientation, and distribution of hydrides. The expected results are that (1) the oxide thickness will be consistent with both the predicted thickness and the thickness measured during the poolside PIE and (2) hydride amounts, orientation, and distribution will be similar to those for LEU fuel with M5® cladding and comparable burnup.

Eight samples of fuel will also be examined to determine the structure of the plutonium-rich agglomerates. The expected result is that the structure of the plutonium-rich agglomerates will be consistent with results observed previously for reactor-grade MOX fuel.

Fuel cladding metallography and fuel pellet ceramography may be combined by taking sections of fuel rods that include both pellet and cladding. A single sample might be prepared first for examination of the fuel, then polished and etched again for examination of the cladding.

Cladding Mechanical Tests

This measurement is to confirm that the fuel cladding retains sufficient ductility at end of life. Four short sections of fuel rod will be defueled, and rings of cladding will be prepared. A deformable plug will be inserted into each ring. The cladding will be tested by radially expanding the plug. The tests may be terminated at a predetermined strain rather than at failure. A record of each test will be produced, showing the change in cladding diameter as a function of applied load. The ductility of the cladding will be determined from the change in diameter. The expected result is that the total circumferential elongation will be at least 2%.

Burnup Analysis

This measurement is to confirm models for core power density. Axial burnup profiles for two fuel rods will be determined by gamma scanning. The expected result is that the axial burnup profiles will be consistent with those predicted by neutronic modeling.

Burnup Distribution

This measurement is to confirm models for the radial burnup distribution within a pellet. Two transverse sections will be examined. Burnup will be determined by electron probe microanalysis (EPMA). The expected result is that the burnup distribution will be consistent with the predicted radial burnup distribution. The measured burnup profile is expected to be very irregular because of local variations in the initial plutonium content (agglomerates), so smoothing of the measured burnup distribution will probably be necessary.

2. SQ5.1 BAW-10231P Chapter 13, *COPERNIC Fuel Rod Design Computer Code: Chapter 13 – MOX Applications*, July 2000.

Correction to Table Q16.1 and Q10.5 of Previous Submittal

Table Q16.1. Holddown Margins for Mark-BW/MOX Lead Assemblies (McGuire)

Condition	Minimum Holddown Load (lbs)	Net fuel assembly lift (lbs)	Margin (%)
85 °F BOL 4th Pump Startup	[ ]	[ ]	[ ]
85 °F EOL 4th Pump Startup	[ ]	[ ]	[ ]
Hot operating BOL	[ ]	[ ]	[ ]
Hot operating EOL	[ ]	[ ]	[ ]
Hot operating 120% Pump Overspeed	[ ] (elastic load limit)	[ ]	[ ]

Note: BOL = beginning of life; EOL = end of life

Table Q10.5. Top Nozzle and Bottom Nozzle Stress Margins for Normal Operation

Component	Condition	Maximum Applied Stress (psi)	Margin (%) Pm + Pb
Top nozzle	Normal operating EOL HD force (600 °F) + Scram load	[ ]	[ ]
Top nozzle	Normal operating EOL holddown force @ 70 °F	[ ]	[ ]
Bottom nozzle	Normal operating (EOL HD) @70 °F	[ ]	[ ]
Bottom nozzle	Normal operating (EOL HD) @600 °F + Scram load	[ ]	[ ]
Bottom nozzle filter plate	Normal operating	[ ]	[ ]

Note: EOL = end of life; Pm + Pb = primary membrane + bending; HD = holddown