ENVIRONMENTAL IMPACT APPRAISAL BY THE
DIVISION OF OPERATING REACTORS
SUPPORTING AMENDMENT NO.   TO DRP-64
CONSOLIDATED EDISON COMPANY OF NEW YORK, INC.
AND POWER AUTHORITY OF THE STATE OF NEW YORK
INDIAN POINT STATION, UNIT NO. 3
DOCKET NO. 50-286

I. Description of Proposed Action

In their submittal of June 28, 1976, supplemented by letter dated November 9, 1976, Consolidated Edison Company of New York, Inc. and Power Authority of the State of New York (the licensee) requested approval of the NRC for an amendment to Facility Operating License No. DRP-64 and a concomitant change to the Technical Specifications for the Indian Point Station, Unit No. 3 (IP-3). This amendment to the license and change to the Technical Specifications concerns the proposed expansion of the capacity of the spent fuel storage pool (SFP).

The present storage capacity of the SFP is 264 fuel assemblies plus space accommodations for 2 failed fuel cans. The modification evaluated in this environmental impact appraisal is the proposal by the licensee to replace the existing fuel storage racks with new racks similar in design to the present racks but with closer spacing of the storage locations. The rack spacing would be changed from the present 20.5 inches center to center to 14.0 inches. The new racks would increase the storage capacity of the SFP from the present 264 fuel assemblies to 482 fuel assemblies. Under the proposed modification, the 10 existing racks would be replaced with 10 new racks, 8 of which will hold 47 assemblies and 2 of which will hold 53 assemblies. The new racks will occupy the same space envelope as the present racks. To insure an adequate subcriticality margin with the closer spacing, all the fuel storage cells, except the outermost which are adjacent to the pool liner, will have a boron-stainless steel plate welded to each side.

The earliest expected time of the first refueling for Indian Point Unit No. 3 is March 1978. The present spent fuel storage capacity of IP-3 is 264 assemblies, or slightly more than 1 1/3 cores (four regions). It is prudent engineering practice to reserve storage space to permit an entire core discharge (three regions), should this be necessary. It is expected that spent fuel reprocessing facilities will not be available to IP 3 until 1982, at the earliest. Thus, after the second refueling, scheduled for the fall of 1979, it would not be possible to discharge the entire core into the present storage racks, and the plant would not be able to continue power operation if a situation were to develop requiring a full core discharge. The proposed expansion of fuel storage capacity would provide space for a complete core discharge until 1983. The proposed increment in storage capacity of 218 spent fuel assemblies (83% increase) will permit the storage of approximately 2.5 reactor cores.

The proposed modification will not alter the external physical geometry of the spent fuel pool or require additional modifications to the SFP cooling or purification systems. The proposed modification does not affect in any manner the quantity of uranium fuel utilized in the reactor over the anticipated operating life of the facility and thus in no way affects the generation of spent uranium fuel by the facility. The rate of spent fuel generation and the total quantity of spent fuel generated during the anticipated operating lifetime of the facility and stored in the SFP remains unchanged as a result of the proposed expansion. The modification will increase the number of spent fuel assemblies that can be stored in the SFP at one time and the storage time of some the fuel assemblies will be increased.

Currently, spent fuel is not being reprocessed on a commercial basis in the United States. The Nuclear Fuel Services (NFS) plant in New York was shut down in 1972 for alterations and expansions; on September 22, 1976, NFS informed the Commission that they were withdrawing from the nuclear fuel reprocessing business. The Allied General Nuclear Service (AGNS) proposed plant is under construction in South Carolina, and this facility is not licensed to operate. The General Electric Company's (GE) Midwest Fuel Recovery Plant is Illinois is in a decommissioned condition. Although no plants are licensed for reprocessing fuel, the GE and NFS facilities are licensed for storing spent fuel and applications have been filed for permission to expand these facilities. Also, AGNS has applied for a license to receive and store irradiated fuel assemblies prior to a decision on the licensing action relating to the separation facility. Construction of the AGNS receiving storage station itself is complete.

The NRC Staff is preparing a generic environmental impact statement on spent fuel storage of light water power reactor fuel and is expected to complete this statement by the fall of 1977. The proposed expansion of the SFP capacity at Indian Point Unit No. 3 will afford the licensee operational flexibility by providing storage space for spent fuel discharges through 1983 with storage space for an emergency full core discharge.

