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SPECIAL INVESTIGATION REPORT BY

THE WASHINGTON STATE IODINE-129 TASK FORCE

Don Peterson ORP

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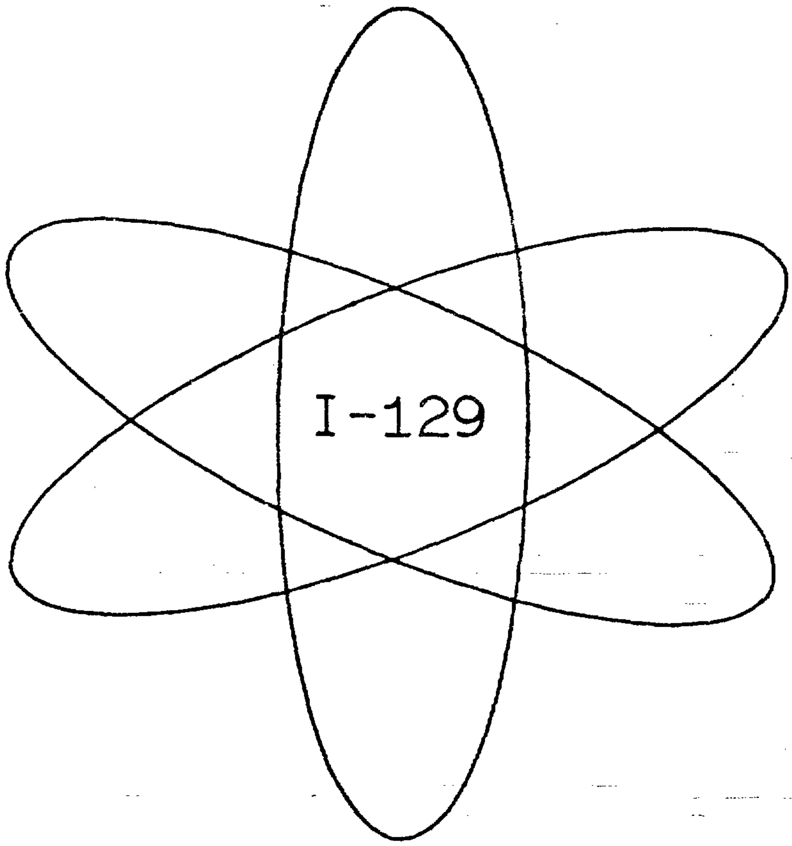

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October 9, 1987

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WASHINGTON STATE DEPARTMENT OF SOCIAL & HEALTH SERVICES

See cover sheet to Ballard

101

SPECIAL INVESTIGATION REPORT

BY

THE WASHINGTON STATE IODINE-129 TASK FORCE

TO

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EXECUTIVE SUMMARY

In August 1987, DSHS convened a task force to investigate the issue of I-129 releases at Hanford. The principal objectives were to evaluate the impact, if any, on public health and to assess the adequacy of the present I-129 monitoring programs on-site and off-site.

In order to effectively conduct its investigation, the task force reviewed copies of the pertinent documents which the Rockwell (now Westinghouse) Intercontractor Working Group (IWG) had gathered in the course of its study of the I-129 issue and the IWG report titled, "Data Compilation: Iodine 129 in Hanford Ground Water." The task force also evaluated source terms and exposure pathways and performed a dose assessment based upon the limited data available. These investigations resulted in a number of questions which were addressed at face-to-face meetings with the U.S. Department of Energy (USDOE), Westinghouse, and IWG representatives. Based upon these document reviews, data evaluation and discussions, the task force made a number of findings and recommendations. The principal findings are as follows:

- No health effects are expected from exposure to I-129 in the Hanford environs.
- Problems of consistency exist between the Pacific Northwest Laboratory's dose calculations and the available historical data.
- The scope of the IWG was too narrow, resulting in many important questions on source terms remaining unanswered.
- Additional sampling of agricultural products is needed.
- Continued verification of environmental and effluent monitoring is needed.
- No standards are being exceeded, though internal control levels have, in the past, been exceeded.
- The IWG needs to remain in place to ensure follow through of all recommendations and questions.
- Intercomparison is needed for PNL I-129 analytical results.
- An important section offering self-criticism in the draft Data Compilation Report was submitted in the final version.

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1.0 INTRODUCTION

During its monthly meeting in April 1987, the Washington Nuclear Waste Board (WNWB) was informed that a technical committee called the Intercontractor Working Group (IWG) had been chartered by Rockwell (now Westinghouse) management to gather, summarize, and evaluate any and all information with regard to I-129 in ground water at Hanford (Reference 1) (see Figure 1 for a map of Hanford's major areas). The information presented generated a great deal of interest and concern for several reasons: (1) the data for I-129 has largely been ignored in published reports and thus its significance as a waste component remains unknown by the state and general public; (2) there is a concern about the potential health impact of I-129; (3) the presence of I-129 in the confined aquifer may have direct implications on the potential repository at Hanford; and (4) there is concern about potentially inadequate communication and sharing of information relative to I-129.

As a result of information obtained from the IWG, the Department of Social and Health Services (DSHS), as the state's radiation control agency, initiated an investigation of an alleged I-129 contamination problem at Hanford. A DSHS task force was formed to investigate the I-129 issues. This investigation centered around those areas within the perview of the agency, and included:

- Potential health implications from exposure to I-129;
- Source terms, environmental pathways and current environmental and effluent monitoring activities for I-129;
- Compliance with standards (federal, state, and internal);
- Communication and coordination at Hanford;
- Environmental baseline data as it relates to the Basalt Waste Isolation Project; and,
- Analytical methods and sampling procedures.

Another major question of relevence is one of aquifer intercommunication. This question has significant implications on the high-level waste repository siting decision. As such, this aspect of the investigation will be conducted by the Department of Ecology"s (DOE) Office of Nuclear Waste Management as it relates to the repository. DSHS evaluated the intercommunication question only to enable a determination of the extent of contamination and potential off-site impact.

In order to meet the objectives of its investigation, the task force employed the varied expertise of its members to:

- Screen and review the I-129 reference documents;
- Review the IWG report;
- Evaluate sources, pathways, and monitoring programs;

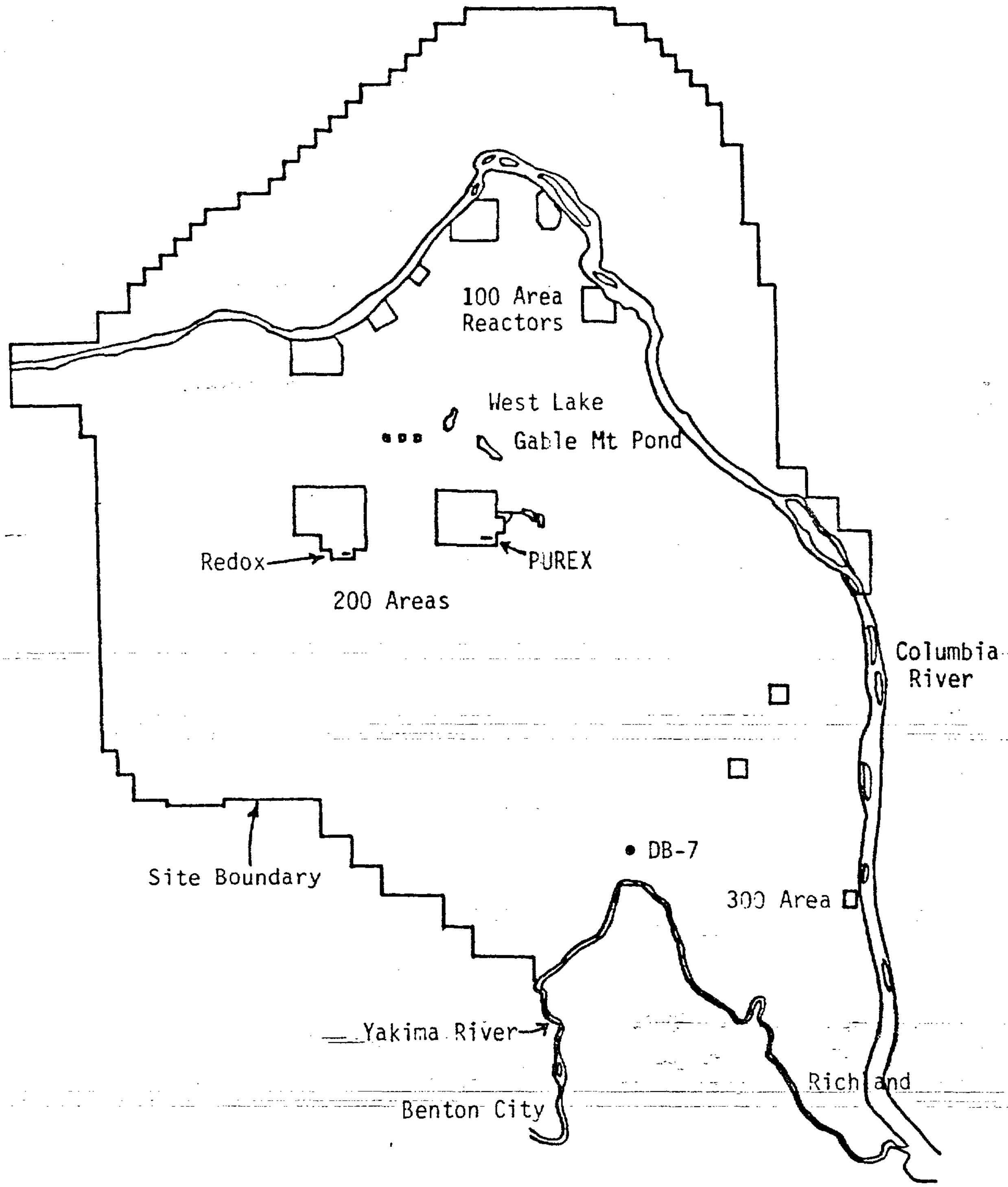


FIGURE 1: THE HANFORD NUCLEAR RESERVATION

— Perform dose assessment (i.e., determine radiation doses which could be potentially received by a member of the public, based on I-129 emissions and environmental measurements); and

— Meet with/and question the IWG and other technical and management personnel from Hanford contractors.

The DSHS investigation was intended to address the entire I-129 issue from a public health perspective. As such, it differed from the scope of the Hanford IWG whose end product was a report entitled "Data Compilation: Iodine 129 in Hanford Ground Water". (Reference 2). This data compilation report mainly assessed the validity of existing existing data (see data summary in Appendix A). It does not address other issues, including:

— Questions and criticisms raised by the IWG in its initial investigation and draft Data Compilation Report;

— How aquifer intercommunication occurred;

— The sources of off-site I-129 in farm irrigation wells;

— Pathways other than ground water;

— An integration of all known I-129 data to present an overall environmental picture;

— Why available data was not included in appropriate reports;

— A dose assessment; and

— An investigation to assess the communications and coordination of information related to I-129.

The DSHS task force felt all were important issues that required investigation. The U.S. Department of Energy (U.S. DOE) cooperated fully in providing answers where possible. Questions that could be answered and those that remain unsatisfactorily answered are addressed in this report.

During this investigation, it was deemed essential and in the best interest of both the state and the U.S. DOE to have meetings to discuss these questions. During the course of two meetings with U.S. DOE and contractor management representing the IWG, numerous technical questions were discussed. Those responses form, in part, the basis for the task force's findings and recommendations. A summary of the questions and responses is contained in Appendix B. All the issues treated in this task force report are grouped under the following categories: (1) health effects; (2) source terms, pathways, and monitoring (environmental and effluent); (3) compliance with standards; (4) communication and coordination; and (5) analytical and sampling procedures.

As this report was prepared a timeline, based on the IWG report and other documentation (Reference 3), was developed of I-129 monitoring and related operations (see Figure 2). An I-129 fact sheet is also included (Table 1).

This report concludes the first phase of the task force's work. It will reconvene, as necessary, to monitor and evaluate the progress of its (and the IWG's) recommendations.

