UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	
	)	
COMMONWEALTH EDISON COMPANY	)	Docket Nos. 50-454 OL
	)	50-455 OL
(Byron Station,	)	
Units 1 and 2)	)	

INTERVENOR ROCKFORD LEAGUE OF WOMEN VOTERS' ANSWERS TO NRC STAFF AMENDED FIRST SET OF INTERROGATORIES

Pursuant to the Memorandum and Order issued by the Licensing Board on August 30, 1982, Intervenor Rockford League of Women Voters ("League") herewith submits its Answers to Amended First Set of Interrogatories propounded herein by the NRC Staff.

Introduction

As the League stated in the Introduction to its Answers to the Amended Second Round of Interrogatories of Commonwealth Edison Company, the Answers submitted herein contain as much information as is available to the League at the time of filing. Document production by Commonwealth Edison Company ("CECO") is continuing and is expected to be completed shortly. Consequently, further information may be submitted regarding these Interrogatories by means of Supplemental Answers when additional facts are ascertained from the documents upon their examination by the League's expert witnesses.

Interrogatory A-1:

For each of Contentions 1A, 8, 19, 22, 28, 32, 34, 39, 41, 42, 47, 53, 54, 61, 62, 63, 71, 77, 106, 108, 109. 111, and 112, list the following:

a. the identity of each person expected to be called as a witness at the hearing.

b. the substance of the witness's testimony.

c. the witnesses professional or other qualifications to testify on the subject matter on which the witness will testify.

Answer to A-1:

(a) The League has not yet determined who will be called as a witness on its behalf to testify regarding the admitted contentions. The witnesses may include any or all of the individuals, other than the League's counsel, listed in the League's response to Interrogatory A-2, as well as CECO and/or Staff personnel and others whose identities cannot be determined until the completion of discovery.

(b) Until the identity of the witnesses to be called on the League's behalf is known, the League will be unable to provide the substance of the witnesses' testimony.

(c) Until the identity of the witnesses to be called is known, the League will be unable to provide the professional or other qualifications of all such witnesses, although the professional qualifications of Messrs. Hubbard, Minor and Dr. Morgan were previously submitted with the League's answers to CECO's First Round of Interrogatories. The League intends to provide this information in a timely fashion together with the identities of the witnesses and the substance of their testimony once the witnesses have been selected.

Interrogatory No. A-2:

For each response to the Interrogatories hereinafter propounded, identify the person or persons who prepared, or substantially contributed to the preparation of, the response.

Answer to A-2:

The persons who prepared or substantially contributed to the preparation of the following responses to Interrogatories include Dale Bridenbaugh, Richard Hubbard, and Gregory Minor, MHB Technical Associates, 1723 Hamilton Avenue, Suite K, San Jose, California 95125; Dr. Karl Morgan, 1984 Castleway Drive, Atlanta, Georgia 30345; and Mrs. Betty Johnson, 1907 Stratford Lane, Rockford, Illinois 61107. Dr. Morgan substantially aided in the preparation of the League's responses to the Interrogatories on Contentions 42, 111 and 112. Mrs. Johnson, after consultation with various experts and officials, contributed to the preparation of the League's responses to the Interrogatories on Contentions 19, 106 and 108. MHB contributed to the answers to the Interrogatories on Contentions 41 and 62. The League's counsel prepared the responses to the Interrogatory dealing with Contention 8 and contributed to the preparation of all the other responses.

Material for the answers to the Interrogatories related to Contentions 39 and 109 are currently being prepared by Professor Bernie Wood, Locy Hall, 1847 Sheridan Road, Evanston, Illinois 60201, and will be filed by October 25, 1982.

Interrogatory No. 8:

8-1: Identify by title, publication date and NUREG number, if any, each and every one of the "[s]tudies carried out by the NRC" referred to in the second sentence of Contention 8.

Answer to 8-1:

See the League's response to Interrogatory 2(a) of the Commonwealth Edison Company's Amended Second Round of Interrogatories.

8-2: Identify by title, publication date and NUREG number, if any, each and every one of the "NRC Staff studies, which are not common public knowledge" referred to in the fifth sentence of Contention 8.

Answer to 8-2:

See the League's response to Interrogatory 2(b) of the Commonwealth Edison Company's Amended Second Round of Interrogatories.

8-3: Identify by title, publication date and NUREG number, if any, the "secret NRC study" referred to in the sixth sentence of Contention 8.

Answer to 8-3:

See the League's response to Interrogatory 2(d) of the Commonwealth Edison Company's Amended Second Round of Interrogatories.

8-4: Identify by author, title and publication date the "General Accounting Office report" referred to in the ninth sentence of Contention 8.

Answer to 8-4:

See the League's response to Interrogatory 2(e) of the Commonwealth Edison Company's Amended Second Round of Interrogatories.

As stated in the above referenced answers to CECO's Amended Second Round of Interrogatories, the League's own investigation and the discovery process are continuing. As additional facts are ascertained, they will be submitted in Supplemental Answers.

Interrogatory No. 19:

19-1: Describe with particularity the "[r]ecently discovered information" referred to in the first sentence of Contention 19 and identify the source thereof.

Answer to 19-1:

See the League's response to Interrogatory 3(a) of the Commonwealth Edison Company's Amended Second Round of Interrogatories.

19-2: Describe with particularity the "[i]nformation gathered by C.E." referred to in the third sentence of Contention 19 and identify the source thereof.

Answer to 19-2:

See the League's response to Interrogatory 3(b) of the Commonwealth Edison Company's Amended Second Round of Interrogatories.

19-3: State in detail the factual basis underlying Contention 19.

Answer to 19-3:

See the League's response to CECO's Interrogatory regarding Contention 19 contained in CECO's First Round of Interrogatories and the League's response to Interrogatory No. 3 of CECO's Amended Second Round of Interrogatories.

As stated in the above referenced answers to CECO's Amended Second Round of Interrogatories, the League's own investigation and the discovery process are continuing. As additional facts are ascertained, they will be submitted in Supplemental Answers.

Interrogatory No. 41:

41-1: Describe with particularity each relevant fact with respect to "extreme cold weather and ice buildup, of the kind which has occurred during each of the past two winters" in the area of the Byron site as referred to in Intervenor's Contention 41, including but not limited to:

a. the range of air and water temperatures involved;

b. the first and last dates of ice buildups;

c. the maximum amount by which water flow was diminished on account of cold weather or ice buildups.

Answer to 41-1:

Since the League's Revised Contentions were filed on March 10, 1980, the "past two winters" referred to in Contention 41 are obviously the winters of 1978-1979 and 1979-1980. The winter of 1978-1979 included some very severe cold weather in January and February of 1979, during which there were sustained periods of zero degree and subzero weather. Since that time, specifically in January of 1982, there has been another period of sustained cold weather involving record low temperatures. See the League's Response to the Interrogatory on Contention 41 contained in CECO's First Round of Interrogatories.

The daily temperatures in the area may be found in the local papers and are, therefore, matters of public record. The periods of ice buildup would coincide with the periods of freezing and subzero temperatures and would probably extend for some time past the point where temperatures began consistently rising above the freezing mark.

Given the fact that the Rock River is relatively shallow, these extended periods of cold weather resulting in even a limited ice cover could substantially interfere with the plant's ability to draw sufficient water to satisfy its needs. See the League's response to the Interrogatory on Contention 41 contained in CECO's First Round of Interrogatories, as well as the League's

response to Interrogatory No. 8 of CECO's Amended Second Round of Interrogatories.

