Omaha Public Power District
1623 Harney Omaha, Nebraska 68102
402/536-4000

June 6, 1983
LIC-83-130

Mr. Richard H. Vollmer, Director
U. S. Nuclear Regulatory Commission
Office of Nuclear Reactor Regulation
Division on Engineering
Washington, D.C. 20555

Subject: Omaha Public Power District's Comments on NUREG/CR-2337

Reference: Docket No. 50-285

Dear Mr. Vollmer:

The Omaha Public Power District and our consultants, Dr. A. B. Schlesinger (Biology Department Chairman of Creighton University) and Dames and Moore Consultants, have reviewed NUREG/CR-2337, Volumes 1 and 4 and the District submits the following comments. The Omaha Public Power District, along with state and federal agencies (Nebraska Game and Parks Commission, University of Nebraska, U.S. Army Corps of Engineers, Nebraska Department of Environmental Control, U.S. EPA), and its consultants (Gibbs and Hill Inc., Dames and Moore, Ecological Analysts, and Dr. A. B. Schlesinger) have invested considerable effort over a period of approximately 10 years to develop an understanding of the ecosystem of the channelized Missouri River. We believe the author's evaluation and conclusions differ significantly from the understanding gained in our studies. These differences are of such a great magnitude that we recommend the Commission withdraw the report or revise it based on the comments supplied by the District (attached). The District's position is further supported by a publication compiled by the above mentioned agencies. This document, "The Middle Missouri River - A Collection of Papers on the Biology with Special Reference to Power Station Effects", has been enclosed.

A professional judgement must be, in part, based on the appraiser's personal experience and familiarity with the specific subject matter. In this case the Missouri River is the subject. The data the author of the NUREG document had available to him on the Missouri River ecosystem was extensive. The decision as to which data to emphasize and which to treat as secondary, is a matter of professional judgement. The Omaha Public Power District believes the author's limited exposure to the same data concerning the ecosystem of the channelized Missouri River has led to some conclusions quite different from those reached by the scientists who contributed to the enclosed publication. The author's presentation leads an uninformed reader to believe that the generating stations possess the potential for severe damage to the Missouri River fishery and that the use

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of the Missouri River for once-through cooling is not ecologically sound. We believe that this conclusion is not justified by the data. Mechanical and judgemental errors that were detected as well as the improper conclusions resulting from them are attached in Appendices A and B. In a report mechanical errors are serious because they lead to incorrect conclusions.

However, in this report it is obvious to us that the same lack of rigor in report preparation that has caused the mechanical errors has also lead to very serious errors in judgement concerning the data. These errors in judgement lead not only to improper conclusions, but to the generation of inferences that are not supported by the data. We believe the author has an improper perception of the Missouri River and its ability to maintain a balanced indigenous population of fish and other fauna while being used as a once-through cooling resource for power facilities.

The most critical single factor influencing the indigenous fish population of the Missouri River is the controlled flow regime. Failure to appreciate the overriding influence this circumstance has upon the river's biota leads to serious errors of judgement as to the actual influence of perceived impacts. We believe this to be the major flaw of NUREG/CR-2337, Volumes 1 and 4.

Summer flows are typically in the range of $906m^3/s$. This provides spawning and nursery habitat in the backwater components of the river. While much reduced from the pre-channelization era, these provide relatively abundant zones for production. The relativity is seen when the winter conditions are examined. At winter flow rates characteristically in the range of $509m^3/s$ the overwintering population which was produced during the preceding breeding season is forced into a river with drastically reduced habitat. Backwater zones are drained or cut off from the winter river which flows exclusively in its high velocity main channel. The drastically reduced flow coincides with severely reduced water temperatures thereby increasing the rigors of the winter river. It must be stressed that the reduction in flow caused by control of impoundment releases at the end of the navigation season is not equivalent to "normal" winter conditions in uncontrolled rivers. The flow reduction is sudden, backwaters are drained rapidly, and habitat for young organisms is almost totally lost. The breeding population which finds suitable overwintering locations maintains a fishery which annually goes through this cycle of abundant productivity followed by massive winter loss of the juvenile component of the population. It is an error of a very fundamental sort to attribute to impingement, for example of Age 0 fish, the level of impact found in NUREG/CR-2337. The fact that breeding age fish are almost totally immune from intake structure effects is a critical item. It is the winter river and its limited habitat provision that sets the carrying capacity of the Missouri River. The sparing of Age 0 fish by removal of all intake structures can in no way increase the fishery.

In conclusion, the Omaha Public Power District takes exception to the final conclusion drawn in NUREG/CR-2337, Volume 4. The comprehensive study performed on the Missouri River ecosystem as documented in the

enclosed publication is presented in support for the Omaha Public Power District's position.

Sincerely,

W. C. Jones
Division Manager
Production Operations

cc: LeBoeuf, Lamb, Leiby, and MacRae
1333 New Hampshire Ave., N.W.
Washington, D.C. 20036

Mr. Robert A. Clark
U.S. Nuclear Regulatory Commission
Office of Nuclear Reactor Regulations
Division of Licensing
Operating Reactors Branch No. 3
Washington, D.C. 20555

Mr. E. G. Tourigny
U.S. Nuclear Regulatory Commission
Operating Reactors Branch No. 3
Division of Licensing
Washington, D.C. 20555

Mr. L. A. Yandell, Senior Resident Inspector

Consolidation of Comments on NUREG/CR-2337 Vol. 1, "Aquatic Impacts from Operation of Three Midwestern Nuclear Power Stations"

Summary of Findings

Pages	Paragraphs	Comments
1 and 2	3 and 4	There is very little scientific data interpretation in these two paragraphs, instead the author has engaged himself into making hypotheses based on only his seemingly biased opinion and lack of knowledge and experience of the ecosystem of the Missouri River.

1.0 Introduction

1.2 Approach and rationale

Pages	Paragraphs	Comments
1-3	2, Item 7	Unfamiliar with this criteria and the tests conducted to test this criteria.
1-4	1	The author comments on the introduction of non-indigenous species of fish (e.g., gizzard shad) into the Missouri River, then makes the presumption that prior to plant operation there had been a balanced indigenous fish community in the vicinity of the station.

2.0 Station Description

2.4 Station Environmental Technical Specification

2.4.3 Study and Evaluation Programs

2.4.4 Entrainment Effects

Pages	Paragraphs	Comments
2-11	4	The new high maximum discharge temperature was allowed to accommodate an increase in power from 1420 MWt to 1500 MWt. This "relaxing" of the operating limits was a result of an operating license change and new ETS issued by the NRC.

3.0 Environmental Impact Assessment

3.1 Potential Impacts of Intakes and Discharge

3.1.1 Potential Direct Effects

3.1.1.1 Thermal Tolerance and Threshold

Pages	Paragraphs	Comments
3-2	1	The author should report the size and times when the limited mixing zone exceeds either thresholds and not leave the reader to ponder these parameters.

3.1.1.2 Plant Shutdown

Pages	Paragraphs	Comments
3-2	4	The authors fails to mention that during several shutdowns, monitoring by OPPD and consultants resulted in no evidence of fish kills.

