UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

February 4, 2000

MEMORANDUM TO: Susan F. Shankman, Deputy Director
Licensing and Inspection Directorate
Spent Fuel Project Office
Office of Nuclear Material Safety
and Safeguards

FROM: Timothy J. McGinty, Project Manager
Licensing Section
Spent Fuel Project Office
Office of Nuclear Material Safety
and Safeguards

SUBJECT: SUMMARY OF JANUARY 18, 2000, MEETING WITH NAC INTERNATIONAL AND MAINE YANKEE REGARDING THE NAC-UMS STORAGE AMENDMENT APPLICATION (TAC NO. L22979)

On January 18, 2000, representatives of the Nuclear Regulatory Commission (NRC), NAC International, Inc. (NAC), and Maine Yankee met to discuss NRC's request for additional information (RAI) for the NAC-UMS Storage system amendment request to incorporate the contents of the Maine Yankee spent fuel pool. An attendance list is included as Attachment 1. Attachment 2 includes the handouts provided by NAC at the meeting. This meeting was noticed on January 11, 2000.

The meeting commenced with a presentation by NAC on its planned responses for several of the RAIs. NAC indicated that Maine Yankee's two consolidated fuel assemblies will be treated as damaged fuel and canisterized. NAC also discussed its bases for establishing a coefficient of friction for the cask seismic stability analysis, including justification for using test results through an administrative control program.

The characterization of Maine Yankee's damaged fuel was also discussed. NAC indicated that it intended to change the definition of damaged fuel to be consistent with the staff's Interim Staff Guidance (ISG) No. 1 and to assume the failure of 100% of the rods in a damaged assembly. However, the definition of damaged fuel has been a subject of recent staff and industry dialogue, and this aspect was further discussed at the meeting. Pending the results of near-term staff/industry discussions, NAC will likely pursue using a definition of damaged fuel consistent with Nuclear Energy Institute's (NEI) protocol. A key provision of the NEI protocol is supportive of not canning Maine Yankee fuel assemblies with defects greater than pinhole leaks/hairline cracks (but small enough to contain fuel fragments and pellets).

The staff's acceptance of the NEI protocol, via an anticipated ISG-1 revision, is a critical path to the scheduled completion of the amendment. Maine Yankee expressed concern that the approval schedule should not be affected by any delays in reaching an NRC/industry consensus on the definition of damaged fuel. Considering the already established definition of damaged fuel within ISG-1 and NAC's preparedness to quickly revise the application if

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reaching a consensus proves difficult, the staff does not anticipate that the review schedule will be adversely affected by this issue.

Maine Yankee's 90 high-burnup fuel assemblies (HBFAs) were the main focus for the remainder of the meeting. Maine Yankee's HBFAs for this amendment request are fuel assemblies with an average assembly burnup between 45,000 and 50,000 MWd/MTU. NAC provided information on the characteristics (CE 14 x 14 array, enrichment, initial fill gas pressure, burnup, clad thickness, clad stress and discharge date) of the Maine Yankee HBFAs, and compared them to the NAC-UMS design bases Westinghouse 14 x 14 assemblies. NAC's comparison highlighted that Maine Yankee's HBFAs have thicker clad, less decay heat and lower clad stress, and are to be loaded in periphery locations of the basket. Furthermore, a review of the plant operating data found that the power, fuel performance, and chemistry histories for the Maine Yankee HBFAs indicate no past operating problems. Subsequent fuel inspections have determined that none of the Maine Yankee HBFAs are "leakers."

The meeting concluded with a summary of the issues discussed. NAC intends to submit responses to the staff's RAIs by February 5, 2000. Maine Yankee, NAC, and the staff remain focused on completing the rulemaking process for this NAC-UMS Storage system amendment application by April 16, 2001, to meet Maine Yankee's current initial loading date.

Docket Nos: 72-1015, 72-30

Attachments: 1. Attendance List
2. Meeting Handouts

cc: Mr. Paul Bemis
Stone & Webster Engineering & Construction

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January 18, 2000, Meeting between NAC International, Maine Yankee, Stone & Webster and Nuclear Regulatory Commission