41-2: Identify the particular paragraph(s) and page number(s) from NUREG-0410 and the Black Fox testimony that specifically identify ice buildup as a problem (not a consideration) at the Byron Nuclear Plant or site.

Answer to 41-2:

Contention 41 indicates only that NUREG-0410 and the Black Fox testimony described a category of plants, which would include Byron, that would experience a problem of ice buildup. NUREG-0410 and the Black Fox testimony did not specifically point to the Byron Nuclear Plant as having a special problem differing from the one shared by others in the category.

41-3: Describe the specific alleged ice buildup problems at the Byron Station and explain why the specific provisions of 10 C.F.R. Secs. 50.57(a)(3)(i) and 50.57(a)(6) cannot be met due to these specified ice buildup problems.

Answer to 41-3:

The specific ice buildup problem at Byron has been described in the League's responses both to the Interrogatory regarding Contention 41 of CECO's First Round of Interrogatories and to Interrogatory No. 8 of CECO's Amended Second Round of Interrogatories. Obviously, should such an ice buildup occur — which it demonstrably does on an almost annual basis in the Byron area — it could substantially interfere with the Byron plant's ability to draw sufficient water for its proper functioning and thus it could not operate without endangering the health and safety of the public in violation of 10 C.F.R. Secs. 50.57(a)(3)(i) and 50.57(a)(6).

As stated in the above referenced answers to CECO's Amended Second Round of Interrogatories, the League's own investigation and the discovery process are continuing. As additional facts are ascertained, they will be submitted in Supplemental Answers.

Interrogatory No. 42:

42-1: Describe with particularity and identify by author, title, publisher, and date of publication the references for the "new information on low-level radiation effects" referred to in the third sentence of Contention 42.

Answer to 42-1:

This request duplicates item 9, page 7 of CECO's Amended Second Round of Interrogatories, and was answered by the League under Section (a) of their response to Interrogatory 9.

42-2: Define the term "low-level radiation" as used in Contention 42.

Answer to 42-2:

The term "low level radiation" as used in Contention 42 refers to doses of less than 4,000 mrem per year and commonly in the range of 500 mrem per year for radiation workers.

42-3: State what specific aspect of occupational radiation exposure to station and contractor personnel has been increasing and state the specific total person-rem per plant and the average dose per worker.

Answer to 42-3:

The various NUREG reports of the NRC answer this request. It is difficult to identify trends in occupational exposures at PWR's because of the extreme vacillation in the curves of man-rem per year and the average exposure per individual per year. Since 1969 the number of radiation workers (i.e., persons with measurable exposure) has increased in these power plants by more than a factor of 5 while the average exposure has remained relatively constant, indicating an increase in man-rem or a statistical increase in the number of radiation-induced malignancies. It is steam generator and head work that are the primary categories of high occupational exposure and very little has been done in the way of major design changes to conform with ALARA. It seems

likely that it would cost more than $1,000 per man rem (an NRC guide) to make improvements in PWR design, and this guide seems to override the ALARA guide.

42-4: State in detail the basis for the allegation that C.E. has used transient workmen rather than "devoting adequate effort to reducing radiation exposures." Define in detail what is meant by "adequate effort". Describe in detail what "adequate effort" C.E. should make.

Answer to 42-4:

The record shows that Commonwealth Edison has made extensive use of transient workers in order to keep the individual doses below the legal limit of 5 rem per year per person. It is less expensive to hire temporary employees and spread out the dose than to reduce radiation from the source.

An "adequate effort" is defined as one which would (a) reduce radiation at the source, and (b) provide better equipment, techniques and plant staff training in how to minimize radiation exposure. For example, there should be an all-out effort made to eliminate the buildup of Co-60 and Co-58 in the steam generator because these radionuclides are the principal source of occupational exposure to external radiation in the repairs of the steam generator. With respect to equipment, more use should be made of shielding (both liquid and solid), of remote-controlled equipment, of closed TV, of integrating alarm meters by employees on all "hot" operations, and of pressure suits rather than face masks. With regard to training, the answer is not to be found in more temporary employees. Rather, Commonwealth Edison should employ more senior-level health physicists certified by the American Board of Health Physics and greatly enlarge its in-house staff of health physics technicians with basic as well as applied training. Such technicians, if properly trained, could not only eliminate most of the need for temporary employees for emergency operations, but could also enlarge the environmental monitoring

program which the League believes needs considerable improvement. The place to begin the search for these properly trained technicians would be in special undergraduate health physics programs in colleges and universities, and such programs should have appropriate support from the nuclear power utilities such as Commonwealth Edison.

42-5: State specifically what "other things" you allege in Contention 42 will result from the practice of using transient workers at nuclear power plants.

Answer to 42-5:

The phrase "among other things" as used in Contention 42 refers to:

(a) spreading out a given man-rem dose to more persons, thus causing more cancers because the lethal cancers per man-rem are more at low doses than at high doses (see references to publications of Dr. Karl Z. Morgan in Intervenor's Response to CECO's Second Round of Interrogatories);

(b) the greater man-rem dose among temporary workers because of their limited experience and lack of familiarity with the local plant;

(c) the moral question of subjecting persons to a risk of developing cancer which may not be able to be properly evaluated 30 years later ;

(d) lack of long-range care and a local utility medical follow-up program for temporary employees such as those which exist for regular employees;

(e) lack of an adequate means for monitoring internal dose for temporary employees;

(f) increased risks of safety-related accidents (e.g., a lighted cigarette at the wrong place and time) that could result in injury to the individual employee or to many other persons; and

(g) the possibility of sabotage when relying on temporary employees whose trustworthiness is unsatisfactorily proven or certified.

42.6: State in detail the basis of your allegaion that using transient workers will increase the risk of sabotage and operator error.

Answer to 42.6:

Obviously no security check can be infallible, but from the beginning of civilization man has mistrusted strangers, and often for good reason. Permanent workers at a plant are there because their education, training, years of experience, and reputation have convinced their employer that they are worthy of hire; but often very little is known about temporary workers except third-party information. Furthermore, permanent employees are interfaced on a day-to-day basis with other employees at many levels — immediate supervisors, friends in the lunchroom, carpools, and churches and social gatherings in the local community — and are much less likely to prove intent on sabotage. The security systems at plants such as Oak Ridge National Laboratory are based on the premise that one puts more trust in those persons one knows and works with on a daily basis.

As far as the question of operational error is concerned, this should require little explanation. Experienced workers should be given more difficult and delicate assignments involving major radiation risks to themselves and others because they are more liable to make the right decision in an emergency. The experienced operator on a "hot" operation knows when to run and when to stay and turn the valve.

42-7: State specifically what "similar safety-related hazards" you allege will result from the use of larger numbers of workers at nuclear plants. Explain in detail why the use of transient workers will increase the risk of these hazards. How does this new information indicate that the Byron design basis wil not provide safe operation as alleged in Contention 42?

Answer to 42-7:

The "similar safety-related hazards" were discussed in items 42-5 and 42-6 above. A few additional considerations are:

(a) more temporary workers are required to do a given job than regular workers and this, in turn, requires more health physics surveillance to supervise them;

(b) transient wowrkers are more likely to be unfamiliar with the rules of the utility. For example, they might not be familiar with the seriousness of entering an area marked off by a yellow rope;

(c) transient workers are more likely to make improper use of protective equipment such as face masks or shoe covers;

(d) transient workers may not realize the risk of smoking or eating food in a potentially contaminated area; and

(e) transient workers may not appreciate their own limitations and may thus fail to ask for advice or call for help before it is too late.