3.1.3 Authetic Change in Missouri River

Pages	Paragraphs	Comments
3-4	2	The loss of variety in habitats and surface area of the Missouri River in the vicinity of the Fort Calhoun Station does more than effect the appearance of the river, but more importantly, severely limits the fishery in that area and the rest of the reach of the channelized river (see Army Engineer Corps, 1981 Mitigation Study).

3.2 Preoperational Final Environmental Statement Projections of Impacts

3.2.1 Thermal Discharge

Pages	Paragraphs	Comments
3-6	1	Catch per unit effort data as late as November indicates fish are seeking habitat other than the warm water of the discharge. Hence, in this winter estimates reports only available winter harborage behind wing and trail dikes, not the channelized section as found below the discharge.

3.2.2 Entrainment and Impingement

Pages	Paragraphs	Comments
3-6	Item 1	The importance of the unchannelized stretch equal or perhaps even succeeds the reservoir upstream. Local inputs and tributaries can also be of importance (Recruitment Study, 1978).
3-6	Item 3	Under average river conditions (velocity and temperature), the time and distance of exposure to a DT greater than 5 F is very limited.
3-6	Item 4	Why discuss white catfishπ Isn°t there more pertinent information available besides Haddam Neck
3-7	Item 5	Why discusss only white crappie and channel catfishπ

3.3 Operational Impacts

3.3.1 Thermal Impacts

Pages	Paragraphs	Comments
3-13	Item 2	The average reported (46.8°F) in the vicinity of the discharge is incorrect. Page 3-2 states the maximum measured at the station from 1973 to 1977 was 31°F. The sentences should read, average in the vicinity of the discharge was 14.8°F.

3.3.2 Entrainment and Impingement

Pages	Paragraphs	Comments
3-13	Item 1	The 500,000 fish qualified by approximately.
3-14	Item 6	The statement that neither thermal nor mechanical effects of entrainment were ever evaluated separately is incorrect. The author failed to acknowledge an important estimate reported in 5-year report. Estimated entrainment losses ranged from 2.6-5.3% of the total larval assemblage.

3.4 Evaluation of Observed Impacts

Pages	Paragraphs	Comments
3-14	2	The author acknowledges he will be offering his "professional judgement" in case of inadequate baseline data. The use of other data is not applicable to the uniqueness of the Missouri River. The author°s lack of experience and familiarity of that uniqueness of the Missouri River is evident throughout the report.

3.4.1 Thermal Discharge

3.4.1.2 Zooplankton

Pages	Paragraphs	Comments
3-22	4	The assumption of 100% mortality of entrained zooplankton is without basis. Chapter 6 of the monograph calculated a 17.5% differential immotility/mortality rate at Fort Calhoun which results in a calculated total effect of less than 1,10. Also, and zooplankton survival are site specific. Time spent in the discharge canal at Conn. Yankee is 50-100 minutes with temperature as high as 39.4°C, compared to 2-3 minutes exposure in the discharge tunnel and temperature as high as 37.1°C.

Pages	Paragraphs	Comments
3-28	2	Author should have Fort Calhoun data on survival of cladocuans and capepods and should report findings here. Don't leave issue hanging.
3-28	4	The first sentence on page 3-29 states that the effects on zooplankton appear to be localized. The localized region at the discharge or nursery zone in any way. The suggested impact is not "apt".

3.4.1.3 Benthic Macroinvertebrates

Pages	Paragraphs	Comments
3-32	1-3	These first three paragraphs reflect an important error likely to be fallen into by those not having experience on the Missouri River. The discharge affected cutting bank has essentially no benthic community. This is stated in paragraph No. 1. The rip-rap bank stabilization structures support an aufwuchs community however, and it is this community that the artificial substrates sample most effectively.
3-32	4	Exactly so. Stability of flow rate promotes stability in the aufwuchs community. Episodic rises and falls in flow rate disturb the aufwuchs. This natural variance of flow and its effects on the aufwuchs could have yielded the differences observed in pre-operational and post-operational data collected.
3-34	1	This kind of discussion is disappointing when it is engaged in. Impossible, in statistical terms, means just that. There is no room for "however," no matter how casually it is used.
3-34	3	The conclusion made in this paragraph is exactly what the author states on pages 3-32 can't be done because the artificial substrate specifically excludes this type of conclusion.
3-34	4 and 5	The various observed seam likely to be due to natural variations found in a fluctuating system such as the Missouri River.

3.4.1.4 Fish

Pages	Paragraphs	Comments
3-39	4	Because of the limited success with trammel nets in this habitat (mid-channel), this data need not be discussed.

3.4.1.4 Fish (Continued)

Pages	Paragraphs	Comments
3-41	3	Differences in pre and post-operational sampling were not that different as author implies. Post-operational seining occurred on the Iowa side, not the Nebraska shore.
3-42	Table 3-7	Incorrect reference. Not from Environmental Series Bulletin No. 3, but Fort Calhoun 5-year Report.
3-45	1	Catch rates are not necessarily associated with spawning or temperature preferences. Carp, for example, spawn in shallow back- water areas inaccessible to electro-shocking equipment.
3-45	2	The three November dates of non-operation in Table 3-7 indicates fish are not attracted to the heated effluent during cold months, since the CPE for non-operation is higher that operational CPE. Shrinking river and dropping temperatures in November tend to congregate the fish in winter harborage areas below wing likes and trail dikes (Hessis winter population data).
3-45	2	Item 2. Same pattern of abundance of Gizzard Shad seen at Station 4.
3-48	1	Data does not indicate east-west movement but movement from trail dike to wing dike habitat on upstream-downstream movement.
3-48	2	Goldeye fed primarily on terrestrial (45.5%) and aquatic (10.4%) insects.
3-49	1	"Will result", changed to could result, in next to last sentence. Some surveillance by OPPD personnel during shut-down failed to produce any indication that a fish kill had occurred nor were any fish kills reported by public during the time the plant has operated.

3.4.1.4 Fish (Continued)

Pages	Paragraphs	Comments
3-49	3	Some November shocking dates it was quite cold with temperatures ranging from 1.1-11.5°C. The mean for five November dates was 6.0°C.
3-50		Winter population studies (Hesse) on the Missouri River indicate fish are not inhabiting the cutting banks but are found in holes and slack water areas behind wing and trail dikes. The references to Lake Michigan seems inappropriate when considering the high velocities of the main channel of the Missouri River.

3.4.1.5 Commercial and Recreational Fisheries

Pages	Paragraphs	Comments
3-50	2 - Item No. 1	Misinterpretation. Main population center in Nebraska is in the eastern section of the state.
3-51	1	The potential of winter sport fisheries in the discharge region is untrue due to lack of winter harborage in that region.
3-51	3	Should explain that this method is used by the Nebraska Game and Parks Commission for the reporting of the commercial catches. Section III goes to Rulo, Nebraska, not Kansas City.
3-53	2	Commericial fishery data should be available for all years.
3-53	3	The commercial fishery data would not necessarily be representative of the ecosystem of the Missouri River for several reasons: (1) The commercial fishery data°s validity is poor. Fishermen, not fisheries biologist, identify and report the catch.

