ENERGY NORTHWEST

Marian Kellett
Document & Data Services
P.O. Box 968, 964T
Richland, WA 99352-0968
Ph. 509-377-8321F. 509-377-2479
mkellett@energy-northwest.com

March 4, 2010

Mr. Tom Clements
1112 Florence Street
Columbia, SC 29201

Reference: Energy Northwest Request for Public Records, Control Number 2010-02 received January 15, 2010

Dear Mr. Clements:

On January 15, 2010, Energy Northwest Document & Data Services received your Request for Public Records, Control Number 2010-02, for documents related to plutonium fuel (mixed oxide fuel, MOX) use in the Columbia Generating Station. Energy Northwest responded on January 20, 2010, and again on February 22, 2010, that the records would be transmitted to you on or before March 18, 2010.

Per the telephone conversation between yourself and Gail Dockter, Energy Northwest Document & Data Services Supervisor on February 22, 2010, you requested a partial transmittal of the documents currently available. The following attachments represent a partial transmittal of the records requested:

1. Report No. EN-MOX-002, October 28, 2009
2. MOX Loading Procedures in Europe, Energy Northwest Comments
3. Major Steps during Fuel Receipt
4. Energy Northwest MOX Summary, August 17, 2009
5. MOX Fuel Board Presentation, June 2009
6. Report No. EN-MOX-001, May 28, 2009
7. MOX Fuel Long Term & Near Term Focus Presentation, May 14, 2009
8. MOX Status Presentation, Lisa Ferek April 28, 2009
9. Memorandum of Understanding between the Tennessee Valley Authority and Energy Northwest for Advanced Fuel Cycle Demonstration, March 2009

In your request, you ask that Energy Northwest waive the production fee. Unfortunately, as a public entity we are unable to honor your request without a gifting of public funds concern. However, to minimize your expense, we will transmit the documents via email. Please advise should you also wish Energy Northwest to transmit the document via the U.S. Mail. The cost will be $.15 cents per page plus postage.

Subject: Energy Northwest Request for Public Records, Control Number 2010-02 received January 15, 2010

The remaining records are scheduled for transmittal on or before March 18, 2010. For further information, please contact Gail Dockter, Document & Data Services Supervisor at 509-377-2499, or at jgdockter@energy-northwest.com.

Respectfully,

M Kellett

Marian Kellett, Manager
Document & Data Services

MK:jgd
cc: M Kellett, MD 964T
Request for Public Records File

ENERGY NORTHWEST
REQUEST FOR PUBLIC RECORD

Date Received: 01/15/2010

Control No.: 2010-02

REQUESTER

Name: Tom Clements	Fax No.:	Telephone No.: 803-834-3084	Date: 01-11-2010

Address: (Street) 1112 Florence Street

City: Columbia	State: SC	Zip Code: 29201

Email address: tomclements329@cs.com

Representing: Friends of the Earth

Nature of Request:
☐ Inspect Records ☒ Obtain a copy - to be provided at cost ☒ Email a copy

Return form to:
Energy Northwest
Attention:
Document & Data Services, MD 964T
P.O. Box 968
Richland, WA 99352

FAX: (509) 377-2479
Phone: (509) 372-5248

Records Request (Be as specific as possible):

1. Memorandum of Understanding between Energy Northwest and the Tennessee Valley Authority (TVA) related to plutonium fuel (mixed oxide fuel, MOX) use in the Columbia Generating Station. I am aware this document exists.

2. Any agreement or communication between Energy Northwest and the Pacific Northwest National Laboratory related to MOX use.

3. Any presentations or documents on MOX use prepared by Mr. Ted Coates, S. K. Gambhir, Vice President, Technical Services, or J. V. Parrish, Chief Executive Officer, or other Energy Northwest staff. This request includes internal presentations or documents made for the use of staff, or presentations made to the Energy Northwest executive board or the Operations, Construction & Safety (OPS) Committee.

Given that the documents gathered under this request will be used for non-profit public interest use only and will help the public to understand the workings of Energy Northwest, I request a fee waiver for this request.

NOTE: By my signature I acknowledge that I am responsible for paying copying and other costs directly incident to providing the requested records.

Thomas W. Clements
Requester's Signature:

1-11-2010
Date:

ENERGY NORTHWEST

Manager, Responding Organization or Designee:	Date: 4 Mar 10	Manager, Responding Organization or N/A: N/A	Date:

Request Granted: ☐ Yes ☐ No ☒ Partial	Page Count: 61	Copying Fee: 61 x $.15 9.15	Postage: E-mail	Total Cost to Be Paid: E-mail	Please make checks payable to Energy Northwest

Request denied for the following reasons:

Attachments included: See attached

Other Review: N/A	Date:	Legal Review:	Date: 2 MAR 10
Request for Public Record Coordinator	Date: 3/4/2010	Manager, Document & Data Services or Designee:	Date: 4 MAR 10

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Request for Public Records Control No 2010-02

Attachment 1

Report No. EEN-MOX-002

October 28, 2009

BUSINESS SENSITIVE

REPORT NO. EN-MOX-002

LICENSE AMENDMENTS FOR LOADING

MIXED OXIDE (MOX)

LEAD USE ASSEMBLIES

AT A

BOILING WATER REACTOR

October 28, 2009

Prepared by Energy Northwest under TVA contract 76715

OFFICIAL USE ONLY

I. Background

Energy Northwest (EN) is evaluating the potential irradiation of mixed oxide (MOX) fuel assemblies. Under a contract with the Tennessee Valley Authority (TVA), EN is performing tasks to evaluate the licensing of MOX fuel in a boiling water reactor (BWR). This report provides a discussion of the potential licensing amendments that would be required to install MOX lead use assemblies (LUA) at Columbia Generating Station (CGS).

II. Plant Licensing

The following topics will need to be addressed in the CGS license amendment – or dispositioned as having no impact:

1. Operating License – No changes are required for CGS. The existing wording regarding special nuclear material adequately addresses the use of MOX fuel: *"The Commission hereby licenses Energy Northwest to receive, possess and use at any time special nuclear material as reactor fuel, in accordance with the limitations for storage and amounts required for reactor operation, as described in the Final Safety Analysis Report."*

2. Technical Specifications (TS)

   a. TS 4.2.1 Design Features, Reactor Core, Fuel Assemblies, needs to be changed to allow use of MOX as reactor fuel. Specifically, the existing TS wording *"Each assembly shall consist of a matrix of Zircaloy clad fuel rods with an initial composition of depleted, natural, or slightly enriched uranium dioxide (UO2) as fuel material ..."* will need to be revised to allow the use of LUAs containing Pu and uranium.

      In addition, TS 4.2.1 requires that *"lead fuel assemblies that have not completed representative testing may be placed in nonlimiting core regions."* The nuclear design of the reactor core will need to ensure this limitation is observed.

   b. TS 4.3.1.1 Design Features, Criticality, contains the requirements on keff for the spent fuel storage racks. No changes are required for CGS since these requirements just refer back to the FSAR. Specifically, 4.3.1.1.a states, *"The spent fuel storage racks are designed and shall be maintained with keff≤0.95 if fully flooded with unborated water, which includes an allowance for uncertainties as described in Section 9.1.2 of the FSAR."*

   c. TS 4.3.1.2 Design Features, Criticality, contains the requirements on keff for the new fuel storage racks. Subparagraph (a) requires the new fuel storage racks be designed and maintained with keff≤0.95 if fully flooded with unborated water. Subparagraph (b) limits a maximum of 60 new fuel assemblies be stored in the new fuel storage racks arranged in 6 spatially separated zones. 10 CFR 73.55(l)(3)(v)(B) requires unirradiated MOX assemblies be stored in the spent fuel pool and not the new fuel storage vault. However, other plants have not had to modify their TS to include this limitation.

   d. TS 5.6.3 Core Operating Limits Report (COLR) requires that the analytical methods used to determine the core operating limits be listed in this specification. Currently, CGS TS 5.6.3.b lists *NEDO-32465-A, BWR Owners' Group Reactor Stability Detect* *and Suppress Solutions Licensing Basis Methodology and Reload Applications and NEDE-24011-P-A and NEDE 24011-P-A-US, General Electric Standard Application for Reactor Fuel (GESTAR II) and Supplement for United States.* Any methods utilized in the development of the core operating limits for MOX fuel that are not addressed under these approved reports, will need to be added to this TS.

e. TS 2.1.1.2 Reactor Core Safety Limits is typically evaluated each cycle as part of reload licensing. The safety limit may or may not change as a result of MOX fuel. However, typically LUAs are placed in non-limiting core locations.

f. TS 3.7 Plant Systems – No changes required for CGS. Certain plants have storage restrictions in the spent fuel pool based on enrichment, exposure and, in some cases, absorber rods. This specification would need to be modified to specifically allow MOX fuel storage in the racks.