There is no indication that Byron has given due consideration to the either the items listed above or those mentioned elsewhere in the League's answers to Interrogatory 42. Every "hot" job should be carefully simulated with mock equipment, with all employees engaging in such an operation until there is reasonable expectation that the job can and will be performed with minimum radiation exposure.

42-8: Define with particularity the term "safe operation" as used in Contention 42.

Answer to 42-8:

The term "safe operation" is used in a relative sense since, at least in theory, few if any operations can be conducted with complete safety in a nuclear power plant. In Contention 42 it was claimed that the Byron design basis would not provide a safe operation because the man-rems per year were higher than they should be in terms of the cancer risk which appears to be no less than one lethal cancer per 1,000 man-rem. This means that if an employee at Byron receives 5 rem per year for 30 years, he has a 15% risk of a radiation-induced malignancy and twice this risk of some type of radiation-induced cancer resulting from this employment.

There are many operations which our society permits which could well be defined as unsafe — rock climbing, motor car racing, and spelunking, for example — but the persons who engage in such activities fully appreciate the risks and serious dangers involved because the hurt resulting from a mistake or accident is immediate. With low-level exposure, however, death from radiation-induced malignancy does not take place until 30 to 50 years later (according to UNSCEAR, the average latency of cancer other than leukemia is 30 years). All Byron employees should be made fully aware of this risk so that they will take ALARA more seriously, just as rock climbers take seriously the condition of their ropes or auto racers assure the safe operation of their vehicle.

As stated in the above referenced answers to CECO's Amended Second Round of Interrogatories, the League's own investigation and the discovery process are continuing. As additional facts are ascertained, they will be submitted in Supplemental Answers.

Interrogatory No. 62:

62-1: State in detail the factual basis underlying Contention 62.

Answer to 62-1:

See the League's response to the Interrogatory dealing with Contentions 8 and 62 of CECO's First Round of Interrogatories and the League's responses to Interrogatory Nos. 2 and 14 in the League's Answers to CECO's Amended Second Round of Interrogatories.

62-2: Describe in detail the "Class 9" accidents which you allege the design of the Byron plant does not provide protection against. State in detail the basis for such an accident.

Answer to 62-2:

See the League's response to the Interrogatory dealing with Contentions 8 and 62 of CECO's First Round of Interrogatories and the League's responses to Interrogatory Nos. 2 and 14 in the League's Answers to CECO's Amended Second Round of Interrogatories.

As stated in the above referenced answers to CECO's Amended Second Round of Interrogatories, the League's own investigation and the discovery process are continuing. As additional facts are ascertained, they will be submitted in Supplemental Answers.

Interrogatory No. 106:

106-1:

Identify and describe with particularity the "serious seismic related site problems discovered subsequent to the construction permits" as referred to in the first sentence of Contention 106.

Answer to 106-1:

See the League's Response to Interrogatory 18(a) of Commonwealth Edison Company's Amended Second Round of Interrogatories.

106-2:

Describe with particularity the "[r]ecent information [which] indicates that the Plum River Fault should be considered a capable fault" as referred to in Contention 106.

Answer to 106-2:

See the League's Response to Interrogatory 18(b) of Commonwealth Edison Company's Amended Second Round of Interrogatories.

106-3:

Identify the specific existing legal and regulatory requirements regarding seismicity which you allege in Contention 106 are not and cannot be met. State in detail the basis for your assertion that such requirements are not or cannot be met.

Answer to 106-3:

Because (as noted in the League's previous answers to Edison's Interrogatories relating to Contention 106) the full seismic analysis of Byron and its structures and equipment is not yet complete and contains numerous unresolved issues even from the Staff's standpoint, as is conceded in the Byron SER and SSER, it is not possible for the League to provide at this time a

definitive answer to this Interrogatory. The necessary information does not yet exist. However, the League believes that the defects in the Byron seismic design and analysis (described in the League's answers to Edison's Interrogatories concerning Contentions 47, 71 and 106 and referred to elsewhere in these Interrogatory answers) and the acknowledged lack of complete information and/or presence of unresolved issues with respect thereto (Id.) violate or may violate — in addition to the regulatory requirements cited in Contention 106 itself — Regulatory Guides 1.12, 1.29, 1.48, 1.60, 1.61, 1.89, 1.92, 1.100, and 1.122. In most cases, Edison's FSAR itself acknowledges Byron's lack of complete compliance (or outright noncompliance) with these Regulatory Guides. See FSAR, Appendix A, and pages 55-61 (including Table 3.5-1) of the November 12, 1980 Affidavit of Richard B. Hubbard and Gregory C. Minor. As further information is developed through the discovery process and as a result of the Staff's ongoing review, this list may expand or contract.

106-4:

Describe with particularity the "new facts" regarding emergency planning which allegedly have become known since the construction permit decision.

Answer to 106-4:

See the League's Response to Interrogatory 18(c) of Commonwealth Edison Company's Amended Second Round of Interrogatories.

As stated in the above referenced answers to CECO's Amended Second Round of Interrogatories, the League's own investigation and the discovery process are continuing. As additional facts are ascertained, they will be submitted in Supplemental Answers.

Interrogatory No. 108:

108-1:

Specify the social and economic costs referred to in Contention 108(b) which you allege should be taken into account by Applicant's emergency plan.

Answer to 108-1:

Some of the specific social and economic costs which should be, but appear not to have been, accounted for in CECO's emergency planning are listed in NUREG-0553, "Beyond Defense In Depth", October, 1979. These costs include payments made to the State of Illinois for funding its radiological emergency preparedness and planning activities. Specifically, these amounts are $350,000 for the initial fee per station, an annual $100,000 fee per reactor, and $1,000 per each shipment of spent fuel.

In addition to the direct costs to CECO, there are indirect costs to the Illinois taxpayers in the form of the funding needed in the approximate amount of $250,000 which is necessary to carry out each nuclear disaster drill. This amount is in addition to the cost involved in the approximately four months work-time necessary for state employees to prepare for each nuclear disaster drill; time which could otherwise be channeled in other directions.

Besides the costs to the state government, there are costs for emergency planning and preparedness which are borne by local governments. These costs include an initial amount of $40,000 for each emergency preparedness plan, $4,000 per year to update the plan, an initial fee of $60,000 for resources for emergency preparedness exercises, and an annual cost of $6,000 per year to update those resources, as well as a figure of $20,000 per year for the emergency preparedness exercises themselves. See NUREG-0553, Chapter 5.

Possibly more significant than the directly measurable economic costs are the indirect costs resulting from a nuclear emergency as became apparent following the events at TMI. These less obvious costs include the loss of jobs and the disruption of business which would be very significant in the Byron area where a large part of the business community depends upon the tourist trade and recreational activities, e.g., the girl scout camp, special recreational area for the Presbyterian Church, the boat club, the Byron Dragway, etc. There is also the psychological stress experienced by residents of the area. This stress may actually come to be regarded officially as a form of nuclear pollution based upon a recent decision of the United States Court of Appeals for the District of Columbia Circuit. There also exists the disruption of the local real estate market; the loss to the people of the state of energy resources, both directly from a shutdown of a plant and also from the resulting disruption and possible bankruptcy of the utility. Finally, and perhaps most importantly, there are the health effects and the related costs incurred, including increased cancer rates and genetic defects.

The costs and considerations set forth above constitute a large number of the factors which should be taken into account by CECO in its emergency plan. Because the emergency plan is not yet in final form this list may be supplemented as the League's investigation and the discovery process reveal additional costs that should be accounted for also.