3.4.1.5 Commercial and Recreational Fisheries (Continued)

Pages	Paragraphs	Comments
3-53	3	(2) Most commercial fishermen today are only casual fishermen, and so the harvest reflects more upon their interests in fishing rather than population levels. (3) One fisherman's presence or absence can significantly change the harvest. In fact, one fisherman in Section III caught the majority of catfish. When he quit fishing, the catfish harvest declined significantly in that section.
3-56	1	The statement that the decline in the number of fish captured commercially may mean a decline in the total river ecosystem, which the station could in turn have influenced, was labeled an unacceptable statement. It is not only dishonest but is not scientifically supportable.

3.4.1.6 Summary and Conclusions: Thermal Effect

Pages	Paragraphs	Comments
3-56	3	The statement that the general decline in commercial fisheries in the Missouri River may be partly related to the use of once through cooling is worse than deceptive and is clearly an unsupported conclusion. The entire discussion of the commercial fisheries in invalid based on the absense of any reliable documentation of the commercial fishing effort during pre and post-operational periods.

3.4.2 Entrainment of Fish Eggs and Larvae

Pages	Paragraphs	Comments
3-59	1	The 1978 study quoted is the Recruitment Study, not entrainment. The seven transects sampled in 1978 were triple depth, not surface samples. Sample locations A, B, C were utilized to represent 1978 river data above the station, not 1 through 4.

3.4.2 Entrainment of Fish Eggs and Larvae (Continued)

Pages	Paragraphs	Comments
3-59	2	OPPD entrainment estimates were based on the density of larvae along the Nebraska bank and the amount of cooling water withdrawn in comparison to the number of larvae in the entire river cross section.
3-62	3 - Sentence 4.	It's relative abundance, not relative density of adult freshwater drum.
3-63	Table 3-13	Adult fish data does not agree with Table 3-8 on page 3-44 for relative abundance of adult fish.
3-64	2	Triple depth study showed larvae to be non-homogenous with larger concentration occurring in upper part of water column. Station 2 changed to Station 3.
3-64	3	Fresh water drum is a game fish. Carp are not pelagic spawners.
3-66	1	Commercial fishes do not make up bulk of larvae collection. Freshwater drum are game fish and not commercially sought in this portion of the Missouri River as stated by the author on page 3-72.
3-66	2	The conclusion and discussion in this paragraph is not tru or correct. The recruitment study emphasizes the importance of the unchannelized portion above Sioux City for its overall contribution of larvae to the main drift of the Missouri River.
3-67	2	This is an outrageous statement because it ignores the triple depth discussion.
3-67	3	In answer to the statement by the author that the method used by OPPD underestimates the real moratality, two points were made:

(1) Larvae were found in some years as early as mid-March but in numbers too low for any statistical analysis.

3.4.2 Entrainment of Fish Eggs and Larvae (Continued)

Pages	Paragraphs	Comments
3-67	3	(2) "Real" mortaility is not the same as "documentable" mortality and the author uses the term "real" mortality as if he is knowledgeable of that value.
3-71	1 and 2	No estimates are given in calculations what percent entrainment mortality adds to natural mortality. The method of establishing a survival rate from larvae to adult of 0.1% is non-supportable. Hergenrader et. al. (Chapter 8, Monograph), assumes 40% natural mortality of larvae exposed to entrainment. Short-term survival after condenser passage was 14.3% and calculated per day permanent loss to the living ichthyoplankton was 3.22%.
		The author (El Shany), by assuming all the entrained larvae were alive prior to entrainment ignores data available to him. (Cada and Hergenrader, 1978 and Kin, 1977). Suckers, freshwater drum, gizzard shad, and carp are considered prolific.

	Paragraph 1 3-72	Items 4-6	Why discuss the survial of yellow perch, alewife, and smelt in lake systemsπ The survival rate of freshwat er drum in Item 6 is merely an assumpti on.
3-72	2		The extrapolation of mortality curves for gizzard shad cannot be uniformly used to estimate adult fish losses for other species. The whole discussion of entrainment and its relationship to the commercial fisheries harvest utilizing commercial fisheries harves data is without scientific backing. The commercial fishery is under-utilized and few if any knowledgeable biologists accept those voluntary reported catches as truthful and accurate.
3-73	2		The assumption of 100% larval mortality due to entrainment is a denial of evidence provided by other and OPPD data.

3.4.2 Entrainment of Fish Eggs and Larvae (Continued)

Pages	Paragraphs	Comments
3-73 3-73	4 1	The "dramatic" decline in the relative relative abundance of freshwater drum from pre-operational to post-operational is not supported (Table 3-8). Why not include previous years pre-operational data available.
3-74	2	Table 3-13 is relative abundance not number.
3-74	3	This paragraph indicates different authors must have written each page and did not read preceeding or following pages.
3-74	4 Last sentence	Who among these authors knows that the spawning season on the Missour River is anything other than reported. Ninety-nine percent of 11 larvae each year pass the plant during the fan weels period in June and July.
3-79	1 First sentence	Absolutely an inaccurate statement about fish eggs. Eggs comprised 2.0% of the total catch and freshwater drum and goldeye eggs were identified. Goldeye eggs comprised 90.0% of the total egg catch. Onset of spawning discussion is simply a misinterpretation of the seasonal progression from the south. Spawning does not occur earlier in Lewis and Clark Lake. Lewis and Clark Lake receives the cold bottom water from the Ft. Randal Dam and has a 7-10 day exchange rate. The lake is usually 2-4 weeks later than the downstream river.
3-81	1. Item 3.	Finally Nothing in this chapter would lead an uninformed reader to the realization that the winter Missouri River cannot provide harborage for the kind of population calculated by the author in his effort to establish the effect of the Fort Calhoun Station.

3.4.3 Impingement of Juvenile and Adult Fishes

3-81	3	The discussion in this paragraph is nothing more than assumption based on a 0.1% survival rate.

PAGES	PARAGRAPHS	COMMENTS
3-84	2	The statement that most fish species are unable to maintain a continuous momentum against a current velocity greater than 1.0 fps is quite interesting in view of the fact that Hesse and Wallace, 1976 (Reference No. 25), documented movement upstream for long distance over short periods of time. Average velocities of the Missouri River range from 3.0 to 5.9 fps.
3-93	1	Along with a sudden drop in river flow, a drop in temperature to about 32° F and a loss of harborage and substinance are factors that influence impingement rates.
3-95	1	The two daily sample episodes do not underestimate or overestimate the real impingement rate but hit the mean on the nose. (See paragraph 3).
3-98	4 Item 1.	Pooling montlhly data for all years may not be a correct method. Strong and weak year classes are the normal situation in the river. The trend observed may be caused simply by this phenomena and not by fish impingement itself.
3-98	4 Item 4	What is the logic or statistical method used behind X + 25 representing an upper limit (worse case).
3-103	1	The statement of the destabilization of the food chain of some pisciworons species has no scientific data support but is merely a supposition. CPE's and other population indicators of the species purported to prey upon these forage species have shown no decline over the last 10 years.

