50-295

POLLUTION AND ENVIRONMENTAL PROBLEMS, INC.

P.O. Box 309 Palatine, Illinois 60067
312/381-6695

October 11, 1982

Director of Inspection and Enforcement
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Re: Request for Action Re Zion Nuclear Station Under Section 2.206 of the Code of Federal Regulations

Dear Sir:

Pursuant to 10CFR Part 2.206, the members of Pollution and Environmental Problems, Inc request that the U.S. Nuclear Regulatory Commission take the following actions:

1. Deny Commonwealth Edison permission to use high burnup nuclear fuel in Zion 1 and 2 nuclear reactors.

2. Provide evidence to the public that Zion 1 and 2 reactors should be allowed to continue operating despite the facts that their reactor pressure vessels are vulnerable to embrittlement and the time for which the NRC has vouched for their ability to withstand a severe overcooling event has already expired.

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The following facts constitute the basis for our requests:

<u>Regarding the Use of High Burnup Nuclear Fuel</u>

The relationship between the use of high burnup nuclear fuel and embrittlement of reactor vessels is not understood at this time. In clear defiance of the National Environmental Policy Act (NEPA), the U.S. NRC is allowing nuclear utilities throughout the country to use high burnup fuel. More than 38,000 fuel rods have already been irradiated to 45,000 megawatt days per metric ton of uranium. Four assemblies at Zion 1 and 2 have already been irradiated to 56,100 MWd/tU. Authorizations for high burnup fuel have been given by the NRC without a generic environmental impact statement as required by NEPA. This becomes more significant in light of the problems of embrittlement at pressurized water reactors, such as the Zion reactors.

The need to avoid corrosion and wear in a reactor pressure vessel because they weaken the vessel material is well known. The public needs to know what type of fuel is being used for high burnup, the leakage rate of the fuel, the relationship between high burnup fuel and vessel corrosion, fatigue and cracking; and where the fuel is loaded in relationship to the rest of the core.

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Cidd: E.L. Jordan, IE
J.M. Taylor, IE

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Dr. Peter Lang in the July 1982 issue of Nuclear Engineering International says: "Low leakage fuel management...is needed for extended burnup, since it makes little sense to load the more highly enriched fuel designed for extended burnup at the core periphery, where its higher reactivity only enhances neutron leakage." The obvious potential for higher reactivity and increased neutron irradiation of the reactor pressure vessel, as caused by high burnup fuel, are real causes for concern.

Before high burnup fuel is used any further in pressurized water reactors--like the Zion reactors--we are entitled to evidence that this fuel will not increase the vulnerability of the reactor pressure vessels to embrittlement and cracking. Until such a public report is made, we urge the NRC to deny Commonwealth Edison permission to use high burnup fuel in its Zion nuclear reactors.

Regarding the Ability of Zion Reactors to Withstand Embrittlement

In a letter dated September 28, 1981 to this petitioner, Victor Stello, Director, Office of Inspection and Enforcement with the NRC in Washington, D.C. said:"With regard to the possible generation of cracks in the Zion pressure vessels, on the basis of our review of the PWR Owners Group's responses and the PWR licensees' responses to our letter of April 20, 1981, and on the basis of our independent analysis, the staff has determined that all operating plants could withstand a severe overcooling event for at least another year of full power operation." Pollution and Environmental Problems, Inc. would like to know what happens after September 28, 1982--a date which is already passed.

In a letter to Harold R. Denton, director of the NRC's Office of Nuclear Reactor Regulations, dated May 28 , 1981, Tom R. Tramm, nuclear licensing administrator of Commonwealth Edison, said: "...all Westinghouse plants, including Zion have been shown to safely sustain severe thermal shock transients, including repressurization to beyond January 1982 at a minimum." It is is now almost two years beyond Tramm's specified date. We would like to know how far beyond January 1982 the Zion reactors can safely operate. We do not believe the lives of millions should be chanced on the hunches or best guesses of owners and operators of nuclear power reactors. We have been given no substantiation for their time estimates.