ATTENDANCE LIST

Name	Affiliation
Tim McGinty	NRC/SFPO
M. Wayne Hodges	NRC/SFPO
Earl Easton	NRC/SFPO
Ross Chappell	NRC/SFPO
Ron Parkhill	NRC/SFPO
Steve O'Connor	NRC/SFPO
David Tang	NRC/SFPO
Geoff Hornseth	NRC/SFPO
Kim Gruss	NRC/SFPO
Sarah Colpo	NRC/SFPO
Don Carlson	NRC/SFPO
Elaine Keegan	NRC/SFPO
Bill Lee	NAC International
Bud Auvil	NAC International
David van Dusen	NAC International
Paul Bemis	Stone & Webster
Perry Robinson	Stone & Webster
Mike Meisner	Maine Yankee
David Rivard	Maine Yankee
Paul Plante	Maine Yankee
Bill Henries	Maine Yankee
Satya Pati	ABB-CE
Steve Love	BNFL
Alan Nelson	NEI
Mike Callahan	GSI

Attachment 1

NAC-UMS® Maine Yankee Amendment RAI-1 Meeting with NRC - SFPO

January 18, 2000

NAC/SWEC/Maine Yankee

ATTACHMENT 2

Introduction

- Introduction and Comments
- Agenda
  - Various RAI Discussion Issues
  - Maine Yankee High Burnup Fuel
- Participants – NAC, Maine Yankee, SWEC, CE
- Objectives
  - Present intended approach for RAI response
  - Obtain feedback from Staff

Detailed Agenda

- RAI Discussion Issues
  - Consolidated Fuel
  - Coefficient of Friction (μ)
  - 25% assumption for damaged fuel
  - High burnup fuel
    - Maine Yankee-specific fuel characteristics
    - Manufacturing records
    - Plant operational information
    - Maine Yankee report - "Evaluation of Burnup Extension in Maine Yankee Fuel"
    - High burnup fuel data
    - Fuel inspection video tape
    - Summary and Conclusions
  - Damaged fuel definition

Maine Yankee RAI Discussion Issues

- Consolidated Fuel
  - Two (2) assemblies in population
  - Will be handled as "damaged fuel" and canned in a corner location (currently under evaluation)
- Coefficient of Friction (μ) on Pad
  - μ=0.5 proposed in Maine Yankee UMS SAR Amendment
  - Published reference states a coefficient of friction of 0.70 between clean steel and concrete

Maine Yankee RAI Discussion Issues

- Damaged Fuel Characterization/Analysis
  - Definition to be changed to be consistent with the requirements of ISG-1
  - 100% of rods in damaged assembly to be conservatively assumed failed (versus 25%)

Maine Yankee High Burnup Fuel

- Today's discussion focuses on ninety (90) *Maine Yankee* fuel assemblies with average assembly burnup between 45,000 and 50,000 MWd/MTU.
  - Fuel Assembly Characteristics – fuel array, fuel vendors, enrichment, initial gas fill pressure, burnup, discharge date
  - Fuel Assembly Manufacturing Records
    - No manufacturing anomalies exist
    - Restricted Tin content leads to reduced oxide layer thicknesses in Zircaloy fuel - Batches Q (partial) and R

Maine Yankee High Burnup Fuel

- Initial Discussion on High Burnup Fuel with NRC in December 1998
- NAC/Maine Yankee SAR Amendment Information

	UMS® PWR Design Basis	Maine Yankee Site-Specific
Number of Assemblies	24	24
Assembly Type	W – 14 x 14	CE – 14 x 14
MTU/Assembly	0.4144	.4037
Clad Thickness (inch)	0.0225	0.028
Pellet O.D. (inch)	0.3674	0.3675
Backfill Pressure (psig)	460	450
Clad Stress (Mpa)	104.2	85.4
Decay Heat/Assembly (Kw)	0.958 (UMS® standard)	0.924 (at 50,000 MWD/MTU, 7 year cooled)

Maine Yankee High Burnup Fuel (continued)

- Comparison of Maine Yankee-Specific Fuel Versus Design Basis
  - Maine Yankee fuel has ~24% (0.0055 inch) thicker clad
  - Maine Yankee fuel has less decay heat
  - Maine Yankee fuel has significantly lower clad stress
    - lower clad stress raises maximum allowable clad temperature (i.e., additional margin)
  - Administrative control to load high burnup assemblies in the periphery locations
- Analysis methodology is conservative

Maine Yankee High Burnup Fuel (Continued)