II. Environmental Impacts of Proposed Action

On September 16, 1975, the Commission announced (40 F. R. 42801) its intent to prepare a generic environmental impact statement on handling the storage of spent fuel from light water reactors. In this notice, the Commission also announced its conclusion that it would not be in the public interest to defer all licensing actions intended to ameliorate a possible shortage of spent fuel storage capacity pending completion of the generic environmental impact statement.

The Commission directed that in the consideration of any such proposed licensing action, the following five specific factors should be applied, balanced, and weighted in the context of the required environmental statement or appraisal.

a. Is it likely that the licensing action here proposed would have a utility that is independent of the utility of other licensing actions designed to ameliorate a possible shortage of spent fuel capacity?

The Indian Point Unit No. 3 reactor core contains 193 fuel assemblies. The facility achieved initial criticality on April 6, 1976 and commenced commercial operation on August 30, 1976. The SFP was designed on the basis that a fuel cycle would be in existence that would only require storage of spent fuel for a year prior to shipment to a reprocessing facility. Therefore, the pool storage capacity of 264 assemblies (1 1/3 cores) was considered adequate. This provided for complete unloading of the reactor even if the spent fuel from the previous refueling were in the pool. Typically, Indian Point Unit No. 3 replaces about one-third of the core at each refueling. The Staff, utilizing a conservative refueling schedule, has estimated that shipment of spent fuel would be required in 1979 if the licensee is to retain the capability to load a full core into the SFP as well as store the spent fuel assemblies from the second refueling.

The proposed expansion would provide the licensee with the ability to continue to operate for an additional four to five year period and have space in the SFP for a full-core discharge. This proposed licensing action would thus provide the licensee with additional operating flexibility which is desirable even if adequate offsite storage facilities hereafter become available to the licensee.

The Staff has concluded that for the reasons set forth above, a need for additional spent fuel capacity exists at IP-3 which is independent of the utility of other licensing actions designed to ameliorate a possible shortage of spent fuel capacity.

b. Is it likely that the taking of the action here proposed prior to the preparation of the generic statement would constitute a commitment of resources that would tend to significantly foreclose the alternatives available with respect to any other licensing actions designed to ameliorate a possible shortage of spent fuel storage capacity?

With respect to this proposed licensing action, the Staff has considered both commitment of material and nonmaterial resources. The material resources considered are those to be utilized in the expansion of the SFP. The ten new spent fuel racks are constructed of stainless steel. They are similar in design to the present ten racks except that the center-to-center distances between storage locations has been decreased from 20.5 inches to 14 inches. In addition, one-eighth inch boron-stainless steel plates (approximately 1.0 - 1.2 weight percent boron) will be installed on the sides of each storage location (except the outermost edges adajacent to the pool liner) to act as neutron absorbers. The licensee has indicated that each of the eight Type I racks and boron-steel plates weigh 23,000 pounds, of which 16,250 lbs is Type 304 stainless steel and 6,750 lbs is Type 304 stainless containing 1% boron. Each of the two Type II racks and associated plates weigh 26,000 pounds, of which 19,250 lbs is 304 stainless and 6,750 lbs is 304 stainless containing 1% boron. Thus, the total weight of stainless steel used in the SFP expansion is about 236,000 pounds or 102.6 metric tons. This material is readily available in abundant supply as evidenced by the U. S. production in 1974 of approximately 1,958,000 metric tons of stainless steel. The total amount of boron that would be used is about 675 pounds; adequate supplies of this material are also available. Since the existing racks in the SFP have not been used to store spent fuel, they may be sold as scrap or used in another facility. If sold as scrap, the net usage of stainless steel would be negligible. In the context of this criterion, the Staff concludes that the amount of material (stainless steel and boron) required for the racks at IP-3 is insignificant and does not represent an irreversible commitment of natural resources. No other resources need be allocated because the other design characteristics of the SFP remain unchanged. No additional allocation of land would be made; the land area now used for the SFP would be used more efficiently by reducing the spacings among fuel assemblies.

