UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	
	)	
DAIRYLAND POWER COOPERATIVE	)	Docket No. 50-409
	)	(SFP License Amendment)
(La Crosse Boiling Water Reactor)	)	

AFFIDAVIT OF JACK N. DONOHEW REGARDING INTERVENORS CONTENTIONS 5(a), 5(b-1), 5(d), 6 and 7

My name is Jack Donohew. I am employed by the Nuclear Regulatory Commission in the Environmental Evaluation Branch of the Division of Operating Reactors. I have been employed in this position since 1976. My professional qualifications are contained in the attachment to this affidavit. This affidavit was prepared by me or under my supervision.

The purpose of this affidavit is to present written testimony addressing Contentions 5(a), 5(b-1), 5(d), 6 and 7 admitted for litigation in this proceeding.

Contention 5 reads as follows:

> It is CREC's contention that an increase in the number of spent fuel locations from 134 to 448* would present a threat to the safety of the public and the maintenance workers that would be completely unacceptable for the following reasons:
>
> 5(a) The design calls for an even smaller cask drop area.
>
> 5(b-1) The two-tier design greatly increases the chances for, and the potential magnitude of, accidents in fuel handling and storage.

* The increase requested is to 440 assemblies, not 448.

5(d) Increased fuel would increase maintenance exposures because of an increase in the number of filter changes and resin volumes and intensities.

Contention No. 5(a)

The design calls for an even smaller cask drop area.

This contention asserts that the smaller cask drop area proposed for the modified spent fuel pool poses a risk to public health and safety by increasing the likelihood of damage to the spent fuel stored in the pool while moving the spent fuel cask into or out of the cask drop area. An evaluation of a cask drop accident will address this contention, since damage to assemblies by moving the cask in a smaller area would necessarily be less than damage from a full cask drop onto stored assemblies.

The size of the cask drop (setdown) area does not affect the probability of dropping the cask into the pool. Because all the spent fuel is assumed to be damaged during the cask drop accident, the size of the cask setdown area does not affect the potential consequences of this accident. Therefore, the smaller cask setdown area in the proposed modification of the LaCrosse pool does not increase the risk of such an accident to the public and workers. The size of the cask with respect to the small LaCrosse pool is such that the increased capacity of the pool will allow more spent fuel to possibly be damaged in a cask drop accident. However, this additional fuel is old fuel which has decayed to a point where the activity in the fuel available for release is insignificant compared to the fuel from the last refueling.

An evaluation of the potential consequences of a drop of the spent fuel shipping cask into the SFP is given in the Safety Evaluation (SE) dated October 22, 1975, for the previous modification of the SFP. That evaluation concluded that, in the event of a cask drop accident, the potential consequences of the accident were less than half the exposure guidelines of 10 CFR §100. Part 100 limits are 25 rem whole body; 300 rem, thyroid.

The potential consequences of the previous evaluation assumed the pool to contain 24 freshly discharged assemblies from a refueling offload, and that all the fuel was ruptured in the accident. The potential consequences calculated in the previous analysis are unchanged by calculating consequences of a cask drop accident in the expanded pool, assuming a fuel pool with one new offloading, and rupture of all spent fuel (440 assemblies). This is because of the decay of old spent fuel in the pool to continuing lower levels of radioactivity. Therefore, the anticipated exposures for the expanded pool capacity of 440 assemblies are no greater than those calculated for the present pool size, and meet the guidelines set forth in 10 CFR §100 of the Commission's regulations.

The previous evaluation did not include a freshly discharged full core in the pool in the cask drop analysis. Therefore, the licensee will be required by new technical specifications to isolate the containment (where the spent fuel pool is located) any time the shipping cask is near the pool if the full core offload has decayed less than 51 days. With this requirement, a cask drop into the spent fuel pool containing a freshly discharged full core will not cause exposures which would exceed 10 CFR §100 guidelines since the isolated containment would prevent releases to the atmosphere.

The potential worker exposures calculated for a cask drop accident are also unchanged for the above reasons, and the licensee's safety procedures for protection of personnel need not change.

