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PRELIMINARY REVIEW OF
TVA FISH SAMPLING AND ANALYSIS REPORT

Report of Task Group Five

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This document contains no classified information.
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#400

INTRODUCTION

A preliminary review of the TVA Fish Sampling and Analysis Report (TVA, 1985) has been performed to determine if any contaminants were found in fish at levels which might pose a problem to human health. Four metals, two organics, and five radionuclides were detected at levels which may warrant further study.

Allowable Daily Intakes

Values of allowable daily intake (ADI) of contaminants considered in this report are listed in Appendix A. The derivation of these values is explained in detail in Hoffman et al. (1984). Briefly, for noncarcinogenic toxic chemicals, Environmental Protection Agency (EPA) values for the ADI were used. For carcinogenic chemicals, the ADI was determined by calculating the daily intake of a carcinogen that would result in a lifetime risk of developing cancer of 10⁻⁵. The ADI for radionuclides was determined by calculating the daily intake of a radionuclide that would result in a maximum effective dose-equivalent of 1 millirem per year. A 1 millirem dose-equivalent results in a lifetime risk of developing cancer of 10⁻⁵. (It should be noted that Hoffman et al. (1984) incorrectly stated that the ADI for radionuclides given in that report was based on an effective dose-equivalent of 10 millirems per year. The report should have stated that the ADI was based on an effective dose-equivalent of 1 millirem per year, the same values used in the present report).

Preliminary Guidance Values

It is often convenient to have safe human exposures expressed in terms of allowable environmental concentrations rather than ADI's. For this reason, a Preliminary Guidance Value (PGV) for concentrations of pollutants in fish flesh was determined for each pollutant. The PGV is that concentration (mg/kg) in fish flesh which would, under normal ingestion conditions, result in an ingestion intake equal to one-third of the ADI. The factor of one-third is included to account for intake of the contaminant via other pathways such as inhalation and terrestrial foodchain ingestion. The PGV is calculated by dividing the ADI by the product of the assumed value for the daily human fish consumption (0.02 kg/d) and a factor of 3.

$$\text{PGV (mg/kg)} = \frac{\text{ADI (mg/d)}}{0.02 (\text{kg/d}) \times 3}$$

A list of PGV's for contaminants considered in this report are listed in Appendix A.

CONTAMINANTS WARRANTING FURTHER STUDY

Metal Contaminants

Twelve priority metal contaminants were found in quantities above the detection limit. Of these, four exceeded the PGV -- arsenic, beryllium, mercury, and thallium. Results are shown in Table I.

ORNL has conducted quarterly evaluations of mercury in fish flesh samples taken from five sites along the Clinch River since 1978. The most recent data, (ORNL, 1985) indicate that some carp at Clinch River Mile 12.0 exceed the PGV. The maximum level reported was 1.3 mg/kg.

Organic Contaminants

Seven priority organic contaminants were found in quantities above the detection limit. These seven were:

4,4 DDD
4,4 DDE
Aldrin
bis (2-ethyl-hexyl) phthalate
chloroform
di-n-butyl phthalate
PCB's

Of these seven, only two, aldrin and PCB's were found in quantities exceeding the PGV. Results are shown in Table II.

Thirty-seven of the organic priority contaminants have PGV's below the lowest detection level of the TVA Instream Contaminant Study. Thus, these organics may be present in fish flesh at levels above the PGV's. These compounds are listed in Table III with their concomitant PGV's and the TVA lowest detection levels.

Additional data exist for PCB concentrations in Clinch River fish. The most recent data (ORNL, 1985) indicate that of 357 fish samples tested from six sites along the Clinch River, none has PCB concentrations exceeding the FDA action level of 2.0 mg/kg. However, PCB concentrations in fish samples from three sites exceeded the PGV (see Table IV).

Metabolites

TVA analyzed fish flesh samples for a total of 16 metabolites. However, EPA has not published ADI values for any of the measured chemicals.

Radionuclides

The TVA analyzed fish flesh samples for eleven radionuclides. Of these, CS-137, K-40, SR-89, and SR-90 were detected at levels above the PGV. Results are shown in Table V.

ORNL has conducted quarterly evaluations of radionuclides in fish flesh samples taken from five sites along the Clinch River. The most recent data (ORNL, 1985) show CS-137 and U-238 at activities above the PGV (see Table VI).

