

ATTACHMENT IV

ENVIRONMENTAL MONITORING PROGRAM

I. GENERAL DESCRIPTION

The Environmental Monitoring Program established by the Supply System will have as its objective the determination of the effects of the project on the environment. Monitored items will include the expected physical effects on land and adjacent waters, and effects on terrestrial and aquatic ecosystems as a result of project construction and the radiological effects, if any, as a result of plant operation. The program will provide an environmental measurement history for evaluation by the Supply System and the Council. Such a program will use best reasonable and available methods and techniques and must be maintained at necessary levels through the life of the project.

The Environmental Monitoring Program will be flexible and may be modified upon approval of the Council as detailed information is acquired from the program. Any modifications will be based upon: (a) project effects, if any, on the terrestrial and aquatic ecology including the wildlife, fish and other aquatic life in the project influence area, (b) informational inputs obtained during the pre-operational monitoring, (c) siting of other nuclear or other facilities in

areas surrounding the site, (d) technological developments in the field of environmental monitoring, (e) changes in type and abundance of natural vegetation, (f) changes in conditions which relate to the pathways which lead to human radiation exposure, and (g) changes in applicable acceptable levels of project discharges to the environment or effects on the environment.

The monitoring program shall be designed to assure appropriate reaction will occur when an unexpected variance occurs in the data results.

Changes, supplements or revisions to the Environmental Monitoring Program will be submitted to the Council for its review and approval.

II. ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM

A. Program Elements

1. Air sampling locations will be established onsite and offsite. Special attention will be given to location of air samplers within five miles of the plant and in areas where populations are concentrated.

2. In the terrestrial monitoring part of this program (vegetation, soil, farm products), the area within a ten-mile radius of the site will be of primary concern. Special emphasis will be placed on dairy farming.

Particular emphasis will be placed on the collection of those primary food chain components which lead to man. Soil samples, vegetation, dairy products (milk) and other items will be sampled.

3. In the aquatic program, sampling will include samples from the Chehalis River, its tributaries, ground water and water supply from wells.

The aquatic food chain constituents included in this program will be taken from the Chehalis River and Grays Harbor and will include the collection of bottom sediments and organisms, plankton, periphyton, and aquatic vegetation, and fish.

Sampling frequencies will depend upon weather, growing season, animal and fish activity and other considerations stated in orders, permits or agreements issued by the Council or deemed appropriate in each case.

B. Surveillance Levels

The radiological monitoring program outlined in Table 1 attached herewith and made a part hereof, represents the level of surveillance during the pre-operational and operations phases.

Analytical Procedures shall be compatible with but not limited to the following documents, or later documents representing state of the art improvements:

1. "Handbook of Radiochemical Analytical Methods,"
U.S. Environmental Protection Agency, EPA-680/4-75-001,
February, 1975.
2. "Health and Safety Laboratory Procedures Manual,"
U.S. Energy Research & Development Administration,
HASL-300, 1972.
3. "Standard Methods for the Examination of Water,"
American Public Health Association, 13th Edition.

For comparison purposes, the Supply System will furnish the Council or its designated representatives, upon request, half samples of specimens for their evaluation and analysis.

Sample stations are described in the following discussion of sample types.

1. Atmosphere

a. Gamma Detectors:

The external gamma spectrum will be continuously monitored at four positions.

b. TLD Dosimeters:

Levels of external radiation will be established by exposing thermo-luminescent dosimeters (TLD) for various periods of time at fifteen locations. Nine dosimeters will be maintained at each station: three dosimeters are changed and read monthly, three dosimeters are changed and read quarterly, while the other dosimeters are changed and read annually.

2. Airborne Particulates and Iodine:

Airborne radioactive particulates and gaseous iodine will be collected on a weekly basis at four of the TLD stations.

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3. Plant Discharge Water

Discharge Water will be monitored continuously for gamma activity.. A weekly sample will be taken for more detailed analysis and for calibration of the continuous gamma monitor.

4. River Water:

Sampling of the Chehalis River will be performed on a monthly basis from four locations: two miles upstream of outfall, at outfall, 1000 meters downstream from outfall, and at the mouth in Grays Harbor. Sampling on a monthly basis will also be performed at one location on the Satsop River one mile above its confluence with the Chehalis.

5. Groundwater

Sampling of groundwater will be performed monthly from wells near the station. The wells include the Elma water supply.