3.4.3 Impingement of Juvenile and Adult Fishes (Continued)

3-103	3	The combined effect of impingement and entrainment of freshwater drum characterized as having a "severe" impact is a completely non-supportive and non-scientific hypothesis.

PAGES	PARAGRAPHS	COMMENTS
3-104 2		The use of commercial fishery data as a basis for establishing "large" without any idea of the nature of the commercial fishery is unacceptable.

PAGE	PARAGRAPHS	COMMENTS
3-106	2	This whole paragraph is totaly unacceptable as a scientific conclusion. The author's use of commerical fisheries data and his lack of knowledge and experience of the limited winter harborage for the survival of the young of the year fish to adulthood has lead the author to this erroneous assumption. According to Hesse and Wallace, only 0.4% to 10% of the yound of the year fish stocks will be recruited to the fishery and reach sexual maturity.
3-107	1	Again, a conclusion based on commercial fishery data. This is an unacceptable scientific conclusion.

APPENDIX A

Mechanical errors from NUREG/CR-2337 Vol. 1, "Aquatic Impacts From Operation of Three Midwestern Nuclear Power Stations"

Summary of Findings

Pages	Paragraphs	Comments
1	3	Contrary to the author's statement, the Recruitment Study data base allows the estimate of the number of fish eggs entrained (Ref. No. 33 in NUREG and Middle Missouri River: Chpt. 8, Pg. 187).

1.0 Introduction

1.2 Approach and Rationale

Pages	Paragraphs	Comments
1-4	1	The classification of gizzard shad as "exotic" is not correct. The Nebraska Game and Parks Commission in 1886 reported gizzard shad as a native species.
1-4	1	The author contradicts himself. He points out invasion and establishment of non-indigenous species in the river, then presumes a balanced indigenous community of fish prior to plant operation.

2.0 Station Description

2.1 Introduction

Pages	Paragraphs	Comments
2-1	2	The design power rating is 1500 megawatts thermal for Fort Calhoun, not 1500 megawatts.

Appendix B

Issues of Professional Judgement from NUREG/CR-2337, Volume 1, "Aquatic Impacts from Operation of Three Midwestern Nuclear Power Stations"

I. Thermal Discharge

Topics	In NUREG/CR-2337, Volume 1, Pgs., Paragraphs
1. Attraction of fish during the cold water months to the heated discharge, their subsequent impingement, and the commercial and recreational winter fishery potential below the outfall at the Fort Calhoun Station.	3-6, 1 3-45, 2 3-49, 3 3-50, 1 3-51, 1

Comments

Contrary to the author's assumption catch per unit effort data as late as November (Table 3-7 in NUREG) and winter electro-fishing data collected at the Fort Calhoun Station during the winter of 1974 (Middle Missouri River: Chpt. 7, Pgs. 240-242 and Ref. No. 25 in NUREG) indicate fish are seeking habitat other than the warm water discharge located on the cutting bank. Planned reductions in flow and dropping river water temperatures in November tend to congregate the fish in slackwater habitat below wingdikes which are located on the filling bank (Middle Missouri River: Chpt. 11, Pg. 297). The discharge is at the cutting bank which with its current and absence of harborage is extremely poor winter habitat. The increased water temperature cannot offset the inadequacy of this location and the assumption of attraction for either a winter fishery or potential for markedly increased impingement is unsupported by the data.

II. Relative Abundance

Topics	
1. Factors affecting the catch per unit effort of various species collected at the Fort Calhoun Station.	3-45, 1

Comments

Catch rates are not necessarily associated with spawning and temperature preferences as stated by the author. Gear selectivity, recruitment success, and the changes in the habitat as a result of seasonal differences in flow volumes and water levels at the time of collection are the factors most responsible for the trends in species relative abundance noted (Middle Missouri River: Chpt. 9, Pgs. 232-234 and Ref. No. 8 in NUREG: Chpt. 1, Pgs. 4 and 5).

III. Zooplankton

Topics

1. Zooplankton entrainment mortality rates and subsequent impact on the feeding behavior of larvae and juvenile fish.	3-22, 4 3-28, 4

Comments

The assumption of 100% mortality of entrained zooplankton is unwarranted based on data provided to the author (Ref. No. 5 in NUREG: Pg. 72). In the Middle Missouri River (Chpt. 6, Pgs. 141-143) a calculated 17.5% differential immotility/mortality rate at the Fort Calhoun Station resulted in losses in viability which did not exceed 0.8% at 0 hrs. or 0.6% at 4 hrs..

The author's comparisons of mortality rates of zooplankton at Fort Calhoun to other stations where condenser passage times and temperatures vary considerably are unacceptable. Time spent in the discharge canal at Connecticut Yankee is 50-100 minutes with temperatures as high as 39.4° C, compared to 2-3 minutes exposure in the discharge tunnel and temperatures as high as 37.1° C at the Fort Calhoun Station. The subsequent impact on the feeding behavior of larvae and juvenile fish, as suggested by the author, cannot be supported. The localized region at the discharge is in no way a breeding or nursery area for larval or juvenile fish (Middle Missouri River: Chpt. 8, Pg. 191 and Ref. No. 5 in NUREG: Pg. 25).

IV. Benthic Macroinvertebrates

Topics

1. Aufwuchs vs. benthic community.	3-32, 1-4 3-34, 1,3, 4,5

Comments

The first three paragraphs on page 3-32 reflect an important error likely to be fallen into by those not having experience on the Missouri River. The author of the NUREG document objects to the utilization of rock baskets and artificial substrates to sample benthic communities. The discharge-affected cutting bank has essentially no benthic community. The rip-rap bank stabilization structures support an aufwuchs community that the artificial substrates sample most effectively (Middle Missouri River: Chpt. 7, Pgs. 147, 150, 161-167 and Ref. No. 8 in NUREG: Pgs. 1-1, 1-4, and 1-5).

The variability observed in the benthic population between pre-operational and post-operational years is attributed to the natural variance of flow and its effects on the aufwuchs. Stability of flow rate promotes stability in the aufwuchs community while episodic rises and falls disturb the aufwuchs (Middle Missouri River: Chpt. 7, Pgs. 152-153 and Ref. No. 8 in NUREG: Pg. 2-4).

V. Larval Fish

Topics

1. The method of calculating entrainment mortality. — 3-59, 2; 3-67, 2

Comments

Contrary to the author's statement, the Omaha Public Power District's entrainment estimates were not based on average larval fish density across the Missouri River but on the density of larvae at the Nebraska bank and the amount of cooling water withdrawn in comparison to the total living population passing the station (Middle Missouri River: Chpt. 8, Pg. 220 and Ref. No. 34 in NUREG: Pgs. 12 and 13).

Triple depth studies conducted by the District demonstrated that larvae are distributed non-homogeneously in the water column with larger concentrations occurring in the upper part of the water column. The water utilized by the Fort Calhoun Station is withdrawn from the lower part of the water column (Middle Missouri River: Chpt. 8, Pgs. 194-196 and Ref. No. 8 in NUREG: Chpt. 3, Pg. 58). This fact was ignored by the author during the discussion of entrainment estimates, while this information had been utilized in District calculations of entrainment effects.