The possibility of a catastrophic accident in the Zion area is intolerable. There can be no thought of capitulation to what is economical for the licensee or expedient for the NRC. The federal government's own Reactor Safety Study (WASH-1400) warns that certain pressure vessel ruptures could cause a piece of the pressure vessel to be propelled like a missile through the concrete containment wall around the pressure vessel. The Reactor Safety Study states:

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"This type of rupture could involve a core meltdown in a non-intact containment"--explaining that a reactor vessel rupture leads directly to a core meltdown. Thus we can see that the concrete containment building, the last line of engineered defense against the release of vast quantities of radioactivity, can be penetrated. The lives of millions of people are at stake.

We urge your immediate attention to our petition.

Sincerely,

Catherine Quigg

Catherine Quigg, research director
Pollution and Environmental Problems, Inc.

Update

Extending LWR fuel burnup

The extension of burnup in LWRs is well under way, both in the United States and in Europe, with excellent progress being achieved in r and d and appropriate implementation taking place in utility reactors. Peter M. Lang* reports that continued advances in both of these areas are expected in the future.

In an earlier Update (*NEI*, February 1979), many different ways of improving the utilization of uranium in the once-through light water reactor fuel cycle were presented. Extending the burnup of LWR fuel was recognized then as the largest and most significant single improvement, and several other proposed improvements each of much smaller impact were also discussed. The work done since then, as well as changes in objectives, has led to a concentration of present effort on extended burnup, with only those other improvements that synergize with extended burnup still of significant interest. Low leakage fuel management, for example, is needed for extended burnup, since it makes little sense to load the more highly enriched fuel designed for extended burnup at the core periphery, where its higher reactivity only enhances neutron leakage.

In the last three years, very significant progress has been made on extended burnup, both in the United States and in Europe. This progress has included research and development on all major fuel performance phenomena at higher burnup levels, test assembly irradiations of existing fuel to extended burnups, development and initial irradiation of fuel designs incorporating advanced features intended to improve high burnup performance, and the utilities taking the first step of extending burnup somewhat for entire batches of reload fuel in their power reactors.

This progress was highlighted recently at an international topical meeting on extended burnup sponsored by the American Nuclear Society (Williamsburg VA, USA, 4-8 April 1982) and this provides an appropriate occasion for reviewing current perceptions regarding extended burnup, areas of consensus as well as disagreement, technical status and progress, and likely future directions.

Motivation for change. Although reprocessing is now expected in the United States as well as in other countries, extended burnup remains highly desir[illegible] to utilities on economic grounds and [illegible]duce the rate at which spent fuel is [illegible]ated. While these are the principal motives for most utilities, others consider the facility of longer operating cycles (in PWRs) and reducing the fast neutron irradiation of reactor vessels equally important. With reprocessing, uranium utilization is not of long-range strategic importance since residual fuel values are recoverable from spent fuel; however, in the near term uranium utilization continues to be of importance to utilities remaining on a *de facto* once-through fuel cycle. For the United States government, reduction in spent fuel generation is the principal justification for supporting extended burnup. Extension of burnup to the present consensus goals of about 40 to 45 MWd/kg U discharge batch average for BWRs and 45 to 50 MWd/kg U for PWRs yields reductions in spent fuel generation of about 40 per cent and in estimated nuclear fuel cycle cost of about 10 per cent.

No major technical or licensing issues appear to prevent attainment of the burnup goals indicated. An ever expanding data base on fuel performance phenomena at extended burnups is being generated. These data include steady-state and transient fission gas release, resistance to failure upon ramping, waterside corrosion, fuel rod and fuel assembly dimensional changes, and grid spring relaxation. No discontinuities or other major surprises have been encountered; completion of the work in progress should therefore provide a confident basis for licensing. Several independently conducted licensing assessments have reached the conclusion that although further data needs exist, no major issues are anticipated. Licensing approvals of ongoing test irradiations and of initial partial extensions of burnup for larger quantities of fuel in power reactors confirm this conclusion.