6. Vegetation

a. Garden Vegetables:

Samples of the edible portions of garden vegetables will be collected three times annually during the growing season.

b. Pasture Grass:

Edible portions of food and feed crops will be sampled at three locations within a ten-mile radius of the station. Samples will be collected at the same locations as the milk samples and will be collected three times during the growing season.

7. Soil

Soil samples will be collected semi-annually at three locations.

8. Sediment Samples

Samples of the Chehalis River bottom sediment will be collected quarterly at three locations in common with water and aquatic organism sampling.

9. Milk Samples

In the selection of milk sample locations, an attempt will be made to select milk producers who are likely to remain in the business of milk production during succeeding years of plant operations. Information regarding source of feed will be included with milk sample results. A pooled area sample and a controlled sample will also be obtained.

10. Aquatic Biota

a. Animals

Fish will be collected quarterly from the Chehalis River and Grays Harbor at the same locations used for the water sampling.

b. Benthic organisms will be collected quarterly at four stations.

c. Aquatic plants and plankton will be sampled at two locations, one above and below the out-fall.

11. Wildlife

- a. At least one raccoon or substitute animal will be collected annually from land adjacent to the site.
- b. At least two waterfowl from resident species will be collected annually near the site.

III. METEOROLOGICAL PROGRAM AND AIR QUALITY

A. Onsite Meteorological Program

The Supply System will maintain a meteorological tower to record meteorological characteristics of WNP-3 and WNP-5 during the life of the project. The program will begin at least two years prior to start-up. Detailed measurements of wind speed, direction, low level stability and humidity will be gathered.

B. Air Quality Monitoring Program

Stack monitoring will be conducted when the diesel generators or auxiliary boilers are being operated.

IV. AQUATIC MONITORING PROGRAM

The aquatic monitoring program will be an integrated program for all phases of WNP-3 and WNP-5 site development and use.

The intensity of effort on the monitoring program will vary with increasing activity immediately before and after the initial operation of each project. Continuous evaluation of monitoring data will be accomplished to produce a more efficient environmental surveillance program. Portions of the program may be adjusted depending upon an evaluation of program results.

A. Pre-Operational Aquatic Monitoring Program

The pre-operational monitoring program for WNP-3 and WNP-5 will include an effort in each of the trophic levels of importance.

1. Benthic Macroinvertebrates Program

Benthic macroinvertebrates and drift-emergent insect fauna will be studied at three Chehalis River stations during the period from prior to site preparation for the first unit. These stations include:

Discharge (to 1000 ft. below)

Greenbanks

Intake Area

The sampling schedule is as follows:

| | Macrobenthos/Drift/Emergent Insect | | | | | | | | | | | |
|-----------------------|------------------------------------|---|---|---|---|---|---|---|---|---|---|---|
| | J | F | M | A | M | J | J | A | S | O | N | D |
| Macrobenthos | X | | | | | X | X | X | X | X | X | X |
| Drift/Emergent Insect | X | | | | | X | X | X | X | X | X | X |

Following the conclusion of the initial year of the pre-operational studies each task and sampling effort will be reviewed.

2. Drift - Emergent Insect Fauna

The drift-emergent insect study will complement the benthic program. Sampling stations and the monthly sampling frequency of benthos/drift will coincide as to provide a more complete picture of the river fauna.

3. Periphyton Program

Beginning before site preparation, three stations in the Chehalis River will be utilized for periphyton studies. These stations coincide with those established for the fisheries program and the benthid macroinvertebrate/drift-emergent insect program.

4. Fisheries Program

The pre-operational monitoring period beginning two years prior to start-up of the first unit will include as fisheries study sites: the intake area, the discharge area (to 1000 ft. downstream), the "Greenbanks" region, the Fuller Bridge area, the Chehalis River holding area above the discharge, a station on the Wynoochee within one mile of its mouth, and a station on Workman Creek above its mouth.

Fisheries work performed will include estimates of species composition, food habits, length and weight relations, and an identification of Chehalis River habitat utilization by adult and juvenile fishes, including migratory routes and spawning areas. Sampling of the fishery will be performed monthly for the initial two year period.

Fishery work planned for the first two years of the pre-operational studies and for the last year before startup of the first unit will involve an intensive survey of fishery community characteristics. These will include: species composition, growth patterns, condition factors, population age structure, food habits, habitat utilization by species, species di-

versity, timing of sexual maturity, incidence of disease and migrational patterns of anadromous fish. Water depth, temperature, dissolved oxygen, turbidity, and BOD will be measured simultaneously with biological sampling.