The probability of dropping a cask into the pool is not changed by reducing the size of the cask setdown area or by increasing the capacity of the pool. Since analysis of a fuel cask drop accident shows no increase in risk to public or worker safety, there is also no increased risk from lesser accidents during movement of the cask in a smaller area.

Contention No. 5(b-1)

Contention No. 5(b-1) states that the expanded pool is a risk to public and worker health and safety because:

> The two-tier design greatly increases the chances for, and the potential magnitude of, accidents in fuel handling and storage.

The potential consequences to the public and worker of a fuel handling accident in the SFP are not changed by the proposed action. This is because, effectively, the only spent fuel in the pool which contributes to the consequences of these accidents is the last spent fuel to be placed in the pool. This is the spent fuel discharged during a refueling or full core offload. Most of the gaseous fission products have short half lives and decay to insignificant levels within a few months. In addition, there will not be a significant increase in the number of

fuel handling movements because of the increase in capacity of the SFP. Because there are no requirements in the technical specifications as to where the freshly discharged spent fuel must be stored in the double tiers, the number of fuel handling movements should not change significantly because of the increase in the SFP capacity. Therefore, the expanded SFP capacity at LaCrosse and storing the fuel in double tiers does not increase the risk of accidental releases to workers and the public.

The Staff has evaluated the potential consequences of postulated fuel handling accidents for the proposed SFP modification at LaCrosse, with fuel stored in double tiers. For this present evaluation, we assumed the equivalent of all the fuel pins in two freshly discharged fuel assemblies are damaged and the fuel is discharged from the reactor 72 hours after shutdown. The other assumptions, which are the same as in the previous evaluation for a cask drop accident, are given in the attached Table 1. The estimated potential consequences are 162 rem to the thyroid and 2 rem to the total body at the Exclusion Area Boundary (EAB). The potential consequences at the Low Population Zone are smaller than those at the EAB. These are within the guidelines of 10 CFR Part 100.

We believe this postulated accident is appropriately conservative for the following reasons: The probability of the postulated fuel handling accident involving extensive release of radioactivity is small. There have been several hundred reactor years of plant operating experience with only a few accidents involving

the dropping of spent fuel, none of which have resulted in measurable releases of radioactivity. The likelihood of a dropped assembly directly striking another assembly stored in the racks, an impact which results in the greatest energy available for crushing fuel pins in both assemblies, is small due to moments of the drag forces exerted by the water on the falling assembly which cause it to fall in a tipped orientation. The licensee does not plan to store freshly discharged assemblies in both the upper and lower tiers; thus, an assembly dropped on the one stored in the upper rack position should not initiate an impact involving three freshly discharged assemblies. Furthermore, there are steel plates positioned at the bottom of each of the upper tier fuel storage cells which should render three assembly impacts unlikely. There is also no increased risk of worker exposures for the reasons explained above.

Therefore, for the reasons above-stated, I conclude that there is no increased risk of fuel handling accidents due to the two-tier design, nor an increased risk of public or worker exposures from fuel handling accidents due to the proposed modification.

Contention No. 5(d)

Contention No. 5(d) states that the expanded pool is a risk to worker safety because:

> Increased fuel would increase maintenance exposure because of an increase in the number of filter changes and resin volumes and intensities.

Present operating experience at LaCrosse has indicated that the occupational exposure for resin sluicing and filter changing provide an annual occupational exposure of 1.5 man-rem. It is anticipated that, as a result of the proposed modification, the frequency of filter-demineralizer changing may double. This could provide an additional 1.5 man-rem per year to La Crosse occupational man-rem burden. However, from the standpoint of in-plant occupational exposure experience, this additional exposure represents less than 1% of the average total annual occupational exposure received operating this facility and, therefore, should not affect the licensee's ability to maintain individual occupational exposures to as low as is reasonably achievable (ALARA) levels and within the limits of 10 CFR Part 20.