3. Final Safety Analysis Report (FSAR)

a. Codes and Methods - FSAR Section 1.6 contains a listing of topical reports incorporated by reference into the CGS FSAR. Any new or revised codes and methods used to analyze the MOX fuel will need to be included as part of this listing. In general, changes to codes and methods to allow the application to MOX fuel must be approved by the NRC and will be included in a license amendment either requested by the fuel vendor or licensee. The following codes will be used to analyze the MOX fuel:

- Lattice physics
- Steady-state reactor physics (core simulator)
- Fuel rod thermal mechanical
- Advanced reactor transient and accident methods (possibly)

b. Fuel Design - FSAR Section 4.1.2.1 describes the reactor core including the fuel rod and fuel bundle design. The design description will need to be updated to include a discussion of the MOX fuel design. In general, changes to the fuel design to utilize MOX fuel must be approved by the NRC and will be included in a license amendment either requested by the fuel vendor or licensee.

c. Fuel Mechanical Design - FSAR Section 4.2 provides the fuel system mechanical design bases limits and references the applicable reports, codes and methods used to verify that the fuel remains within limits. Applicable topics are: stress/strain, fatigue, fretting wear, oxidation/hydriding/corrosion, dimensional changes, internal gas pressure, hydraulic loads, control rod reactivity, hydriding, cladding collapse, fretting wear, overheating of cladding, overheating of pellets, excessive fuel enthalpy, pellet-cladding interaction, bursting, mechanical fracturing, cladding embrittlement, violent expulsion of fuel, generalized cladding melt, fuel rod ballooning and structural deformation. The new/revised fuel rod thermal mechanical code will be used to analyze much of the aforementioned fuel rod behavior. In general, changes to codes and methods to allow the application to MOX fuel must be approved by the NRC and will be included in a license amendment

d. Fuel Nuclear Design - Plutonium (Pu) has a higher thermal absorption cross section compared with uranium which reduces control rod worth and integral fuel assembly absorber worth affecting shutdown margin. In addition, Pu has larger fission cross sections at high neutron energies which cause the coolant void coefficient of reactivity to be less negative for MOX fuel than for low enriched uranium (LEU) fuel. FSAR Section 4.3 provides the fuel system nuclear design bases and references the applicable reports, codes and methods used to analyze the fuel. Applicable topics are nuclear design description, power distribution, reactivity coefficients, control requirements, shutdown reactivity, reactivity variations, control rod patterns and reactivity worths, and stability. The impact of MOX fuel on control rod worths and other reactivity coefficients will need to be addressed.

e. Neutron Fluence - Pu has a harder neutron energy spectrum which could enhance irradiation damage in the reactor pressure vessel and internals. FSAR section 4.3.2.8 discusses the reactor pressure vessel (RPV) irradiation calculations and results. In addition, FSAR section 5.3 describes the reactor vessel including materials, pressure-temperature (P-T) limits, and vessel integrity. The RPV peak fluence is used for development of the P-T limit curves. The impact of MOX fuel on vessel lifetime and the BWR vessel internals program (BWRVIP) will need to be addressed.

f. Loss of Coolant Accident (LOCA) – Emergency Core Cooling System (ECCS) Performance Evaluation - MOX fuel has reduced thermal conductivity compared with LEU fuel which causes the MOX fuel rods to operate with higher centerline temperatures for a given fuel rod power, increasing the initial fuel rod stored energy for LOCA and possibly resulting in the need for reduced power limits for MOX assemblies. FSAR Section 6.3.3 evaluates the ECCS performance using analytical methods in compliance with the requirements of 10 CFR 50 and Appendix K to show conformance to the acceptance criteria of 10 CFR 50.46. A summary description of the reload design basis LOCA analysis methods is provided in this section of the FSAR. A limiting reactor recirculation coolant (RRC) break is identified and then used in the ECCS heatup analyses to determine the maximum average planar linear heat generation rate (MAPLHGR) limits for the specific fuel type. The MAPLHGR limits calculated in this performance evaluation provide a basis to ensure conformance with the acceptance criteria of 10 CFR 50.46. In general, any new or revised methods for analyzing MOX fuel under LOCA conditions must be approved by the NRC. The LOCA methodology, input variables, break spectrum calculations, and results are reported in this section of the FSAR. The MAPLHGR limits will be reported in the COLR.

g. Criticality - MOX fuel has different isotopics and material properties from LEU fuel necessitating new criticality analysis for fuel storage and handling. FSAR section 9.1.2.3 describes the criticality safety analyses for the spent fuel pool racks. In general, the fuel vendor performs the criticality analysis for their fuel design with the utility reporting the results in its FSAR. Specific analyses need to be performed to model the MOX fuel isotopic concentrations. In the past, the NRC has placed restrictions on the use of various industry-standard codes for the analysis of MOX fuel. Therefore, the criticality analysis will, most likely, need to be included in the utility's license amendment for the use of MOX. Other criticality analysis may need to be completed but are not generally submitted to the NRC including MOX rod storage in a fuel rod storage basket.

h. Decay Heat - Irradiated MOX fuel has a larger inventory of actinides than LEU fuel resulting in greater decay heat levels for cooling times greater than one year. FSAR section 9.1.3 describes the fuel pool cooling system capabilities. Any increase in decay heat levels will need to be addressed.

i. New Fuel Handling – FSAR sections 9.1.4.2.10 and 9.1.4.3 contain a description of the new fuel receipt process and the fuel handling safety evaluation, respectively. The receipt of MOX fuel will need to be addressed especially if a new/different type of shipping container/cask is utilized. Generally the utility is not responsible for licensing/certification of the shipping cask although it must comply with the requirements of the cask Certificate of Compliance.

   In addition, FSAR section 12.2 describes radiation sources and refers exclusively to spent fuel. However, fresh MOX fuel, especially reactor grade Pu, has a higher dose rate than normal LEU fuel such that inclusion in the list of radiation sources may be required to address the fuel receipt and handling operations that occur in air prior to placement in the fuel pool.

   Finally, a drop of a fresh MOX bundle in air may need to be analyzed due to the isotopic differences between fresh LEU and MOX assemblies.

j. Reactivity and Power Distribution Anomalies - Inhomogeneities (Pu clusters) in MOX fuel may affect fuel behavior during reactivity accidents, especially at high burnups. Any burnup limitations on MOX fuel will most likely be related to the reactivity insertion events. FSAR section 15.4.9 describes the control rod drop accident (CRDA) which is the limiting accident for a BWR relative to peak fuel enthalpy. This event is mitigated, in part, by an initial rod configuration that complies with the banked position withdrawal sequence (BPWS). The withdrawal (or insertion) sequence is implemented by the operator and enforced by the rod worth minimizer (RWM). An operator error in control rod movement will be detected and stopped by the RWM. Impact of the use of MOX fuel on the assumptions and results of the CRDA analysis will need to be addressed.

   Other reactivity insertion accidents in FSAR section 15.4 include the rod withdrawal error, recirculation flow control failure with increasing flow, and misplaced bundle accident. These accidents are mitigated by establishing an operating limit minimum critical power ratio (MCPR) that limits the change in critical power ratio during the accident such that the safety limit MCPR is always preserved. Generally these accidents are re-evaluated on a cycle specific basis with the limits reported in the COLR.

k. Radiological Analyses - MOX fuel has reduced thermal conductivity compared with LEU fuel which causes the MOX fuel rods to operate with higher centerline temperatures for a given fuel rod power. Higher temperatures increase gas release from fuel pellets and, hence, fission product gap inventory, which may impact offsite dose calculations. In addition, MOX fuel has different fission product and actinide concentrations than LEU fuel which could also affect the radiological source term and accident consequences. CGS has implemented the alternative source term per 10 CFR 50.67 for use in the design basis radiological analyses. The impact of the use of MOX fuel on the accident source term and development of a bounding source term will need to be included in the license amendment submittal. The following four accidents are analyzed for the radiological consequences:

- FSAR 15.6.5 LOCA - The source term used for the design basis LOCA analysis is defined by the quantity, type and timing of the release of radioactivity from a damaged reactor core to the containment. The core inventory is based on an ORIGEN2 run and the release rates are consistent with Regulatory Guide (RG) 1.183, Alternative Radiological Source Terms for Evaluating Design Basis Accidents at Nuclear Power Reactors.

- FSAR 15.7.4 Fuel Handling Accident (FHA) – The FHA involves the drop of a fuel assembly in the reactor vessel cavity over the reactor core during refueling operations. Fuel pin damage is postulated to occur to both the dropped assembly and to some portion of those assemblies impacted in the reactor core. The gap activity from the damaged pins is the radioactive source term for this event. Of this activity, all of the noble gases and only a fraction of the iodine are available for release based on the scrubbing effect of the water above the dropped fuel. The fission product inventory assumed to be gap activity is taken from RG 1.183.

- FSAR 15.4.9 CRDA – The CRDA involves the rapid removal of a highest worth control rod resulting in a reactivity excursion. Consistent with the current licensing basis, 1.8% of the fuel pins in the full core are postulated to be damaged, with melting occurring in 0.77% of the damaged rods. The source term is composed of releases from melted fuel and the gap activity from the fuel pins postulated to be damaged. The core damage fractions and transport fractions for each radionuclide group are consistent with RG 1.183. The iodine species released to the reactor coolant are assumed to be 95% aerosol, 4.85% elemental, and 0.15% organic.

- FSAR 15.6.4 Main Steam Line Break (MSLB) Outside Containment – The MSLB accident assumes the double-ended break of one main steam line outside the primary containment. The mass of coolant released is the amount in the steam line and connecting lines at the time of the break plus the amount passing through the main steam isolation valves prior to closure. Two source term cases for the released coolant are considered. One is a pre-accident spike case of 4 micro-Ci/g dose equivalent (DE) I-131 and the second is a maximum equilibrium case of 0.2 micro-Ci/g DEI-131. These source term assumptions are consistent with RG 1.183.

It should be noted that RG 1.183 contains the following note: "The release fractions listed here have been determined to be acceptable for use with currently approved LWR fuel with a peak burnup up to 62,000 MWD/MTU. The data in this section may not be applicable to cores containing mixed oxide (MOX) fuel." The license amendment will need to justify the continued use of RG 1.183 release fractions.