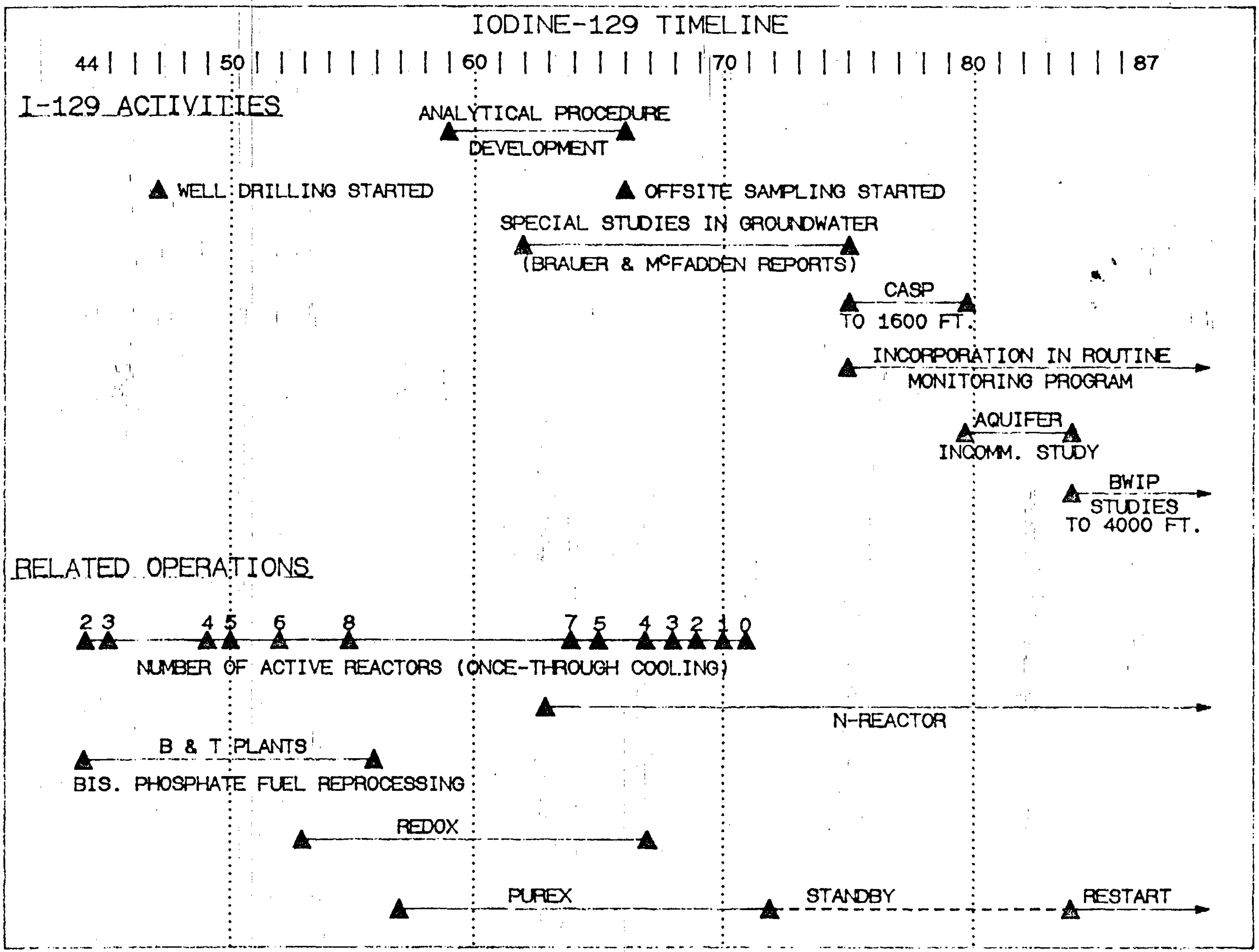


Figure 2: Iodine 129 Timeline

TABLE 1: IODINE-129 FACT SHEET

- Half-Life = 17,000,000 years
- Water soluble, moves with ground water
- Principal exposure pathways = airborne deposition, then consumption via milk or agricultural products.
- Concentrates in the thyroid (critical organ)
- Analysis is expensive: $500,000 initial capital costs, then $1,000 to $2,500 per sample (using neutron activation analysis procedure)
- Sources: Artificial - fission product of nuclear reactor
  - weapon testing fallout

  Natural = decay product of uranium
- Artificial can usually be differentiated from natural based on I-129/I-127 ratio and presence of other manmade isotopes

2.0 DISCUSSION

2.1 Health Effects

I-129 has an extremely long half-life, can accumulate in environmental media, and when ingested concentrates in the thyroid. A major question, therefore, was whether any health effects would be expected as a result of the presence of I-129 in the environment. To answer that question, the DSHS task force performed a preliminary dose assessment to verify U.S. DOE's conclusions that health was not impacted. To accurately assess the dose was extremely difficult due to scarce and conflicting environmental data. The limited data was used to determine a magnitude of dose to evaluate the possibility of health effects and to determine compliance with standards.

Using assumptions that were as conservative as possible, the potential dose to the public was determined using two avenues of approach. The first method used actual environmental measurements. Though this data was scarce, it was considered the most reasonable data to use for a dose assessment. The second method used effluent data to perform an atmospheric dispersion model from the source term (primarily from the PUREX Plant). Using both methods, the dose that a member of the public received would have ranged approximately from .1 to 13 millirem per year to the infant thyroid (see Appendix C for detailed assessment). This dose, even assuming a wide error range, is well within current standards. A more complete assessment of past emissions will take place under the direction of the Hanford Historical Documents Review Committee. The conclusion that the DSHS task force draws, based on limited data, is that no significant health effects could be expected from I-129 emissions from the Hanford Reservation.

2.2 Source Terms, Pathways and Monitoring

Sources of releases of I-129 to the environment from Hanford operations include reactor operations, reprocessing, and waste disposal. The amounts of I-129 released are difficult to quantify, but estimates of relative magnitudes can be made.

Releases were made to the atmosphere through venting from reactor operations and reprocessing. In addition, a smaller amount is occasionally vented (mostly from unmonitored release points) from tanks holding high-level waste when pressures buildup in these tanks. These additional releases are not considered high enough to significantly affect environmental levels of I-129.

Reported atmospheric releases of I-129 are low (Appendix A, Table A.1). It is interesting to note that for the period 1944 through 1972, total releases from all the 200 Area reprocessing plants (at various times PUREX, Redox, B-Plant, T-Plant, and Semi-Works) are less than for one year of current PUREX operations (460 mCi in 28 years, versus 500 mCi in 1986) (Reference 4).

Analysis of the effluent data, in conjunction with field measurements, raises a question whether these numbers are very accurate. The values listed were apparently calculated by using the estimated I-131 releases and assuming a given ratio of I-129 to I-131 at the time of the releases. This approach may be flawed and releases may have been larger, although not to a level that would raise concerns for health, even if the releases had actually been substantially larger. The field data of the 1960's and 1970's indicate that releases of I-129 must have been larger than the estimated releases in Table A.1. This may explain the comparable doses from current by reported larger releases compared to releases prior to 1972. Advances made over the years in modeling and effluent monitoring have confounded the situation. Even today, an order of magnitude difference exists between projected doses based on emission and projected doses based on field measurements (Appendix C). The latter problems should be resolved if possible, and is dependent, in part, on more field measurements. Since I-129 emissions to the air can contribute a major portion of the dose to the infant thyroid, it is recommended that I-129 releases be evaluated and included in the dose reconstruction project being led by the Hanford Historical Documents Review Committee.

Liquid low-level waste containing I-129 has, and continues to be, disposed directly to the soil through cribs, French drains, reverse wells (injection wells), and ponds. No evidence was found of direct injection to the confined aquifer. Only one reverse well (216-B-5) is known to have been constructed directly to the ground water in the unconfined aquifer. This site may have received small amounts of I-129, though the predominate radionuclide disposed in this site appears to be to have been Sr-90 (Reference 5). Though no evidence exists concerning direct injection, the high mobility of I-129 results in rapid movement to the ground water with a continuing driving force from additional water disposed to that site. There have been suspicions expressed that other injection wells may exist (Reference 6) but are not well documented. A smaller amount of I-129 has leaked from high-level waste single shell tanks in the 200 Areas. This iodine, however, would probably not migrate all the way to the ground water since no continuing driving force from water disposal exists through those tanks. The total amount of iodine released as high and low-level waste apparently is classified and not directly available. Individual waste site inventory records, which are not classified, inaccurately indicate that iodine (as well as many other radionuclides) released to these sites are all "zero" (Reference 7). It is highly recommended that these official inventory records be clarified and the zeros replaced by "classified" or "data not available" or "no records" as appropriate. Zeros are not feasible and are misleading.

The iodine released to the environment moves by various pathways and eventually may be taken up by humans either by drinking water or through agricultural products. The exposure pathway by direct inhalation of gaseous or particulate iodine contributes a much smaller dose than other pathways. The predominate mode of exposure is from the ingestion of agricultural and dairy products that have been contaminated as a result of the deposition of airborne I-129.

Iodine released to the atmosphere has been deposited to the soils and vegetation around the Hanford site. Plants tend to bring some of the iodine up through their root systems and deposit it in the litter as they die. Material deposited on the soil generally remains in the top layers of soil and in litter. Because of the long half-life of I-129, there is a tendency for iodine to build up in the surface litter and soil. However, uptake by plant roots appears to be relatively small. It appears that some of the soil iodine is volatilized by microbial action and redeposited on vegetation. The I-129 concentrations in the soil on the Hanford site from 1974 to 1978 ranged from 0.00014 to 0.02 pCi/gm (Reference 4). There is some question whether iodine could be washed by rain from surface soils into the ground water via unsealed well casings. There are positive concentrations (though very low) of iodine in the off-site ground water that cannot be attributed to natural causes. The source of iodine in these off-site ground water wells east of the reservation has not been determined. No comparison of the concentrations in the area sampled were found of these wells versus wells upwind of Hanford.

Iodine released to the gravelly soils, primarily from low-level waste disposal sites, migrates down into the ground water if there is a continued hydraulic driving force from continued liquid disposal to the soil column. Once iodine reaches the ground water, it moves readily with that water. The water flows more slowly through the sedimentary layer holding the ground water than through the gravels. Since I-129 is highly mobile in ground water, it is assumed that the on-site extent of iodine contamination coincides with the tritium and nitrate plumes in the unconfined aquifer (Figure 3). The limited data appears to confirm this. This contamination is due to waste disposal activities. The actual travel time of ground water is not well known although estimates by the U.S. Geological survey (Reference 8) indicate travel times from the 200 Area to the Columbia River to be about 10 to 20 years. The range of concentrations of I-129 in the on-site aquifers is from 0.000001 to 4000 pCi/l (Reference 2). The areas of highest concentration are those wells adjacent to retired and operating waste disposal sites near 200 Area reprocessing plants. The plume has reached and discharges directly into the Columbia River. Dilution reduces the concentration of iodine and other radionuclides in the river to levels well below public health concern.