Contention No. 6

Intervenors' Contention No. 6 reads as follows:

> CREC contends that a significant increase in the SFP capacity and the resultant increase in spent fuel handling necessitated by Applicant's proposed amendment increases the risk of accidental releases to employees and the public in the event of a cask drop accident to an unacceptable level.

The potential consequences of dropping a spent fuel shipping cask into the expanded SFP or of a fuel handling accident in the SFP are not significantly changed by the proposed action as shown in the analyses in answers to Contentions 5(a) and 5(b-1). This is because the only spent fuel in the

pool which significantly contributes to the consequences of these accidents is the last spent fuel to be placed in the pool. This is the spent fuel discharged during a refueling or full core offload. Most of the gaseous fission products have short half lives and decay to insignificant levels within a few months. There will not be a significant increase in the number of fuel handling and shipping cask movements because of the increase in capacity of the SFP other than during the modification of the pool. The total number of shipping cask movements will depend on the size of the cask and the number of assemblies to be shipped and not on the capacity of the SFP as is the case for all nuclear plants. Because there are no requirements in the technical specifications as to where the freshly discharged spent fuel most be stored in the double tiers, nor has the licensee proposed storage of freshly discharged fuel in only one tier, the number of fuel handling movements should not change significantly because of the increase in the SFP capacity. Therefore, a significant increase in the SFP capacity at LaCrosse does not significantly increase the risk of accidental releases to employees and the public from fuel handling or cask drop accidents from those releases previously calculated for the present SFP capacity.

Contention No. 7

Intervenors' Contention No. 7 reads as follows:

> CREC further contends that Applicant's proposed amendment to its provisional operative license should be denied due to the increased threat to the environment generally, and to maintenance personnel specifically. The increased threat to which we refer is that of the storage of failed fuel rods, including several grossly failed rods, which results in a more dangerous and shortened storage life and increased storage costs.

As stated in NUREG 0032, fuel failures "compound the problems of storage, waste reprocessing, and disposal." As fuel failures are predicted for the future, ACRS January 26, 1978, p. 173, and expansion of SFP capacity would serve to produce even more unacceptable hazards and increase maintenance exposures at LACBWR, which is already above the average for the nuclear industry in that regard.

Experience with failed fuel storage at other operating nuclear power plants has not endangered the public health and safety. Fuel failures can be detected and removed from the core and stored in the spent fuel pool without increased risk to the environment or plant personnel. Outside the core when stored in the SFP, the failed fuel assemblies will cool and the amount of fission products released will decrease significantly from that which occurred in the core. In the pool, the fuel assemblies are in a benign, tranquil environment and experience has shown that damaged fuel assemblies can be stored without further damage being done to them.

Fuel failure increases the concentration of activity in the primary coolant and the amount of activity released from the plant as compared to operation of the plant without fuel failures. The increase in the concentration of activity in the primary coolant is an indication of fuel failure and an indication of possible future increases in the amount of activity which could be released from the plant. A significant increase of activity in the primary coolant will be detected by the sampling of the primary coolant and the monitoring of the radwaste system and of the plant. This is discussed in the plant's Safeguards Report and required in the plant's Technical Specifications.

As discussed in the EIA concerning this proceeding, in Section 5.3.1, operational reports submitted by licensees and discussions with the operators of the Morris Operation (MO) (formerly Midwest Recovery Plant) at Morris, Illinois, and the Nuclear Fuel Services' (NFS) storage pool at West Valley, New York, there has not been any significant leakage of fission products from spent light water reactor fuel stored in their pools. Spent fuel has been stored in these two pools which, while it was in a reactor, was determined to have significant leakage and was, therefore, removed from the core. After storage in the nuclear plant's onsite spent fuel pool, this fuel was later shipped to either MO or NFS for extended storage. Although the fuel exhibited significant leakage at reactor operating conditions, there was no significant leakage from this fuel in the offsite storage facility. This facility experience indicates that there is little radionuclide leakage from damaged spent fuel stored in pools after the fuel has cooled for several months. These facilities have encountered no problems with excessive radiation, shorter storage capability or increased cost of storage of grossly failed fuel.