B. Operational Aquatic Monitoring

The operational aquatic monitoring program will be a continuation of the pre-operational preliminary sampling program. The scope of the operational aquatic monitoring program will be determined as the results of the preliminary survey are developed. This program will be developed by the Supply System and approved by the Council prior to operation of either project.

V. WATER QUALITY MONITORING PROGRAM

This program will be established to monitor water quality parameters. Data obtained by this program will also supply necessary information to the study of the aquatic life in the river. Monitoring will begin two years prior to start-up of the first unit.

A. Construction of Blowdown Diffuser

Measurements of suspended sediment concentrations and turbidity will be performed at river cross-sections

100 feet above and 300 feet downstream from the outfall structure. The measurements will be conducted weekly in mid-afternoon during construction of river bank facilities. The sampling areas and frequency may be modified according to the sampling results. Sediment concentrations will be measured by a conventional suspended sediment sampler.

B. Surface Water

Four sampling stations have been selected on the Chehalis River and one on the Satsop. An additional five stations have been located on creeks in the vicinity of the project site.

1. Construction Period

Suspended solids, turbidity, oil and grease, fecal coliform and pH are to be measured weekly. Total dissolved solids, alkalinity, total hardness, dissolved oxygen, conductivity, sulfate, nitrate, nitrite, BOD, COD, total dissolved gas, ammonia-nitrogen, kjeldahl nitrogen, total coliform and total phosphate are to be measured monthly.

2. Pre-Operational Period

All of the above parameters will be measured monthly; in addition calcium hardness, chloride, flouride, calcium, magnesium, sodium, bicarbonate, carbonate and phenol will be measured monthly at the four Chehalis River sites and one Satsop River site.

3. Operational Period

The operational water quality monitoring program will be a continuation of the pre-operational sampling program. The scope of the operational program will be determined as the results of the pre-operational survey are developed. This program will be developed by the Supply System and approved by the Council prior to operation of either project.

4. Thermal Effluent Monitoring

Surface and bottom temperatures of the river 100 feet above and 100 feet below the blowdown diffuser and the blowdown itself will be monitored continuously.

VI. TERRESTRIAL ECOLOGY PROGRAM

The terrestrial ecology monitoring program for WNP-3 and WNP-5 is part of an integrated monitoring program for the construction, pre-operational and operational phases. Pre-construction monitoring will begin in 1976 and continue for a minimum of two years.

The purpose of the terrestrial ecology program will be to identify the impact of construction activities and plant operation upon the terrestrial ecosystem.

A. Aerial Photography

Aerial photographs in natural color and false color infrared of the site and adjacent area will be made to provide a basis for mapping the extent of changes in existing plant communities. Future photography will depend on the utility of the photographs as determined by the Council.

B. Establishment of Experimental Watersheds

Four experimental watersheds, each comprising 40 to 60 acres, will be located within 1.5 miles of the plant facilities. Selection of watersheds and delineation of

boundaries will be based on an analysis of aerial photographs, vegetation maps, topographic maps, and existing soil survey information.

C. Vegetation Sampling

A quantitative description of the vegetation of the four experimental watersheds will serve three purposes: aid analysis of the eco-system processes selected for monitoring possible biological responses to construction and operation of the pwer plant; provide estimates of simi-

larities and differences between the vegetation of the four experimental watersheds; and allow comparison of the watersheds with other Douglas fir forests of western Washington which have been the focus of watershed eco-system studies.

1. Establishment of Sampling Quadrats

Ten quadrats, each 5 meters by 15 meters, will be established in each watershed. Additional quadrats will be added during the construction program until the variability of the recorded data is reduced to an acceptable level. Initial work will commence

in 1976, after selection of the experimental areas on sites corresponding to points randomly selected from a grid system developed for each watershed.

2. Recorded Data

Species, diameter at breast height (dbh), and estimated height will be recorded for each canopy (dbh greater than or equal to 10cm) and subcanopy trees (dbh greater than 5 cm but less than 10 cm). Cores may be obtained with an increment borer, from selected trees to determine stand age, should this information not be available. Species, density, and estimated cover will be recorded for shrubs (dbh greater than 1.0 cm but less than 50 cm) and herbs (dbh less than 1.0 cm). These data will be recorded in a form suitable for computer calculation of density, dominance, frequency, and importance values for each species.

Aspect and slope will be determined at each quadrat with a compass and clinometer. Insect damage, disease and other natural stresses on vegetation will be noted and recorded photographically.