Contamination of the confined aquifer has also occurred. The Department of Ecology has made measurements to determine the degree to which migration can take place through the Basalt layers separating the confined and unconfined aquifers. Their determination is that the region under the low-level disposal sites is fractured to the degree that migration could take place (Reference 9). U.S. DOE studies of the area's geology also support the possibility of aquifer intercommunication (Reference 10, 11). Figure 4 illustrates an area north of the 200 areas where the basalt layers come to the surface at Priest Lake. Intercommunications at this location is likely. Intercommunication has also apparently occurred through well casings (Reference 2). The sources of contamination in individual wells should be addressed by the BWIP project and other Hanford programs especially in well DB-7 (a well located on the southern

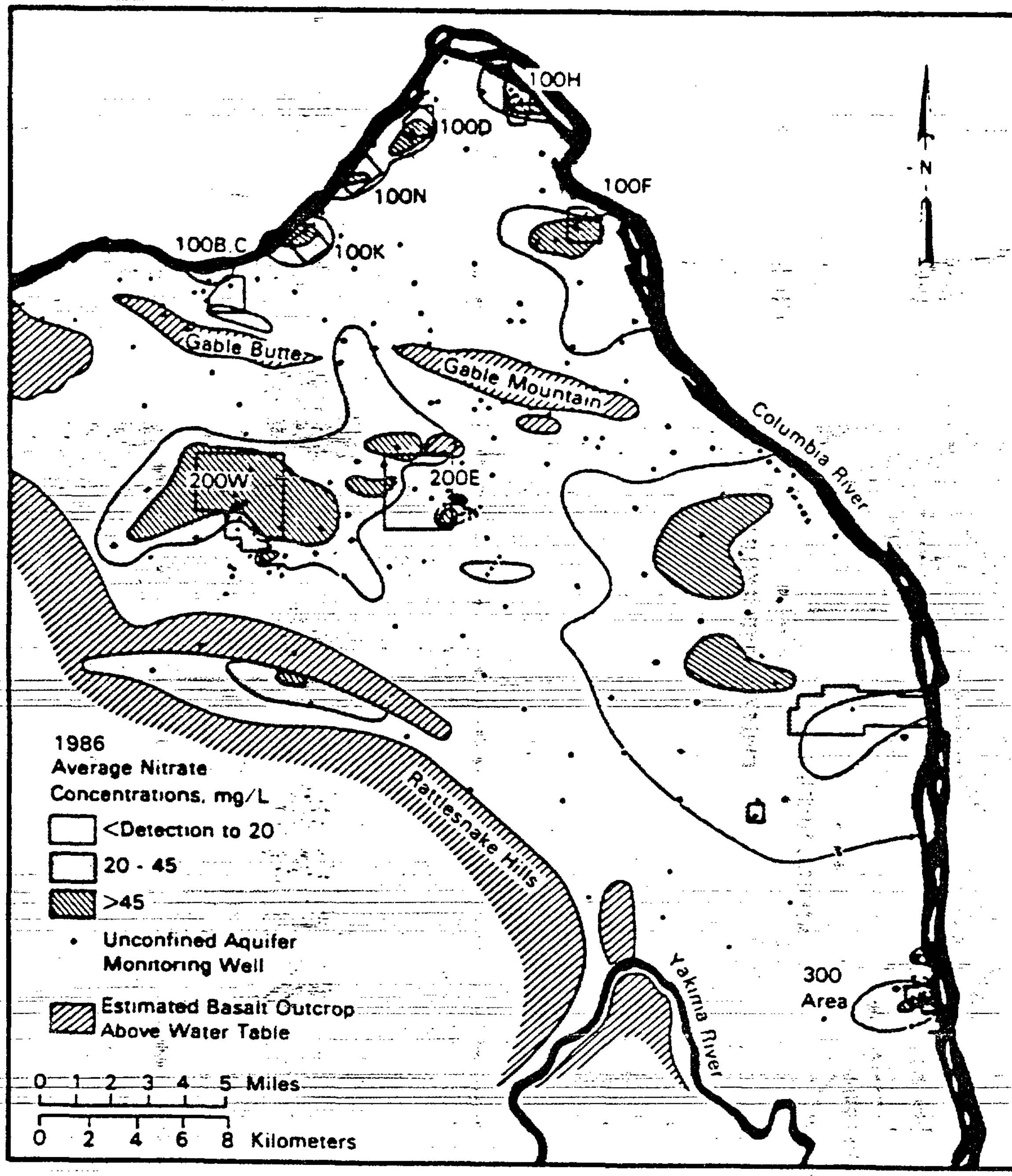
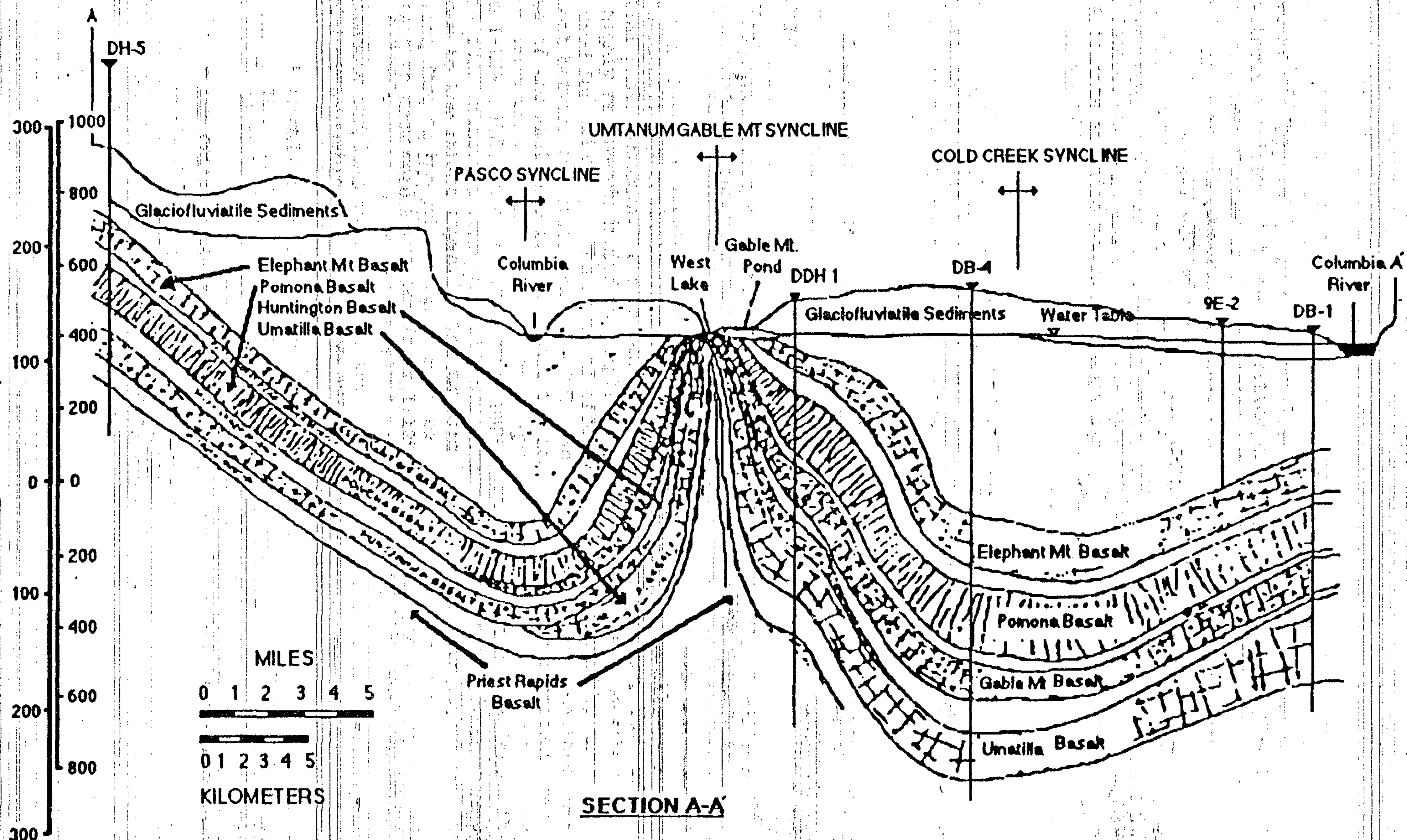


Figure : Average Nitrate in Unconfined Groundwater (1983).



Figur. : C. s-Section of Basalt Layers Illustrating Area of Aquifer Intercommunication at West Lake boundary of the Hanford Reservation and illustrated on Figure 1) where I-129 is found without a sufficient trace of tritium to point directly to waste disposal activities. Other sources of contamination (natural uranium deposits, the Yakima River, and well construction) have also apparently been ruled out. Answers to that anomaly are needed.

Environmental monitoring of I-129 is done regularly and data is included in the annual Pacific Northwest Laboratory Environmental Monitoring Reports (Reference 12). Effluents are also monitored (Reference 13). Well water, Columbia River water, air and milk are sampled. Data collected by PNL is graphically illustrated in Appendix A. Other than milk, agricultural products are not analyzed for Iodine 129. The Pacific Northwest Laboratory's analytical results conclude that the levels of iodine found in environmental media are below that of public health concern. The DSHS review of that data and a preliminary dose assessment concurs with that conclusion. However, dose assessment calculations from past and present environmental measurements and estimated releases are contradictory, as noted previously, resulting in questions concerning the adequacy of the data base. In large part, this is due to an inadequate data base for recent sampling of most agricultural products, including pasture grass, leafy vegetables and fruits. Previous, though sketchy, data have been found to have had sufficient concentrations of I-129 to warrant additional sampling.

The I-129 concentrations in the off-site environment are too low to justify any extensive increases in existing monitoring efforts. However, since past data are scarce, and shows a contribution by Hanford of environmental I-129, a one-time sampling of selective agricultural products and pasture grass would do much to establish a credible data base for dose assessment and alleviate any potential public concern. For the ongoing environmental program, the task force highly recommends including sampling of pasture grass and on-site well water used for drinking. The level of effort can be established by mutual agreement between the state and U.S. DOE. While the task force realizes the expense of the analyses, it feels that the additional efforts represent the minimum increase in data needed for an adequate representation of dose levels due to I-129. PNL indicated in a draft paper presented to the task force, that for the 1986 emissions from the PUREX stack, I-129 accounted for 88 percent of the dose to the infant thyroid. The thyroid is a key indicator organ used for assessing dose to the public due to Hanford emissions. It is, therefore, important to know more about levels of I-129 in the environment.

The enhanced sampling should enable the resolution of several key questions in regard to establishing a viable dose assessment:

* Is milk a valid primary indicator for I-129 in the food chain? The task force questions whether it adequately reflects I-129 concentrations in fruits and leafy vegetables.

* Are PNL's modeling parameters consistent with actual environmental measurements of I-129?

* Are current estimates of I-129 emissions too high, or are changes needed to PNL's dose models based on airborne releases?

* What is environmental half-life of I-129 (i.e., how quickly is it dispersed and diluted due to various environmental phenomena)?

Continued evaluation of the ground water and environmental programs does take place. Active communication between Hanford contractors, U.S. DOE and the state must continue to evaluate the need for additional monitoring and assessment as the need arises.

2.3 Compliance with Standards

In addition to dose assessment, DSHS compared I-129 concentrations in effluents and the environment with state and federal requirements and standards (see Table 2). The result of those comparisons are as follows:

- No federal or state standards for I-129 exposure by the public are exceeded.

- No community drinking water systems exceed the drinking water standards for I-129.

- Current I-129 emissions fall within internal Westinghouse control levels and U.S. DOE requirements.

- No on-site or off-site U.S. DOE radionuclide concentration standards for I-129 are being exceeded.

- Internal contractor control levels have been exceeded in the past (mid-1960s) (Reference 14).

Concerning the last bullet, internal control levels are established conservatively by the contractors to ensure that state and federal standards are met at the site boundary, with a safety margin. This is an excellent practice. It should be stressed, however, that when internal controls are exceeded and no immediate concerted effort is undertaken to correct the deficiency, it raises into question the credibility and environmental safety consciousness of the contractor. The state has been assured that even though internal standards have been exceeded in the past, all internal standards are now being met and will continue to be met in the future. Verification of this assurance will further be enhanced as the state begins to enforce state air emissions requirements (Reference 15) with an on-site verification program.

Though the drinking water standards apply to community drinking water systems, compliance should also be demonstrated wherever drinking water is withdrawn from a contaminated aquifer. Two on-site locations use ground water downgradient from the 200 Areas (the Fast Flux Test Facility (FFTF) and the WNP-1 and WNP-4 power plants). These wells are monitored for tritium and nitrates but not for I-129 (a radionuclide equally as mobile). Compliance with the

TABLE 2: SUMMARY OF APPLICABLE I-129 STANDARDS

Description	I-129 Conc.	Dose
Current Std. for Community Systems*	1 pCi/l	4 mrem/yr. WB or any organ
Current USDOE DCG for water (off-site)**	500 pCi/l	100 mrem/yr. thyroid
Former USDOE Table II Guide (off-site) for water	60 pCi/l	500 mrem/yr. WB 1500 mrem/yr. thyroid
Former Internal Rockwell control level-liquid eff.	5,000 pCi/l	--
Former Internal Rockwell control level-ground water	None	--
Current Westinghouse effluent control levels-water		
PUREX process cond.	5,000 pCi/l	--
Others	20 pCi/l	
Current Westinghouse Operational limits-ground water	20 pCi/l	--
Clean Air Act (off-site)	-	75 mrem/yr. thyroid 25 mrem/yr. WB
Westinghouse Operational limits-airborne effluents	-	5 mrem/yr. WB

* Proposed final standards to replace interim standards (40 CFR 141) expected to increase to 100 pCi/l based on new dosimetry methodology of ICRP 26 and 30. Current information is insufficient to evaluate methodology and assumptions used that result in this difference. Resolution is expected with proposed rule making. (reference 20)

** Different standards and associated dose cannot be compared due to differences and upgrades in dose factors, differing pathways of exposure, whole-body vs. organ doses, etc. (references 21,22) drinking water standard should be demonstrated by periodic analysis of ground water samples. Eventual compliance with the drinking water standards for all radionuclides is expected on the entire reservation. State standards to ensure ground water protection are under development.