108-2:

Specify those emergency facilities referred to in Contention 108(d) which you allege "are not situated far enough from the Byron site...."

Answer to 108-2:

Based upon material contained in the Byron Station Emergency Plan Annex, June 1980, it is apparent that there are already two emergency facilities located too close to the Byron site. As regards the civilian population, the most crucial of these is the Rockford Memorial Hospital. This hospital is listed as the only supporting medical facility in the event of a radiological emergency at the Byron plant. See BSEPA, p. 721. Yet Rockford Memorial Hospital is not only within the 50 mile ingestion pathway, but, depending on the wind direction, may also be within the 10 to 20 mile radius of the plume pathway. As was indicated with wind roses in the Byron SER, the wind blows from Byron in the direction of Rockford approximately 25% of the time. Thus it appears that the only designated medical facility may itself be in grave danger of radiological contamination during a Byron plant accident. In addition, CECO's own emergency operational facilities, i.e., Rockford, Dickson and Cordova, are all within 50 miles of the Byron site. Dickson, which is listed at pp. 6.5 and 6.9 of the BSEPA as the near site operational facility, is located only 19 miles from Byron. This represents a clear danger that, depending upon wind direction, the emergency operational facilities may be totally unusable.

Because the various state emergency plans have not yet been formulated, it is uncertain what other emergency facilities may be located in too close proximity to the Byron site. Once these plans become available and the League has had an opportunity to examine them in full, additional material on this matter may be submitted in supplemental answers.

108-3:

Identify the specific existing legal and regulatory requirements regarding emergency planning which you allege in Contention 108 are not and cannot be met. State in detail the basis for your assertion that such requirements are not or cannot be met.

Answer to 108-3:

The existing legal and regulatory requirements which are not being met include the Commission's Final Rule On Emergency Planning, 45 Fed. Reg. 55402 (August 19, 1980); NUREG-0654, FEMA-Rep-1, Rev. 1, "Criteria For Preparation And Evaluation Of Radiological Emergency Response Plans And Preparedness In Support Of Nuclear Power Plants" (November 1980); and 10 C.F.R. Sec. 50.57(a)(3)(i) and 10 C.F.R. Sec. 50.57(a)(6).

Among the ways in which CECO is failing to comply with these regulatory requirements is the fact that formal agreements with states and state agencies regarding emergency preparedness and planning have yet to be formulated. This fact also violates Byron SER Appendix D, pp. D-1 to D-2. Furthermore, Figure BYA 1-4 of the BSEPA, pp. 1-8, indicates that the 50 mile EPZ includes Iowa. However, it appears that no mention has ever been made of contacting the Iowa authorities in regards to emergency planning. Additionally, no plan exists to conduct hydrological monitoring; the plant seismic alert equipment is qualified only as Category 2, thus leaving open the possibility that the warning equipment would be destroyed at the beginning of a seismic event and would, therefore, be unavailable for any subsequent warnings. In addition, the Byron meteorological monitoring tower will take 72 hours to be re-erected if damaged or destroyed, and there also exists a serious question as to the public notification provisions. See BSEPA pp. 6.3, 7-4 to 7-18.

As stated above, the full emergency plan has not yet been formulated. Until such time as that information exists, the League cannot provide a full answer to this Interrogatory. Additional facts may reveal additional non-compliance and this information will be supplied in Supplemental Answers.

108-4:

Describe with particularity the "new facts" regarding emergency planning which allegedly have become known since the construction permit decision.

Answer to 108-4:

Among the new facts which have become known since the construction permit decision are the events at TMI-2 and the resulting regulations, including NUREG-0654; the new emphasis by FEMA and the Illinois Department of Nuclear Safety on stock piling potassium iodide, the Rogovin and Kemeny Report recommendations on emergency planning, and NUREG-0694, "TMI Related Requirements For New Operating Licenses." The above are some of the significant new facts which call into serious question the decision on emergency preparedness made at the construction phase. The League's own investigation and the discovery process are continuing. As new facts become known they will be submitted in the form of supplemental answers.

Interrogatory No. III:

III-1: Specify the levels of radiation which you allege would properly protect the health and safety of the public. State in detail the basis for your response.

Answer to III-1:

The significant word in the request is properly. On the linear hypothesis where the cancer coefficient is at a minimum one lethal cancer per 1,000 man-rem, one is literally setting the price of human life. The NRC has set $1,000 per man-rem for conformance with ALARA. Thus the NRC has set the price of a human life at $1,000/man-rem x 1,000 man-rem/lethal cancer = $1,000,000 per lethal cancer. There is overwhelming evidence to support the super-linear hypothesis rather than the linear hypothesis (see references to Morgan and Stewart in the League's Answers to CECO's Second Round of Interrogatories). Thus the cancer coefficient is greater than one cancer per 1,000 man-rem at low doses; with the study of Mancuso, Stewart and Kneale of the Hanford radiation workers where the average dose was only 2.1 rem (i.e., only 40% of the 50-year natural background dose) the cancer coefficient was seven to eight lethal cancers per 1,000 man-rem. On this basis, the NRC has set the value of a human life at $140,000 to $125,000.

This is not necessarily intended to be a sharp criticism of the NRC per se, but rather to answer the Staff's question by reminding the Staff how much our society values a human life, not only when justifying nuclear energy, but also with regard to chemicals in our environment, cigarettes, etc. Actually, Interrogatory III is related to moral values, ethics, and religion. Certainly it would not seem to be reasonable to spend all of our country's tax monies to save one life. A compromise must be reached between what is best for the statistical victim of radiation-induced cancer in the neighborhood of a nuclear

power plant and what is a reasonable price to pay for electricity, and also what would be the comparative risks of alternative sources of electricity.

Irrespective of the above, the League believes that the NRC and EPA have provided the basis for radiation levels that would properly protect the health and safety of the public. The EPA has given us 25 mrem per year for total body and all individual body organs, except the thyroid gland where the limit is 75 mrem per year as a result of planned discharges of radioactive materials to the general environment. These levels apply to any and all members of the public (not the average, where the levels must be lower) and they apply to the entire range of fuel cycle operations. Thus these levels apply to all operations inherent to the operation of the Byron nuclear plant — mining, leakage from waste basins, reprocessing, enrichment, fabrication and shipment of fuel assemblies, and routine operations of the power plant, including the common higher releases during refueling and repairs to the steam generators. It should also be noted that this includes the population exposure for specially planned operations during steam generator replacement and cleanups following accidents.

Although these EPA levels of 25 and 75 mrem per year can serve as a "first cut" in choosing levels for members of the public, the levels are far too high where nuclear plants are located in densely populated communities. These EPA levels do, of course, apply to all releases of all nuclear plants and to all related nuclear operations (e.g., fuel and waste shipments) in the Byron community, but still the levels are high by a factor of 10 to 100. This is because 25 mrem per year to a million people results in a minimum of 25 lethal cancers per year (i.e., $0.025 \times 10 \times 10^{-3} = 25$) and this in no way accounts for the deaths caused per year worldwide due to the release of I-129, Kr-85, C-14, and H-3.

The EPA and NRC give other levels which I believe can serve as the "fine tuning" when choosing a proper level. The NRC chose 5 mrem per year for a nuclear plant that is operated in conformance with ALARA, and the EPA stated "the averge annual concentration of beta particle and photon radioactivity from man-made radionuclides in drinking water shall not produce an annual dose equivalent to the total body or any internal organ greater than 4 mrem per year" (EPA-570/9-76-033, 1977). There appears to be no good reason for not extending this limit to air and food as well as water.