2. Natural mortality and entrainment survival in entrainment estimates. — 3-71, 1,2; 3-72, 2; 3-73, 2

Comments

The author's assumptions that all entrained larvae were alive prior to entrainment and that there is a 100% mortality rate for entrained larvae ignore data available to him (Ref. No. 8 in NUREG: Chpt. 3, Pgs. 58-61). The discussion that followed of survival rates of yellow perch, alewife, and smelt in lake systems and the extrapolation of mortality curves for gizzard shad to estimate losses for other species such as freshwater drum simply cannot be supported. Studies by Cada and Hergenrader (1978) and King (1977) were utilized to estimate a mean 40% natural mortality rate while short-term survival after condenser passage averaged 14.3% over the entire study. An average daily loss of 3.22% of the living ichthyoplankton community that passes the Fort Calhoun Station is a much more accurate estimate than made by the author (Middle Missouri River: Chpt. 8, Pgs. 215 - 220).

VI. Adult Fish

Topics

1. Factors affecting fish impingement. — 3-84, 2; 3-93, 1

Comments

The statement that most fish species are unable to maintain a continuous momentum against a current velocity greater than 1.0 fps contradicts the findings of Hesse and Wallace (Ref. No. 25 in NUREG), that documented movement upstream for long distances over short periods of time. Average

VI. Adult Fish (Continued)

Comments (Continued)

velocities of the Missouri River range from 3.0 to 5.9 fps. The author fails to acknowledge that the planned sudden drop in river flow produces a severe loss of winter harborage and sustenance, two very important factors that influence impingement rates (Middle Missouri River: Chpt. 11, Pg. 297, Middle Missouri River: Chpt. 7, Pgs. 150, 151, and 155-167, and Ref. No. 8 in NUREG: Chpt. 2, Pgs. 32 and 33).

2. Impingement of small fish and subsequent destabilization of the food chain.	3-103, 1

Comments

The statement of the destabilization of the food chain of some piscivorous species has no data to support it. Catch per unit efforts and other population indicators of the species purported to prey upon these forage species have shown no decline over the last 10 years (Middle Missouri River: Chpt. 9, Pgs. 232, 233, 254 and Ref. No. 8 in NUREG: Chpt. 1, Pgs. 6-9 and Chpt. 2, Pg. 35).

3. Combined effects of entrainment and impingement on freshwater drum.	3-103, 3

Comments

The combined effects of impingement and entrainment of freshwater drum characterized by the author as having a "severe" impact is not supported by the data (Middle Missouri River: Chpt. 9, Pg. 254 and Ref. No. 8 in NUREG: Chpt. 2, Pg. 35). Freshwater drum have not experienced a decline based on catch rate data.

4. The method of calculating impingement rate.	3-95, 1,3,4 3-98, 4

Comments

See Attachment 1.

VII. Commercial Fisheries Data

Topics

1. Use of commercial fisheries data as a basis for scientific conclusions.	3-53, 3 3-56, 1 3-72, 2 3-81, 3 3-104, 2 3-106, 2 3-107, 1

Comments

See Attachment 2

Methods of Calculating Impingement Rates

The author of the NUREG/CR-2337, Volume 1, document objected to the method utilized in the Fort Calhoun Station Unit No. 1 Five Year Report of estimating the impingement rate. The author stated that the 24 hour sample periodicity was inadequate and that diel differences were not accounted for. To correct the perceived errors of the statistical technique utilized in the Fort Calhoun Station document, the author utilizes a "simple parametric statistical technique." The District attempted to duplicate the stated results using the data cited but was unable to do so (Tables 1, 2 and 3 attached). The months of February, August, September, October, and November vary considerably (Table 3) from the NUREG figures while the remaining seven months were quite similar. Either the District has failed to duplicate the method utilized in the NUREG document or possibly a calculational error has been committed by the NUREG author.

The Omaha Public Power District, in preparing a document for the Nebraska Department of Environmental Control for its Nebraska City Station, has devised a method of calculating impingement rate that utilizes both daily and 24 hour studies and thus provides a more accurate estimate of the impingement rate than provided in the Five Year Report. Using this technique with the Fort Calhoun data, the monthly diurnal and monthly nocturnal impingement rates are adjusted to account for diel differences utilizing data from the 24 hour studies (Table 4). The projected mean daily diurnal impingement rate (Equation 1, Figure 1) is added to the projected mean daily nocturnal impingement rate (Equation 2, Figure 1) to yield a total mean 24 hour impingement rate. This mean 24 hour impingement rate can be multiplied by the number of days in the month to yield a monthly impingement rate. Yearly projections are based on the addition of these monthly rates (Tables 5, 6, 7, 8 and 9). A formula to account for nocturnal fish impingement when nocturnal sampling was not accomplished (October thru April) is also included (Equation 3, Figure 1).

Tables 10 and 11 list the various extrapolated fish impingement values at the Fort Calhoun Station from 1973 to 1977 utilizing the different techniques. The recalculated values (OPPD) account for an increase of approximately 20.0% from the values listed in the Fort Calhoun Station Unit No. 1 Five Year Report and are approximately 28.1% under the NUREG document figures. As a result of this evaluation, we believe the author's estimate is too high and unrepresentative of the actual impingement rate, but more significant than this is the author's misperception of the effect of this level of cropping.

The differences in estimates are believed to be insignificant based on the loss of fish attributed to the severe winter conditions that exist in the Missouri River. Young-of-the-year fish subjected to these severe conditions are highly susceptible to cropping. Examination of the impingement data from the Fort Calhoun Station reveals that approximately 70.0% of the impinged fish were 100mm or less (young-of-the-year). The projected figures in the Fort Calhoun Station Five Year Report were based on a 100% mortality rate. The data reveals approximately 50% of the fish impinged were classified as alive and returned to the river. Under these premises

and with the knowledge gained about the Missouri River ecosystem over approximately 10 years of study, the Omaha Public Power District maintains that impingement losses at the Fort Calhoun Station have had no detectable impact on the Missouri River adult fish community.

Figure 1. Procedures Used to Calculate Impingement Data that Compensate for the Diel Periodicity of Fish Impingement at the Fort Calhoun Station.