Excellent fuel integrity. A large amount of fuel of current design has been taken to extended burnup in many reactors, both BWRs and PWRs. The table shows the present status and, for irradiations still in progress, target burnups and completion dates, for fuel of United States suppliers. None of this fuel has exhibited any evidence of failure for burnups up to the values shown. In some cases these burnups are equivalent to, or are even beyond, the previously indicated goals. The absence of failures has

*Programme manager for extended burnup, Office of Nuclear Power Systems, Department of Energy, Washington DC.

Extended burnup fuel irradiations with US current product-line fuel

Utility/fuel vendor/reactor	No. of assemblies (rods)	Current average burnup* MWd/tU	Status or target burnup, MWd/tU, and date achieved
Duke Power/B & W/Oconee 1	4	40 000	Completed
	1	40 300	50 000 by 1983
Omaha Public Power/CE/ Fort Calhoun	20	33 400	Completed
	1	46 500	52 000 by 1982
Baltimore Gas & Electric/CE/ Calvert Cliffs 1	1	43 000	Completed
	(8)	53 500	55 000 by 1982
Arkansas Power/CE/ANO 2	1	19 900	44 000 by 1984
Carolina Power/Exxon/ H. B. Robinson 2	3	40 300	Completed
	1	47 300	Completed
Consumers Power & General Public Utilities/Exxon/Oyster Creek	4	31 400	35 500 by 1984
Big Rock Point	(59)	39 300	Completed
Northern States Power/GE/ Monticello	5	36 100	Completed
	2	39 400	41 000 by 1982
	2	42 900	45 000 by 1982
Philadelphia Electric/GE/ Peach Bottom 2	2	35 000	Completed
	2	35 000	42 000 by 1983
Commonwealth Edison/W/Zion 1 & 2	4	50 100	Completed
Virginia Electric Power/W/Surry 2	1	42 500	Completed
None/W/BR-3 (Belgian)	(5)	57 000	Completed

*As of March 1, 1982

been explained by the fact that failures are due either to "infant mortality effects" or to pellet-clad interaction (p.c.i.). Extended burnup fuel has been effectively guarded against p.c.i. and is less subject to it in power reactors because of the lower reactivity of the fuel at high burnup.

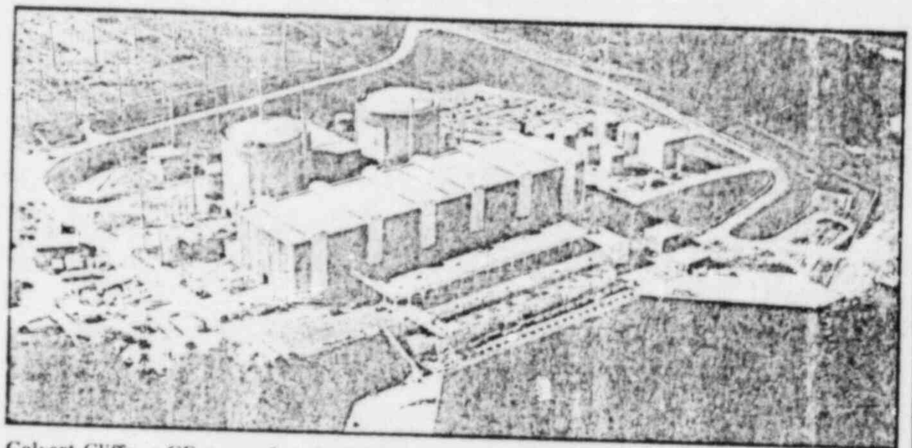
No "wear-out" type of fuel failures has been encountered within the range of burnups obtained. Similar results have also been obtained for fuel of European suppliers: a large amount of Kraftwerk Union PWR fuel in five reactors typically to 40MWd/kgU, four Kraftwerk Union BWR fuel assemblies in Würgassen to 34MWd/kgU, five Fragema fuel assemblies in Fessenheim 2 now in a fourth cycle of irradiation, and a number of ASEA-Atom assemblies up to 35MWd/kgU.