There is no significant difference between the NRC level of 5 mrem per year and the EPA level of 4 mrem per year. The 5 mrem per year represents a minimum of 5 cancer deaths per year per million persons so exposed. It would seem that a more acceptable standard might be 1 mrem per year, or a minimum of 1 cancer death per year per million persons so exposed. This would be 7 to 8 cancer deaths per year were we to use the Hanford low dose data.

III-2: State the types and additional numbers of monitoring devices which you allege should be placed within and without the plant site. State in detail the basis for your response.

Answer to III-2:

The following estimate of the types and numbers of radiation monitoring devices which should be placed within and without the Byron plant is based upon the recommendation of Dr. Karl Morgan, who was for 29 years director of the ORNL health physics program at Oak Ridge, Tennessee and who has made extensive investigations of the instrument deficiencies during and after the Three Mile Island II accident. When Dr. Morgan left the ORNL program

in 1972, 39 operating stations were in operation consisting of 22 local stations within the laboratory area, 9 perimeter area stations out to about 15 miles, and 8 stations out to about 60 miles. He has stated that, were he still in charge of the ORNL program at Oak Ridge, he would install more monitors despite a limited budget and despite the fact that the risks to the environment there were probably of an order of magnitude less than those of a 1120 MWe plant such as Byron.

TMI-II, by way of comparison, had only a total of 20 environmental monitoring stations at the time of the accident. They had TLD meters at these stations, but only two of the stations were at any time near the "hot" passing radioactive cloud. It is impossible to properly judge the exposure to thousands of persons from only two meter readings. This was true especially since the dose rate at ground level under the cloud was changing from minute to minute due to changes in isotopic composition of the releases, changes in cloud height, cross-section, etc. Furthermore, the TLD meters did not measure beta and alpha doses. Also, the TLD readings at the same station differed among themselves by 100%, resulting in a very poor quality system. Even if they had had 360 TLD stations (i.e., one at each degree at a distance of 12 miles, the distance to the nearest city), the stations would have been over 1,000 feet apart and could have underestimated the dose at ground level by more than an order of magnitude unless the height and width of the cloud had been known accurately.

In the case of the Byron plant, a chamber should be attached to each of the electric power meters at the homes of all persons living within 10 miles of the plant, several hundred additional chambers to be placed on power poles. Such chambers should contain TLD's to measure both beta and gamma radiation.

Additionally, Byron should have 50 off-area stations equiped with air samplers, fallout trays, gummed paper collectors, and rain water collectors to evaluate the alpha as well as the beta and gamma activity.

Byron's environmental surveillance program also should include taking water samples from nearby rivers, lakes, creeks, wells, and springs, sampling raw milk, thyroid and liver from local slaughterhouses, and fish and silt from rivers, and the occasional sampling of tissue from field mice and other wild animals in the environs of the plant. Dr. Morgan's surveillance program at Oak Ridge included all such samplings, and he states that there was never more data than was needed.

Approximately 10% of the instruments at Byron should be contained within the plant area, as was the case at ORNL. The in-service inventory of portable survey instruments at that plant on January of 1971 was 499 geiger counters, 441 cutie pies, 253 alpha survey meters, 106 neutron survey meters, and 27 miscellaneous meters. Among the fixed-area monitors, there were 99 air alpha monitors, 178 air beta monitors, 33 hand and foot counters, 184 laboratory surface alpha monitors, 212 laboratory surface beta-gamma monitors, 222 monitors, and 118 other types of monitors. In addition, there were meters in the sample counting facilities, calibration facility, laundry monitoring area, and total body counting facility.

Byron should likewise have facilities for total body counting, calibration of instruments, reading of TLD's, sample counting, laundry of protective clothing, decontamination of equipment, chemical analysis, pocket and film meter reading, etc. Needless to say, it must develop in-house capacity to process its own film meters, TLD'S, and pocket meters, analyze its urine

and fecal samples, calibrate its own instruments, and numerous other similar functions. Byron presently falls short in equipment and properly-trained health physics personnel to carry out expeditiously many of the above-mentioned functions.

III-3: Specify the frequency at which you allege the monitors should be read. State in detail the basis for your response.

Answer to III-3:

All area monitors should be read once each week and always read as soon as possible following any accident or incident that might cause unusual releases of radioactivity and whenever high readings are recorded on the stack monitors. Some of the distant area monitors should be read on a monthly and biannual schedule in order to obtain data of statistical value that can be related to the meterological patterns. Water, sludge, filters, fallout trays, slaughterhouse samples, etc., should routinely be processed on a weekly basis and as soon as possible following any abnormal plant releases.

The in-house TLD's, film badges, neutron meters, etc., should be read at the close of each shift. Urine and fecal samples should be taken and analyzed as soon as possible after each incident. Urine samples should be analyzed immediately following all operations where internal dose is possible. Total body counts should follow a schedule similar to that set for urine sampling.

The basis for the above-mentioned schedules is to avoid loosing valuable information on exposure, to locate sources of human exposure, and to take remedial measures to reduce exposure and in case of high doses to take appropriate medical action.

III-4: What specifications do you allege must be met to achieve the requirement of "better monitoring devices?" State in detail the basis for your response.

Answer to III-4:

The principal specifications of instruments and their uses for achievement of better monitoring are as follows:

1. With regard to the instruments:

(a) they must provide reliable information on all types of external exposure (alpha, beta, gamma, thermal neutron, fast neutron, and epithermal neutron dose;

(b) they must maintain their calibration and hold up well under conditions of humidity, temperature, dust, mechanical shock, etc., to which they may be subjected;

(c) they must measure all types of airborn radioactivity (gases, particulates, alpha, beta, and gamma);

(d) they must measure all types of water radioactivity (soluble, insoluble, alpha, beta, and gamma).

2. With regard to their use:

(a) they must be calibrated frequently with standard sources;

(b) their calibrations must be checked annually against the other operations, e.g., National Bureau of Statistics and instruments at other power plants;

(c) where possible, cross checks must be made, i.e., total body counts checked against air contamination, fish contamination checked against water and mud activity, TLD readings checked against pocket dosimeters, neutron meters (that is, tracks in polycarbonate foils and CR-39 read via the electrochemical etch technique) readings compared with the neutron survey meter reports, etc.

The present personnel neutron monitoring program at Byron is very unsatisfactory. The NTA thick emulsion film monitoring system is being used, a system first introduced by Dr. Karl Morgan in the early years of World War II.

If these films are not read within a few weeks, there can be 100% fading of the proton recoil tracks. The new technique -- electrochemical etching of polycarbonate foils and CR-39 foils — has no fading of tracks and a sensitivity 1,000 times that of the NTA film method.

In addition, it is believed that Byron presently has an unsatisfactory method for the following operations:

(1) identifying the short-lived radionuclides of iodine and noble gases;

(2) identifying the chemical form of radioiodine;

(3) distinguishing between airborne gases and particulates; and

(4) measuring quantitatively the C-14.

III-5: State the purpose to be accomplished by measuring the differences in alpha, beta, and gamma dose levels (as opposed to the absolute values of these quantities).

Answer to III-5:

It is unsatisfactory to merely measure the absolute values of alpha, beta, and gamma dose levels. The risks and corresponding MPC's for the various alpha, beta, and gamma emitters can differ by many orders of magnitude for the various radionuclides, e.g., MPC's for Rn-220 alpha-emitter is 3×10^{-7} μCi/cc and that of the Pu-239 alpha-emitter is 2x10-12. This is a difference by a factor of 150,000. For beta-emitters, we might compare H-3 with an MPC of 5×10^{-6} μCi/cc with Sr-90 where the MPC is 3×10^{-10} μCi/cc; thus a difference by a factor of 16,666. Surely the Staff would not wish to tolerate errors of 16,000 to 150,000 in the estimates of exposure.