The increased SFP storage capacity was considered as a nonmaterial resource and was evaluated relative to proposed similar licensing actions within a one year period (the time the Staff estimates is necessary to complete the generic environmental statement) at other nuclear power plants, fuel reprocessing facilities and fuel storage facilities. The Staff has determined that the proposed 83% expansion to the SFP at IP-3 is only a measure to allow for continued operation and provide operational flexibility at the facility, and will not affect similar licensing actions at other nuclear power plants.

The Staff concludes that the expansion of the spent fuel pool at IP-3 prior to the preparation of the generic statement does not constitute a commitment of either material or nonmaterial resources that would tend to significantly foreclose the alternatives available with respect to any other individual licensing action designed to ameliorate a possible shortage of spent fuel storage capacity.

c. Can the environmental impacts associated with the licensing action here proposed be adequately addressed within the context of the present application without overlooking any cumulative environmental impacts?

The SFP at IP-3 was designed principally to store spent fuel assemblies prior to shipment to a reprocessing facility. These assemblies are transferred from the reactor core to the SFP during a core refueling, or to allow for inspection and/or modificaton to core internals. The assemblies are initially intensely radioactive and have a high thermal output. They are stored in the SFP to allow for radioactive and thermal decay.

The major proportion of decay occurs during the 150 day period following removal from the reactor core. After this period, the assemblies may be withdrawn and placed into a heavily shielded fuel cask for offsite shipment. Space permitting, the assemblies may be stored for an additional period allowing additional preshipment fission product decay and thermal cooling. Presently, the SFP at IP-3 contains no spent fuel assemblies but during the first refueling, scheduled for April 1978, approximately 64 assemblies will be transferred to the SFP.

Since the additional capacity of the SFP is proposed only for fuel from this site and for this licensee, all the environmental impacts can be assessed within the context of this application. Potential impacts, both nonradiological and radiological, relative to the fuel rack conversion and subsequent operation of the expanded SFP at this facility were considered by the Staff. No environmental impacts on the environs outside the spent fuel storage building were identified during the proposed construction of the expanded SFP. The impacts within this building are expected to be limited to those normally associated with metal working activities.

No significant environmental impacts, either onsite or offsite, could be identified as resulting from operation of an expanded SFP at this facility. The only potential offsite nonradiological environmental impact that could arise from this proposed action would be an additional discharge of heat to the Hudson River. Storing spent fuel in the SFP for a longer period of time will add more heat to the SFP water. Both the licensee and the staff have evaluated the existing SFP cooling system and have concluded that the latter had adequate capacity to maintain the pool water temperature below 120°F during normal refueling operations and below 150°F during full core discharge situations. The SFP cooling system is described in Section 9.3 of the FSAR. The spent fuel pool heat exchanger is cooled by the component cooling water system, which in turn is cooled by the service water system. Compared to the existing heat load on the service water system and the total heat rejected to the Hudson River by the once through circulating water system, the small additional heat load from the SFP cooling system (attributable to the longer storage of additional spent fuel) will be negligible.

The potential offsite radiological environmental associated with this expansion would result from an incremental addition in the long-lived radioactive effluents released from the facility. This was evaluated and has been determined to be environmentally insignificant as discussed below.

The expansion of the SFP will allow spent fuel to be stored for an additional 4 to 5 year period without shipment offsite and still maintain space to off-load a full core. During the storage of the spent fuel under water, both volatile and nonvolatile radioactive nuclides may be released to the water from the surface of the assemblies or from defects in the fuel cladding. Most of the material released from the surface of the assemblies consists of activated corrosion products such as Co-58, Co-60, Fe-59, and Mn-54 which are not volatile. Radionuclides that could be released to the water through cladding defects, such as Cs-134, Cs-137, Sr-89 and Sr-90, are also predominantly nonvolatile. As with the activated corrosion product nuclide, the primary impact of such nonvolatile radioactive material is its contribution to radiation levels to which workers in and near the SFP would be exposed. The volatile fission product nuclides of most concern that might be released through defects in the fuel cladding are the noble gases (xenon and krypton), tritium and the iodine isotopes.

The clarity and purity of the spent fuel pool water is maintained by passing approximately 5 percent of the cooling loop flow through a filter and demineralizer. A skimmer pump, strainer and filter are also provided for surface skimming of the spent fuel pool water. The SFP purification system is described in Section 9.3 of the FSAR.