2.4 Communication and Coordination

A review of the iodine reference documents revealed an historical problem at Hanford with dissemination of information. Information flow has been impeded in the past by misunderstandings on security issues (real or imagined), feelings that the information was of no interest or value outside the organization doing the work, fear of misinterpretation or censorship, questionable quality of data, or a number of other reasons (Reference 16, 17, 18). Evidence of problems relative to these and other issues were observed by the IWG and included in a draft of the Data Compilation Report. It was detected in the final version. The state feelsit should have remained. It is also evident that many of the problems have been solved in recent years. It is imperative that this trend continues. A method for assurance is available.

The state of Washington's Department of Social and Health Services has a legislative mandate (Reference 19) to verify the adequacy and accuracy of monitoring programs within the state, with emphasis on Hanford. One means of accomplishing through the Environmental Radiation Quality Assurance Task Force for the Pacific Northwest (QATF), a group that serves in an advisory capacity to the state and other environmental monitoring organizations in the region. A subgroup of this organization could be organized to meet regularly to coordinate all sampling activities and data reporting, and to discuss monitoring results, environmental problems, corrective actions taken, and changing conditions in the Hanford environment that would affect any environmental baseline. All information relating to environmental conditions should remain open and above board to help alleviate public concern and overcome Hanford's credibility gap. U.S. DOE has assured the state that no environmental data is classified and all is available for review. Effluent data that must remain classified for national security reasons can be reviewed by state personnel with security clearances to ensure that no problems exist.

The state is concerned, that, with the reported completion of the IWG's mission, continuity of recommendation follow-up will not be assured. No single group would coordinate the follow-up. The above group could takt that role.

2.5 Analytical and Sampling Procedures

The task force reviewed data from I-129 analyses. Laboratory analytical sample collecting procedures were also examined. The purpose was to evaluate data quality of I-129 measured in a wide variety of environmental sample matrices (air, water, milk, soil, vegetation and agricultural products) and in animal thyroids.

For samples of nominal I-129 activity, (>0.1 pCi), analysis is by any one of several documented procedures. Most procedures include chemical separation of I-129 prior to counting of the beta particle or gamma-ray energy. Detection systems include low energy photon detection, liquid scintillation counting, low level beta spectrometry, gamma spectroscopy and beta-gamma coincidence spectroscopy (Reference 24, 25, 26, 27, 28 and 29).

Trace level I-129 measurement (10^{-6} pCi) is by neutron activation analysis (NAA) (Reference 24). The analytical techniques used for NAA have been continually improved since their initiation at PNL in 1966. Present techniques enable detection of I-129 concentrations in ground water, which are orders of magnitude less than I-129 concentrations found in surface samples. Ultra-clean sample collection and handling procedures must be followed to prevent I-129 contamination during processing. For many years, the capabilities of the analytical techniques for trace measurements of I-129 exceeded the ability to collect uncontaminated samples. Deficiencies in collection techniques and sample preservation were noted and necessary improvements were made. As recognized in the Data Compilation Report (Reference 2), data credibility cannot be established for those samples where sample collection procedures were inadequate or cannot be traced. For these reasons, "trace level" I-129 data from samples collected prior to 1979 are considered unreliable. For surface or on-site unconfined aquifer samples, where "nominal" levels are present, the data base for I-129 is generally considered reliable.

Use of NAA for I-129 analysis is limited to PNL. The procedure is expensive (approximately $1500/sample). This procedure requires access to a nuclear reactor and a specialized, ultra-clean, low-level laboratory for sample processing. (Reference 30 describes the department's evaluation of this and other analytical procedures for I-129, their capabilities, their advantages and disadvantages, and the approximate cost to develop the system. The cost of implementing trace level systems is estimated at $500,000.)

Washington State's responsibility is to accurately report on the radiological quality of the environment. Data quality is of paramount importance and is substantiated through a quality assurance (QA) program. One part of most QA programs is inter-laboratory crosschecks of split samples. The absence of an independent laboratory crosscheck for measuring trace I-129 concentrations impedes PNL's ability to perform this important QA function. PNL also analyzes for trace I-129 concentration by mass spectrometry. Some intra-laboratory comparisons of sample results are made. Intra-laboratory crosschecks of data are encouraged.

The University of Rochester, New York analyzes trace I-129 by tandem accelerator mass spectrometry. To enhance the QA program for trace I-129 analysis, it is recommended that a cross check program be established with another laboratory with detection limits comparable to PNL. For the samples of nominal activity, inter-laboratory crosschecks are also recommended. The U.S. Testing Laboratory in Richland has this capability.

3.0 FINDINGS AND RECOMMENDATIONS

A. Health Effects

1. Finding: There is no evidence of adverse public health impacts from I-129. Though data are too limited for an accurate calculation of dose, by using conservative assumptions in the modeling, a magnitude of dose could be determined. Even assuming a wide error in dose calculations and estimates of I-129 releases, no health impact is expected.

   Recommendation: None.

2. Finding: The problem of establishing a viable dose assessment is confounded by contradictions among the airborne release data, field measurements and modeling results. This does not substantially alter the previous finding, but raises questions on reported air emissions of I-129, how representive the field data is and the doses routinely reported by PNL on an annual basis. The inconsistencies can be summarized as follows: (a) PNL projected doses based on recent air emissions yield substantially higher results than projected doses based upon milk or air concentrations. Task force calculations confirm this (see Appendix C). (b) The small estimated releases of I-129 from PUREX before it was shutdown in 1972 (see Appendix A) are not borne out by the field data from that time period. Releases were probably much larger and comparable to those since PUREX restarted. A dose reconstruction project for historical releases will be coordinated by the Hanford Historical Documents Review Committee.

   Recommendation: Additional sampling data in conjunction with a review of the method of source term estimation and the dispersion/ dose modeling calculations need to be implemented.

B. Source Terms, Pathways, and Monitoring

1. Finding: There is a paucity of I-129 data in agricultural products. Though the present environmental monitoring program for I-129 is generally adequate, the past data includes some anomolously high values for agricultural products with no recent data to clarify the issue. Additional selective monitoring is needed.

Recommendation: A one-time sampling of selected agricultural products to include fruits, vegetables and pasture grass should be done by U.S. DOE to better characterize the levels and enhance public assurance. It is also recommended that periodic analyses be done for on-site drinking well water (e.g., Fast Flux Test Facility and WNP-1 and WNP-4) and pasture grass at selected milk sampling stations.

2. Finding: Questions concerning aquifer intercommunication need to be addressed. These questions will be accomplished through the Department of Ecology investigation.

Recommendation: None.

3. Finding: Liquid and solid wastes that are discharged to or buried in the ground are not quantified. Values given in the Waste Information Data System report waste site inventories of I-129 and other radionuclides as "zero" when those radionuclides are known to have been discharged to those sites.

Recommendation: These wastes should be monitored and quantified. The inventories including I-129 should not cite "zeroes" when in fact it should be listed as "information not available" or "classified".

4. Finding: The extent, direction, and rate of movement of I-129 in the confined aquifers are not well characterized around the 200 Areas.

Recommendation: The sampling and analyses for I-129 in these areas should be enhanced. The I-129 picture is further confounded by apparently anomalous data (e.g., at wells DB-7 and DB-15). These anomalies should be resolved.

5. Finding: The disposal pathway of I-129 is not clear. Intercommunication occurs north of the 200 East Area while most I-129 is disposed in the unconfined aquifer on the southeast corners of 200 East Area (PUREX) and 200 West Area (the retired REDOX Plant).

Recommendation: The question of how these areas interact should be addressed to fully understand the disposal pathway of this and other radionuclides.

6. Finding: The source of I-129 contamination in irrigation wells east of the river is not known.

Recommendation: A monitoring program should be implemented to clearly identify the sources.

7. Finding: There is no independent verification of air emissions monitoring.

Recommendation: The department expects to accomplish this through its air emissions program within the next calendar year.

8. Finding: There is no independent monitoring for I-129 in the environs of Hanford. The state, in the process of implementing an air emissions program to monitor for compliance with air emission standards, can monitor for indications of I-129 releases by looking at other parameters such as I-131. The analytical procedure for I-129 has not been developed by the state and is not recommended due to the extreme cost and the low levels of I-129 found in the environment (i.e., below health concern and within applicable standards).

Recommendation: The state should continue to develop an independent monitoring program at Hanford, using other indicators that may indicate a potential I-129 problem (e.g., I-131 for air and milk monitoring, tritium and nitrate for ground water monitoring).

C. Compliance with Standards

1. Finding: No state or federal standards for radiation exposure to the public are or have been exceeded by exposure to I-129.

Recommendation: None.

2. Finding: Current I-129 emissions fall within internal Westinghouse control levels as well as U.S. DOE requirements. (These requirements differ from radiation exposure requirements). While current control levels are not exceeded, it should be recognized that in the past, they have been exceeded. It is not the purpose of this document, however, to judge past operations but rather to ensure that current and future operations comply with all laws, regulations, and internal controls. The state has been assured that all appropriate standards and control levels will be met.

Recommendation: Notification of the state by U.S. DOE when any internal control levels are exceeded should be continued.

3. Finding: No community drinking water systems exceed the drinking water standards for I-129. Though no community drinking water system exists on site, there are wells using ground water for drinking on the site downgradient from the source of I-129 (i.e., WNP-1 and WNP-4 and the FFTF).

Recommendation: Periodic sampling of those drinking water wells for I-129 and other radionuclides is recommended to ensure continued compliance with drinking water standards.

D. Communication and Coordination

1. Finding: Continuity is needed for a follow-through of the Intercontractor Working Group recommendations that were made in their report. The IWG's mission is reported to be completed with the data compilation report. Further work is scheduled by individual Hanford programs.

Recommendation: A system should be implemented to enable periodic assessment of progress on its recommendations. Ensure the necessary continuity. There needs to be a commitment by U.S. DOE contractors and individual programs to ensure a follow-through of their recommendations as well as those of this task force report.

2. Finding: Data has not been readily available to groups and organizations having a need for this data. As a result of this, the data has not been used in a number of reports where it should have been used, and the data has not been shared with a number of organizations having a need to assess the data.

Recommendation: A subcommittee of the QATF should be organized to meet regularly to coordinate and discuss all sampling whether for routine monitoring or special studies. This will ensure that all data is available to all organizations having a need. This data should include that collected by operational contractors as well as by PNL. It is imperative that any information or data concerning off-site and on-site environmental conditions not be withheld for any reason.

3. Finding: The scope of the inter-contractor working group was too limited. The previous findings in this report were addressed in preliminary evaluations made by the IWG but never answered. The scope, as outlined at the inception of the IWG, was to evaluate any and all information on I-129. The end product (the data compilation report) did not address all of the questions related to I-129.

Recommendation: The IWG or similar group should continue to operate until the questions raised by the IWG and state are satisfactorily answered in writing.

4. Finding: A major factor contributing to suspicions that there have been coverups of I-129 data is that several major documents (e.g., the PUREX EIS, the Defense EIS, etc.) contain nothing about I-129.

Recommendation: If the recommendations in this report are implemented, this problem and misconception should be corrected.

5. Finding: An important segment of the draft Data Compilation Report was omitted from the final version. This important section offered self-criticism of Hanford programs and addressed many questions. It should have remained.

Recommendation: A follow-up report should be issued by U.S. DOE on the entire I-129 investigation; not just a data summary.

E. Analytical and Sampling Procedures

1. Finding: Cross checking of I-129 analyses are not currently performed by PNL. Several laboratories have the capability to measure I-129 at concentrations which would allow public health risk assessment. However, only the University of Rochester in New York is able to measure trace levels of I-129 for interlaboratory quality assurance.

Recommendation: An interlaboratory cross check program should be established as part of the PNL quality assurance program for analysis of trace and nominal levels of I-129.

2. Finding: The IWG's assessment of the traceability and credibility of data appears accurate.

Recommendation: None.

3. Finding: Laboratory techniques for trace I-129 analyses have evolved at a rate faster than the sample collection and handling techniques. PNL has identified and corrected problems which have resulted in unreliable data.

Recommendation: Since the problems appear to have been corrected, none are necessary.