REFERENCES

1. Instream Contaminant Study - Task 4, Fish Sampling and Analysis, Tennessee Valley Authority (April 1985).
2. F. O. Hoffman et al., Preliminary Screening of Contaminants in Sediments, ORNL/TM-9370 (1984).
3. Environmental Monitoring Report, United States Department of Energy, Oak Ridge Facilities Calendar Year 1984, ORNL-6209 (1985).

Table I. Priority Metal Pollutants Detected in Fish Samples

Metal	Maximum Level Found mg/kg	Mean Level Found mg/kg	PGV mg/kg	Ratio Maximum Level Found/PGV
Antimony	1.0E+0	0.294	5.2E+0	1.9E-1
Arsenic	5.3E-1	1.6E-1	7.1E-4	7.5E+3
Beryllium	1.0E-1	5.2E-2	3.6E-3	2.8E+1
Cadmium	9.4E-1*	7.8E-2	1.0E+0	9.4E-1
Chromium	9.8E-1	9.1E-1	1.8E+0	5.5E-1
Copper	1.0E+1	7.6E-1	3.6E+1	2.8E-1
Lead	1.6E+0	1.6E-1	1.8E-0	8.9E-1
Mercury	3.3E+0	3.3E-1	4.2E-1	7.9E+1
Selenium	2.6E+0	5.3E-1	5.2E+0	5.0E-1
Silver	6.2E-1	2.2E-1	1.2E+1	5.0E-2
Thallium	3.8E+0	1.1E+0	6.6E-1	5.8E+0
Zinc	1.7E+1	7.6E+0	1.8E+2	9.0E-2

*A level of 115 mg/kg was found in crayfish at 2 stations.

Appendix A. Allowable Daily Intakes (ADI) and Preliminary Guidance Values (PGV) of Organics, Metals and Cyanide, and Radionuclides Used for the Instream Contaminant Study

CONTAMINANT	ALLOWABLE DAILY INTAKE	PRELIMINARY GUIDANCE VALUE
ORGANICS	ug/d	mg/kg
ACENAPHTHENE	4.0E+1	7.1E-1
ACENAPHTHALENE	2.5E-2	4.5E-4
ACROLEIN	1.1E+2	2.0E+0
ACRYLONITRILE	3.4E-1	6.1E-2
ALDRIN	4.0E-2	7.0E-3
ALPHA-BHC	2.7E-1	4.8E-3
ALPHA-ENDOSULFAN	2.8E+2	5.0E+0
ANTHRACENE	2.5E-2	4.5E-4
BENZIDINE	4.9E-3	9.0E-5
BENZENE	3.2E+1	5.7E-1
BENZO(A)ANTHRACENE	2.5E-2	4.5E-4
BENZO(A)PYRENE	2.5E-2	4.5E-4
BENZO(GHI)PERYLENE	2.5E-2	4.5E-4
BENZO(K)FLUORANTHENE	2.5E-2	4.5E-4
BETA-BHC	4.6E-1	8.2E-3
BETA-ENDOSULFAN	2.8E+2	5.0E+0
BIS(CHLOROMETHYL)ETHER	5.0E-5	8.9E-7
BIS(2-CHLOROETHOXY)METHANE	—	—
BIS(2-CHLOROETHYL)ETHER	1.0E+0	1.8E-2
BIS(2-CHLOROISOPROPYL)ETHER	4.6E+1	8.2E-1
BIS(2-ETHYLHEXYL)PHthalate	4.2E+4	7.5E+2
BROMFORM	4.0E+0	7.1E-2
BUTYLBENZYLPHthalate	1.0E+3	1.8E+1
CARBON TETRACHLORIDE	8.6E+0	1.5E-1
CHLORDANE	1.3E-1	2.3E-3
CHLOROBENZENE	4.0E+1	7.1E-1
CHLORODIBROMOMETHANE	4.0E+0	7.1E-2
CHLOROETHANE	9.3E+5	1.7E+4
CHLOROFORM	4.8E+0	8.5E-2
CHRYSENE	2.5E-2	4.5E-4
DELTA-BHC	3.5E-1	6.2E-3
DI-N-BUTYLPHthalate	1.3E+4	2.2E+2
DI-N-OCTYLPHthalate	1.0E+3	1.8E+1
DIBENZO(AH)ANTHRACENE	2.5E-2	4.5E-4
DICHLOROBROMOMETHANE	4.0E+0	7.1E-2
DICHLORODIFLUOROMETHANE	6.0E+3	1.1E+2
DIELDRIN	3.8E-3	6.8E-5
DIETHYLPHthalate	4.4E+5	7.8E+3
DIMETHYLPHthalate	7.1E+5	1.3E+4
ENDOSULFAN SULFATE	2.8E+2	5.0E+0
ENDRIN	3.6E+1	6.7E-1
ENDRIN ALDEHYDE	7.0E+1	1.2E+0
ETHYLBENZENE	1.6E+3	2.9E+1
FLUORENE	2.5E-1	4.5E-4
FLUORANTHENE	1.0E+2	1.8E+0