Fuel Array	Fuel Vendor	Batch Type	Number of Assemblies	Initial Gas Fill – max (psia)	Initial Enrichment ($^{w}/_{o}$ U235)	Burnup (MWD/MTU)	Discharge Date
CE 14 X 14	ENC	M-8	1	390	3.30	46045	4/90
		M-8	1			47079	2/92
	CE	N-8	8	410	3.30	45466	4/90
		P-8	8	410	3.50	46894	2/92
		P-4	4			46697	2/92
		P-4	8			45938	2/92
		Q-8	8	410	3.70	49241	7/93
		Q-4	8			47887	7/93
		Q-4	8			47094	7/93
		Q-0	4			45536	7/93
		Q-0	4			45068	7/93
		R-8	8	410	3.70	48341	1/95
		R-8	4			47647	1/95
		R-8	8			47643	1/95
		R-4	8			46835	1/95

Maine Yankee High Burnup Fuel (Continued)

- Summary of YAEC Report
  - Oxide layer thickness correlations
  - Impacts of reduced Tin Zircaloy
  - Hydrogen pick-up
  - Fission gas release

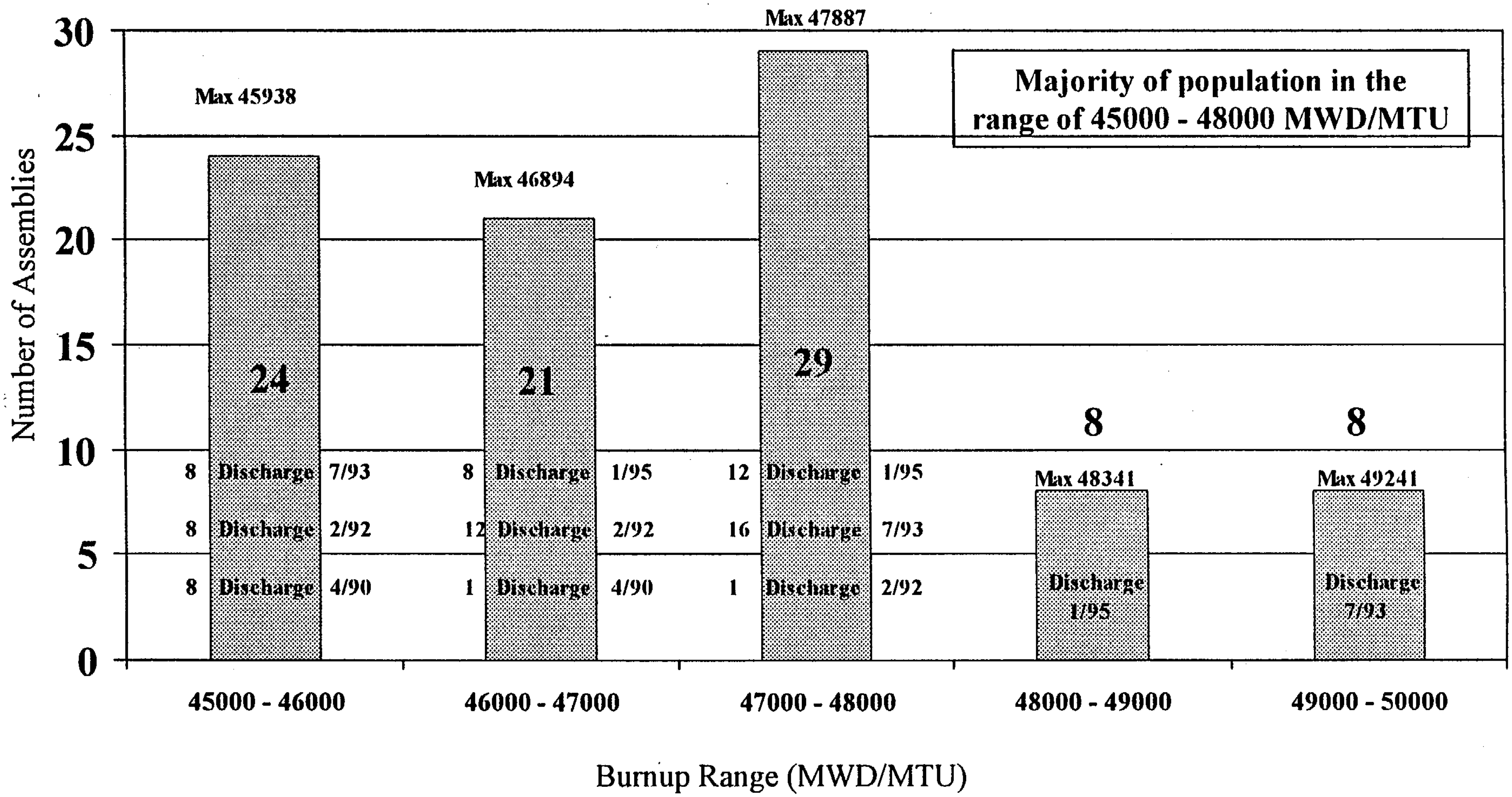
Maine Yankee High Burnup Fuel (Continued)