4.0 REFERENCES

NOT YET COMPLETED

APPENDIX A

I-129 DATA

TABLE A.1

ESTIMATED AIRBORNE RELEASES OF IODINE 129 FROM THE 200 AREAS

YEAR	ESTIMATED RELEASE (Ci)
1944	0.00001
1945	0.102
1946	0.156
1947	0.109
1948	0.065
1949	0.00008
1950	0.00015
1951	0.00021
1952	0.00029
1953	0.00039
1954	0.0005
1955	0.00057
1956	0.00091
1957	0.0014
1958	0.0014
1959	0.0018
1960	0.0019
1961	0.0021
1962	0.002
1963	0.0018
1964	0.002
1965	0.0021
1966	0.0016
1967*	0.0013
1968	0.0017
1969	0.0013
1970	0.0006
1971	0.0011
1972	0.00045
	0.460 Total To Date
1985	0.300
1986	0.500

* PUREX only from 1967

Table A.2: Summary of I-129 Data Ranges *

Description	$^{129}I/^{127}I$ atom ratio	^{129}I concentration (atoms/unit)	Unit	^{129}I concentration (pCi/unit)
Old natural iodine	2 E − 14 to 1 E − 11			
Uranium ores	6 E − 10 to 1 E − 06			
Old groundwater	1 E − 13 to 2 E − 09	2 E + 04 to 2 E + 08	L	7 E − 10 to 7 E − 06
Well 699-53-103 (deep artesian)	1 E − 09 to 1 E − 08	6 E + 07 to 4 E + 08	L	2 E − 06 to 1 E − 05
DB wells (Mabton) (pre-CASP)	2 E − 09 to 4 E − 08	1 E + 08 to 6 E + 09	L	4 E − 06 to 2 E − 04
DB-7 (Mabton)	6 E − 09 to 1 E − 08	4 E + 09 to 6 E + 09	L	1 E − 04 to 2 E − 04
Columbia River	5 E − 09 to 9 E − 07	1 E + 08 to 1 E + 10	L	4 E − 06 to 4 E − 04
Olympic rain	2 E − 07 to 8 E − 07	2 E + 09 to 7 E + 09	L	7 E − 05 to 3 E − 04
Washington and Idaho lakes	4 E − 08 to 4 E − 07	6 E + 08 to 3 E + 09	L	2 E − 05 to 1 E − 04
Hanford rain (300 Area)	6 E − 06 to 8 E − 05	2 E + 09 to 7 E + 11	L	7 E − 05 to 3 E − 02
Hanford lakes	2 E − 06 to 2 E − 04	1 E + 10 to 1 E + 13	L	4 E − 04 to 4 E − 01
Hanford springs	8 E − 08 to 1 E − 04	6 E + 08 to 1 E + 12	L	2 E − 05 to 5 E − 02
Wells east of Columbia River	6 E − 10 to 1 E − 06	2 E + 07 to 3 E + 10	L	7 E − 07 to 1 E − 03
Hanford 699 wells	4 E − 09 to 4 E − 02	3 E + 07 to 3 E + 15	L	1 E − 06 to 1 E + 02
Hanford 299 wells	2 E − 06 to 6 E − 03	2 E + 10 to 1 E + 17	L	7 E − 04 to 4 E + 03
Olympic air	5 E − 08 to 1 E − 06	1 E + 06 to 1 E + 07	$stdm^3$	4 E − 08 to 4 E − 07
Hanford air (300 Area)	2 E − 06 to 5 E − 04	1 E + 08 to 1 E + 10	$stdm^3$	4 E − 06 to 4 E − 04
Olympic grass	5 E − 08 to 2 E − 07	2 E + 07 to 1 E + 09	g	7 E − 07 to 4 E − 05
Benton County grass	4 E − 05 to 9 E − 04	4 E + 10 to 1 E + 12	g	1 E − 03 to 4 E − 02

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* USDOE," Data Compilation: Iodine-129 in Hanford Groundwater", WHC-EP-0037, Richland,Wa,August 1987.

Figure A.1: Iodine-129 in Milk From All PNL Stations

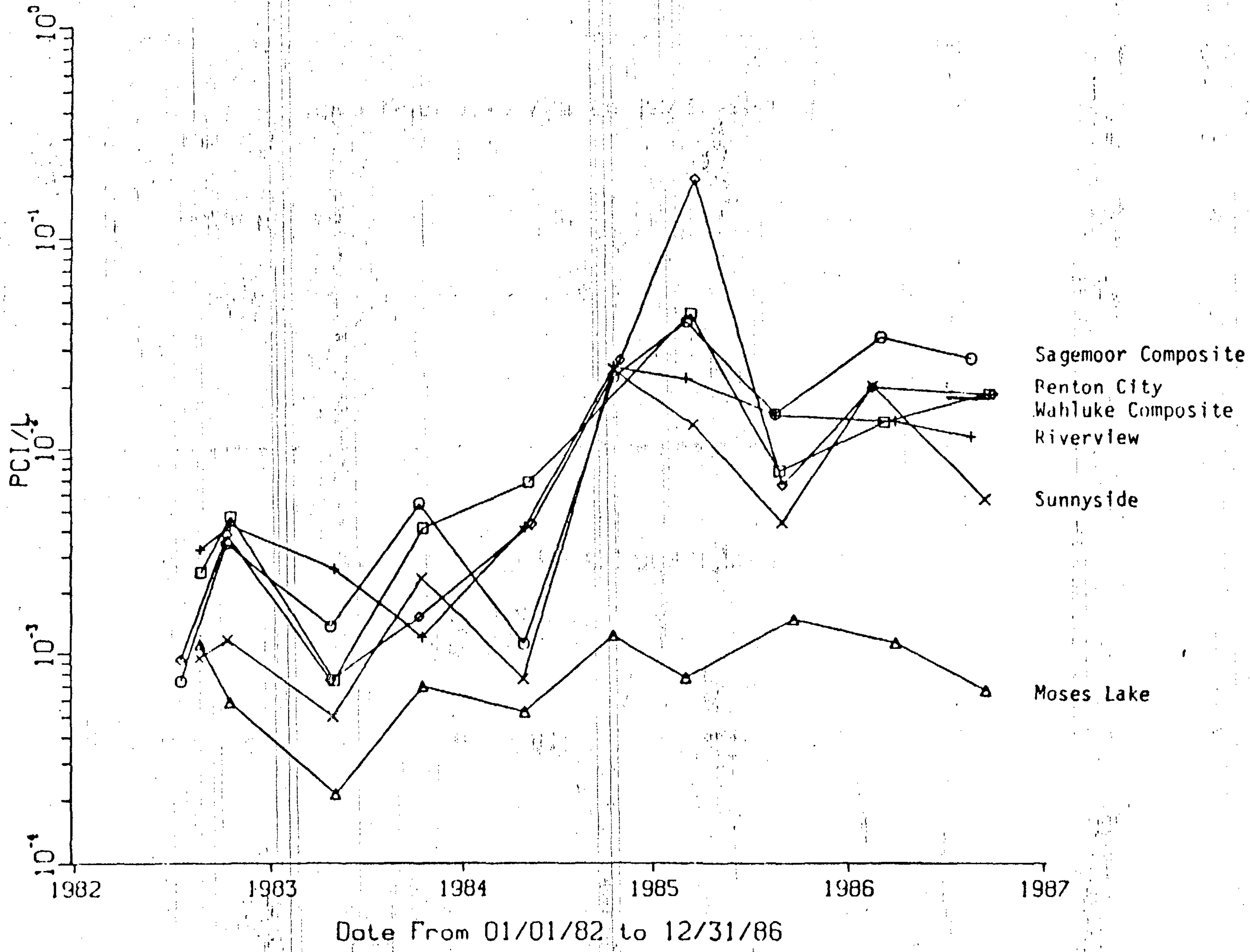


Figure A.2: Iodine-129 in Columbia River Water (PNL)

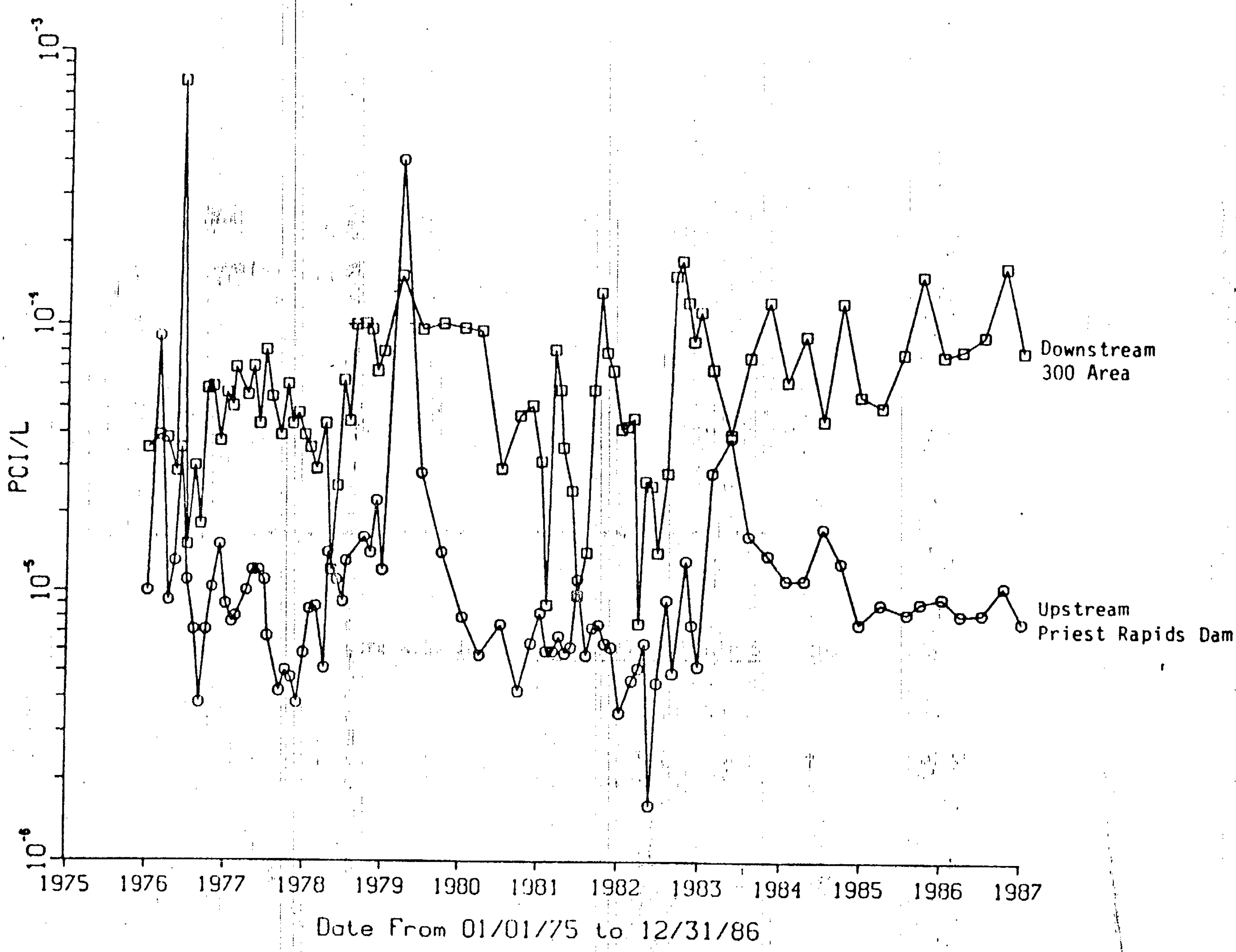
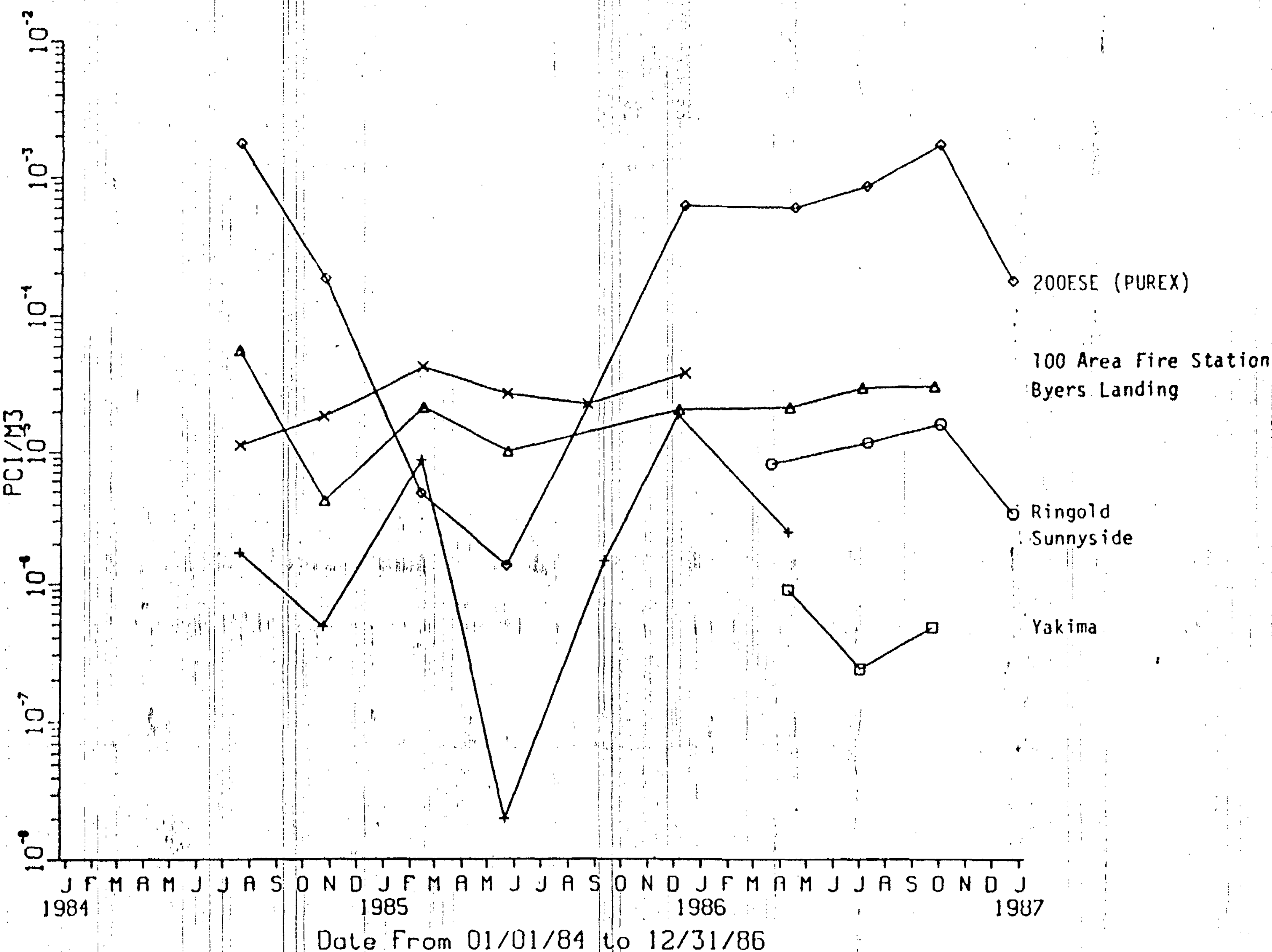