III-6: What nuclides, in addition to I-129 and plutonium, fit into the category of "dangerous long lived radionuclides" which you allege must be monitored and recorded? State in detail the basis for your response. Are any of these currently not being monitored?

Answer to III-6:

Long-lived radionuclides, in addition to I-129 and Pu-239, 240, 238, and 241 that should be monitored are H-3, Kr-85, Sr-90, Cs-137, C-14, and Am-241. There are many others, but these are the ones of greatest significance. The various Pu radionuclides should be identified in order to distinguish what is emitted from Byron from emissons by other plants and from weapons fallout.

H-3 and Kr-85 are dangerous because of the very large amounts of them emitted by Byron. H-3 and C-14 present genetic as well as somatic risks and A-241, like Pu, is a bone-seeker for which the MPC is only 6×10^{-12} μC/cc. In this case and all the above MPC's, the values are concentrations in air that are given by ICRP as permissible for the radiation worker 40 hours per week. The permitted values for members of the public are less by a factor of at least 1,000.

Other long-lived radionuclides which are very dangerous are Sr-90 and Cs-137, Sr-90 because it can cause bone cancer and Cs-137 because as a total body seeker it can cause cancer in any part of the body and also is a genetic hazard. Co-60 has a relatively long half-life and should be monitored because of its high concentration in the steam generator and its intense alpha-radiation. In the environment it tends to concentrate in the essential vitamin B-12.

Several studies have indicated the serious risks of C-14 emissions by PWR's (see "C014 Gaseous Effluent from PWR's" by C. Kuntz, W.E. Mahoney and T.W. Miller, New York Department of Health, Albany, New York; or the report "Assessment of Public Health Risk Associated with Radiocative Air Emissions from Two Minnesota Nuclear Power Plants," by M.W. Carter, B. Kahn and K.Z. Morgan).

III-7: Define "bioaccumulative testing in a tiered system." Describe how this differs, if at all, from the method of assessment proposed by the utility.

Answer to III-7:

Bioaccumulative testing in a tiered system refers to the accumulation of radionuclides in the bottom sediments of a body of water or, for example, in the shells of clams. The layers of Pu-239 and Cs-137 in the layer of mud provide a history of the sediment year by year in the body of water below the plant and in the case of clams the layers of Sr-90 and Pu in the the shells provide a similar history of past radioactive release. Radiographic techniques make this method quantative, inexpensive, and simple to carry out. There is no indication that Byron has developed these techniques.

III-8: Identify at what locations you allege additional monitoring devices should be placed within the plant. What is the basis of your contention that these additional monitoring devices will keep radiation levels as low as is reasonably achievable?

Answer to III-8:

Additional monitors for external beta and gamma, for airborn particulates from which alpha, beta and gamma radiations are emitted, neutron monitors, and emergency monitors are needed in several locations within the Byron plant. All of these should be provided with bells or horns that will sound an alarm when certain radiation levels are exceeded. More of these instruments are needed in the general area, but they are needed especially in the steam generator and head work areas where more than 50% of the PWR exposure occurs. Other areas around the coolant pumps, the refueling area, the clean-up area, and the filter areas can reach high backgrounds and should have more extensive monitoring.

There is little question that more monitors will aid in adherence to ALARA if they are properly supervised by an adequate health physics program that responds to their readings and keeps them functioning properly.

As stated in the above referenced answers to CECO's Amended Second Round of Interrogatories, the League's own investigation and the discovery process are continuing. As additional facts are ascertained, they will be submitted in Supplemental Answers.

Interrogatory No. 112:

112-1: Describe with particularity every preventive measure (other than those already listed) to "reduce radiation, including neutron exposure levels to regular plant personnel and transient workers" as referred to in Intervenor's Contention 112.

Answer to 112-1:

Some of the best and most productive preventive measures of reducing radiation exposure are:

(a) more on-site regular employees and less temporary employees;

(b) better educated and trained personnel in the health physics program;

(c) more certified health physicists;

(d) more health physics monitors in areas of greatest exposure potential; and

(e) discontinuance of the use of the NTA film monitoring system for personnel monitoring of fast neutron dose and its replacement by a system that is more sensitive, that does not have track fading, and that responds to thermal and epithermal flux as well as that of fast neutrons. The electrochemical etching of polycarbonate and C-39 foils meets the above requirements, i.e., has a sensitivity of 1,000 times greater than the NTA film method, has no track fading, and measures the dose of neutrons of all energies.

In addition to the above, design changes should be made in the PWR to reduce the large exposure to Co-60 and Co-58.

Perhaps the greatest reduction in dose could be made through design changes that would reduce the frequency with which maintenance is required on the steam generators.

Another area in which dose can be reduced is through the development of a better and more complete program for the decommissioning of Byron after its 30 to 35 year life.

The Byron Plant should be designed so that the steam generators never need to be replaced, or so that they can be replaced without occupational exposure.

There are many things Byron should do to reduce exposures during emergencies caused by plant accidents. Three of these are as follows:

(a) conduct training seminars for critical groups such as medical men, schoolteachers, and law enforcement officers;

(b) have the means to distribute KI pills immediately; and

(c) install a PWR Filtered Vent System (see J. Beyea and F. von Hipple, "Containment of a Reactor Meltdown," TECH. OF NUCLEAR SAFETY, Vol. 2, Ch. 21, MIT Press [1973]) to prevent the most serious type of PWR accident from reaching catastrophic proportions.

112-2: State in detail the basis for the allegation that C. E. has not adequately assessed the effect of radiation on plant workers.

Answer to 112-2:

That C. E. (CECO) has not adequately assessed the effect of radiation on plant workers is attested to by the following:

(1) CECO considers the cancer risk to be equal to or less than that indicated in the BEIR-III report. Subsequent publications have indicated that BEIR-III based its cancer coefficient of 2 to 4 x 10^{-4} fatal cancers per person rem on the studies of survivors of Hiroshima and Nagasaki atomic bombings, but these data are fraught with biases (see K.Z. Morgan, "Hazards of Low-Level

Radiation", Encyclopedia Britannica, pp. 216-229 [1980]) and recently serious errors in dosimetry have been uncovered such that the risk estimates used in BEIR-III must now be increased by a factor of 2, i.e., to 4 to 8 x 10^{-4} fatal cancers per person rem (see K.Z. Morgan, "Radiation Dosimetry," Science 213, No. 4508, p. 64 [August 7, 1981]).

2. CECO does not recognize the strong evidence that for many typess of cancer the super linear hypothesis fits the data better than the linear hypothesis, i.e., more cancers are produced per rem at low doses than at high doses. (See Britannica publication of K. Z. Morgan, cited above, and chapter 12, page 12 of 1981 GAO Report. See also the references to Alice Stewart listed in the League's response to Item 9, Contention 42, requested by CECO in their Amended Second Round of Interrogatories.)

3. CECO has not set up or proposed a strong educational program on radiation protection and effects of radiation exposure for all its employees. Adequate information at all levels of management must be an essential response of CECO's assessment of the effects of radiation exposure to plant workers.

4. CECO's lack of an adequate system of personnel neutron monitoring serves as evidence that CECO either has not adequately assessed the neutron exposure risks or is not willing or able to respond to the need for better neutron monitoring. Perhaps CECO is not aware that ICRP has increased the quality factor for ions of high specific ionization, e.g., alpha and proton particles produced by neutron interactions with the human body.