No consensus exists now on whether burnups still higher than the goal values previously indicated should be sought. There are some indications that substantially higher burnups may be economic and that some organizations may be working toward such higher targets. Similarly, there is no consensus on whether advanced fuel designs are needed to achieve extended burnup, or whether current designs are adequate for present goal burnups. Advanced designs of course become increasingly more interesting as burnup goals are raised. Specifically, there is wide disagreement on the need for and desirability of annular pellets.

Similarly, although the need for advanced burnable poisons for PWRs is generally accepted, not everyone agrees that gadolinia admixed with UO_2 is the best advanced burnable poison. For BWRs, the need for incorporating p.c.i. remedies is accepted, but opinion is divided on whether barrier fuel (high purity zirconium lining the inside of the clad) or more rods per assembly (9 × 9 instead of 8 × 8) is the best way to prevent or avoid p.c.i.

Other improvements. The use of extended burnup facilitates the use of longer operating cycles, particularly in PWRs, by reducing the fraction of the core replaced at each refuelling, in comparison to lower burnups. Longer operating cycles are generally economic when replacement power costs are high, even though nuclear fuel cycle costs are higher than for shorter cycles. Other advantages of longer cycles include fewer licensing submittals, fewer refuellings to be conducted, and lower total radiation exposure to operating personnel.

Low leakage fuel management (placing fresh fuel in the core interior and partly burned fuel on the periphery) similarly interacts synergistically with extended burnup and will become the only practical fuel management scheme as burnups reach goal values. Low leakage fuel management brings savings (small compared to those of extended burnup by itself) in uranium and s.w.u. consumption and consequently in fuel cycle cost. Reduced fuel rod size (without changing the number of rods per assembly) similarly brings smaller savings, but requires somewhat increased burnup for its implementation when cycle length and refuelling fraction remain unchanged, because of the reduced amount of uranium reloaded each cycle.



Calvert Cliffs, a CE PWR, (2 × 865MWe) is one US station where extended burnup has been achieved – 55MWd kgU is aimed at this year.

In BWRs, both spectral shift operation through flow control and reconstitution of higher enrichment rods from otherwise spent fuel to form assemblies with enough reactivity for an extra cycle are improvements each of which yields moderate burnup increases without increasing enrichment; these improvements should provide worthwhile economic benefits and become accepted as the fuel performance technology for the necessary burnup increase is demonstrated.

R & D priorities changing. Past research and development has concentrated strongly on the effects of extended burnup within the fuel rod; specifically, on issues of fission gas release, p.c.i., and various dimensional changes (radial, axial, bowing). Present work is providing a good base of data on these effects, with few unanticipated results. While effects on the surface of the fuel rod such as corrosion and crudding are also being measured, these results show very wide variation and cannot yet be adequately related to water chemistry parameters, temperature, radiation fields, etc.

Although excessive corrosion is of particular concern for future plants which are designed for higher coolant inlet temperatures, it is unlikely to limit the allowable in-core residence time of fuel, and hence its burnup, provided that proper water chemistry conditions are maintained. Consequently, understanding what the conditions must be is becoming one of the highest priorities for future research. In addition, the proper design of gadolinia burnable poison for PWRs and the behaviour in the reactor of such poisons has recently gained much interest. This is due to the realization that such poisons are needed for practical extended burnup fuel management schemes and because the relatively higher concentrations needed (typically 4 to 8 per cent Gd_2O_3 in UO_2) for extended burnup and extended cycle length are beyond the range of past experience.

Utility implementation. Several utilities in the United States and in Europe are moving ahead with implementing the first step toward extended burnup in their power reactors; this step is typically an increase in the range of 3 to 7MWd/kgU. Increases of this magnitude are now considered technologically proven and readily licensable, even given the conservative perspective prevailing throughout the utility industry. The availability of burnup extensions of this magnitude is becoming a significant competitive factor in the purchase of reload fuel by utilities; because of this, information concerning utility burnup extensions is sometimes maintained proprietary. Nevertheless, it is estimated that implementation of burnup extensions for entire reload batches within the range indicated is now under way, or that firm decisions to implement such extensions have been made, for at least 25 operating utility power reactors in the United States. Discussions at Williamsburg gave the impression that similar burnup extensions are being seriously considered for several European reactors.