III. Appendix K to Part 50 – ECCS Evaluation Models

The regulations in Appendix K refer to "the thermal conductivity of the UO2" and "the thermal conductance of the gap between the UO2 and the cladding". There is no mention of Pu or MOX fuel. Therefore, an exemption must be granted by the NRC for the use of MOX fuel.

IV. Physical Security Plan

The onsite physical protection requirements for un-irradiated MOX fuel assemblies are outlined in 10 CFR 73.55(l). The physical security plan must be updated to describe the operational and administrative controls to be implemented for the receipt, inspection, movement, storage and protection of un-irradiated MOX fuel.

1. Administrative Controls include the use of tamper-indicating devices during transport, a search of the MOX fuel for damage and unauthorized materials upon receipt, the presence of at least one armed security officer during the receipt and inspection activities, storage of MOX fuel within the fuel pool (so that access to MOX requires passage through at least two physical barriers and the water barrier), and implementation of a material control and accountability program that includes predetermined and documented storage locations for each MOX fuel assembly.

2. Physical Controls include the lockout of equipment and power supplies to equipment required for the movement and handling of un-irradiated MOX fuel assemblies when not in use, implementation of a two-person, line-of-sight rule within the fuel pool area when fuel handling equipment is not locked-out, conducting random patrols of areas containing the MOX fuel assemblies, control of locks by the security organization, and approval to remove locks by both the on-duty security shift supervisor and the operations shift manager.

3. Surveillance Requirements: 1) At least one armed security officer shall be present to observe activities involving the movement of un-irradiated MOX fuel assemblies before the removal of the locks from fuel handling equipment. 2) At least one armed security officer shall be present at all times until power is removed from equipment and locks are secured. 3) At least one armed security officer must be present and maintain constant surveillance of un-irradiated MOX fuel when not located in the fuel pool or reactor.

V. Certificate of Compliance for Spent Fuel Storage Casks

Energy Northwest has installed an Independent Spent Fuel Storage Installation (ISFSI) under the general license requirements of 10 CFR 72.210 using an approved spent fuel storage cask listed in 10 CFR 72.214. The cask certificate of compliance (CoC) contains a listing of approved contents and design features. Energy Northwest's cask vendor has only requested and received approval to store a particular fuel design of BWR MOX fuel – 6x6 array containing up to 9 MOX rods with $\leq$0.635 wt% U235 and $\leq$1.578 wt% total fissile Pu. Therefore, the holder of the CoC, the cask vendor, must prepare a license amendment request to update the allowable contents to include the storage of any proposed MOX LUA design (10x10 array). Required analyses include thermal, shielding, and criticality evaluations for the proposed fuel design. The results of these analyses are presented in the FSAR for the cask system.

ENERGY NORTHWEST

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Attachment 2

MOX Loading Procedures in Europe
Energy Northwest Comments

MOX Loading Procedures in Europe

Energy Northwest comments:

In the past, we have handled similar sized containers in disposing of radioactive materials. Those containers were also 16 ft in length. As for comments, only a few items from the big picture standpoint:

- We would perform the unloading of the cask from the truck just outside the truck bay (as we do currently with receipt of new fuel).
- The MX6 cask would then be moved into the truck bay and likely up righted there (depending on just exactly how the cradle is).
- We would then fly the MX6 cask to the 606' near the fuel inspection stand for off loading the fuel into the pool.
- Seismic issues would likely need to be addressed as well as any paperwork to allow the overhead crane to place the fuel into the pool.
- This would then be performed in the opposite order to remove the MX6 from the refuel floor.

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Attachment 3

Major Steps during Fuel Receipt

Major Steps During Fuel Receipt

- Fuel shipment arrives onsite (~12 boxes, 2 bundles per box) on a covered flatbed tractor trailer). The current fuel shipping container is the RAJ-II.
- Truck drives in through the sally port and over in front of the reactor building truck bay.
- Fuel boxes are offloaded from the truck outside (stacked to the area just south of the truck bay entrance) and prepared for removal of the inner boxes containing the bundles.
- The truck bay doors are opened.
- The inner boxes are removed from the outer boxes where they are staged separately inside the truck bay with the fork lift.
- The empty outer boxes are stored in the area north of the truck bay entrance for loading on the next truck following the offloading of the new boxes arriving on site.
- The truck bay doors are closed.
- From the truck bay, four inner boxes are loaded onto the lifting basket and transferred onto the 606' elevation (refueling floor) near the fuel inspection stand. This is typically performed using the auxiliary hook due to the weight of the load and the time savings over the big overhead crane; the smaller auxiliary hook can be lowered and raised in about half of the time of the larger main hook.
- Once on the refueling floor, the inner box lids are removed and the box lifted upright into the lifting basket (which holds four boxes).
- The basket is moved to the staging area near the spent fuel pool using the overhead crane.
- Individual fuel bundles are removed from the basket and put into the inspection stand.
- Once inspected, the bundles are loaded into the spent fuel pool using the smaller jib crane (rated at 1000 lbs).
- The lifting basket is then moved back to the staging area and the empty boxes unloaded.
- The lids are placed back onto the empty inner boxes.
- The empty inner boxes from the lifting basket are lowered back to the truck bay in groups of four boxes.
- Inner boxes are transported out of the building, placed back in the outer boxes, and shipped back to the vendor.

Fuel Receipt Scheduling

Fuel receipt at Columbia Generating Station takes approximately three weeks to accomplish plus a week of set up and a week of demobilization. Fuel receipt should to be completed at least 5 weeks before the outage to avoid interfering with other outage preps.

Equipment & Building Information

The overhead crane is rated for 125 Tons on the Main Hook and 15 Tons on the Auxiliary Hook.

The truck bay is large enough to accommodate a tractor trailer rig comfortably.

The loading limit for the refueling floor is 900 lb/sqft (DWG S726).

The truck bay doors are 20' 8" wide and 23' 4" tall (210A-08,8).

The floor opening from the refueling floor to the truck bay is 25' 6" x 15' (DWG S726).

The auxiliary hook has a maximum height of approximately 37' above the refueling floor. The auxiliary hook can be used to unload the individual bundles from a shipping cask, if needed, into the fuel inspection stand where the jib crane could place them into the spent fuel pool.

Request for Public Records Control No 2010-02

Attachment 4

Energy Northwest MOX Summary

August 17, 2009

MOX SUMMARY

Energy Northwest is considering the use of Mixed Oxide (MOX) fuel in CGS. Initially, the source of Pu would be from dismantled weapons (known as Weapons Grade Pu).

The **long term benefits** to EN ratepayers will be:

- Reduced fuel costs (MOX fuel provided at a discount to low enriched uranium (LEU) fuel)
- Alternate supply of fuel (from Pu instead of LEU) that provides reduced risk to fuel supply shortages

The **conditions** under which EN will use MOX include:

- MOX will be introduced in a phased approach to manage risks to reactor operation
- Deployment of MOX remains cost neutral to EN
- MOX use will not negatively impact plant operation
- Flexibility in the use of MOX will at least equal that of LEU fuel

EN has developed a plan for the introduction of MOX fuel using the aforementioned phased approach. Three phases have been identified:

- Lead pins – target 2013
- Lead assemblies – 2019
- Reload quantities – 2025

The **first phase** of the program would be to load a total of ~16 pins containing MOX fuel into approximately four fuel bundles. Key elements of the program are outlined below:

Fabrication

- PNNL fabricates MOX pellets and rods using GNF design specification and components

Licensing

- GNF licenses the codes and methods required for analyzing MOX fuel
- GNF licenses the MOX fuel design (to be utilized in cycle 22)
- EN licenses the use of MOX fuel pins in CGS (Tech Spec amendment, Physical Security Plan revision, alternate source term evaluation, fuel pool criticality analysis)

Implementation

- PNNL ships MOX pins to EN
- GNF installs MOX pins in ~4 bundles at CGS (normal LEU bundles with ~4 empty spaces per bundle to accommodate the MOX pins)
- EN implements heightened Security requirements for fresh MOX fuel
- GNF removes up to 4 pins each outage for shipment back to PNNL for post-irradiation exam

Ramifications of the MOX Program

- The MOX rods will be a GNF fuel design. It is not desirable to transition to a new fuel vendor during irradiation of the rods. The current fuel contract with GNF was negotiated for 3 reloads (2009-2013) after which we would go out for bid for additional fuel supplies. **With MOX fuel, we will be committing to loading GNF fuel at least through 2017.**

- DOE will want EN to sign a letter of intent (LOI) for the use of MOX fuel in CGS probably as a condition to funding the pins program. **The LOI will pledge EN to loading reload quantities of MOX fuel manufactured at DOE's MOX Fuel Fabrication Facility**

following successful completion of the lead pin and lead assembly programs. (A similar LOI was signed by TVA.)

- We believe that the MOX pins will have little actual impact on the operation of CGS. This impact can be effectively monitored and managed. Rather, we see this as a management policy decision on whether or not to be one of the leaders in pursuing the use of MOX in a US BWR.

- Regional and state politics should be considered regarding our announcement / LOI with DOE.