Appendix A. (Continued)

CONTAMINANT	ALLOWABLE DAILY INTAKE	PRELIMINARY GUIDANCE VALUES
ORGANICS	µg/d	mg/kg
GAMMA-BHC	9.0E-1	1.6E-2
HEPTACHLOR	2.3E-2	4.1E-4
HEPTACHLOR EPOXIDE	1.9E-1	3.3E-3
HEXA CHLOROBENZENE	3.0E-1	5.3E-3
HEXA CHLOROBUTADIENE	1.4E+1	2.5E-1
HEXA CHLOROCYCLOPENTADIENE	2.1E+0	3.7E-2
HEXA CHLOROETHANE	4.7E+1	8.4E-1
INDENO(1,2,3-CD)PYRENE	2.5E-2	4.5E-4
ISOPHORONE	1.1E+3	1.9E+1
METHYL BROMIDE	4.0E+0	7.1E-2
METHYL CHLORIDE	4.0E+0	7.1E-2
METHYLENE CHLORIDE	4.0E+0	7.1E-2
N-NITROSODIPHENYLAMINE	1.4E+2	2.5E+0
N-NITROSODI-N-PROPYLAMINE	1.9E-2	3.3E-4
N-NITROSODIMETHYLAMINE	5.0E-2	8.9E-4
NAPHTHALENE	4.5E+2	8.0E+0
NITROBENZENE	6.0E+2	1.1E+1
P-CHLORO-M-CRESOL	7.9E+3	1.4E+2
PCB-1016	2.2E-1	3.9E-3
PCB-1221	2.2E-1	3.9E-3
PCB-1232	2.2E-1	3.9E-3
PCB-1242	2.2E-1	3.9E-3
PCB-1248	2.2E-1	3.9E-3
PCB-1254	2.2E-1	3.9E-3
PCB-1260	2.2E-1	3.9E-3
PENTACHLOROPHENOL	2.1E+3	3.7E+1
PHENANTHRENE	2.5E-2	4.5E-4
PHENOL	7.0E+3	1.2E+2
PHENOLS (TOTAL)	6.8E+3	1.2E+2
PYRENE	2.5E-2	4.5E-4
TETRACHLOROETHYLENE	8.1E+0	1.4E-1
TOLUENE	2.9E+4	5.3E+2
TOXAPHENE	1.6E-1	2.9E-3
TRICHLOROETHYLENE	5.7E+1	1.0E+0
TRICHLOROFLUOROMETHANE	6.4E+4	1.1E+3
VINYL CHLORIDE	1.1E+3	1.9E+1
1,1-DICHLOROETHANE	2.9E+5	5.2E+3
1,1-DICHLOROETHYLENE	2.8E+0	4.9E-2
1,1,1-TRICHLOROETHANE	3.8E+4	6.7E+2
1,1,2-TRICHLOROETHANE	5.7E+0	1.1E-1
1,1,2,2-TETRACHLOROETHANE	4.2E+0	7.5E-2
1,2-DICHLOROBENZENE	1.3E+3	2.3E+1
1,2-DICHLOROETHANE	1.5E+1	2.6E-1
1,2-DICHLOROPROPANE	4.2E+2	7.5E+0

Appendix A. (Continued)