Figure A.3: Iodine-129 at All PNL Air Stations



APPENDIX B

QUESTIONS AND ANSWERS

DSHS I-129 TASK FORCE QUESTIONS

TO THE

INTERCONTRACTOR WORKING GROUP

I. SCOPE OF THE INTERCONTRACTOR WORKING GROUP

1. Is the investigation concluded with the distribution of the IWG Report? If not, what are future investigative plans?

Answer: With the publication of the data compilation report, the IWG job is considered complete. Individual projects, waste management, Hanford environmental monitoring, and BWIP will be continuing with I-129 investigations that are pertinent to their area of interest.

2. If the investigation is completed with this report, how will questions initially raised by the IWG be answered?

Answer: Based on the IWG understanding of their charge as issues were addressed some of them were dropped since they were beyond the limited scope of their investigation. There is no current official plan to address questions that were initially raised by the IWG though some questions may be answered in other program's investigations.

3. Please clarify the scope of the IWG. In one document, the scope was suggested to be expanded beyond ground water if appropriate. Another document says that the IWG's scope is to gather, not analyze data (M. L. Brown memo to J. L. Deichman). (It appeared much broader in the December 16, 1986, letter from J. L. Deichman to those listed).

Answer: The IWG only considered the ground water. They did not look at other aspects of the overall monitoring program. Also the scope of the IWG was not to analyze data in terms of its implications, but rather to evaluate the I-129 data's credibility. The December 16, 1986, presentation was an effort to narrow the scope.

II. DATA COMPILATION REPORT

1. Why are the preliminary conclusions drawn by the IWG not included in this report (see J. L. Deichman's presentation in December 1986)?

Answer: Some preliminary conclusions by the IWG were considered in this report although many were considered outside the scope of the project. All information collected was turned over to Westinghouse to be considered by individual projects. No technical information was screened out. A major question to be considered was whether the report should be a technical report or should be written in a manner the media could understand. The decision was made to keep the writing at a technical level. The media and general public's understanding was not considered.

2. Why did the scope of the investigation change for the IWG from the forward "to....evaluate any and all information on I-129" to merely presenting available data as stated in the Introduction? The scope appears to have narrowed within the report itself.

Answer: Again, the problem is with the word "evaluate". The IWG definition equates evaluate with merely establishing the credibility of data. Because the resource of time was short, a decision was made not to make interpretations but rather provide data to others to interpret.

3. In a presentation given by V. G. Johnson on May 14, 1987, he concludes that borehole or sample contamination appears to be unlikely explanations for the occurrence of I-129 in well DB-7. Please clarify your conclusions concerning contamination found in that well.

Answer: This was an informal briefing to thrash out a position and try to come to conclusions. The IWG cannot explain the I-129 in well DB-7 but the data cannot be thrown out. The iodine levels are not natural. The cause is unknown. A lack of tritium seems to rule out the waste disposal sources. The geology doesn't make it very probable that it would be from uranium ore deposits. Although hydraulically connected to the Yakima River, contaminants do not flow from the river to that location. Obviously, more work needs to be done. Perhaps new wells drilled and definitely more samples need to be collected. The BWIP Hydrology Group is preparing a position paper on this subject and will provide copies to the media and to the state when it is available.

4. In the IWG report under Findings, it states that "Current I-129 analytical methods have detection sensitivities approaching natural background levels (pre-1964); however the techniques used in collecting some of the samples were inadequate to support the detection sensitivity of the analytical methods." What was done wrong in collecting the samples? How were the samples invalidated?

Answer: An evalution in the analysis and collection of samples for I-129 transpired over the years. I-129 analysis is very sensitive and requires that careful collection of samples be made. Credibility of data cannot be assured when improper or used collection containers were used. It is not always clear if wells were properly cleaned out (through pumping) after well installation or before sample collection. "Well christening" ceremonies (urinating) were not uncommon events at the completion of well construction. Wells sampled with air lift pumps introduced airborne I-129 contamination as well. In later years, there was coordination between lab/field/drilling crews to ensure the integrity of the samples. Recent data, probably after 1979, is good for the confined aquifer.

5. Under Findings it states that no current applicable regulatory standards presently appear to be exceeded. A review of the Iodine reference documents, however, indicates that standards have been exceeded at one point or another. Why was that issue not addressed in this report? What was the reason for a lack of corrective action when those standards were exceeded?

   Answer: The IWG was not able to answer why action was not taken in the past when regulatory standards appeared to be exceeded. However, at this time, at ten percent of the allowable concentration, a disposal site (crib) is abandoned though drainage still continues after abandonment. At that point, after the standard has been exceeded, there is no feasible action to take other than to abandon the site.

6. In the report in the "Introduction" it says under one bullet "to be alert for potential security issues". Why are environmental issues security issues?

   Answer: Care had to be taken to ensure that no possibility existed for tracing I-129 levels back to reprocessing plants and classified work being done. The original work was not done for the DOE but as a tracer to the source. Those early methods that were developed at Hanford were considered classified. Care had to be taken not to uncover that classified material. At this time, however, environmental data is not classified, but an indication of total I-129 produced could indicate production rates. That information must remain classified.

7. Constant reference is given to the derived concentration guides (DCG) of the U.S. Department of Energy (U.S. DOE). However, in the 1986 PNL annual report, as well as this report, it says that these DCGs are draft or proposed.

   Answer: Though the DCG is not currently part of an active DOE order, letters from headquarters have been sent to field offices requiring that the DCG's be used on an interim basis until the complete orders come out. They are, therefore, required but the orders themselves remain in a draft state.

8. A statement is made that "Most elements of technology were available by the mid-1970s to properly sample and acquire site baseline knowledge". That statement indicates that by 1975, sampling had been done correctly and analyzed correctly for I-129. This seems to contradict the statements made throughout the report questioning the validity of such data.

   Answer: The key word is "most". By 1973, procedures were in place. By 1978, sampling procedures necessary to enable detection limits to be reached had been developed.

9. On page 1-8 of the IWG document, its states that documentation was not found to support the injection hypothesis. Has the investigation on this particular point ended?

Answer: Though many people remembered that there was an injection into the unconfined aquifer, injection into the confined aquifer cannot be discerned by looking at the documentation.

10. This report shows a generalized stratigraphy of the Hanford site which to a casual observer gives the impression that no aquifer intercommunication locations exist. It is recognized, however, in a number of the Iodine reference documents that intercommunication does exist. Why wasn't an interpretation of those cross sections and an inclusion of an illustration showing an intercommunication cross-section included within this document?

Answer: The IWG stated that an interpretation of stratigraphy was not part of their charge. This area is being addressed in the BWIP site characterization plan.

11. In the reference documents there was an unreferenced Iodine plume map (unconfined aquifer) of the Hanford Reservation which indicates that at some point someone had evaluated the total extent of the Iodine plume. Unfortunately, no date nor reference is included on that map. In this report, the only indication of the Iodine contamination in the unconfined aquifer is expressed as coincidental with the Tritium plume map. The Tritium plume map, however, shows a less extensive Iodine plume than the map included in the reference documents. Why was no Iodine plume map for the unconfined aquifer included in this document and a complete evaluation of the extent of such contamination performed?

Answer: Iodine data in the unconfined aquifer is too limited in quantity to be able to construct a valid I-129 plume. The I-129 distribution should, however, follow the tritium and nitrate plume allowing for differences in the half-life of I-129 versus tritium.

12. A reason given for much of the data to be invalid is that NQA-1 requirements for documentation are not followed for the earlier data. Information within the reference documents, including a technical question contained in Mr. Deichman's presentation in December 1986, indicates that NQA-1 is still not complied with. Given the reason in this document for the lack of validity for the data due to NQA-1, no data is any good that is currently being produced by Hanford. Even though NQA-1 was not applicable at the time, most laboratories have had some kind of a QA program to check the consistency of results. Wouldn't this add to the validity of some of that pre-1983 data?

Answer: The problem with NQA-1 requirements is limited to documentation for licensing only. The monitoring program has complied with NQA-1 for about one year.

13. Figure 4-5 illustrates wells having significant contamination over the years. However, the text associated with that graph is not clear. For example, "First the linear trend over a ten decade range in concentrations is remarkable. This implies dilution from a single source." Clearer definition and discussion of this graph is needed.

    Answer: The interpretation of source is different. While the state considers each reprocessing plant as an individual source, the intention in this report was to indicate that the 200 Areas in total was considered a single source.

14. On page 4-21, it says that the ranges listed on Table 4-4 indicate the range of most results, but do not always include the lowest or highest values since some values were screened out because they were probably invalid analyses. What justification for invalidating those data is given?

    Answer: Data that was considered to be an outlier are not included in the data evaluation. However, all sample results are included in Appendix D.

15. Given that most Iodine problems appear directly adjacent to the Redox and Purex plants, could you please explain the interaction between this area and the area of intercommunication north of 200 East area that would result in contamination of the deeper aquifers. Were there sufficient quantities of Iodine released to Gable Mountain pond or 200 North that would result in significant migration to the confined aquifers?

    Answer: The IWG does not have data on this topic. It was outside the scope of the investigation. No information can, therefore, be shared here.

16. There is an indication in this document that sampling methods could be responsible for the introduction of contamination in samples collected. If that is the case, the subject is not discussed in any detail in this report. How would that have impacted the potential for sample cross-contamination?

    Answer: Refer to answer number 4 in this section.