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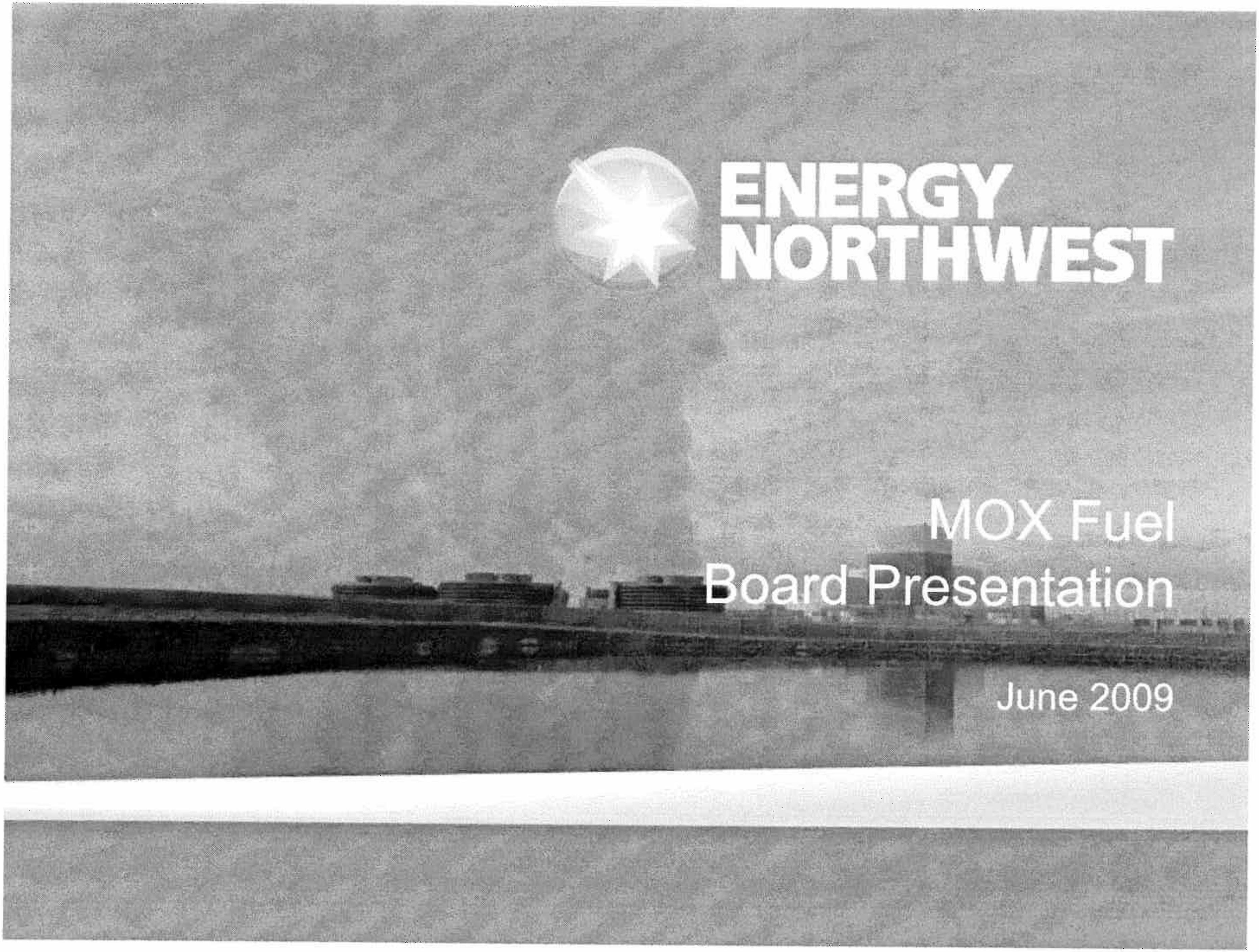
Request for Public Records Control No 2010-02

Attachment 5

MOX Fuel Board Presentation
June 2009


ENERGY NORTHWEST
MOX Fuel
Board Presentation
June 2009

Background

- Mixed Oxide (MOX) fuel is composed of plutonium mixed with depleted or natural uranium.
  - MOX = UO_2 + PuO_2
- Sources of Pu:
  - Recycled fuel
  - Weapons

Long Term Vision for MOX

- Goal - MOX becomes a viable fuel supply for some portion of the reload batch (~30% of core).
  - Must have good in-reactor performance
    - Ability to be irradiated for 3 cycles (24 months/cycle)
    - **NO** negative impact on reactor operation
    - Wet and dry storage of spent MOX allowed
  - Must be economical (real benefit to ratepayers)
    - Must be cost effective compared to LEU fuel
    - Must engage multiple fuel vendors to foster competition
    - Should model the normal fuel procurement processes used in the US (utility in control)
  - Intangible Benefits
    - Achieve US nonproliferation goals
    - Assist nuclear industry in closing the fuel cycle

WE ARE NOT THERE YET !

How to Get There?

- Phased approach
  1. Individual MOX fuel pins
     - Irradiate for 3 cycles beginning in 2013
     - Obtain data from post irradiation exams
  2. MOX Lead Use Assemblies (LUAs)
     - Resolve any issues with pins prior to LUAs
     - Irradiate for 3 cycles beginning in ~2019
  3. MOX reloads
     - Resolve any issues with LUAs prior to reload quantities
     - Irradiate beginning in ~2025

- EN criteria for proceeding
  1. Pin program is cost neutral.
     - Cost neutral now with the goal of discounted fuel in the future
     - Prospect of preferential access to other DOE nuclear material
  2. MOX LUA program must be cost neutral to EN.
     - Cost neutral now with real prospects of discounted fuel in near term.
  3. MOX reloads provide discounted fuel supply relative to LEU fuel.

Phase 1 – MOX Pin Program

- PNNL
  - Act as subcontractor for GNF for MOX fuel rods
    - Fabricate pellets
    - Load pellets into GNF-supplied fuel rods
    - Weld end caps on fuel rods according to GNF specifications
    - Ship MOX fuel rods to CGS
  - Perform post irradiation exams (PIE) on irradiated MOX rods
- GEH/GNF
  - Qualify codes and methods for application to MOX fuel
  - Supply fuel bundle components to PNNL
  - Analyze MOX fuel performance using NRC-approved methodologies
- EN
  - Support GNF loading of MOX fuel pins into designated fuel bundles
  - Irradiate MOX fuel
  - Support required pool-side examinations performed by GNF
  - Support MOX fuel pins removal by GNF after irradiation
  - Ship irradiated MOX fuel pins back to PNNL for hot cell examination

Why pins? Why now?

- Minimize risk to reactor operation ~16 pins
- Use current fuel vendor GNF/GEH
  - GNF-J supplied MOX bundles to Japan (fabricated in France)
- Fabricate at PNNL facilities – adjacent to CGS
  - PNNL has hot cell facilities for PIE
  - PNNL has NQA-1, 10 CFR 50 Appendix B QA program
  - PNNL has experience supplying tritium targets to TVA
- Gather data on MOX fuel performance
- Obtain funding from DOE to remain cost neutral
- Provides ability to implement in the near term (2013)

Next Steps

- EN, PNNL, GEH determine rough cost estimates for their piece
- EN perform risk assessment of pin program
- Present MOX pin concept to DOE for consideration
  - Target 3Q09
  - Joint presentation by EN-PNNL-GEH
  - EN provides "utility perspective" on MOX fuel
    - Absolute need to limit risk to reactor operation
    - Minimize risk through pin and LUA program
    - Cost neutral now to achieve reduced fuel costs in future

Request for Public Records Control No 2010-02

Attachment 6

Report No. EN-MOX-001
May 28, 2009

REPORT NO. EN-MOX-001

LICENSING STRATEGY FOR LOADING

MIXED OXIDE (MOX)

LEAD USE ASSEMBLIES

May 28, 2009

Prepared by Energy Northwest under TVA contract 76715

I. INTRODUCTION

This document contains a licensing strategy for obtaining NRC approval to load mixed oxide (MOX) lead use assemblies (LUAs) in a boiling water reactor (BWR). The licensing activities can be broken down into three main areas: 1) fuel and core design methods, which are typically performed by the fuel vendor, 2) plant impacts including physical security, which are typically performed by the utility, and 3) fuel assembly design and fabrication, which are typically the responsibility of the fuel vendor. Transportation of the MOX fuel is outside the scope of this report.

II. BACKGROUND

MOX fuel differs from low-enriched uranium (LEU) fuel in the following key areas:

- Plutonium has a higher thermal absorption cross section compared with uranium which reduces control rod and absorber worths, affecting shutdown margin. This issue is typically addressed in pressurized water reactors (PWRs) by limiting the core loading of MOX to ~30%.

- Plutonium has larger fission cross sections at high neutron energies which cause the coolant void coefficient of reactivity to be less negative for MOX fuel than for LEU fuel. This issue is typically addressed in PWRs by limiting the concentration of plutonium in the fuel rod. Tests have demonstrated that the void coefficient of MOX fuel becomes positive between 9.7 and 14.4 wt% loading in each rod which suggests an upper limit on plutonium content might be needed for MOX fuel.

- Plutonium has a harder neutron energy spectrum which could enhance irradiation damage in the reactor pressure vessel and internals. This issue is typically addressed during development of the core loading pattern by limiting the number of MOX fuel assemblies located on the core periphery.

- MOX fuel has reduced thermal conductivity compared with LEU fuel which causes the MOX fuel rods to operate with higher centerline temperatures for a given fuel rod power, increasing the initial fuel rod stored energy for a loss of coolant accident (LOCA) and possibly resulting in the need for reduced power limits for MOX assemblies. This issue is typically addressed in PWRs by limiting MOX assemblies to non-rodded core locations.