CONTAMINANT	ALLOWABLE DAILY INTAKE	PRELIMINARY
		GUIDANCE VALUES
ORGANICS	ug/d	ng/kg
1,2-DICHLOROPROPYLENE	1.3E+0	2.3E-2
1,2-DIPHENYLHYDRAZINE	1.0E+0	1.8E-2
1,2-TRANS-DICHLOROETHYLENE	6.7E-1	1.2E-2
1,2,4-TRICHLOROBENZENE	2.6E+1	4.6E-1
1,3-DICHLOROBENZENE	1.3E+3	2.3E+1
1,4-DICHLOROBENZENE	1.3E+3	2.3E+1
2-CHLOROETHYL VINYL ETHER	—	—
2-CHLORONAPHTHALENE	—	—
2-CHLOROPHENOL	6.0E-1	1.2E-2
2-NITROPHENOL	1.4E+2	2.5E+0
2,4-DICHLOROPHENOL	1.0E+0	1.8E-2
2,4-DIMETHYLPHENOL	—	—
2,4-DINITROPHENOL	1.4E+2	2.0E+0
2,4-DINITROTOLUENE	1.6E+0	2.9E-2
2,4,6-TRICHLOROPHENOL	3.5E+1	6.3E-1
2,6-DINITROTOLUENE	1.6E+0	2.9E-2
3,3-DICHLOROBENZIDINE	6.5E-2	1.2E-3
3,4-BENZOQUINONETHENE	2.5E-2	4.5E-4
4-BROMOPHENYL PHENYL ETHER	—	—
4-CHLOROPHENYL PHENYL ETHER	—	—
4-NITROPHENOL	1.4E+2	2.0E+0
4,4-DDD	7.2E-1	1.3E-2
4,4-DDE	7.2E-1	1.3E-2
4,4-DDT	7.2E-1	1.3E-2
4,6-DINITRO-O-CRESOL	2.7E+1	4.9E-1

Appendix A. (Continued)

CONTAMINANT	ALLOWABLE DAILY INTAKE	PRELIMINARY GUIDANCE VALUES
METALS AND CYANIDE	$\mu\text{g}/\text{d}$	mg/kg
ANTIMONY	2.9E+2	5.2E+0
ARSENIC	4.0E-2	7.1E-4
BERYLLIUM	2.0E-1	3.6E-3
CADMIUM	5.7E+1	1.0E+0
CHROMIUM	1.0E+2	1.8E+0
COPPER	2.0E+3	3.6E+1
CYANIDE	4.1E+2	7.3E+0
LEAD	1.0E+2	1.8E+0
MERCURY	2.4E+1	4.2E-1
NICKEL	2.9E+2	5.2E+0
SELENIUM	7.0E+2	1.2E+1
SILVER	1.6E+1	2.9E-1
THALLIUM	3.7E+1	6.6E-1
ZINC	1.0E+4	1.8E+2
RADIOMONUCIDES	pCi/d	pCi/kg
AC - 228	1.7E+3	2.9E+4
BI - 212	2.4E+3	3.9E+4
BI - 214	8.9E+3	1.5E+5
CO - 60	2.4E+2	4.0E+3
CS - 134	2.4E+1	4.0E+2
CS - 137	3.3E+1	5.6E+2
K - 40	1.5E+2	2.4E+3
PB - 214	5.6E+3	9.7E+4
PB - 212	1.5E+2	2.6E+3
PU - 238	6.8E+0	1.1E+2
PU - 239	6.2E+0	1.0E+2
SR - 89	3.0E+2	5.1E+3
SR - 90	1.9E+1	3.2E+2
TC - 99	2.7E+3	4.5E+4
U - 234	9.7E+0	1.6E+2
U - 235	1.0E+1	1.7E+2
U - 238	1.1E+0	1.8E+1