5. CECO has not adequately provided for lower exposure during plant accident recovery, such as that now being experienced by workers in the cleanup of Three Mile Island No. 2.

6. Adequate assessment of effects of radiation on plant workers must be accomplished by and with adequate response.

7. It is not evident that CECO is providing the medical surveillance which plant workers have the right to expect. For example, CECO does not have underway a "tried program" of fecal analyses, differential blood counting, wound decontamination, and lense opacity examination. When employees are exposed in areas of high loading of radioactive dust, they must undergo fecal analyses as well as urine counting because the colon is a prime target for radiation-induced malignancies. Studies have shown that if a contaminated wound is not properly cleaned or excised during the first hour there is a high probability that a considerable fraction of the radioactive material will escape into the hematopoietic and reticuloendothelial systems. Unless the total lucocyte count in the differential blood counting program is obtained within the first hour following a high radiation exposure, the initial large rise will not be observed. Also, the dramatic drop in lymphocyte count should be followed. Studies of lense opacity are important for workers who have neutron exposure because of the risk of development of lense cataracts.

112-3: Specify the "new evidence on low levels of radiation referred to in Contention 112(a).

Answer to 112-3:

New evidence of carcinogenesis of low-level exposure was previously provided in the League's response to Interrogatory No. 9 (in regard to Contention 42) of CECO's Amended Second Round of Interrogatories, specifically those publications of Dr. K. Z. Morgan referenced in section 9(a) and numbered 4, 5, 6, 8, 9, 11, 12, 13, 17, 20, 21, 22, 23, 25, 26, 27, and 30. The papers by

Stewart, Mancuso and Knead (listed in the same document as 1(a), 1(b), 1c), 1(d), and 1(e) should also be reviewed. The papers relating to I-131 under subsections 6(a), 6(b), and 6(d) are most pertinent. In addition, the most recent reports of R. Colton and T. Najarian reference cancer induced by radiation exposure of submarine workers.

The so-called Heidelberg Reports of B. Franke, et. al., provide some very important new evidence of population exposure from nuclear power operations.

One of the most recent reports of new evidence of effects of low-level exposure is that of Alice Stewart, "Delayed Effects of A-Bomb Radiation; A Review of Recent Mortality Rates and Risk Estimates for Five-Year Survivors," Journal of Epidemiology and Community Health, 36, 80 (1982).

S. Chinn has produced a paper which must be included in this list. It is entitled, "The Relation of Rocky Flats Plant and Other Factors to 1969-1971 Cancer Incidence in the Denver Area," Denver, Colorado (September 29, 1981).

112-4: State in detail the basis for the allegation in Contention 112(c) that transient or temporary workers will not have experience equivalent to that of regular trained personnel. Define what is meant by "regular trained personnel."

Answer to 112-4:

The term "regular trained personnel" as used in Contention 112(c) refers to health physicists who have had an adequate college education in physics, mathematics, biology, chemistry, health physics, statistics, instrumentation, etc., and have had appropriate experience working at a nuclear power plant.

The best evidence that transient or temporary workers will not have experience equivalent to that of regular trained personnel is found in the exposure record prepared by B. G. Brooks, "Occupational Radiation Exposure at Commercial Nuclear Power Reactors," 1980, NUREG-0713, Vol. 2, USNRC, as shown in Table 1, infra at 112-7. Brooks reports the startling fact that on the most dangerous jobs of special maintenances, such as repairs of the steam generators, the temporary workers (commonly called "jumpers") receive 34% of the total exposure from all plant exposures. This is to be compared with 3.4% exposure received by station employees and 3.2% by general utility employees who are the regular employees. One explanation for the disproportionate doses received by jumpers might be that the industry is assigning the more dangerous jobs to temporary workers because their regular workers are not adequately trained. Alternatively, one might speculate that the industry does not wish its regular employees to be "burned-out" or to sustain such high cancer risks. There are other possible explanations, but none can justify the acceptability and properness of CECO employment practices, work assignments, and information provided or withheld from workers regarding "hot" jobs.

Table 2 (infra at 112-8) from the same above-referenced report indicates that the average collective dose per reactor year is on the increase. Two explanations (neither of which is satisfactory) are possible — namely, the reactors are giving more trouble than formerly due to age or poor design; or the new employees (mostly jumpers) are not as skillful in doing the job with a minimum dose. The answer is not that present reactors are producing more power, because the man-rem-per-MWe-year is also on the increase. Many reasons suggest themselves for this discouraging trend of LMR's, none of which are encourging for nuclear energy. If the answer is that as a reactor ages it

TABLE I

ANNUAL COLLECTIVE DOSES
BY WORK FUNCTION AND PERSONNEL TYPE

WORK FUNCTION	STATION EMPLOYEES		UTILITY EMPLOYEES		CONTRACT WORKERS & OTHERS		TOTAL PER FUNCTION	
	MAN-REMS	% OF TOTAL	MAN-REMS	% OF TOTAL	MAN-REMS	% OF TOTAL	MAN-REMS	% OF TOTAL
All Light Water Reactors								
Reactor Operations	3399.1	6.6%	177.3	0.3%	1243.6	2.4%	4820.0	9.3%
and Surveillance	4207.0	8.2%	2075.4	4.0%	11988.2	23.3%	18270.6	35.5%
Routine Maintenance	267.0	0.5%	269.8	0.5%	2293.4	4.5%	2830.2	5.5%	
Inservice Inspection	1764.8	3.4%	1648.4	3.2%	17478.1	34.0%	20891.3	40.6%	
Special Maintenance	858.1	1.7%	43.7	0.1%	608.4	1.2%	1510.2	3.0%	
Waste Processing	1160.9	2.3%	386.4	0.8%	1546.1	3.0%	3093.4	6.1%	
Refueling								
TOTALS	11658.9	22.7%	4601.0	8.9%	35157.8	68.4%	51415.7	100.0%

SOURCE: B. G. Brooks, Occupational Radiation Exposure at Commercial Nuclear Power Reactors, 1980, NUREG-0713, Volume 2 (Washington, D.C.: U.S. Nuclear Regulatory Commission, 1981), p. 18.

TABLE 2

SUMMARY OF ANNUAL OCCUPATIONAL RADIATION DOSES
FOR COMMERCIAL LIGHT WATER REACTORS
IN THE UNITED STATES, 1973-1980

Year	Number of reactors included	Average collective dose per reactor-year (man-rems)	Average man-rem/ MWe-year	Number of workers with measurable doses	Average dose per worker (rems)
1973	24	582	1.9	14,780	0.94
1974	34	404	1.3	18,466	0.74
1975	44	475	1.2	25,491	0.82
1976	53	499	1.2	35,447	0.75
1977	57	570	1.2	42,266	0.77
1978	64	497	1.0	45,998	0.67
1979	67	593	1.3	64,073	0.62
1980	68	791	1.8	80,331	0.67

SOURCE: B. G. Brooks, Occupational Radiation Exposure at Commercial Nuclear Power Reactors, 1980, NUREG-0713, Vol. 2 (Washington, D.C.: U.S. Nuclear Regulatory Commission, 1981), p. 5.

presents far more radiation problems and thus jumpers are employed in increasing numbers, then it would appear that the utility is not taking the best remedial action. It should be increasing its own staff of well-trained regular employees who are thoroughly familiar with the local nuclear power plant rather than depending on outside help to share its responsibility for increased doses.