- Higher temperatures increase gas release from fuel pellets and, hence, fission product gap inventory which may impact offsite dose calculations.

- Inhomogeneities (plutonium clusters) in MOX fuel may affect fuel behavior during reactivity accidents, especially at high burnups. This issue is typically addressed in PWRs by limiting MOX assemblies to non-rodded core locations. Any burnup limitations on MOX fuel are most-likely related to the reactivity insertion events.

- Weapons grade (WG) plutonium contains gallium, which chemically attacks zirconium. The effect of limited amounts of gallium on cladding integrity and behavior needs to be analyzed.

- MOX fuel has different fission product and actinide concentrations than LEU fuel which could also affect the radiological source term and accident consequences.

- MOX fuel has different isotopics and material properties from LEU fuel necessitating new criticality analysis for fuel storage and handling. Dose rates for fresh MOX fuel are higher than LEU fuel.

- Irradiated MOX has a larger inventory of actinides than LEU fuel resulting in greater decay heat levels for cooling times greater than 1 year. The effects of higher decay heat on fuel pool cooling needs to be evaluated. (Note: Storage of MOX fuel in dry cask storage systems must be specifically allowed under the 10 CFR Part 72 license and is not considered further in this document.)

- The physical security requirements for MOX fuel are different than LEU fuel and are generally more stringent, warranting additional security measures during the receipt and handling of fresh MOX assemblies.

III. FUEL AND CORE DESIGN METHODS

10 CFR 50.34 requires that safety analysis reports be submitted that analyze the design and performance of structures, systems and components provided for the prevention of accidents and the mitigation of the consequences of accidents. As part of the core reload process, reload safety evaluations are performed to ensure that the safety analyses remain bounding for the design cycle. Reload safety analyses are performed utilizing, in part, approved codes for fuel rod performance and core design. As such, the fuel vendor must have codes and methods that are approved by the NRC for application to MOX fuel.

The vendor must have approved codes for reactor kinetics specifically applicable to MOX fuel. (Note: In some cases, the utility performs the nuclear design in lieu of the fuel vendor.) In general, the neutronics codes include the lattice physics code and the three-dimensional core simulator. These codes need to account for the larger cross sections, changes in the energy dependence of the cross sections, smaller delayed neutron fraction, increased energy per fission, and other basic neutronic parameters that are altered by the plutonium isotopes.

In addition, the vendor must have codes approved to model the fuel rod performance of MOX fuel including the properties of stress, cladding strain, cladding fatigue, fretting, oxidation, hydriding, crud buildup, fuel rod bow, axial growth, fuel rod internal pressure, and assembly liftoff. The physical properties that may be affected by the addition of PuO2 include thermal conductivity, thermal expansion, thermal creep, fission gas release, in-reactor densification and swelling, helium gas accumulation and release, radial power profile, and melting point.

IV. PLANT IMPACTS

Once the fuel vendor has codes and methods approved for application to MOX fuel, the vendor, in conjunction with utility staff, prepares the nuclear design and licensing analyses of the fuel and core. Various licensing basis documents will need to be reviewed to determine if changes are required and if these changes require NRC review and approval prior to implementation. A discussion of relevant utility documents is provided below:

- **Operating License**

  The operating license grants approval for, among other things, receipt, possession and use of source and special nuclear material as reactor fuel in accordance with 10 CFR Parts 40 and 70. The utility must ensure that the license allows the receipt of plutonium as mixed oxide fuel.

- **Technical Specifications**

  The Design Features section contains a description of the approved fuel assembly design and the new and spent fuel storage facilities. The utility must ensure the technical specifications allow the use of plutonium as reactor fuel and allow the storage of irradiated and unirradiated MOX fuel.

  The Administrative Controls contains requirements for the core operating limits report (COLR) including a listing of the codes and methods used in the reload design and licensing analysis. The utility must ensure the codes which have been approved for application to MOX fuel are listed in the COLR technical specification.

  The Safety Limits protect the integrity of physical barriers that guard against the uncontrolled release of radioactivity. The Limiting Conditions for Operations relate primarily to process variables, design features or operating restrictions that are initial conditions of a design basis accident or transient or structures, systems or components (SSCs) that function or actuate to mitigate a design basis accident or transient. In general, the safety analyses for the MOX fuel will encompass the initial conditions and minimum performance requirements contained in the technical specifications such that the existing requirements remain bounding. Any resultant changes to the minimum critical power ratio (MCPR) safety limit as a result of burning MOX will need to be approved by the NRC. However, other fuel-related power distribution limits are located in the COLR and do not require prior NRC approval.

  In some instances, utilities have fuel assembly storage limitations in the spent fuel pool delineated in the Limiting Conditions for Operations section in the technical specifications (e.g., to address boraflex degradation or close-packed cell spacing). The utility must ensure that the storage of MOX fuel is specifically addressed.

- **Final Safety Analysis Report**

  <u>LOCA</u> – 10 CFR 50.46 and 10 CFR 50 Appendix K establish fuel temperature limits that are used as a basis for the cooling performance requirements for the emergency core cooling system using an acceptable evaluation model. The utility must evaluate the effect of the MOX fuel on the LOCA analysis, using an approved evaluation methodology, and demonstrate compliance with the requirements of 10 CFR 50.46.

10 CFR 50.46(a)(1)(i) contains ECCS acceptance criteria for reactors "fueled with uranium oxide pellets". In addition, Appendix K contains several references that assume that only uranium dioxide fuel pellets are being used. Thus, the utility must apply for an exemption from the requirements of these sections in order to irradiate the MOX fuel.

Non-LOCA – 10 CFR 50 Appendix A, General Design Criteria (GDC) establish performance requirements for the reactor core and related systems for other (non-LOCA) accidents and transients. The utility must evaluate the effect of the MOX fuel on the non-LOCA analyses to demonstrate compliance with the following criteria:

GDC 10 requires that specified acceptable fuel design limits are not exceeded during normal operation including the effects of anticipated operational occurrences (AOOs).

GDC 11 requires that the reactor core be designed to ensure it is inherently safe during power range operations, thus eliminating the possibility of an uncontrolled nuclear excursion.

GDC 12 requires that the reactor core and protection systems be designed to protect the reactor from the consequences of power oscillations that could challenge the integrity of the fuel and result in the release of fission products.

GDC 20 requires automatic initiation of the reactivity control systems to prevent damage to the fuel during AOOs and, in the early stages of an accident, to minimize the extent of damage to the fuel, thus reducing the release of fission products to the coolant system.

GDC 26 requires that two independent or redundant reactivity control systems of different or diverse design be provided to assure that core reactivity can be safely controlled and that sufficient negative reactivity exists to maintain the core subcritical under cold conditions.

GDC 27 requires that the reactivity control systems have a combined capability of reliably controlling reactivity changes under postulated accident conditions, with appropriate margin for stuck rods, to assure the capability to cool the core is maintained.

GDC 28 requires that the effects of postulated reactivity insertion accidents not result in damage to the reactor coolant pressure boundary or cause sufficient damage to the core and internals to significantly impair the capability to cool the core.

Criticality (fuel storage) – GDC 62 requires that criticality in the fuel storage and handling system be prevented by physical systems or processes, preferably by use of geometrically safe configurations. The utility must perform criticality analyses for the MOX fuel stored in the fuel pool, using transport analysis methods, including benchmarking the code against critical experiments involving MOX fuel. In addition, the utility must ensure that the requirements of 10 CFR 50.68 or 10 CFR 70.24, whichever is applicable, continue to be met for storage of MOX fuel.

Dose Consequences / Source Term (including Fresh MOX drop) – GDC 16 requires that the reactor containment and associated systems be provided to establish an essentially leak-tight barrier against the uncontrolled release of radioactivity to the environment under accident conditions, including a LOCA. GDC 19 requires that a control room be provided from which actions can be taken to maintain the unit in a safe condition under accident conditions, including a LOCA. Limits for offsite dose consequences of postulated accidents are provided in either 10 CFR 100.11 or 10 CFR 50.67 depending upon whether the licensee has revised the accident source term to use the alternative source term (AST). The utility must address changes in the source term due to the MOX fuel and the impact these changes have on the resultant offsite and control room doses. In addition, the utility should evaluate the consequences of a drop of a fresh MOX assembly in air due to the isotopic differences between fresh LEU and MOX assemblies.

Spent Fuel Pool Cooling – GDC 61 requires that the fuel storage system be designed with reliable decay heat removal capability to assure safety under normal and postulated accident conditions. The utility must evaluate the effects of the potential increase in decay heat levels for MOX fuel on the cooling capability of the fuel pool cooling system.

Reactor Vessel Materials – GDC 31 requires that the reactor coolant pressure boundary be designed with sufficient margin to assure that, when stressed, it behaves in a non-brittle manner and the probability of rapidly propagating fracture is minimized. The design shall reflect consideration of service temperature and other conditions of the boundary material such as the effects of irradiation on material properties. The utility must evaluate the effects of the change in neutron fluence for MOX fuel on the material properties of the reactor vessel.