17. There is no indication of total releases of Iodine-129 (curies per year). The Iodine reference documents do contain information for airborne releases but none was found for liquid releases. A stated objective of the report was to include all current and past source terms for I-129. Why was this not included in the report? Can an accurate estimate be made of total Iodine releases from all of the production reactors and reprocessing plants?

Answer: There is no data available to answer this question. Liquid and solid wastes to the ground are not quantified.

18. Why were no recommendations included to sample agricultural products by the IWG?

Answer: It was outside of the scope of the IWG.

19. Given the five boxes of Iodine reference documents which the state received, we were surprised by the lack of references cited in the main evaluation and text of this report. What is the reason for this and why weren't more of the documents which do contain valuable information cited as references?

Answer: The lack of references that could be accurately documented contributed to the narrow scope of the investigation. Other working groups like BWIP, Hanford Environmental Monitoring Groups and Waste Management will be looking further into additional references.

20. Table D-3 gives Iodine-isotopic analysis results on seasonable rain and snow water samples, some of which indicate fairly high concentrations of Iodine-129. Was an analysis done in this investigation and a comparison made of the total rain and snowfall in the area to determine what the total deposition of Iodine may have been during that time? If not, are there plans to do so?

Answer: No analysis of data was done for this report. Further analysis will be done as part of other reports. Elevated I-129 concentrations may be attributed to weapons testing or production.

21. As part of a QA program, which other labs are currently able to analyze I-129 at environmental levels (10^{-6} pCi/l)? Are these labs used to cross-check analyses?

Answer: In addition to PNL, the University of Arizona and the University of Rochester are the only labs able to measure I-129 at environmental levels. There is no cross-checking performed.

22. Consistency in analysis can be established through replicate analyses. Results from a set of replicate analyses in Appendix D, sample 5511341, ranged from 4 to 2800 pCi/l. What is the explanation for this spread of data. In using this data, which is the "good" data?

Answer: All I-129 data is included in this report. "Let the User Beware".

23. The report states (page 4-12) that confidence in using I-129 data will come from trend analyses. How do we use these data to evaluate health risks or establish adequacy?

Answer: Data outliers can be spotted from trend analysis. Over a long period of time, buildup in the environment can be discerned.

24\. On page 1-8 it states "migration of ground water I-129 to the Columbia River has occurred, as evidenced by higher concentrations down stream than upstream from the Hanford site." Where is the data that substantiates this statement? Where is the I-129 sampled upstream?

Answer: Available data can be found in past annual reports. Upstream sampling is done at Priest Rapids Dam five miles north of the Vernita Bridge. Downstream samples are taken near the 300 area.

III. DOSE ASSESSMENT

1. Is U.S. DOE monitoring for compliance with the Clean Air Act?

   Answer: Yes.

2. Does the dose calculation that appears in the PNL annual report include I-129? How is the difference in calculated results resolved?

   Answer: Yes, I-129 doses are included in the PNL dose calculation. Dose assessment is based on source term and modeling. The DSHS results are substantially different (higher) primarily for the following reasons: (1) a much longer environmental half-life, based upon grass data from 1974-78 (PUREX not operational), than the 14 day half-life used by PNL; (2) measurements based upon dry rather than wet weight; and (3) assumed ground-level release rather than 89 meters, the height of PUREX main stack. (NOTE: DSHS has performed a preliminary analysis of dose from exposure to I-129. See Appendix __, "Dose Assessment".)

IV. STANDARDS

1. In a memo from G. F. Booth to B. E. Knight dated May 14, 1984, Mr. Booth says that; (1) I-129 is not sampled routinely in violation of Rockwell standards and (2) that I-129 is being discharged to Table 1 concentrations which would be a violation of DOE standards. What was done? What is currently monitored? Has this inadequacy ever been corrected? Why wasn't this issue discussed in the report, as it has major implications for the Hanford ground water?

   Answer: Effluent data did show higher than normal readings, however, further analysis of I-129 indicated no violation of Rockwell and U.S. DOE standards. Effluents are currently monitored routinely for I-129.

2. Please explain the exemption of I-129 expressed in Rockwell's Environmental Protection Manual that normally requires shutting down a crib at ten percent of Table 2 concentrations. For Iodine that would equal six picocuries per liter, which is exceeded in Purex area ground water sampling locations. Documentation included in the reference documents indicate that this exemption is no longer needed (Hughes memo to Wiegman on RHO-MA-139). Justification and an explanation would be appreciated.

   Answer: Most internal regulations come under ALARA. If ALARA is exceeded, then analysis is made to determine the feasibility of shutting down operations and taking corrective action. Current procedures contain no exemption for I-129. The goal is to reach zero release by the year 2000. The ten percent of Table 2 standard is used primarily to ensure that the soil column is not saturated. This is particularly important for the less mobile radionuclides.

3. Rockwell's environmental protection manual states that all older facilities shall meet the requirements for new facilities specified in Section D as soon as technically and economically practicable. Section D further states that annual average concentrations of radionuclides released to the environment in airborne effluents shall not exceed the MPC specified in Table 2, Appendix A of this manual at the point of release. In 1984, the average Iodine-129 concentration in airborne effluents from Purex was 4×10^{-11} microcuries per ml. Table 2 is 2×10^{-11} microcuries per ml. Since the PUREX plant was modified for restarting in late 1983, it either should have had to comply immediately with the Table 2 concentration, or, if the interpretation is that it is an older facility, immediate plans should have been made to bring it into compliance. What plans have been developed?

   Answer: The calculated projections of I-129 were close to the Table 2 values. However, the new standard, the Derived Concentration Guide, is significantly greater than Table 2 values (there is a built-in margin of protection). All I-129 emissions comply with that DCG standard. It should also be added that the PUREX Plant did add a fourth filter bank to reduce any particulate emissions to bring it into compliance with Rockwell's environmental protection standards.

4. Another document cites a main stack exhaust in 241-AW exceeding Table 2 concentrations for two months in 1986. A deviation was then prepared. It is our understanding that a deviation is prepared only until the facility can come into compliance. Has the problem that resulted in these emissions been corrected at this time? If not, what is the status of this deviation and what is the purpose of a deviation when internal standards are exceeded?

Answer: It is important to note that Table 2 concentration standard was for a yearly average. The yearly average for I-129 was in compliance with Table 2. Concerning deviations, if there is a good reason as determined by management that a deviation is required, then one is allowed. However, their current goal is to modify procedures so they do not have to operate under deviations all of the time.

V. SOURCE TERMS, PATHWAYS, MONITORING

1. As a result of this investigation, has the issue of travel time in the unconfined aquifer cleared up any? The I-129 reference documents postulate varied travel times from the 200 Areas to the river.

Answer: A new document to be published by PNL will address this issue. That question was not within the scope of the IWG.

2. In a document entitled "Environmental Concerns 1984" dated 1984, one of the environmental concerns cites tank pressurizations resulting in untreated, unsampled airborne releases that perhaps violate DOE requirements. This situation has serious Clean Air Act implications. Was this area addressed in the investigation? If so, what were your conclusions?

Answer: In single shell tanks, there are a number of emission sources due to structural behavior and pressure surges that occur. Not all emission points can be monitored and emission rates are highly variable. In 1985, Rockwell did extensive sampling around the tanks and found no violation of standards. Single shell tanks have since been sealed so there are no unmonitored emission points. The tanks are kept at negative pressure to mitigate atmospheric pumping. No problems have been noted with the newer double shell tanks though internal Westinghouse audits have uncovered several areas in the tank farm surveillance program that do need improvement. Environmental monitoring activities have been expanded inside the tank farms to ensure continuous compliance with internal and federal regulations.

3. Is there a reason given for the paucity of data in off-site agricultural products? The few analyses that are to be found in the Iodine reference documents indicate a positive impact from Hanford operations. Why was no additional sampling ever done?

Answer: Even though preliminary numbers did indicate a positive impact from Hanford operations, the numbers were considered too low to be a health threat. Also due to the high cost of I-129 analyses, comprehensive sampling must be limited. However, currently, the most significant environmental pathways are sampled and analyzed for I-129. The milk analyses are considered to be the key indicator for monitoring levels of I-129 in the environment.

4. Has the unconfined aquifer been evaluated to determine if particular zones within the aquifer tend to concentrate or have higher concentrations of radionuclides than other zones? Is the concentration found in these wells merely dependent on the depth of the sampling within the aquifer or is it a true indication of the actual ground water concentrations (i.e., are samples being collected from the unconfined aquifers accurate representations of the actual ground water concentrations)? There are indications in the 1986 PNL annual report that digging a new well deeper into an aquifer actually reduces the concentration observed due to dilution. How representative of the unconfined aquifer is the current and previous sampling projects?

   Answer: The evidence shows dispersion. PNL has not seen pockets of concentrations. The concentration, rather, is dependent on depth, is the most concentrated at the surface of the aquifer and becomes less concentrated with depth though some mixing does occur. The current monitoring program basically samples the surface of the aquifer which would be the most contaminated portion.

5. What is the routine program for sampling effluents from PUREX for Iodine and other mobile radionuclides?

   Answer: There are five liquid streams. Each is monitored with flow proportional meters and flow totalizers. Weekly composites are analyzed for gross alpha and beta. A number of isotope-specific analyses are done as monthly composites. This data is found in the Rockwell effluent reports.

6. Have you evaluated all environmental monitoring and analytical procedures for Iodine and if so, do you consider them to be adequate?

   Answer: Yes to both questions.

7. In a letter from G. F. Booth to B. E. Knight, Mr. Booth attests to a Tc-99 sampling deficiency in PUREX preoperational monitoring with a strong recommendation that it be accomplished. (Tc-99 is a good tracer and indication of the presence of I-129.) Has it been completed and has a report come out to supplement the EIS or preoperational survey report?

   Answer: Booth made suggestions on the basis of funding available and not necessarily upon the need. Well samples were taken and archived. These wells are not part of the Battelle program. There is no supplemental report planned.

8. Is there any monitoring of I-129 in the FFTF drinking water well and any other drinking water wells, past or present, on the Hanford Reservation?

Answer: Not in drinking water wells on the reservation or at WNP-2. However, a well within the fence of FFTF and WNP-2 is monitored.

9. Why has DOE monitoring of Iodine-129 been primarily and almost exclusively in ground water?

   Answer: I-129 has been looked at as a tracer and not as a health threat.

10. In view of high Iodine-129/127 atom ratios data and high Iodine-129 concentrations in the environment, why has there not been more surface environmental Iodine-129 monitoring done?

    Answer: See answer to questions 3 and 9, this section.

11. The Figure 4-4 shows consistently higher concentrations in the Wanapum region than the Saddle Mountain region. Does this imply vertical mixing through this region?

    Answer: This question was outside of the scope of the IWG but rather relates to BWIP and will be addressed by BWIP hydrology.

12. Why are there no inventories of I-129 given in the Waste Information Data System? All are listed as "0".

    Answer: No specific waste site inventories have been evaluated.

VI. ORGANIZATION, COMMUNICATION, COORDINATION

1. In Rockwell's Environmental Protection Manual, it states in Section L that prior to start up of a new disposal site, a baseline study must be conducted in accordance with the requirements of DOE Order 5484.1, Chapter 3. Has a baseline study in the ground water been conducted for the 216-A-45 crib which receives Purex effluent? Did it include I-129?

   Answer: A baseline study report was released in January 1987. The I-129 baseline was not specifically covered because of data availability from nearby wells.

2. Why was no follow-up sampling conducted following the 1966 to 1975 special sampling program even though it was highly recommended in a number of the Iodine reference documents?

   Answer: This question cannot be answered to anyone's satisfaction. However, this was the time that most reactors were shut down resulting in a funding shortage. Funding was therefore probably not allocated though some follow-up sampling in the confined aquifers was performed.

3. In 1965, ground water concentrations were extremely high adjacent to the S-7 crib and A-10 cribs. What happened at that time during the operations of the Redox and Purex plants to result in such high concentrations of I-129? Was it a gradual increase or was it a sudden release that may have occurred? What is happening now in the Purex plant to prevent a reoccurrence of this high a concentration? Is it merely coincidence that the high concentrations in S-7 and A-10 were only one day apart or was that due merely to the sampling schedule?

Answer: This subject is not within the scope of the IWG. To prevent reoccurrence of high I-129 concentrations cribs are shutdown when sampling concentrations are ten percent of the DCG (there are no deviations for I-129).