Equation 1: Calculated Mean Daily Diurnal Fish Impingement (D)

$(D) = x \cdot 79.2$

where:

x = mean monthly diurnal impingement rate from daily sampling
= No. Sampled Per Month/Hrs. Sampled Per Month

and:

$79.2 = 6[4(34.3/10.4)]$

34.3* = total daily diurnal impingement as a percent of the diel impingement

10.4* = percent of diel impingement collected during one hour sampling between 1000-1400 hours

4 = expansion factor required to correct for sampling just one hour in four hour period (1000-1400 hours)

6 = number of traveling screens utilized

Equation 2: Calculated Mean Daily Nocturnal Fish Impingement (N)

$(N) = Y \cdot 72.0$

where:

Y = mean monthly nocturnal impingement rate from daily sampling = No. Sampled Per Month/Hrs. Sampled Per Month

and:

$72.0 = 6[4(65.7/21.9)]$

65.7* = total daily nocturnal impingement as a percent of the diel impingement

21.9* = percent of diel impingement collected during one hour sampling between 2200-0200 hours

4 = expansion factor required to correct for sampling just one hour in four hour period (2200-0200 hours)

6 = number of traveling screens utilized

* See Table 4

Equation 3: Calculated Mean Daily Nocturnal Fish Impingement When Nocturnal Sampling Did Not Occur (D_x)

$(D_x) = (D) \times 1.5$

where:

(D) = Equation 1

1.5 = (100/65.7)

and:

65.7 = percent of total diel impingement occurring between the hours of 1800-0559

Table 1. Comparison of Monthly Mean Impingement Rates Calculated by Author of NUREG/CR-2337, Volume 1 vs. Duplication Effort by OPPD

MONTH	Total monthly mean impingement[1] rate for all 6 screens no. fish/hr./6 screens					Total of monthly[2] mean impingement rates/6 screens all years	Total of monthly[3] mean impingement rates/screen all years	OPPD Monthly[4] mean impingement rate (no. fish/hr./screen)	Reported Monthly mean impingement rate calculated in NUREG
	73	74	75	76	77				
January	--	8.7	1.7	33.0	2.8	46.2	7.7	1.9	1.9
February	--	7.6	0.3	33.6	7.2	48.7	8.1	2.0	2.4
March	--	2.8	3.2	55.6	2.6	64.2	10.7	2.7	2.7
April	--	0.8	4.4	29.0	5.8	40.0	6.7	1.7	1.7
May	6.3	9.0	5.0	22.9	2.2	45.4	7.6	1.5	1.6
June	5.8	6.2	4.4	8.3	1.4	26.1	4.4	0.9	0.9
July	20.1	7.4	24.5	1.4	7.6	61.0	10.2	2.0	2.0
August	33.5	11.2	1.6	0.7	5.4	52.4	8.7	1.7	2.1
September	13.2	12.6	0.9	0.4	5.0	32.1	5.4	1.1	2.9
October	14.3	31.8	1.5	0	4.8	52.4	8.7	1.7	5.6
November	22.9	46.7	18.4	5.6	26.9	120.5	20.1	4.0	4.5
December	11.2	32.9	53.6	7.8	4.4	109.9	18.3	3.7	3.6

[1] Data from Table 2.7, page 51 of Fort Calhoun Unit No. 1 Five Year Report

[2] Sum of monthly mean impingement rates for all six screens, 1973-77

[3] Monthly mean impingement rates for all 6 screens, 1973-77, divided by 6

[4] Monthly mean impingement rates per screen, 1973-77, divided by number of years that month was sampled.

Table 2. Comparison of Mean Number of Fish Impinged Per Year Calculated by Author of NUREG/CR-2337, Volume 1 vs. Duplication Effort by OPPD

Month	Mean[1] no./hr./screen	Mean no./day/screen	Mean no./month/screen	OPPD Mean no./month/6 screens	Reported in[2] NUREG
January	1.9	45.6	1,413.6	8,481.6	8,481.6
February	2.0	48.0	1,344.0	8,064.0	9,676.8
March	2.7	64.8	2,008.8	12,052.8	12,052.8
April	1.7	40.8	1,224.0	7,344.0	7,344.0
May	1.5	36.0	1,116.0	6,696.0	7,142.4
June	0.9	21.6	648.0	3,888.0	3,888.0
July	2.0	48.0	1,488.0	8,928.0	8,928.0
August	1.7	40.8	1,264.8	7,588.8	9,374.4
September	1.1	26.4	792.0	4,752.0	12,528.0
October	1.7	40.8	1,264.8	7,588.8	24,998.4
November	4.0	96.0	2,880.0	17,280.0	19,440.0
December	3.7	88.8	2,752.8	16,516.8	16,070.4
				109,180.8	139,924.8

mean no. fish impinged per year, all six screens

[1] Calculated in Table 1.

[2] In this table the difference in mean no./hr./screen between OPPD and the NUREG author are manifested in a 30% over calculation of mean annual impingement.

Table 3. Comparison of Mean Number of Fish Impinged Per Year Calculated by Author of NUREG/CR-2337, Volume 1 vs. Duplication Effort by OPPD

Month	Mean[1] no./hr./screen	Mean[2] no./day/screen	Mean no./month/screen	OPPD Mean no./month/6 screens	Reported in NUREG
January	1.9	54.7	1,696.3	10,177.9	10,177.9
February	2.0	57.6	1,612.8	9,676.8	12,856.3
March	2.7	77.8	2410.6	14,463.4	14,463.4
April	1.7	50.0	1,468.8	8,812.8	9,106.6
May	1.5	43.2	1,339.2	8,035.2	8,570.9
June	0.9	25.9	777.6	4,665.6	4,821.1
July	2.0	57.6	1,785.6	10,713.6	10,713.6
August	1.7	49.0	1,517.8	9,106.6	11,249.3
September	1.1	31.7	950.4	5,702.4	15,534.7
October	1.7	49.0	1,517.8	9,106.6	29,998.1
November	4.0	115.2	3,456.0	20,736.0	24,105.6
December	3.7	106.6	3,303.4	19,820.2	19,284.5
				131,017.1	170,882.0

mean no. fish impinged per year, all six screens

[1] Calculated in Table 1.

[2] The NUREG author multiplied the figures in Table 2 by a factor of 1.2 to adjust for diel difference.

Table 4. Diel Pattern of Fish Impingement at the Fort Calhoun Station, Unit 1 Based on 22 Combined 24-Hour Monitoring Studies, 1974-1975

Time (Hours)	Fish Impinged (%) Per two hour period		
0600 - 0800	9.5		Diurnal (34.3%)
0800 - 1000	6.0		
1000 - 1200	5.9	Diurnal Sampling Period (10.4%)	
1200 - 1400	4.5		
1400 - 1600	1.6		
1600 - 1800	6.8		
1800 - 2000	7.3		Nocturnal (65.7%)
2000 - 2200	13.3		
2200 - 2400	11.4	Nocturnal Sampling Period (21.9%)	
2400 - 0200	10.5		
0200 - 0400	12.0		
0400 - 0600	11.2		

Table 5. Fort Calhoun Monthly Fish Impingement Extrapolations for 1973

ime (1973) (Months)	$\bar{x}$ Monthly Diurnal[3] Impingement Rate (no./hr./scr.)	Calculated[4] $\bar{x}$ Daily Diurnal Impingement (no./day)	$\bar{x}$ Monthly Nocturnal[5] Impingement Rate (no./hr./scr.)	Calculated[6] $\bar{x}$ Daily Nocturnal Impingement (no./night)	Total Impingement[7] Per 24 Hours	Extrapolated[8] Monthly Impinge.
January	----------[1]	---------[1]	-----------[1]	--------[1]	--------[1]	--------[1]
February	"	"	"	"	"	"
March	"	"	"	"	"	"
April	"	"	"	"	"	"
May	7.0	554.4	1.0	72.0	626.4	4,384.8
June	2.3	182.2	0.5	36.0	218.2	6,546.0
July	2.6	205.9	1.9	136.8	342.7	10,623.7
August	2.6	205.9	6.2	446.4	652.3	20,221.3
September	0.7	55.4	2.6	187.2	242.6	7,278.0
October	1.7	134.6	-----------[2]	201.9	336.5	10,431.5
November	3.7	293.0	"	439.5	732.5	21,975.0
December	1.7	134.6	"	201.9	336.5	10,431.5
					Total Approx.	91,891.8

[1]Plant operation began 25 May 1973.