Most failed fuel contains small pinhole-like performations in the fuel cladding at the reactor operating condition of approximately 800°F. A few weeks after refueling, the spent fuel cools in the spent fuel pool so that fuel clad temperature is relatively cool, approximately 180°F. This substantial temperature reduction reduces the rate of release of fission products from the fuel pellets and the gas pressure in the gap between pellets and clad, thereby tending to retain the fission products within the gap. Thus, no increased risk is expected for failed fuel storage. Additionally, LACBWR has stored assemblies with grossly failed fuel in the present spent fuel pool for more than a year without difficulty.

The report NUREG-0032 referenced by Intervenors is a qualitative evaluation of fuel failures at thirty-three light water nuclear plants up to December 31, 1974. It did not include fuel failures that have occurred at LaCrosse Boiling Water Reactor (LACBWR). The report (NUREG-0032) concluded that the fuel failures at these plants did not have any adverse effect on the public health and safety. It concluded that plant operating restrictions, due to fuel failures or due to actions to mitigate fuel failures, have resulted in lowered plant availability and capacity factors. It did state that fuel failures have the potential for (1) increasing radiation exposure of plant personnel and the public, (2) compounding the problems of spent fuel storage, waste reprocessing and disposal, (3) increasing the cost of generating power and (4) increasing the number and complexity of plant radwaste disposal systems. However, there was no attempt in NUREG-0032 to quantify the magnitude of the increases mentioned above, and the report merely indicates a need to address and account for the problems of failed fuel. These problems can be effectively accommodated so as to prevent risk to the public and workers.

LACBWR has had a history of fuel failures of their stainless steel clad Alis-Chalmers fuel. An independent evaluation of these fuel failures was made by NRC and used as the basis for NRC approval of Cycle 5 at LACBWR. To assure improved fuel performance, limits were included in the LACBWR Technical Specifications on the rate of control rod movement, power escalation and the exposure of the highest burnup fuel assembly. In addition, Technical Specifications

were imposed for monitoring and limiting the offgas and primary coolant activities to detect the presence of fuel failures.

Operation of LACBWR in Cycle 5 has been completed and some fuel failure was discovered after shutdown. This was expected and the fraction of fuel failures is about 0.3%. Experience during Cycle 5 further indicates that the operating limits imposed effectively addressed previous fuel failure problems. Thus, the significant fuel failures during Cycle 4 are unlikely to recur.

The subject of fuel failures at LACBWR was discussed on Thursday, January 16, 1978, at a subcommittee meeting of the Advisory Committee on Reactor Safeguards (ACRS). At the meeting, the NRC Staff explained: (1) the conditions imposed on LACBWR for its safe operation during Cycle 5, (2) why the Staff believes it understands the trend of fuel failures at LACBWR, (3) the basis for the monitoring of fuel failures being required for operation of LACBWR and (4) that the Staff expects less than 0.5% fuel failures at LACBWR during Cycle 5. Nuclear power reactors are not expected to operate entirely without failed fuel. The 0.5% fuel fraction is smaller than the failed fuel fraction assumed for the safety evaluation for the operation of LACBWR when it was originally licensed and presents no risk to the environment or the workers.

I have estimated the increment in onsite occupational dose resulting from the proposed increase in stored fuel assemblies, including the failed fuel, on the basis of information supplied by the licensee for dose rates in the spent fuel area from radionuclide concentrations in the SFP water and the spent fuel assemblies. Failed spent fuel assemblies in the double tier will contribute a small fraction of the dose rates in the pool area because of the depth of water shielding the fuel and the rapid decrease in radionuclide emissions, explained above. A Technical Specification will require the licensee to provide a minimum of 16 feet of water above the spent fuel elements. This depth of water will reduce dose rate levels from the SFP elements to small fractions of the radionuclide concentrations in the spent fuel. Consequently, the occupational radiation exposure resulting from the additional spent fuel in the pool represents a negligible burden. Based on present and projected operations in the spent fuel pool area, we estimate that the proposed modification will add less than one percent to the total annual occupational radiation exposure burden at this facility. The small increase in radiation exposure will not affect the licensee's ability to maintain individual occupational doses to as low as is reasonably achievable and within the limits of 10 CFR Part 20. Thus, I conclude that storing the present and possible future failed fuel in a double tier arrangement in the SFP will not result in any significant increase in doses received by occupational workers.