Storing additional spent fuel in the SFP may increase the amount of corrosion and fission product nuclides introduced into the SFP water. The purification system is capable of removing the increased radioactivity to maintain acceptable radiation levels above and in the vicinity of the pool. Redesign of the SFP racks increases only the storage capacity of the pool and not the frequency or the amount of the core to be replaced for each fuel cycle. Thus, the amount of corrosion product nuclides released into the pool during any year will be about the same regardless of the length of time or number of assemblies stored in the pool. Expansion of the capacity does increase the potential for increasing the amount of fission products introduced into the SFP water. This will increase the amount of radioactivity accumulated on the filter and demineralizer which are disposed of as solid waste.

As a conservative estimate, we have assumed that the amount of solid radwaste may be increased by an additional resin bed a year. During 1974, an average of 17,600 cubic feet of solidified waste was shipped offsite from pressurized water reactors. If the increased storage of spent fuel does increase the amount of solid waste by 30 cubic feet per year, the increase in total waste volume would be less than 1% and would not have any significant additional environmental impact.

We have estimated the increment in onsite occupational dose resulting from the proposed increase in stored fuel assemblies on the basis of information supplied by the licensee and by utilizing realistic assumptions for radionuclide concentrations in the SFP water and for occupancy times. The spent fuel assemblies themselves contribute a negligible amount to dose rates in the pool area because of the 23 foot depth of water shielding the fuel. This analysis indicates that the occupational radiation exposure resulting from this proposed action represents less than one percent of the present total annual occupational radiation burden at this facility.

The only significant noble gas isotope remaining in the SFP and attributable to storing additional assemblies for a longer period of time would be Krypton-85. Based on operating experience for Zircaloy clad fuel (see NUREG-0017), we have assumed that 0.12% of all fuel rods will have cladding defects which permit the escape of fission product gases. This value is the weighted average percent defective fuel for nine pressurized water reactors. It is assumed that the fission product gases escape on a relatively linear basis with time. On this basis, we have conservatively estimated that an additional 34 curies per year of Krypton-85 will be released when the modified pool is completely filled. The fuel storage pool area is continuously ventilated. This air is released through the containment vent. If the plant does eventually release an additional 34 curies per year of Kr-85 as a result of the proposed modification, the increase would result in an additional offsite dose of less than 0.1 mrem/year. This dose is insignificant when compared to the approximately 100 mrem/year that an individual receives from natural background radiation. Thus, we conclude that the proposed modification will not have any significant impact on radiation levels or personnel exposure offsite.

Assuming that the spent fuel will be stored onsite for several years (rather than shipped offsite after 6 to 12 months storage as originally planned), Iodine-131 releases will not be significantly increased by the expansion of the fuel storage capacity. The Iodine-131 inventory in the fuel will decay to negligible levels between each annual refueling. Storing additional spent fuel assemblies is not expected to increase the bulk water temperature above the 120°F used in the design analysis during normal refuelings or above 150°F during a full core off-load. The licensee has proposed procedural controls which will be used to insure that a full core will not be unloaded to the spent fuel pool until it has been determined that the SFP water temperature will not exceed 150°F. Connections are available to substitute a temporary pump if the spent fuel pool cooling system pump is inoperable. Since the temperature of the pool water will normally be maintained below 120°F, it is not expected that there will be any significant change in evaporation rates and the release of tritium as a result of the proposed modification.

The licensee will be prohibited from moving the spent fuel cask in the spent fuel building until either a cask drop/tip analysis is complete or the NRC staff determines that the overhead handling system meets the intent of proposed Regulatory Guide 1.104. In addition, the maximum weight of loads which may be transported over spent fuel may not be substantially in excess of that of a single fuel assembly. The consequences of fuel damage accidents, therefore, remain unchanged from those previously evaluated.

We have considered the potential cumulative environmental impacts associated with the expansion of the SFP and have concluded that they will not result in radioactive effluent releases that significantly affect the quality of the human environment during either normal operation of the expanded SFP or under postulated fuel handling accident conditions.

d. Have all technical issues which have arisen during the review of this application been resolved within that context?

This impact appraisal and the accompanying safety evaluation report point out that all questions concerning health, safety and environmental concerns have been answered.

e. Would a deferral or severe restriction on this licensing action result in substantial harm to the public interest?