[2]Diurnal and nocturnal sampling conducted May through September (5 months). For the months October through April, only diurnal sampling was conducted and, therefore, Equation 3 from Figure 1 was utilized.

[3]Calculated from diurnal sample collections. See Equation 1 from Figure 1.

[4]Calculated using Equation 1 from Figure 1.

[5]Calculated from nocturnal sample collections. See Equation 2 from Figure 1.

[6]Calculated using Equation 2 from Figure 1.

[7]Sum of calculated $\bar{x}$ daily diurnal and calculated $\bar{x}$ daily nocturnal impingement rates.

[8]Calculated by multiplying total impingement per 24 hours by days in month.

Table 6. Fort Calhoun Monthly Fish Impingement Extrapolations for 1974

Time (1974) (Months)	x̄ Monthly Diurnal[2] Impingement Rate (no./hr./scr.)	Calculated[3] x̄ Daily Diurnal Impingement (no./day)	x̄ Monthly Nocturnal[4] Impingement Rate (no./hr./scr.)	Calculated[5] x̄ Daily Nocturnal Impingement (no./night)	Total Impingement[6] Per 24 Hours	Extrapolated[7] Monthly Impinge.
January	1.3	103.0	-----------[1]	154.5	257.5	7,982.5
February	1.3	103.0	"	154.5	257.5	7,210.0
March	0.5	39.6	"	59.4	99.0	3,069.0
April	0.2	15.8	"	23.7	39.5	1,185.0
May	1.1	87.1	1.9	136.8	223.9	6,940.9
June	1.6	126.7	0.4	28.8	155.5	4,665.0
July	0.9	71.3	1.5	108.0	179.3	5,558.3
August	2.0	158.4	1.7	122.4	280.8	8,704.8
September	1.7	134.6	2.4	172.8	307.4	9,222.0
October	5.6	443.5	-----------[1]	665.3	1,108.8	34,372.8
November	7.7	609.8	"	914.7	1,524.5	45,735.0
December	1.2	95.0	"	142.5	237.5	7,362.5
					Total Approx.	142,007.8

[1]Diurnal and nocturnal sampling conducted May through September (5 months). For the months October through April, only diurnal sampling was conducted and, therefore, Equation 3 from Figure 1 was utilized.

[2]Calculated from diurnal sample collections. See Equation 1 from Figure 1.

[3]Calculated using Equation 1 from Figure 1.

[4]Calculated from nocturnal sample collections. See Equation 2 from Figure 1.

[5]Calculated using Equation 2 from Figure 1.

[6]Sum of calculated x̄ daily diurnal and calculated x̄ daily nocturnal impingement rates.

[7]Calculated by multiplying total impingement per 24 hours by days in month.

Table 7. Fort Calhoun Monthly Fish Impingement Extrapolations for 1975

Time (1975) (Months)	$\bar{x}$ Monthly Diurnal[2] Impingement Rate (no./hr./scr.)	Calculated[3] $\bar{x}$ Daily Diurnal Impingement (no./day)	$\bar{x}$ Monthly Nocturnal[4] Impingement Rate (no./hr./scr.)	Calculated[5] $\bar{x}$ Daily Nocturnal Impingement (no./night)	Total Impingement[6] Per 24 Hours	Extrapolated[7] Monthly Impinge.
January	0.3	23.8	-----------[1]	35.7	59.5	1,844.5
February	0.1	7.9	"	11.9	19.8	554.4
March	0.5	39.6	"	59.4	99.0	3,069.0
April	1.0	79.2	"	118.8	198.0	5,940.0
May	0.7	55.4	0.8	57.6	113.0	3,503.0
June	0.7	55.4	0.8	57.6	113.0	3,503.0
July	4.3	340.6	4.2	302.4	643.0	19,933.0
August	0.4	31.7	0.1	7.2	38.9	1,205.9
September	0.3	23.8	0.03	2.2	26.0	780.0
October	0.3	23.8	-----------[1]	35.7	59.5	1,844.5
November	2.5	198.0	"	297.0	495.0	14,850.0
December	8.8	697.0	"	1,045.5	1,742.5	54,017.5
					Total Approx.	111,044.8

[1]Diurnal and nocturnal sampling conducted May through September (5 months). For the months October through April, only diurnal sampling was conducted and, therefore, Equation 3 from Figure 1 was utilized.

[2]Calculated from diurnal sample collections. See Equation 1 from Figure 1.

[3]Calculated using Equation 1 from Figure 1.

[4]Calculated from nocturnal sample collections. See Equation 2 from Figure 1.

[5]Calculated using Equation 2 from Figure 1.

[6]Sum of calculated $\bar{x}$ daily diurnal and calculated $\bar{x}$ daily nocturnal impingement rates.

[7]Calculated by multiplying total impingement per 24 hours by days in month.

Table 8. Fort Calhoun Monthly Fish Impingement Extrapolations for 1976

ime (1976) (Months)	x̄ Monthly Diurnal[2] Impingement Rate (no./hr./scr.)	Calculated[3] x̄ Daily Diurnal Impingement (no./day)	x̄ Monthly Nocturnal[4] Impingement Rate (no./hr./scr.)	Calculated[5] x̄ Daily Nocturnal Impingement (no./night)	Total Impingement[6] Per 24 Hours	Extrapolated[7] Monthly Impinge.
January	6.3	499.0	-----------[1]	748.5	1,247.5	38,672.5
February	6.0	475.2	"	712.8	1,188.0	33,264.0
March	9.6	760.3	"	1,140.5	1,900.8	58,924.8
April	4.9	388.1	"	582.2	970.3	29,109.0
May	4.8	380.2	2.6	187.2	567.4	17,589.4
June	1.7	134.6	1.1	79.2	213.8	6,414.0
July	0.3	23.8	0.1	7.2	31.0	961.0
August	0.2	15.8	0	0	15.8	489.8
September	0.1	7.9	0.03	2.2	10.1	303.0
October	0	0	-----------[1]	0	0	0
November	0.9	71.3	"	107.0	178.3	5,349.0
December	1.2	95.0	"	142.5	237.5	7,362.5
					Total Approx.	198,439.0

[1]Diurnal and nocturnal sampling conducted May through September (5 months). For the months October through April, only diurnal sampling was conducted.

[2]Calculated from diurnal sample collections. See Equation 1 from Figure 1.

[3]Calculated using Equation 1 from Figure 1.

[4]Calculated from nocturnal sample collections. See Equation 2 from Figure 1.