- **Physical Security Plan**

The physical security plan describes how the requirements of 10 CFR Part 73 and Part 11, if applicable, will be met. The safeguards contingency plan contains plans for dealing with threats, thefts and radiological sabotage, as defined in 10 CFR Part 73, relating to the special nuclear material in the possession and control of the utility. Since the MOX fuel will be at a power reactor site, physical protection during the receipt, handling and storage of the MOX fuel will occur in a physical protection environment that is currently subject to the requirements of 10 CFR 73.55. Sub-section (l) addresses facilities using MOX fuel containing up to 20 wt% PuO2 and provides an exemption from the requirements of 10 CFR 73.20, 73.45, and 73.46. However, this section then goes on to specify administrative and physical controls required to be implemented for the receipt, inspection, movement, storage, and protection of un-irradiated MOX fuel assemblies. The utility must revise the physical security plan to describe the implementation of these requirements.

- **Other**

Occupational Dose – 10 CFR 20.1201 contains dose limits on occupational dose to individual adults. 10 CFR 20.1301 contains dose limits for individual members of the public resulting from normal operation of the facility. The utility must estimate and evaluate the neutron and gamma dose rates during receipt and handling of the unirradiated MOX fuel due to the presence of plutonium and americium in fresh MOX assemblies.

Effluents – 10 CFR 50.34a requires updates to the estimated quantity of radionuclides expected be released annually in effluents – liquid, gases, halides and particulates, and how the licensee maintains the releases as low as reasonably achievable. The utility must address any changes in the types or amounts of plant effluents resulting from the use of MOX fuel.

Quality Assurance – 10 CFR 50 Appendix B contains quality assurance (QA) criteria for nuclear power plants. In general, the fabrication of MOX fuel pellets will differ from that of LEU fuel and the final rod and bundle assembly may be performed at other facilities than normally utilized by the fuel fabricator. As such, the utility must ensure the QA program is adequate for the fabrication of MOX fuel. The utility should provide a description of the QA measures applicable to the MOX fuel fabrication including a description of fuel vendor QA plans, if relied upon, use of qualified suppliers, implementation of QA processes, and reporting of defects and noncompliance per 10 CFR Part 21.

V. FUEL ASSEMBLY DESIGN AND FABRICATION

The fuel system must be analyzed to meet the following requirements:

- The fuel system is not damaged as a result of normal operation and anticipated operational occurrences. Fuel is “not damaged” when fuel rod cladding integrity is maintained , fuel system dimensions remain within operational tolerances, and functional capabilities of the fuel system are not reduced below those assumed in the safety analysis.

- Fuel system damage is never so severe as to prevent control rod insertion when required.

- The number of fuel rod failures (cladding breach) is not underestimated for postulated accidents. Fuel rod failures must be accounted for in the dose calculations.

- Coolability is always maintained by retaining the rod-bundle geometrical configuration with adequate coolant channels to permit removal of residual heat.

In general, specific NRC approval of the MOX fuel design is required. Typically, the fuel vendor will request approval of the fuel design via submittal of a topical report to the NRC. Each fuel damage and rod failure mechanism listed in SRP Section 4.2 should be evaluated to confirm that the design criteria are not exceeded during normal operation including AOOs. The impact of postulated accidents in which severe fuel damage may occur on factors affecting coolability should be evaluated.

Fabrication of MOX fuel pellets must be performed at specially-designed facilities capable of handling plutonium. The licensing and construction of a MOX Fuel Fabrication Facility (MFFF) is currently underway in South Carolina with production estimated to begin in 2018. As such, licensing of this facility is outside the scope of this report. Another option is to utilize fabrication facilities in France, the UK, or Japan. A final option is to utilize facilities at one of the national laboratories. In any event, the facility must have a nuclear material license pursuant to 10 CFR Part 70 (or equivalent for DOE facilities) for the possession of SNM or must have an import license for this material, if outside the US. Control of fabrication processes must ensure vendor design specifications for pellets, rods, and bundles are met in all cases, including appropriate QA programmatic controls.

In some instances, portions of the fabrication process are specifically identified as part of the approved fuel design. For the MOX lead test assemblies irradiated by Duke, the homogeneity of the MOX fuel was assured by using the micronized master blend (MIMAS) manufacturing process. The gallium content in the PuO2 power was limited to 300 ppb. And, the UO2 powder used in the MOX fuel pellets was fabricated by using the ammonium diuranate (ADU) process. Also, the normal controls on moisture and hydrogenous impurities in the fuel were credited for limiting the occurrence of internal hydriding. Each of these items was identified in the NRC's safety evaluation report.

Finally, fuel examinations may be required by the NRC to confirm the current models on the fuel performance and fuel behavior characteristics of MOX fuel under US BWR conditions and to justify application of the methodologies to batch implementation of the MOX fuel design.

VI. REFERENCES

1. NRC Memorandum, Mixed-Oxide Fuel Use in Commercial Light Water Reactors, dated April 14, 1999. (ML993620025)

2. NRC White Paper, NRC Licensing Requirements for Reactor Fuel and Validation of New Fuel Types, dated September 12, 2005. (ML051540149)

3. NRC Memorandum, Review Plan for Evaluating the Physical Security Protection Measures Needed for Mixed Oxide Fuel and Its Use in Commercial Nuclear Power Reactors, dated January 29, 2004. (ML033560532)

4. Duke, Catawba Nuclear Station Units 1 & 2 and McGuire Nuclear Station Units 1 & 2 Proposed Amendments to the Facility Operating License and Technical Specifications to Allow Insertion of Mixed Oxide (MOX) Fuel Lead Assemblies and Request for Exemption from Certain Regulations in 10 CFR Part 50, dated February 27, 2003. (ML030760734)

5. NRC, Safety Evaluation for Proposed Amendments to the Facility Operating License and Technical Specification to Allow Insertion of Mixed Oxide Fuel Lead Assemblies, dated April 5, 2004. (ML040970046)

6. NRC, Supplement 1 to Safety Evaluation for Proposed Amendments to the Facility Operating License and Technical Specifications to Allow Insertion of Mixed Oxide Fuel Lead Assemblies, dated May 5, 2004. (ML041260544)

7. NRC, Supplement 2 to Safety Evaluation for Proposed Amendments to the Facility Operating License and Technical Specifications to Allow Insertion of Mixed Oxide Fuel Lead Assemblies, dated July 27, 2004. (ML042100490)

8. NRC, Final Safety Evaluation for Topical Report BAW-10231P "COPERNIC Fuel Rod Design Code" Chapter 13, MOX Applications, dated January 14, 2004. (ML040150701)

9. NRC, Final Safety Evaluation for Framatome ANP Topical Report BAW-10238(P) Revision 1 "MOX Fuel Design Report", dated July 1, 2004. (ML041840220)

10. NRC, Final Safety Evaluation fro Duke Topical Report DPC-NE-1005P "Nuclear Design Methodology Using CASMO-4/SIMULATE-3 MOX", dated August 20, 2004. (ML042370178)

11. NRC, Catawba Nuclear Station, Units 1 and 2 Re: Issuance of Amendments [220 and 215, respectively], dated March 3, 2005. (ML042320059)

12. NRC, Exemptions from Title 10 of the Code of Federal Regulations for the Use of Mixed Oxide (MOX) Fuel Lead Test Assemblies, dated March 3, 2005. (ML042300171)

13. Columbia Generation Station (CGS) Operating License, Technical Specifications, Final Safety Analysis Report, and Core Operating Limits Report.

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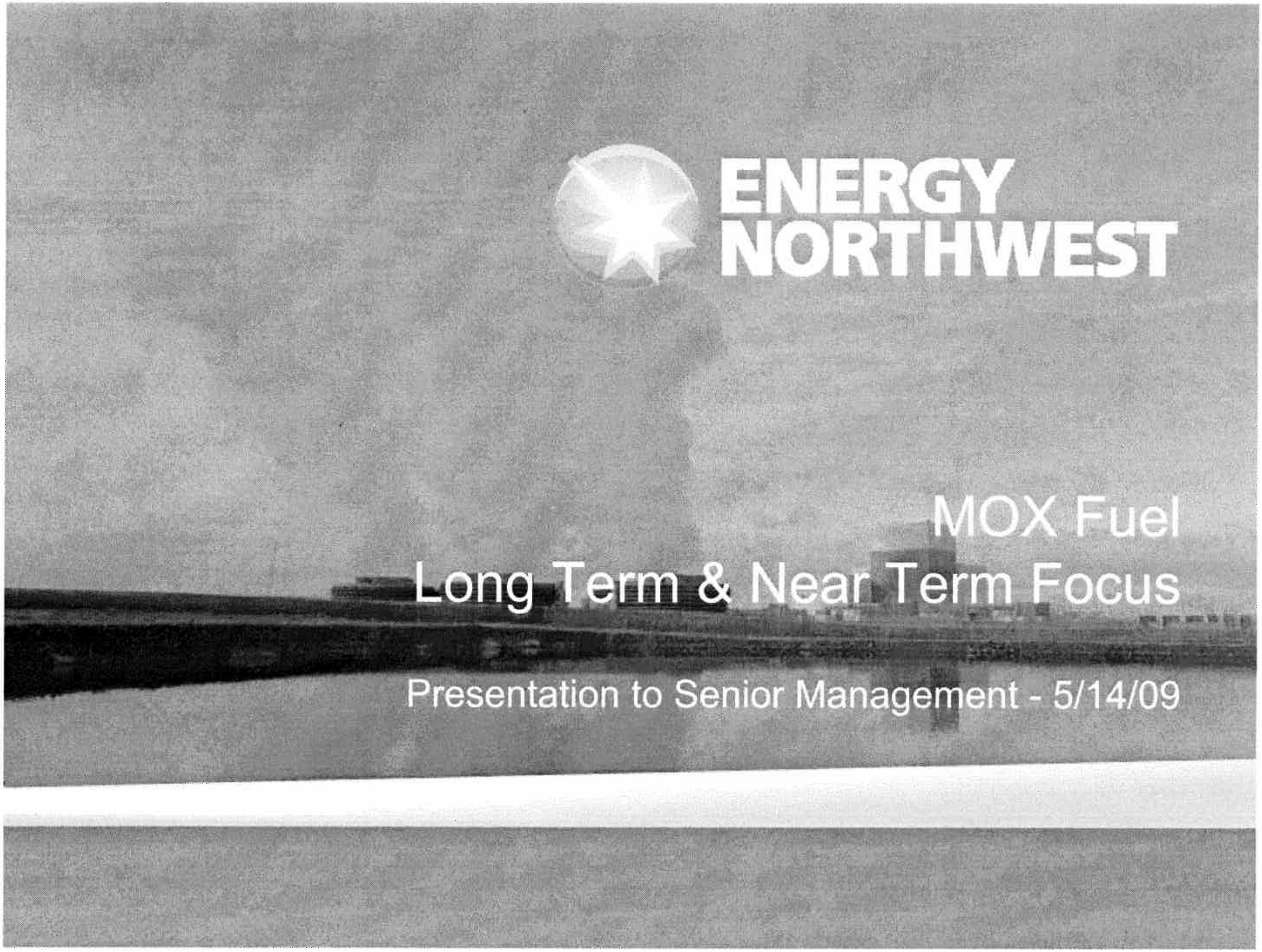
Attachment 7