In regard to this licensing action, the staff has considered the following alternatives: (1) shipment of spent fuel to a fuel reprocessing facility, (2) shipment of spent fuel to a separate fuel storage facility, (3) shipment of spent fuel to another reactor site, and (4) ceasing operation of the facility. These alternatives are considered in turn. For comparison, the proposed rack modification, fabrication and replacement will cost the licensee about $2.7 million, equivalent to $27 per kilogram of fuel storage provided ($/KgU). While this is costly, the alternatives are more costly.

(1) The licensee has made inquiries to fuel reprocessors both in the U. S. and in Europe to determine the availability of storage space and fuel reprocessing services. At present,

neither the NFS or AGNS facilities in the U. S. nor two European firms (British Nuclear Fuel and United Reprocessors) were able to extend a contract to the licensee for the storage or reprocessing of spent fuel. On September 22, 1976, NFS announced that they were withdrawing from the fuel reprocessing business. As discussed earlier, there are no storage and/or reprocessing facilities in the U. S. that are presently able to contract for the storage and reprocessing of spent fuel. With the present spent fuel storage and reprocessing situation, it appears unlikely that shipment of spent fuel to such facilities could be made within the next several years.

(2) The licensee evaluated storage at an independent storage facility, assuming one could be built, and at a reprocessor's facility, assuming the latter could be licensed to accept additional spent fuel. The estimated cost of storage at an independent facility, based on a 15 year commitment, would be $75 to $85 per kg of uranium. The cost of storage at a reprocessor's storage facility, based on a 10 year committment, would be $90 to $130/kgU. This does not include the cost of transporting spent fuel to an off-site storage facility. The licensee estimates these shipping costs would add another $10/kgU. The NFS and GE storage pools are either full or committed to their present capacity. It is unlikely that an independent storage facility could be licensed and built in time to meet the licensee's needs. It is also unlikely that the total environmental impacts of constructing an independent facility and shipment of spent fuel to the facility would be less than the minor impacts associated with the proposed action.

(3) The alternative of storing spent fuel in the storage pool of another nuclear reactor compares poorly with the proposed action. In 1975, the licensee requested and received approval to increase the storage capacity at Indian Point Unit No. 2 by 218 spent fuel assemblies. This increased capacity is needed for continued operation of Unit No. 2; there would not be sufficient space to store Unit No. 3 spent fuel in the Unit No. 2 pool except on a temporary basis. The cost of storing the spent fuel at another reactor facility, if such storage space were available, would probably be comparable to the cost of storage at a commercial storage facility and the licensee would be utilizing storage space which the recipient might require at a future date. Such a transfer would also impose additional fuel handling and transportation requirements and related additional shipping expense.

According to a survey conducted and documented by the Energy Research and Development Administration, 46 percent of the operating nuclear power plants may not be able to refuel during the period 1975-1984 if there are not any additional spent fuel storage pool expansions or commitments to utilize offsite storage facilities. Thus, the licensee cannot assuredly rely on any other power facility to provide additional storage capability except on a short-term emergency basis.

Because the fuel reprocessing problem is generic to the nuclear industry, it is not logical to store fuel from Indian Point Station Unit No. 3 at another facility. In the long-term, other facilities will have no more storage space available than Indian Point Unit No. 3 has itself.

(4) Typically, Indian Point Unit No. 3 is refueled approximately every 15 months. Each refueling replaces about one-third of the core. A fuel core contains 193 assemblies. The first refueling is scheduled for April 1978, with the second refueling scheduled for October 1979, the third refueling for January 1981, the fourth refueling for April 1982 and the fifth refueling for October 1983. After the second refueling, Indian Point Unit No. 3 would not be able to off-load a full core should this be necessary, unless the first batch of spent fuel could be stored elsewhere. After the fourth refueling, the spent fuel pool would be filled. This implies that at the end of the fifth fuel cycle, Indian Point Unit No. 3 would be unable to discharge spent fuel and operation of the facility would have to be terminated.