[5]Calculated using Equation 2 from Figure 1.

[6]Sum of calculated x̄ daily diurnal and calculated x̄ daily nocturnal impingement rates.

[7]Calculated by multiplying total impingement per 24 hours by days in month.

Table 9. Fort Calhoun Monthly Fish Impingement Extrapolations for 1977

ime (1977) (Months)	$\bar{x}$ Monthly Diurnal[2] Impingement Rate (no./hr./scr.)	Calculated[3] $\bar{x}$ Daily Diurnal Impingement (no./day)	$\bar{x}$ Monthly Nocturnal[4] Impingement Rate (no./hr./scr.)	Calculated[5] $\bar{x}$ Daily Nocturnal Impingement (no./night)	Total Impingement[6] Per 24 Hours	Extrapolated[7] Monthly Impinge.
January	0.4	31.7	-----------[1]	47.6	79.3	2,458.3
February	1.2	95.0	"	142.5	237.5	6,650.0
March	0.4	31.7	"	47.6	79.3	2,458.3
April	0.8	63.4	"	95.1	158.5	4,755.0
May	0.6	47.5	0.1	7.2	54.7	1,695.7
June	0.5	39.6	0	0	39.6	1,188.0
July	1.6	126.7	0.03	2.2	128.9	3,995.9
August	1.6	126.7	0.1	7.2	133.9	4,150.9
September	1.1	87.1	0.5	36.0	123.1	3,693.0
October	1.2	95.0	-----------[1]	142.5	237.5	7,362.5
November	4.8	380.2	"	570.3	950.5	28,515.0
December	0.7	55.4	"	83.1	138.5	4,293.5
					Total Approx.	71,216.1

[1]Diurnal and nocturnal sampling conducted May through September (5 months). For the months October through April, only diurnal sampling was conducted.

[2]Calculated from diurnal sample collections. See Equation 1 from Figure 1.

[3]Calculated using Equation 1 from Figure 1.

[4]Calculated from nocturnal sample collections. See Equation 2 from Figure 1.

[5]Calculated using Equation 2 from Figure 1.

[6]Sum of calculated $\bar{x}$ daily diurnal and calculated $\bar{x}$ daily nocturnal impingement rates.

[7]Calculated by multiplying total impingement per 24 hours by days in month.

Table 10. A Comparison of Fort Calhoun Station Reported and Recalculated Annual Fish Impingement Extrapolations for 1973 through 1977

Time (Years)		Extrapolated Impingement	
		Five Year Report Values	Recalculated OPPD Values
1973		73,583	91,891.8
1974		111,448	142,007.8
1975		85,536	111,044.8
1976		155,376	198,439.0
1977		66,096	71,216.1
Totals	5 (years)	492,039	614,599.5*
	Per Year	98,408	122,920

*The 5 Year Report values are about 20% lower than the recalculated values.

Table 11. Comparison of Extrapolated Fort Calhoun Fish Impingement Values for 1973 through 1977

	Fort Calhoun Five Year Report	Recalculated Values (OPPD)	NUREG Document	Duplication Effort (OPPD) Table 3
Five Year Total	492,039	614,600	854,410	655,085
Mean No. Fish/Year	98,408	122,920	170,882	131,017

Recalculated Values = 20.0% increase over Fort Calhoun Five Year Report

NUREG Values = 28.1% increase over Recalculated Values

Attachment 2

Use of Commercial Fisheries Data

Throughout the NUREG/CR-2337, Volume 1 document, the author utilizes the commercial fisheries data as an indicator of the health of the Missouri River ecosystem (page 3-53, 3), the Fort Calhoun Station's influence on that ecosystem (page 3-56, 1), and the effects of entrainment and impingement at the Fort Calhoun Station on the Missouri River ecosystem (pages 3-72, 2; 3-81, 3; 3-104, 2; 3-106, 2 and 3-107, 1).

Contrary to the author's methodology and beliefs, the commercial fisheries data is not an adequate or representative indicator of the adult fish standing crop of the Missouri River (Middle Missouri River: Chpt. 11, Pgs. 295-296).

Three reasons for OPPD's position on this issue are:

1. The commercial fisheries harvest reflects the catchability and market realities rather than population estimates.

2. In an industry with very few total fishermen, one fisherman's absence or presence can significantly alter the harvest.

3. The commercial fisheries data does not contain estimates of catch per unit of effort. Without this value, estimates of standing crop are not reliable.

Larry Hesse of the Nebraska Game and Parks Commission in the publication, "The Missouri River Channel Catfish", Nebraska Technical Series No. 11, 1982, supports our contention stating, "Fabrication of commercial fishing reports is a serious concern since creeling these fishermen has proven ineffective." Hesse also states that "sport and commercial fishermen have been estimated to harvest nearly 15,000 channel catfish annually, for an average of 39 fish/km. Commercial fishing reports were used to estimate harvest. We feel these are inaccurate though and harvest is likely greater. In fact, the predicted catch of 120 fish/km may represent the extent of non-reporting on commercial annual reports." Hesse goes on to say that if this is true, nearly 40,000 fish are caught but not reported by commercial fishermen in the three regions between Yankton, South Dakota and Rulo, Nebraska.

Rather than utilizing the commercial fisheries data which is clearly deficient, the author could have used data available to him in the form of catch per unit effort from AC and DC boat shocking, telephone shocking, seining, hoop-netting, and basket trapping from studies conducted by state agencies, utilities, and consultants over a period extending more than ten years (Ref. Nos. 3, 4, 6, 8, 10, 25 and 31 in NUREG). This data base demonstrates stability in the fishery. Although the abundance of individual species collected at each station varied between years, the same species were most abundant during all years, pre and post-operational (Middle Missouri River: Chpt. 9, Pgs. 232-234). The changes in abundance of species between years were attributed to differences in recruitment success which is directly affected by the seasonal and yearly differences in release rates of water through the Gavins Point Dam. High water years (1971 and 1975) provided additional spawning and nursery habitat by inundating areas normally dewatered during times of "normal" or lower releases (Middle Missouri River: Chpt. 9, Pgs. 236-238).

A method recently developed to estimate population numbers for selected species of Missouri River fish (Hesse et. al., Nebraska Game and Parks Commission unpublished report, 1980 and 1981) characterized the standing crop of some fish species such as channel catfish, carp, and river carpsucker in the channelized section as "large and may well equal numbers estimated to occur in the unchannelized segments" (Middle Missouri River, Chpt. 9, Pgs. 269-270). Comparisons of standing crops of channel catfish, carp, and river carpsucker with other river systems reveal that standing crops of these species are quite comparable (Middle Missouri River: Chpt. 11, Pgs. 294-295).

The Omaha Public Power District believes the data derived from the commercial fishery effort is seriously deficient and thus cannot be utilized to estimate the realities of the fishery. Contrary to this belief, the author of the NUREG document has utilized commercial fisheries data in an attempt to establish the potential for impact of operation of the Fort Calhoun Station on the aquatic biota of the Missouri River. The conclusions derived from this analysis are contrary to the conclusions based on the catch per unit effort studies presented.