MOX Fuel Long Term & Near Term Focus Presentation

May 14, 2009


ENERGY NORTHWEST
MOX Fuel
Long Term & Near Term Focus
Presentation to Senior Management - 5/14/09

Introductions

- Pacific Northwest National Lab
- GE Hitachi / Global Nuclear Fuel
- Energy Northwest

Background

- Reactor Grade (RG) Pu
  - Source of funding is DOE NE
- Weapons Grade (WG) Pu
  - Source of funding is DOE NNSA
- Existing WG MOX program

Long Term Vision for MOX

- Goal - MOX becomes a viable fuel supply for some portion of the reload batch (~30% of core).
  - Must have good in-reactor performance
    - Ability to be irradiated for 3 cycles (24 months/cycle)
    - **NO** negative impact on reactor operation
    - Wet and dry storage of spent MOX allowed
  - Must be economical (real benefit to ratepayers)
    - Must be cost effective compared to LEU fuel
    - Must engage multiple fuel vendors to foster competition
    - Should model the normal fuel procurement processes used in the US (utility in control)
  - Intangible Benefits
    - Achieve US nonproliferation goals
    - Assist nuclear industry in closing the fuel cycle

WE ARE NOT THERE YET !

How to Get There?

- Phased approach
  1. Individual MOX fuel pins
     - Irradiate for 3 cycles beginning in 2013
     - Obtain data from post irradiation exams
  2. MOX Lead Use Assemblies (LUAs)
     - Resolve any issues with pins prior to LUAs
     - Irradiate for 3 cycles beginning in ~2019
  3. MOX reloads
     - Resolve any issues with LUAs prior to reload quantities
     - Irradiate beginning in ~2025

- EN criteria for proceeding
  1. Pin program is cost neutral.
     - Cost neutral now with the goal of discounted fuel in the future
     - Prospect of preferential access to other DOE nuclear material
  2. MOX LUA program must be cost neutral to EN.
     - Cost neutral now with real prospects of discounted fuel in near term.
  3. MOX reloads provide discounted fuel supply relative to LEU fuel.

Phase 1 – MOX Pin Program

- PNNL
  - Act as subcontractor for GNF for MOX fuel rods
    - Fabricate pellets
    - Load pellets into GNF-supplied fuel rods
    - Weld end caps on fuel rods according to GNF specifications
    - Ship MOX fuel rods to CGS
  - Perform post irradiation exams (PIE) on irradiated MOX rods
    - Final disposal at WIPP (since it's derived from weapons)
- GNF/GEH
  - Qualify codes and methods for application to MOX fuel
  - Supply fuel bundle components to PNNL
  - Analyze MOX fuel performance using NRC-approved methodologies
- EN
  - Support GNF loading of MOX fuel pins into designated fuel bundles
  - Irradiate MOX fuel
  - Support required pool-side examinations performed by GNF
  - Support MOX fuel pins removal by GNF after irradiation
  - Ship irradiated MOX fuel pins back to PNNL for hot cell examination using approved shipping cask

Why pins? Why now?

- Minimize risk to reactor operation ~16 pins
  - Formal Risk Assessment for CGS needs to be performed
- Use current fuel vendor GNF/GEH
  - GNF-J supplied MOX bundles to Japan (fabricated in France)
- Fabricate at PNNL facilities – adjacent to CGS
  - PNNL has hot cell facilities for PIE
  - PNNL has NQA-1, 10 CFR 50 Appendix B QA program
  - PNNL has experience supplying tritium targets to TVA
- Gather data on MOX fuel performance
- Obtain funding from DOE to remain cost neutral
  - DOE has no customers signed up for output from its MOX fabrication plant (estimated startup date >2018)
    - If DOE cannot secure customers for its MOX, it will be impossible to get DOE funds for any future MOX recycle facilities
- Provides ability to implement in the near term (2013)
  - Work on pin program (code development, licensing, security) directly applicable to leads

Energy Northwest Activities

- Prior to Receipt
  - Submit License Amendment Request for NRC approval
    - Tech Spec change
    - New bundle & core design methods
    - Impact of MOX on transients & accidents
    - New criticality analysis for MOX storage in fuel pool
    - Revised source term for MOX fission product inventories – impact on offsite dose consequences of accidents
    - Impact of MOX on vessel internals
  - Submit Physical Security Plan revision for NRC approval
    - Additional security measures for unirradiated MOX to protect against theft and diversion
    - May need method to restrict access to refuel floor or post guards (2 man rule)

Energy Northwest Activities (cont'd)

- Receipt
  - Implement license amendment for MOX
  - Implement additional security measures
  - Receive 2-3 shipments of fresh MOX fuel rods
  - Place MOX fuel rods in new bundles prior to outage
    - Perform underwater using GNF-supplied equipment
- Irradiation
  - After each cycle, perform visual examination during outage consistent with current fuel inspection practice
  - Remove designated rods (and replace with filler rods) during selected outages (or discharge bundle for one cycle)
  - Load irradiated rods in shipping cask
  - Ship irradiated rods to PNNL for hot cell examination

Next Steps

- EN, PNNL, GEH determine rough cost estimates for their piece
- EN perform risk assessment of pin program
- Present MOX pin concept to DOE for consideration
  - Target late June
  - Joint presentation EN-PNNL-GEH
  - EN provides "utility perspective" on MOX fuel
    - Absolute need to limit risk to reactor operation
    - Minimize risk through pin and LUA program
    - Cost neutral now to achieve reduced fuel costs in future

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Attachment 8

MOX Status Presentation

Lisa Ferek

April 28, 2009

ENERGY NORTHWEST

MOX Status

Lisa Ferek 4/28/09

MOX Program Objectives

- Identify risks and benefits of burning MOX fuel
  - Burning MOX from weapons-grade (WG) Pu supports nonproliferation goals
  - Burning MOX from reactor-grade (RG) Pu supports closing the fuel cycle
  - Ultimately, MOX fuel needs to be economically competitive with low enriched uranium (LEU) fuel
- Support diversity of fuel vendor supply of MOX

Program Initiatives

- EN-TVA MOU
  - Identify actions to load RG MOX lead use assemblies (LUAs)
- EN-GEH-PNL
  - Identify actions to load WG MOX fuel pins (6-12)
- EN-GEH
  - Identify actions to load WG MOX LUAs
  - Identify national lab partner for fabricating pins and loading into assemblies

TVA Agreement

- March
  - MOU signed
  - Joint presentation (TVA-EN) to DOE NE
- April
  - EN scope of work defined
  - Contract signed for work through 9/30/09
    - $50K funded by DOE NE through TVA GNEP grant
- May
  - Prepare licensing strategy
  - Prepare topics for licensing BWR use of MOX LUAs
- July
  - Provide input to MOX transportation plan
- August
  - Provide input on feasibility of GEH-designed MOX LUAs

TVA Issues

- No funding from DOE NE past 2009
- Lead Use Assemblies
  - AREVA quote to TVA for providing LUAs was unacceptably high
  - AREVA offered 75 MTHM with European fabrication as an alternate
  - TVA is seeking other utility participants
    - Would have to commit to multiple reloads without future funding source identified
    - Duke OE – suspended MOX program
  - EN continuing to work with GEH for supply of LUAs
- Transportation costs remain the major hurdle

Future Funding

- DOE NNSA has funding for disposition of Weapons Grade (WG) plutonium
  - US-Russia Pu Disposition Program
    - Both nations committed to reduce nuclear stockpile of Pu
    - US program relies on the MOX Fuel Fabrication Facility (MFFF)
      - No current customers – doesn't look good politically
      - Construction in progress – startup ~2017
      - Shaw-AREVA MOX Services vendor for construction and fuel
- How can we maintain DOE funding while still maintaining diversity of fuel vendors?
  - We need to show how EN burning MOX advances the objectives of NNSA