Further inspection of Table 2 indicates that while the average dose per worker has remained relatively constant, the dose per reactor year and the number of workers with measurable doses have been on the increase — again, due to the practice of employing jumpers. The dose is being spread out among an escalating number of workers and this results in more cancers per MWe because, as indicated above, there are more cancers per rem at low doses than at high doses. The solution would seem to be to reduce the source of radiation exposure and to employ more regular employees with higher education who are furnished with improved instruction and more experience through utility training programs.

112-6: Define specifically what is meant by "[b]etter education about radiation dangers." State in detail how this education will ensure cooperation of workers in keeping radiation exposures to a minimum.

Answer to 112-6:

The term "better educated about radiation dangers" has been rather well defined in the above discussions. A few additional requirements for "better education" are as follows:

(a) Education about the dangers of radiation should be required of all employees as a condition for employment. This should apply from the plant manager down to the janitors in the plant.

(b) Outside lecturers should be called upon to assist in the educational programs so there will be less tendency to underestimate the dangers of low-level exposure.

(c) Numerous props should be used to improve the students' understanding. Such props should include slides, models, handbooks, etc.

(d) Tests should be given on the above course and a passing grade should be required of all nuclear employees.

(e) "Dry runs" should be held before any hot operations are undertaken, except in emergencies where there can be no delay.

(f) Some of the older employees should be sent back to school at a local university for courses in physics, radiobiology, etc., where there is a weakness in their education that cannot be corrected easily by in-house courses.

(g) The in-house education program must cover the three types of radiation damage — genetic, teratogenic, and somatic. No punches must be pulled.

(h) The need for better education for members of the public is imperative. Special seminars for medical doctors, firemen, schoolteachers, and policemen should be conducted, again with the assistance of outside lecturers. A close interface should be established with all the neighboring communities.

112-7: Define in detail what allegedly constitutes "high levels of exposure".

Answer to 112-7:

"High levels of exposure" is a relative term and its value depends upon the context of its use. In this Contention, the phrase refers to high levels even beyond the 5 rem per year that might be encountered during emergency operations. It is suggested that for hot operations during emergencies and for such tasks as repairing the steam generators an employee's job not be "put on the line" if the employee expresses reluctance to engage in such operations, or

that the utility have on hand a cadre of volunteers who are properly trained and prepared to take the risks of a high exposure. These volunteers should (i) understand the risks and possible consequences of cancer at some future date — 20, 40, or 60 years later; and (ii) appreciate the risks to future generations and be prepared to avoid procreation for a few weeks following high exposures. Due to the risks of teratogenic damage to children, the utility should avoid using women of childbearing age and young men for "hot" operations. It is preferable to select men and women beyond the reproductive age for special teams to engage in hot operations. In general, exposure of persons in the reproductive age should result from routine tasks such that their annual dose does not exceed 10% of the MPE or 0.5 rem per year.

112-8: State in detail the basis for the allegation that exposure of individuals to radiation (presumably within NRC regulations) should be limited to older workers and others incapable of reproduction.

Answer to 112-8:

Some of the reasons for limiting high exposures to older workers are given in subsection 112-7, supra. These reasons are described in more detail in the 1975 NRDC petition to the NRC to reduce occupational exposure limits.

In addition to the risks of genetic and teratogenic risks from radiation exposure of young workers, there is an increased somatic risk of radiation-induced carcinogenecis for younger persons because a worker at age 60 may not live long enough to die of a radiation-induced malignancy that has a latency period of 30 to 40 years. Also, older individuals probably have fewer persons dependent on their income.

112-9: Describe in detail all other preventative measures to reduce radiation exposure levels that are referred to but not specified in Contention 112(a)-(e).

Answer to 112-9:

A few important preventive measures to reduce exposure levels, not previously mentioned in our Contention, are as follows:

(a) provide every radiation worker with a "beeper" that provides a beeping sound, the intensity of which increases with the intensity of the level of radiation;

(b) provide more fixed alarm monitors;

(c) block off and restrict from entry areas at lower radiation levels;

(d) make more use of local shielding around hot objects;

(e) provide more remotely-operated equipment;

(f) make more use of closed television;

(g) delay hot operations until the short-lived radionuclides have mostly decayed;

(h) provide more space for workers, equipment, and shielding in hot areas;

(i) hold more dry runs;

(j) have more effective emergency drills;

(k) make more use of protective clothing;

(l) provide extensive training in the proper use of respirator systems;

(m) prohibit eating and smoking in areas that might become radioactively contaminated;

(n) reassign to lower-rated jobs those workers who consistantly get high exposures due to poor work habits or carelessness;

(o) increase the value of a man-rem from $1,000 to $10,000 (agree that an expenditure of $10,000 to reduce exposure by one person-rem is justified and expected under the ALARA principle);

(p) provide a better emergency plan to be followed in case of an emergency;

(q) provide a large holdup time for radioactive gases and a better filter system for particulates;

(r) install more off-area radiation monitors;

(s) provide personnel neutron monitors that are reliable and 1,000 times more efficient;

(t) make KI pills available immediately in case of emergency;

(u) expand the personnel monitoring program to include urine and feces analyses, differential blood counts, and total body counting.

112-10: What improved recordkeeping system can be used at Byron and other facilities to reduce exposure? How does this system differ from the one currently used at Byron?

Answer to 112-10:

Radiation recordkeeping can be improved in the following ways:

(a) computerize all personnel records;

(b) keep all records of radiation exposure (alpha, beta, gamma, fast neutron, thermal neutron, epithermal neutron, urine and feces analyses, total body counts) together and available immediately upon demand;

(c) include all medical records (differential blood counts, opacity lense examinations, beta burns, etc.) with these same exposure recordings;

(d) place in these records a summary of all potential and actual radiation incidents;

(e) record cases of skin and clothing contamination;

(f) record all medical (diagnostic and therapeutic) x-ray examinations and medical exposure to other sources of ionizing radiation;

(g) record time of diagnosis of any malignancy;

(h) record birth defects of children;

(i) arrange for confidentiality of these records so long as the employee is alive, unless there is written permission for the release of these records as attested by the written and signed permission of the employee;

(j) have the data so recorded and computerized that it may be analyzed easily in epidemiological studies of effects of low-level exposure of radiation workers;

(k) keep an annualized duplicate of these records in a master file of NRC;

(l) furnish a complete copy of these records to each employee every month.

As stated in the above referenced answers to CECO's Amended Second Round of Interrogatories, the League's own investigation and the discovery process are continuing. As additional facts are ascertained, they will be submitted in Supplemental Answers.

STATE OF ILLINOIS)
) SS.
COUNTY OF C O O K)

VERIFICATION

BETTY JOHNSON, being first duly sworn, on oath states that she is a member of the Rockford League of Women Voters and Chairman of the League's Byron Nuclear Power Plant Intervention Committee, and as such is authorized to execute this Verification on behalf of the League; that she has reviewed the foregoing Answers to Interrogatories; and that the same are true and correct to the best of the League's knowledge and belief.

Betty Johnson
for the ROCKFORD LEAGUE OF WOMEN VOTERS, Intervenor

Signed and Sworn
to before me this 15th
day of October, 1982

Fran M. Anderson
Notary Public

My Commission Expires: 4/6/83

PROOF OF SERVICE

I certify that the foregoing Intervenor Rockford League of Women Voters' Answers to NRC Staff Amended First Set of Interrogatories was served upon all parties of record herein, by postage prepaid properly addressed mail, this 15th day of October, 1982.

Bruce Ross