- YAEC Report Data
  - Maximum Oxide Layer - 87 microns at 48,200 MWD/MTU (compared to 120 microns limit at 50,000 MWD/MTU)
  - Restricted tin levels in clad lowers thickness of oxidation layer
  - Hydrogen Pick-up
    - assuming an oxide layer of 120 microns, clad would absorb 580 ppm of hydrogen
    - industry testing of hydrogen pick-up of 1000 ppm at 1000 °F, clad remains ductile
  - Fission Gas Release (based upon measurement)of 1.5% at 50,000 MWD/MTU
  - Additional conservatism - clad yield strength increase with irradiation

Evaluation of Burnup Extension

- Review of Plant Operating Data
  - Cycle Power History
    - power escalation rate and CEA withdrawal limits based on fuel vendor requirements
    - review of operating reports found no unanticipated events
  - Cycle Chemistry History – RCS and SFP chemistry program demonstrates compliance with fuel vendor requirements
  - Fuel Performance History
    - radiochemistry and fuel inspection data demonstrates no fuel "leakers" in high burnup fuel population
    - fuel inspection did not show any cladding indications

Maine Yankee High Burnup Fuel (Continued)



Maine Yankee High Burnup Fuel (Continued)

- Fuel Inspection Summary
  - Comparison of fuels with burnup of:
    - 35,000 MWd/MTU
    - 40,000 MWd/MTU
    - 45,000 MWd/MTU
    - Up to 50,000 MWd/MTU
  - Video summary

Maine Yankee High Burnup Fuel Summary

- High Burnup Fuel Issue Summary
  - Compared with Westinghouse and B&W fuels, Maine Yankee fuel has:
    - Thicker cladding
    - Reduced initial gas fill pressures
    - Lower MTU loadings
    - Thinner oxide layer
    - Lower resultant stresses even at higher burnup
    - Lower fission gas release fraction
    - Lower thermal decay heat
    - Lower measured hydrogen pick-up
  - No fuel fabrication anomalies
  - No "leakers"
  - Fuel inspection records support "no damage" and no excessive oxide layer conclusion

Maine Yankee High Burnup Fuel Conclusion

- Maine Yankee High Burnup fuel is safe to store as other intact Maine Yankee fuel assemblies (i.e., cladding stresses are bounded by UMS design basis fuels at 45,000 MWD/MTU)
- The Maine Yankee High Burnup fuel has additional margin and conservatism as compared to standard analysis and measurements
- Additionally, there will be administrative controls to load High Burnup fuel in periphery locations that will reduce the thermal impact on the fuel
- NAC will submit supporting data in summary form to respond to High Burnup RAIs

Maine Yankee RAI Discussion Issues

- Proposed Damaged Fuel Protocol
  - MY/SWEC/NAC support the ongoing dialog with NEI
  - If NEI-recommended definition is generically approved in current form (e.g., via ISG-1 revision), amendment likely to be submitted
  - NEI protocol is supportive of <u>not</u> "canning" Maine Yankee assemblies with defects greater than pinhole leak/hairline crack but small enough to contain fuel fragments and pellets (Type 2A)

Maine Yankee Damaged Fuel

- 1999 Visual Fuel Inspection
  - Categories
    - 1A - Standard (undamaged and non-suspect)
    - 1B - Fuel cage damage, but otherwise intact
    - 1C - Clad defects less than pinhole leak/hairline crack
    - 2A - Clad damage larger than pinhole leaks or hairline cracks, but small enough to contain fuel fragments and pellets
    - 2B - Clad damage significant enough to potentially allow the escape of fuel fragments and pellets

Maine Yankee Damaged Fuel

- 1999 Visual Fuel Inspection
  - Results
    - Category 1A - 1293
    - Category 1B - 63
    - Category 1C - 43
    - Category 2A - 26
    - Category 2B - 11

Summary

- Various RAI discussion issues
  - Canisterize consolidated fuel
  - Coefficient of friction of 0.5 to be demonstrated
  - Damaged fuel definition to be consistent with ISG-1
  - 100% rod failure for damaged fuel assumed
- Maine Yankee "high burnup" equivalent to UMS design basis fuel at 45,000 MWd/MTU
- Parallel-track approach to damaged fuel with NEI
- Response to RAI by 2/5/00