PNL Idea

- Team EN-GEH-PNL
- Concept: Irradiate a few MOX fuel pins (6-12)
  - GNF provides licensed fuel and core design codes for application to MOX
  - PNL fabricates MOX pins using GNF design
    - PNL obtains the Pu (WG)
  - EN inserts MOX pins into select GNF new bundles
  - EN irradiates MOX pins – target 3 cycles
  - EN removes select MOX pins after each cycle and ships to PNL for hot cell exam

Benefits

- Minimize transportation issues/costs
  - Pu stays on Hanford reservation
- Return irradiated MOX rods to PNL
- Obtain hot cell information on MOX behavior
- Implement in fairly short timeframe - 2013
- Remain "cost neutral" using DOE NNSA funding
  - Allows DOE to obtain data on 3-cycle (6 year) MOX product
    - Current (Duke) product limited to 2 cycles (3 years)
  - Provides DOE with a potential customer for the MFFF
    - EN will be ready for LUAs in 2019 (~start date of MFFF)
  - Supports supply diversification by using GNF design

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Negatives

- Logistics
  - PNL would fabricate and ship one pin at a time
  - EN would receive multiple shipments of single pins
    - Pins would need to be stored in a new pin basket
  - EN would reconstitute the pins into fuel bundles prior to the start of the outage
  - EN would need to remove the irradiated MOX pins during subsequent refueling outages and replace with filler rods
- EN would still need to load LUAs
  - What information are we really gaining from pins
- Unclear if licensing pins would be any easier than licensing LUAs

EN Impact from MOX Use

- Requires a license amendment
  - Tech Spec changes
  - Security Plan changes
  - Need to establish a project team
  - Implement via a PDC
- Risk
  - Can always remove Pu pins and replace with filler rods (Zr or natural UO2)
  - Pins and LUAs allow opportunity to evaluate MOX issues while limiting the cost impact
    - Duke experience

Next Steps

- Obtain feedback from EN Senior Management
  - Lead pins versus lead assemblies
    - Utility role is vital since we are the eventual (potential) customer.
  - "Cost neutral" requirement
    - There is limited to no financial (DOE) support for RG MOX.
    - Is EN willing to assume costs?
  - Diversity of supply
    - GNF has provided MOX fuel to Japan (with fabrication in France).
    - AREVA has RG Pu on offer to TVA (with fabrication in France).
    - Shaw-AREVA MOX Services has WG Pu (with fabrication at MFFF starting 2017) *and no customers*. Should we respond to the expression of interest?
- Establish regular briefings to Senior Management

Request for Public Records Control No 2010-02

Attachment 9

Memorandum of Understanding between the Tennessee Valley Authority And Energy Northwest for Advanced Fuel Cycle Demonstration

March 2009

MEMORANDUM OF UNDERSTANDING
between the
TENNESSEE VALLEY AUTHORITY
and
ENERGY NORTHWEST
for
ADVANCED FUEL CYCLE DEMONSTRATIONS

I. Background

The Tennessee Valley Authority (TVA) and the U.S. Department of Energy (DOE) have entered into a Memorandum of Understanding dated April 21, 2008, as amended, and an Interagency Agreement dated July 3, 2008, as amended, whereby TVA is providing support to DOE for an Advanced Fuel Cycle Demonstration (AFCD). As a part of TVA's current work scope, TVA is evaluating the use of recycle MOX fuel (fuel created from recycling used light water reactor (LWR) fuel) in the domestic fleet of power reactors and developing a qualification plan to define actions that would be needed for the design, licensing, fabrication, and shipping of MOX lead use assemblies (LUAs) for several reactor types and fuel assembly designs within that fleet.

Energy Northwest (EN) is interested in evaluating the use of MOX fuel in its Columbia Generating Station, which is a boiling water reactor (BWR). As such, Energy Northwest is interested in assisting TVA in developing plans to implement MOX LUAs at a BWR. Furthermore, Energy Northwest has loaded fuel designs from each of the current BWR fuel vendors and can assist in the qualification planning for multiple BWR fuel assembly designs consistent with TVA's current scope of work.

II. Purpose

This Memorandum of Understanding (MOU) is entered into by TVA and EN and sets forth their intention to jointly evaluate the role EN and owners of other similar reactor designs could play in DOE's AFCD program. The initial phase of this arrangement will establish the guiding principles and overall framework for the exchange of information and conduct of activities between TVA and EN. Subsequent phases could lead to the performance by EN of certain tasks with regard to the development of a qualification plan to define actions that would be needed for the design, licensing, fabrication, and shipping of MOX LUAs for several reactor types and fuel assembly designs.

III. Scope

The activities under the initial phase of this arrangement are focused on providing supporting data and information to help TVA prepare a MOX fuel qualification program for the U.S. reactor fleet. Details for specific work activities (including deliverables, schedules, cost and funding details) which the parties may agree upon will be established and implemented through a separate definitive agreement. Activities envisioned under such a definitive agreement may include the following, as appropriate:

- Provide support in developing a conceptual MOX qualification plan for BWR reactors.

- Develop a preliminary NRC licensing strategy for MOX BWR lead use assemblies.
- Provide input to DOE efforts to evaluate potential design and licensing of MOX fuel assembly shipping containers and development of a commercially viable MOX transportation.

This MOU creates no binding obligations on the part of the parties.

IV. Roles and Responsibilities

TVA and EN will each be responsible for assigning a point of contact for the various interactions and activities where TVA and EN mutually agree that involvement is necessary or beneficial to achieve the goals of this MOU. TVA and EN will meet periodically, as mutually agreed on, to coordinate activities and to develop a definitive agreement, as appropriate. Any identified potential conflicts will be mutually resolved.

V. Terms of Agreement

Information Sharing.

The sharing of information between EN and TVA will be consistent with each party's legal obligations. Both parties recognize that data and information exchanged between them may fall within the definition of trade secrets, privileged, confidential commercial or financial information, or other information that is protected and/or exempt from public disclosure under the Atomic Energy Act of 1954, as amended, and its implementing regulations, the Freedom of Information Act, as amended, the Washington State Public Records Act, or other applicable laws. To the extent practicable and allowable under the applicable laws, the parties agree to keep confidential the information exchanged between them and to not issue any press releases or public announcements regarding this MOU and the project described herein without first consulting the other party.

Funding and Authorizations.

EN enters into this MOU under the authority of Chapter 43.52 of the Revised Code of Washington, as amended, which established EN as a joint operating agency of the State of Washington with the authority, among other things, to generate, use and sell electric energy and conduct studies to promote wider and better use of electric power. TVA enters into this MOU under the authority of the Tennessee Valley Authority Act (16 U.S.C. 831 et seq., as amended), which established TVA as an agency of the federal government with the authority, among other things, to generate, use and sell electric energy and conduct studies and experiments to promote wider and better use of electric power. The working relationship of the parties under this MOU will be consistent with all relevant statutory authority.

Nothing in this MOU authorizes, nor is intended to obligate, either entity to expend, exchange, or reimburse funds, services, or supplies, or transfer or receive anything of value, or enter into any contract, definitive agreement, or other financial obligation. All activities pursuant to this MOU are subject to the availability of funds and each party's budget priorities.

This MOU is strictly for EN and TVA internal management purposes. This MOU is not legally enforceable and shall not be construed to create any legal obligation on the part of either party. This MOU shall not be construed to provide a private right of action for or by any person or entity.

Services shall be provided under this MOU only after an appropriate definitive agreement has been signed by an authorized representative of each party.

Agreement Amendment, Modification, and Termination Period.

This MOU may be modified or amended only by written, mutual agreement of the parties. This MOU shall be effective on the date of signature, and shall remain in effect until its termination. Either party may terminate this MOU by providing written notice to the other party. The termination shall be effective on the thirtieth (30th) calendar day following notice, unless a later date is set forth.

VI. Points of Contact

EN and TVA assign the following senior managers as the key points of contact for this MOU. The senior managers are EN's and TVA's official representatives and are authorized to act on the parties' behalf.

EN's Representative	TVA's Representative
Name: Lisa L. Ferek	Name: James T. Robert
Title: Fuel Management Lead	Title: Manager AFCD Project
Telephone: (509)377-8148	Telephone: (423) 751-6504
Fax: (509)377-4786	Fax:
E-mail: llferek@energy-northwest.com	E-mail:jtrobert@tva.gov

IN WITNESS WHEREOF, the parties hereto have caused this Memorandum of Understanding to be executed by their duly authorized representatives.

AGREEMENT

TENNESSEE VALLEY AUTHORITY	ENERGY NORTHWEST
Ashok Bhatanagar,	Joseph V. Parrish For J. V. Parrish
Senior Vice President,	Chief Executive Officer
Nuclear Generation Development and Construction	Energy Northwest
Tennessee Valley Authority	
3/17/09	3-13-09
Date	Date

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Cadwell, Beverly A.

From: Cadwell, Beverly A.
Sent: Wednesday, March 11, 2009 8:12 AM
To: #Distribution A
Cc: Control Room; Procedure Control
Subject: Delegation of Authority - JV Parrish -March 13, 2009

J.V. Parrish

Mr. J. V. Parrish, Chief Executive Officer will be away from Energy Northwest Friday, March 13, 2009. Mr. Al Mouncer, Vice President Corporate Services/General Counsel/CFO will act as Chief Executive Officer during his absence. Mr. Mouncer will have the full authority of the position except that which by policy cannot be delegated.

Should his return be delayed, this delegation will remain in effect until otherwise rescinded.

"Original signed and filed"

Bev Cadwell | Executive Assistant, CEO Office
Energy Northwest | ☎ 509.377-8222 | F 509.377.8637 |

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