The alternatives of ceasing operation of IP-3 has been considered by the Staff and found to result in substantial harm to the public interest. If a situation arose that required the removal of a full reactor core to inspect or make repairs in the reactor vessel and SFP storage space was not adequate, the licensee could conceivably be required to shutdown IP-3. Adequate replacement power is not projected to be available in the 1984 to 1987 time period. The licensee is required by the New York Power Pool to maintain an 18% reserve margin. Without IP-3, the reserve margin in the summer of 1984 is projected to be 16.4%, dropping to 10.9% in 1985 and 7.0% in 1986, then rising slightly to 10.5% in 1987. The licensee has indicated that the additional oil consumption required to replace IP-3 would be about 40,000 barrels per day which amounts to a fuel cost of about $480,000 per day. Including applicable taxes, the total cost to licensee's customers would be approximately $550,000 per day. The licensee has estimated the total construction cost for the expansion of the SFP at $2.7 million. Thus, in approximately 5 days the cost of shutting down IP-3 and supplying equivalent power from existing oil fired generating units would exceed the cost of expanding the storage pool.

In summary, alternatives (1) to (3) described above do not offer the operating flexibility of the proposed action nor could most of them be completed as rapidly as the proposed action. The alternatives of shipping the spent fuel to a reprocessing facility, an independent storage facility or to another reactor would be more expensive than the proposed action and might preempt storage space needed by another utility. The alternative of ceasing operation of the facility would be more expensive than the proposed action because of the need to provide fossil fuel replacement power.

In addition to the economic advantages of the proposed action, we have determined that the expansion of the SFP would have a negligible environmental impact. Accordingly, deferral or severe restriction of the proposed action would result in substantial harm to the public interest.

III. Basis and Conclusion for not Preparing an Environmental Impact Statement

We have reviewed this proposed facility modification relative to the requirements set forth in 10 CFR Part 51 and the Council of Environmental Quality's Guidelines, 40 CFR 1500.6 and have applied, weighted, and balanced the five factors specified by the Nuclear Regulatory Commission in 40 CFR 42801. We have determined that the license amendment will not significantly affect the quality of the human environment. Therefore, The Commission has found that an environmental impact statement need not be prepared, and that pursuant to 10 CFR 50.5 (c), the issuance of a negative declaration to this effect is appropriate.

F127

SEP 10 1976

Docket Nos. 50-3/247/286

MEMORANDUM FOR: R. Reid, Chief
Operating Reactors Branch No. 4, DOR

FROM: J. T. Collins, Chief
Effluent Treatment Systems Branch, DSE

SUBJECT: ACCEPTANCE REVIEW OF THE APPENDIX I INFORMATION FOR INDIAN POINT UNIT NOS. 1, 2, AND 3

We have completed our review of the information provided by the licensee for Indian Point Station, Unit Nos. 1, 2, and 3, dated June 4, 1976, to meet the requirements of Section V.B of Appendix I to 10 CFR Part 50. The licensee has not provided all of the information needed to permit evaluation under Appendix I to 10 CFR Part 50. Information is needed concerning the source term calculation, radiological dose analyses and cost-benefit analysis as required by Section II.D of Appendix I.

The Radiological Assessment and the Effluent Treatment Systems Branches will need the information noted above before they can complete their acceptance review. The questions are enclosed. The Hydrology-Meteorology Branch finds that the information is satisfactory to complete their detailed evaluation.

ORIGINAL SIGNED BY
JOHN T. COLLINS

John T. Collins, Chief
Effluent Treatment Systems Branch
Division of Site Safety and
Environmental Analysis

Enclosure:
Acceptance Review Questions

cc: K. Goller
R. Vollmer
W. Kreger
L. Hulman
F. Congel
E. Markee
B. Grimes
T. Verdery
P. Erickson
W. Burke
R. Bellamy

Distribution:
Docket Files 50-003/247/286
NRR Reading File
DSE Reading File
ETSB Reading File

Memo

OFFICE ➤	DSE:ETSB	DSE:ETSB	DSE:ETSB			
x27775 SURNAME ➤	RRBellamy:lw	WCBurke	JTCollins			
DATE ➤	09/10/76	09/10/76	09/10/76			

SEP 1 0 1976

REQUEST FOR ADDITIONAL INFORMATION
INDIAN POINT STATION, UNIT NOS. 1, 2, AND 3
DOCKET NOS. 50-3, 50-247, 50-286

1. If there is a prior knowledge that the current 50 mile population age distribution may be significantly different from the U.S. population distribution, then furnish the current age distribution of the 50 mile population (e.g., 0-12, 12-18, >18).