Based on the above, it is my opinion that the storage of presently stored, and possible future additional failed fuel in an enlarged spent fuel pool would not produce unacceptable hazards or occupational exposures at LACBWR. The occupational exposure at LACBWR is not above average for nuclear power plants as a whole nor for the operating boiling water reactors. In NUREG-0463, "Occupational Radiation Exposure, Tenth Annual Report, 1977," LACBWR is listed as below average for each of the two categories from 1973 to 1977. Their occupational exposure has ranged from 110 to 234 man-rems per reactor year, whereas the average for the industry and for just the operating boiling water reactors is about 500 man-rems per reactor year.

I have read the foregoing affidavit and swear that it is true and accurate to the best of my knowledge and belief.

Jack N. Donohew

Subscribed and sworn to
before me this 24th day of
July 1979.

Notary Public

My Commission Expires: July 1, 1982.

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TABLE 1

ASSUMPTIONS USED IN EVALUATING
LACBWR FUEL HANDLING ACCIDENTS

Power Level	165 Mwt
Total Number of Fuel Rods in Core	7200
Number of Fuel Rods Damaged	200
Shutdown Time	72 hours
Radial Peaking Factor	1.5
Inventory Released from Damaged Rods	
Iodines and Noble Gases (not Kr 85)	10%
Kr 85	30%
Pool Decontamination Factors	
Iodines	100
Noble Gases	1
X/Q Values, sec/m^3	
0 - 2 hours @ 1,109 ft	2.2×10^{-3}
0 - 8 hours @ 3 miles	3.8×10^{-5}
8 - 24 hours @ 3 miles	2.5×10^{-5}
24 - 96 hours @ 3 miles	9.1×10^{-6}
96 - 720 hours @ 3 miles	2.6×10^{-6}

JACK N. DONOHEW, JR.

PROFESSIONAL QUALIFICATIONS

DIVISION OF OPERATING REACTORS

OFFICE OF NUCLEAR REACTOR REGULATION

My name is Jack N. Donohew, Jr. I am a Senior Nuclear Engineer in the Environmental Evaluation Branch in the Division of Operating Reactors, U. S. Nuclear Regulatory Commission (NRC). My duties include the review of rad-waste treatment systems and engineered safety feature ventilation systems for operating reactors.

I received a Bachelor of Engineering Physics Degree from Cornell University in 1965, a Masters of Science Degree in Nuclear Engineering from Massachusetts Institute of Technology in 1968, and a Doctor of Science Degree in Nuclear Engineering from Massachusetts Institute of Technology in 1970. I received my Professional Engineers License in Nuclear Engineering from the Commonwealth of Pennsylvania in 1974.

After graduation, I worked for Stone and Webster Engineering Corporation as an engineer in the Radiation Protection Group. I was responsible for estimating source terms, release rates and resulting doses for the Safety Analysis Report, Environmental Report and response to NRC questions for boiling water nuclear reactors. I was also responsible for shielding design for the reactor water cleanup system.

In February, 1973, I became a Power Engineer in the Process Engineering Group, Stone and Webster Engineering Corporation. I was lead engineer for the Shoreham Project and the equipment specialist for all nuclear plants

for the containment iodine spray removal system, ventilation filter assemblies, and Boiling Water Reactor and Pressurized Water Reactor gaseous waste treatment system.

In June, 1975, I joined the Nuclear Regulatory Commission as a senior nuclear engineer in the Effluent Treatment Systems Branch, Directorate of Licensing. I was involved in rad-waste system licensing reviews of nuclear power plants. I have conducted generic studies of the degradation of charcoal adsorbers in ventilation filter assemblies.

In December, 1975, I joined the Environmental Evaluation Branch in the Division of Operating Reactors.