$5.2 \text{ mg}/\text{kg}$

$= 21 \beta_\gamma/\text{kg}$

Table III. Organic Pollutants with PGV's below
Detection Levels

Organic Compound	Lowest Detection Level mg/kg	PGV mg/kg
ACENAPHTHALENE	0.41	0.00045
ANTHRACENE	0.41	0.00045
BENZIDINE	2.1	0.00009
BENZO (A) ANTHRACENE	0.41	0.00045
BENZO (A) PYRENE	0.41	0.00045
3 ,4-BENZOFUORANTHENE	0.41	0.00045
BENZO (GHI) PERYLENE	0.41	0.00045
BIS (2-CHLOROMETHYL) ETHER	0.41	0.0178
ALDRIN	0.01	0.00007
ALPHA-BHC	0.01	0.0048
BETA-BHC	0.01	0.0082
DELTA-BHC	0.01	0.0062
CHLORDANE	0.01	0.0023
HEPTACHLOR	0.01	0.00041
HEPTACHLOR (EXPOXIDE)	0.01	0.0033
CHRYSENE	0.41	0.00045
DIBENZO (AH) ANTHRACENE	0.41	0.00045
3,3-DICHLOROBENZIDINE	1	0.0012
2,4-DINITROTOLUENE	0.41	0.0285
2,6-DINITROTOLUENE	0.41	0.0285
1,2-DIPHENYLHYDRAZINE	0.41	0.0178
FLUORENE	0.41	0.00045
HEXA CHLOROBENZENE	0.41	0.0053
HEXA CHLOROBUTADIENE	0.41	0.2513
INDENO (1,2,3-CD)PYRENE	0.41	0.00045
N-NITROSODIMETHYLAMINE	0.41	0.000891
N-NITROSODI-N-PROPYLAMINE	0.41	0.00033
PHENANTHRENE	0.41	0.00045
PYRENE	0.41	0.00045
METHYLENE CHLORIDE	0.25	0.0713
1,2 TRANS-DICHLOROETHYLENE	0.05	0.0119
BIS (CHLOROMETHYL) ETHER	0.05	0.000000891
2-CHLOROPHENOL	0.41	0.0107
2,4-DINITROPHENOL	4.1	2.0107
DIELDRIN	0.01	0.000068
HEXA CHLOROCYCLOPENTADIENE	0.41	0.0374
TOXAPHENE	0.50	0.0029

Table II. Priority Organic Pollutants Detected in Fish Flesh Samples

Organic Compound	Maximum Level Found mg/kg	PGV mg/kg	Ratio Maximum Level Found/PGV
4,4-DDD	1.0E-1	5.4E+1	1.9E-3
4,4-DDE	4.0E-2	1.5E+1	2.7E-3
ALDRIN	2.0E-2	1.0E-2	2.0E+0
BIS (2-ETHYLHEXYL) PHthalate	3.3E+0	7.5E+2	4.0E-4
CHLOROFORM	5.0E-2	8.5E-2	5.9E-1
DI-N-BUTYL PHthalate	2.4E+0	2.2E+2	1.0E-2
PCB	4.7E+0	3.9E-3	1.2E+4

Table IV. PCB Concentrations Exceeding PGV in Clinch River Fish¹

Location		No. of fish sampled		max
CRM2.0	4	4.2E-3	1.4E-3	1.1E+0
CRM5.0	5	9.1E-3	2.4E-3	2.3E+0
	5	4.9E-3	3.0E-3	1.3E+0
CRM12.0	46	8.2E-3	5.8E-4	2.1E+0

¹Data from ORNL (1985).

Table V. Radionuclides Detected in Fish Flesh Samples

Radionuclide	Maximum Level Found pCi/kg	PGV pCi/kg	Ratio Maximum Level Found /PGV
AC - 228	8.0E+2	2.9E+4	2.8E-2
BI - 212	9.0E+2	3.9E+4	2.3E-2
BI - 214	2.6E+3	1.5E+5	1.7E-2
CO - 60	1.2E+2	4.0E+3	3.0E-2
CS - 134	2.7E+2	4.0E+2	6.8E-1
CS - 137	2.6E+4	5.6E+2	4.6E+1
K - 40	2.2E+4	2.4E+3	9.2E+0
PB - 214	9.0E+2	9.7E+4	9.3E-3
SR - 89	1.6E+3	3.2E+3	5.0E+0
SR - 90	1.3E+3	3.2E+2	4.1E+0
TC - 99	1.0E+3	4.5E+4	2.2E-2

Table VI. Radionuclides Detected in Clinch River Fish¹

Radionuclide	Maximum Level Found pCi/kg	PGV pCi/kg	Ratio Maximum Level /PGV
CO - 60	2.4E+1	4.5E+3	5.3E-3
CS - 137	1.3E+3	6.2E+2	2.1E+0
PU - 238	4.1E-1	1.1E+2	3.7E-3
PU - 239	1.5E+0	1.0E+2	1.5E-2
SR - 90	9.6E+1	3.2E+2	3.0E-1
U - 234	5.3E+1	1.6E+2	3.3E-1
U - 235	2.5E+0	1.7E+2	1.5E-2
U - 238	3.0E+1	1.8E+1	6.7E+0

¹Data from ORNL (1985).

error, should
be 1.8×10^{-2}

$$620 \text{ pCi/kg} = 23 \text{ } \beta_{\text{q}} \text{ /kg}$$

$$1 \text{ } \beta_{\text{q}} = 27.0 \text{ pCi}$$