D. Distribution and Chemical Composition of Lichens
and Mosses

This aspect of the program will provide information needed to assess the importance of atmospheric inputs associated with cooling tower operation.

1. Lichen Distribution

A systematic photographic record of lichens and mosses at ground level and different heights above ground will be obtained at each quadrat established in the Vegetation Sampling Program. Lichen studies will be conducted, initially, at two experimental watersheds and expanded if preliminary data do not provide a data statistically adequate description of lichen distribution. Lichens will be identified in the field, when possible, and appropriate voucher specimens are collected. A less intensive lichen program will be conducted during the period of plant construction to obtain information on natural variability of lichen species abundance.

2. Chemical Composition

From analysis of field data, a species of lichen which is relatively abundant and widely distribu-

ted will be selected for chemical analyses. Lichen thalli will be ashed and analyzed with atomic absorption techniques or appropriate standard methods for S, Cl, Ca, Na, and the heavy metals Hg, Cu, Zn, and Cr. This phase of the program will be conducted once prior to construction, two years before scheduled startup of the first unit.

E. Chemical Composition of Follar Leachate

Analysis of precipitation which has filtered through the canopy foliage leachate will be utilized, along with data obtained from the Meteorology - Air Quality Programs, assessing possible biological responses to atmospheric inputs resulting from cooling tower operation.

1. Collection

Leachate will be collected at least monthly during the first year of the program, at five stations in each of two experimental watersheds. Additional stations will be established if data analyses reveals an unacceptable level of variation. A collector at each station will retain leachate and minimize entry of particulate matter and evaporation of leach between collection periods.

2. Analysis

Leachate will be analyzed, using standard technique methods for $\text{SO}_4^{=}$, Cl^- , CA^{++} , Na^+ . Sampling of foliar leachate will be conducted throughout the construction period, although the intensity of sampling may be altered after analysis and review of the initial data.

F. Soil Characteristics

1. Classification

Classification of the soils of the four experimental watersheds as to series and type will be ascertained from existing soil surveys. This information will be necessary to determine the similarity of the watersheds, and to interpret the measured chemical composition of soil and stream water.

2. Chemistry

Soil samples will be extracted with an auger from two definable horizons, decomposed litter (O_2) and mineral - litter interface (A_1). Additional samples may be obtained from only one of the two

horizons, based on observed variability of chemical analyses. Three soil samples will be collected at each of the vegetation quadrats described in Section B.

Replicate analyses will be conducted, with standard techniques, for available $\text{SO}_4^{=}$, CL^- , CA^{++} , Na^+ and Hg, Cu, Zn, and Cr.

G. Watershed - Ecosystem Analysis

The program of watershed ecosystem analyses is designed to collect information which will describe the principal interrelationships between terrestrial and aquatic ecosystems. These are the interrelationships responsible for the transfer of terrestrial organic production from the forest to the aquatic system, upon which the latter is largely dependent. This program will attempt to scientifically assess several of the key processes which the terrestrial and aquatic ecosystem depend on.

Physical processes will be monitored by the meteorology, and water quality programs. These data will be interpreted as inputs to and outputs from the proposed experimental watersheds. In this scheme, the forest is viewed as the recipient of atmospheric inputs. The terrestrial ecosystem processes these inputs and then

exports, by way of the streams, a spectrum of organic and inorganic materials. The stability and diversity of these receiving bodies is, in large part, dependent upon the amount and rates of flux of these substances.

1. Leaf Litter

Litter fall will be collected on screen traps (0.25 m²) arrayed in three groups of five in two watersheds. Allocation of sample stations will be based upon a review of aerial photographs, in an effort to insure homogeneity of forest type. Samples will be collected monthly, sorted into representative constituents, oven dried, and weighed.

2. Leaf Litter Decomposition

Leaf litter decomposition will be studied using the mesh bag techniques of Cromack (1973) during the summer and fall of 1976. These will be compared statistically with IBP studies conducted at Thompson Forest.

Soil arthropods will be collected at five stations in two watersheds using soil coring apparatus. Core samples will be split into O₁ and O₂ horizons and

their arthropod populations extracted using Berlese funnels. Soil arthropods will be oven dried (70°C) to constant weight. These data will be correlated with soil respiration (CO₂), moisture content, temperature and litter depth.