2. Provide in tabular form, the distances from the centerline of the first operational reactor for each of the 16 sectors described in Section 2.1.3 of Regulatory Guide 4.2 Revision 1, to the nearest vegetable garden (greater than 500 ft^2) out to a distance of five miles.

3. Tabulate, for each compass point sector radiating from the center of the plant, the location of the nearest existing milk producing animals (cows and goats) within five miles of the site.

4. Provide data on annual meat (kg/yr), milk (liters/yr) and truck farming production (kg/yr) and distribution within a 50 mile radius from the reactor. Provide the data by sectors in the same manner indicated in Sections 2.1.3.1 and 2.1.3.2 of Regulatory Guide 4.2, Revision 1.

5. Furnish information on type, quantity and yield (kg/m^2) of crops grown.

6. Provide information on grazing season (give dates), feeding regimes for cattle (such as grazing practices, green chop feeding, corn and grass sileage feeding and hay feeding) pasture grass density (kg/m^2) and yield statistics (kg/m^2) for harvested forage crops for beef and dairy cattle feeding.

7. Determine and indicate in tabular format the present and projected commercial fish and shellfish catch (in lbs/yr) from contiguous waters within 50 miles of the plant discharge. Report the catch by total landings and by principal species, indicating the relative amounts used as human food. Indicate the location of principal fishing areas and ports of landing associated with these contiguous waters and relate these locations to harvest by species. Indicate the relative amounts consumed locally. Determine and tabulate the present and projected recreational fish and shellfish harvest from these waters in the same format, also indicating principal fishing areas and their yield by species. As above, indicate the relative amounts consumed locally. Include any harvest and use of seaweed, other aquatic life, or any vegetation used as human food from these waters. Identify and

describe any fish farms or similar aquatic activity within the 50 mile area utilizing water that may reasonably be affected by the power plant discharge. Indicate the species and production from each of these facilities and indicate the relative amounts consumed locally.

8. Identify any additional exposure pathways specific to the region around the site which could contribute 10% or more to either individual or population doses.

9. Annual Population Doses - Calculate, using the information provided in response to questions 1-8 above and any other necessary supporting data, the annual total-body man-rem and the annual man thyroid-rem to the population expected to reside in the 50 mile region at the midpoint of plant operation as well as the annual total body man-rem and the annual man thyroid-rem received by the U.S. population at the same time from all liquid and gaseous exposure pathways. Provide as an appendix to your response a description of the models and assumptions used in these calculations.

10. Provide detailed cost estimate sheets, similar to attachments A and B, listing all parameters (and their bases) used in determining capital, operating, and maintenance costs associated with all augments considered in the cost-benefit analysis. All costs should be stated in terms of 1975 dollars.

11. Provide the cost of borrowed money used in the cost analysis and the method of arriving at this cost.

12. Describe the methods and parameters used in the cost-benefit analysis as outlined in Regulatory Guide 1.110 and provide bases for all parameters. Include the following information:

    a. Decontamination factors assigned to each augment and fraction of "on-line" time assumed, i.e., hours per year used.

    b. Parameters and method used to determine the Indirect Cost Factor and the Capital Recovery Factor.

13. Provide the information requested in Appendix B of Regulatory Guide 1.112.

ATTACHMENT A

TOTAL DIRECT COST ESTIMATE SHEET

Description of Augment ______________________________

DIRECT COST (1975 $000)

ITEM	LABOR	EQUIPMENT/MATERIALS	TOTAL	BASIS FOR COST ESTIMATE
1. Process Equipment				
2. Building Assignment				
3. Associated Piping Systems				
4. Instrumentation & Controls				
5. Electrical Service				
6. Spare Parts				
SUBTOTAL				
7. Contingency				
8. TOTAL DIRECT COSTS				

ATTACHMENT B

ANNUAL OPERATING AND MAINTENANCE COST ESTIMATE SHEET

Description of Augment ______________________________

COST (1975 $000)

ITEM	LABOR	OTHER	TOTAL	BASIS FOR COST ESTIMATE
1. Operating Labor, Supervisory and Overhead				
2. Maintenance Material and Labor				
3. Consumables, Chemicals and Supplies				
4. Utilities & Services Waste Disposal Water Steam Electricity Building Services Other				
5. TOTAL O & M ANNUAL COST				