3. Organic-Inorganic Export

Organic-inorganic export from each of the watersheds will be monitored on primary forest streams monthly by the water quality program. Particulate carbon, dissolved carbon, Ca, Na, K, NO₃, PO₄, F, and SO₄ will be measured.

4. *Ariolimax Columbianus*

Because of the potential importance of *A. columbianus* in detrital processes, populations of these species will be estimated using exclusion traps in two watersheds during the summer of 1977-1979.

5. River-Stream Litter Decompositin

Litter input to primary and secondary forest streams will be monitored monthly using litter traps (10/ stream; wire mesh screens). A preliminary study of stream litter decomposition will begin during

the fall of 1976. Information obtained will include rates of decomposition, amount of litter input and the benthic fauna associations in the primary-secondary streams.

This program will be reviewed annually.

H. Faunal Program

Monitoring terrestrial fauna will focus upon surveys of deer, ruffed grouse and birds. The overall program will be limited to seasonal observations of each population. Efforts involved will be limited to qualitative estimates of changes in habitat utilization and seasonal occurrence.

Deer and ruffed grouse habitat utilization will be quantified and described within each watershed. Methods used to describe deer and ruffed grouse habitat utilization procedures will be the same as those employed during the licensing period studies.

Deer techniques include three pellet track transects (200 ft.) in each watershed and observation. Grouse techniques will include call counts. Frequency of sampling will be monthly during the spring, summer and

fall, 1976-1979. This program will be reviewed at the end of the 1979 sampling period.

Aviaco communities will be studied by spot census at the twenty stations selected during the licensing period. Comparative data (spot census) from the four watersheds surrounding the project will be collected. Bird species presence - absence data will be collected four times during each spring, summer, fall and winter season.

I. Operational Program

The operational terrestrial ecology monitoring program will be a continuation of the pre-operational sampling program. The scope of the operational program will be determined as the results of the pre-operational survey are developed. This program will be developed by the Supply System and approved by the Council prior to operation of either project.

TABLE 1

SAMPLING SUMMARY

ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM

| <u>Sample Type</u> | <u>Stations</u> | <u>Sampling Frequency</u> | <u>Analysis</u> |
|----------------------------|-----------------|------------------------------|---|
| 1. Background | | | |
| a. External Gamma Spectrum | 4 | Continuous | (Background Gamma) |
| b. TLD Dosimeters | 15 | Monthly, Quarterly, Annually | (Readout & Record (at Noted Frequency) |
| 2. Air | | | |
| a. Particulates | 4 | Weekly | (Gross Beta (Gamma Scan (Radio Iodine |
| b. Iodine | 4 | Weekly | |
| 3. Plant Discharge Water | 1 1 | Continuously Weekly | (Gamma Activity (Gross Alpha (Gross Beta (Gamma Scan & Tritium |
| 4. River Water | 5 | Monthly | (Gross Alpha (Gross Beta (Gamma Scan & Tritium (Quarterly ⁹⁰ Sr & ⁸⁹ Sr |
| 5. Groundwater | 2 | Monthly | (Gross Beta (Gamma Scan & Tritium |

| <u>Sample Type</u> | <u>Stations</u> | <u>Sampling Frequency</u> | <u>Analysis</u> |
|--------------------------|-----------------|-------------------------------|--|
| 6. Vegetation | | | |
| a. Garden Vegetables | 2 | At Harvest | (Gamma Scan) |
| b. Pasture Grass | 3 | 3 Times during growing season | (Gamma Scan) |
| 7. Soil | 3 | Semi-annually | (Gross Beta (Gamma Scan (⁹⁰ Sr & ⁸⁹ Sr |
| 8. Sediment | 3 | Quarterly | (Gross Beta (Gamma Scan (⁹⁰ Sr & ⁸⁹ Sr |
| 9. Milk | 5 | Monthly | (¹³⁷ I (⁹⁰ Sr & ⁸⁹ Sr (Gamma Scan |
| 10. Aquatic Biota | | | |
| a. Fish | 4 | Quarterly | (⁹⁰ Sr & ⁸⁹ Sr (Gamma Scan |
| b. Benthos | 4 | Quarterly | (⁹⁰ Sr & ⁸⁹ Sr (Gamma Scan |
| c. Vegetation & Plankton | 2 | Quarterly | (⁹⁰ Sr & ⁸⁹ Sr (Gamma Scan |
| 11. Wildlife | | | |
| a. Raccoon/Substitute | 1 | Annually | (Gamma Scan |
| b. Waterfowl | 1 | Annually | (Gamma Scan |