4. Are coordinates available for wells sampled off-site so they can be accurately found again (i.e., the Potato Plant, Ringold, Hildebrant, Hatch, Green Plant, etc., etc.)?

Answer: Coordinates that are available will be provided to the state. (Later, coordinates wer given for three of the stations. The others may be obtained from the Department of Ecology).

5. In one of the Iodine reference documents a question was asked, why confined aquifer data was classified while unconfined aquifer data was not. The original reason given to the state for the classification of data was due to analytical procedures. This question seems to contradict that reason. Could we please have an explanation?

Answer: There is some question about the validity of the handwritten note. Since this is the subject of a GAO investigation, an answer is not appropriate at this time. It should be stressed, however, that all environmental data is not unclassified. It is all included in the data compilation document.

6. Why has the sharing of information at Hanford been so difficult? Why has data been available for so long on Iodine-129 and in concentrations that are very significant in past years yet, in spite of that significance, no explanation or discussion is included in ERDA-1538, in the Purex EIS, in the Purex Final Safety Analysis Report, in the Defense EIS, or in the BWIP Environmental Analysis? Was it a communication problem, a turf battle problem between research and environmental monitoring or was it a desire to withhold information? If it is the latter, what is your evaluation of the current situation?

Answer: There was no clear answer but the Defense Environmental Impact Statement (final) will address the issue. The environmental analysis did reference those documents that are accurately referenceable. In the PUREX EIS, I-129 was not considered a health impact, therefore, it was not addressed. The same for other older documents. ERDA 1538 was too early for available data to be included. Also that data was classified at the time.

7. The Hanford Reservation has an ultimate goal of reaching drinking water standards at the end of institutional control. An item of concern in the iodine documents includes comments made to a revision of Rockwell's Environmental Protection Manual, where a significant objection is noted by Rockwell personnel for meeting the drinking water standards. This same type of conflict is evident in other areas as well, where environmental standards are discussed. What is the authority of safety personnel for ensuring that all of the proper and appropriate standards are included in safety manuals and are enforced?

   Answer: Safety personnel have absolute authority over all federal laws as well as for internal standards. They have no authority below that unless a standard is adopted. DOE does hold the contractors to internal standards at this time.

8. What is the impression of the Hanford intercontractor working group on the high ratio of I-129 to I-127? Should that be a matter of concern?

   Answer: The IWG has no impression.

9. What is the mechanism for ensuring that recommendations made by the IWG are incorporated into everyday operations at Hanford?

   Answer: Communication is the link to ensure recommendations made by the IWG are incorporated into every day operations. These matters are discussed at top level and will be followed up. Recommendations will be reviewed on a six-month interval.

10. A preliminary finding of the IWG is that there appears to be no integration between the principal programs and indeed a "pass the buck" attitude exists. What has been done to ensure that that deficiency has been corrected?

    Answer: Improved communication is necessary to ensure program goals are met and integrated into a larger picture.

11. Have you found any evidence that Iodine-131 was used as a well tracer and may have been contaminated with I-129?

    Answer: I-131 was sometimes used in a logging procedure. It may have been contaminated by some I-129.

12. How did a large discrepancy occur in Purex ____ Condensite samples analyzed both by the 222-S lab and V. Subramanyam? (1,000 vs 5,000 pCi/l). How was this discrepancy resolved?

Answer: The problem was with analytical methods. The analytical procedures were different resulting in an over estimation of concentrations. Appropriate procedures have been developed for accurate analysis.

13. Why did it take 11 years to release the Brauer/McFadden Report?

Answer: Brauer was never requested to write the document. After writing, the clearance process was too much a problem so the document was put on a shelf, though the data was transmitted and a contractual responsibility fulfilled.

APPENDIX C

DOSE ASSESSMENT

APPENDIX C

Task Force Preliminary Dose Assessment for ^{129}Iodine in the Hanford Vicinity

Summary

Table C-1

Year(s)	Location	Data			Env. Half-life	Result mrem/yr infant thyroid
		Source term Ci/yr	Field data	Medium		
1958-63	Benton Co.		39 pCi/kg dry (?)	grass		12.8
1972	Station F		5.2 pCi/kg dry	grass		1.7
1972	Station D		12 pCi/kg dry	grass		4.0
1986	Station F	0.5			14 days	1.6
1986	Station F	0.5			0.53 yrs	3.0
1986	Station F	0.5			0.53 yrs	6.7*
1986	Sagemoor		0.034 pCi/L	milk		0.15

* Corrected for cows grazing on pasture 6 months per year and eating stored feed six months per year. (Other results were based upon the assumption that cows graze on the same grass every 30 days the year around.)

CALCULATIONS

1. 1958-1963 Maximum Benton County Infant Milk Dose

It was initially not known whether the following data was in wet weight or dry weight. Upon consultation with PNL, it was learned that the concentration was probably in dry weight and that the sample location may have been on the the Hanford site.

39 pCi/kg (dry?) grass (upper range of values in Ref. 4 and Ref. 7)
Wet weight of pasture equals 4 times dry weight (Ref. 10).
C(Benton County wet wt) = 39/4 pCi/kg = 9.8 pCi/kg
330 liter/yr infant milk consumption (U_a^D) (Ref. 8)
6 x 10^{-3} day/liter (F_m) stable element transfer data for cow milk (Ref. 8)
50 kg/day (wet) (Q_F) milk cow consumption rate (Ref. 8)
1.33 x 10^{-2} mrem/pCi (DFI_{ija}) I-129 ingestion dose factor for infant (Ref. 9)
D_{ija}(Benton County) = Dose to organ j of age group a from isotope i from Benton County.

Milk, Infant Thyroid Maximum

$$D_{ija}(\text{Benton County}) = \overline{U}_a^D \, C(\text{Benton County wet wt}) \, F_m \, Q_F \, DFI_{ija}$$

$$= \frac{(330 \text{ L})(9.8 \text{ pCi})(6 \times 10^{-3} \text{ d})(50 \text{ kg})(1.33 \times 10^{-2} \text{ mrem})}{\text{yr} \quad \text{kg} \quad \text{L} \quad \text{d} \quad \text{pCi}}$$

= 12.8 mrem/year thyroid infant milk

(Had the concentration been in terms of wet weight, the result would be 4 times 12.4 = 51.2 mrem/yr.)

2. 1958-1963 Average Benton County Infant Milk Dose

12 pCi/kg (dry?) grass average (C(Benton County)) (Ref. 7).

Milk, Infant Thyroid Average

$$D_{ija}(\text{Benton County}) = \frac{(330 \text{ L})(12/4 \text{ pCi})(6 \times 10^{-3} \text{ d})(50 \text{ kg})(1.33 \times 10^{-2} \text{ mrem})}{\text{yr} \quad \text{kg} \quad \text{L} \quad \text{d} \quad \text{pCi}}$$

= 4.0 mrem/year thyroid infant milk average Benton County 1958-1963

3. 1972 Stations F and D

Data was taken within and at the boundaries of the Hanford Reservation from which we can calculate theoretical infant milk doses at the boundaries.

Station F is at the crook in the Yakima River on the southern boundry of the Hanford Reservation. Station D is west of the Columbia River on the east side of the Hanford Reservation. For Station F and D locations see Ref. 1.

5.2 fCi ^{129}I/g (Dry Weight) Station F (Ref. 1)
Wet weight of pasture equals 4 times dry weight (Ref. 10)

This equals 1.3 pCi ^{129}I/kg (Wet Weight)

$$D_{ija}(\text{Station F}) = \frac{(330 \text{ L})(1.3 \text{ pCi})(6 \times 10^{-3} \text{ d})(50 \text{ kg})(1.33 \times 10^{-2} \text{ mrem})}{\text{yr} \quad \text{kg} \quad \text{L} \quad \text{d} \quad \text{pCi}}$$

= 1.7 mrem/year infant thyroid

At Station D the grass concentration of I-129 in 1972 was 12fCi ^{129}I/g (Dry Weight) (Ref. 1).

This equates to 4.0 mrem/year infant thyroid.

4. Potential Equilibrium Dose at Station F

For station F location, see Ref. 1.
Windrose: NW 40% of time at 3.8 km/hr (Ref. 1)
N 17% of time at 2.3 km/hr
Station F lies 22.5 km SSE of PUREX Plant midway between lines drawn through above wind rose bars. Therefore let us take the weighted average of
NNW 29.5% of time at 3.24 km/hr = 0.90 m/sec
Assume stability class C on average (this agrees well with average Chi/Q data from Ref. 6)
At 22.5 km, $sigma_z$ = 1000 meters (Ref. 12)
H = 89 meters (effective stack height as per personal communication from J. K. Soldat)
Q = 0.5 Ci/yr = 1.58×10^{-8} Ci/sec

$$\text{Chi ave} = (2.03\ Q/\text{sigma}_z\ ux)\ \exp\left((-1/2)(H/\text{sigma}_z)^2\right) \quad \text{(Ref. 12, eq. 5.13)}$$

where

Chi ave = average air concentration for sector where calculated (Ci/m^3)
Q = release rate from stack (Ci/sec)
$sigma_z$ = standard deviation of plume dispersion in the z direction (m)
u = average wind speed (m/sec)
x = distance downwind from the stack (m)
H = effective height of the stack (89 m)
(0.295) = fraction of time wind is blowing towards sector of interest

$$\text{Chi ave} = (0.295)((2.03\ 1.58 \times 10^{-8})/(1000\ 0.9\ 22{,}500)) \times \exp\left((-1/2)(89/1000)^2\right)$$

$$= 4.7 \times 10^{-16}\ Ci/m^3$$

$$C_a = 4.7 \times 10^{-4}\ pCi/m^3$$

$$C_f = (C_a V_D R\ (86{,}400\ \text{sec/d})/Y_f)((1 - e^{-30\ \text{lambda}_E})/\text{lambda}_E)$$

where

C_f = concentration in forage (pCi/kg wet weight)
C_a = average concentration in air (pCi/m^3)
V_D = deposition velocity = 10^{-2} m/sec for elemental iodine (Ref. 11)
R = retention factor = 0.25
30 = number of days grass grows between grazings
$lambda_E$ = ln 2/(14 days) = effective environmental constant
Y_f = yield of forage = 1.3 kg/m^2

Therefore,

$$C_{fF} = \frac{(4.7 \times 10^{-4}\ pCi/m^3)(10^{-2}\ m/sec)(0.25)(86{,}400\ sec/d)}{(1.3\ kg/m^2)} \frac{(1 - e^{-30 \times 0.05})}{(0.05\ 1/d)}$$

$$= 7.8 \times 10^{-2}\ pCi/kg\ d \times 15.6\ d$$

$$= 1.2\ pCi/kg \text{ wet on pasture at station F}$$

Milk, Infant Thyroid

$$D_{ija}(F) = \frac{(330\ L)(1.2\ pCi)(6 \times 10^{-3}\ d)(50\ kg)(1.33 \times 10^{-2}\ mrem)}{yr \quad kg \quad L \quad d \quad pCi}$$

= 1.6 mrem/year infant thyroid at Station F with Q = 0.5 Ci/yr

But this calculation assumes an environmental half-life of 14 days. If the net half-life is longer, the dose is higher.

At station F (Ref. 1) the concentration of ^{129}I in grass went from 5.2 fCi ^{129}I/g (dry weight) immediately after shutdown of the PUREX Plant in October 1972 to 0.57 fCi ^{129}I/g (dry weight) in June 1978 (Ref. 1). That is only 3.2 half-lives in 1.7 years and 2.8 half lives in the next 4.0 years. Other stations show the same general trend. If the system were operating with a 14 day half-life, there should be 43.5 half-lives in 1.7 years. It appears that the modeling is incorrect. Let us recalculate the dose using the 0.53 year half-life from 1972 to 1974.

$$\text{lambda}_E = \ln 2/(0.53\ yrs \times 365\ d/yr)$$

$$= 3.6 \times 10^{-3}\ d^{-1}$$

$$C_{fF} = \frac{(4.7 \times 10^{-4}\ pCi/m^3)(10^{-2}\ m/sec)(0.25)(86{,}400\ sec/d)}{(1.3\ kg/m^2)} \frac{(1-e^{-30 \times 3.6\ E-3})}{(3.6\ E-3\ d^{-1})}$$

$$= 7.8 \times 10^{-2}\ pCi/kg\ d \quad \times \quad 28.5\ d$$

= 2.2 pCi/kg wet on pasture at station F

$D_{ija}(F)$ = 3.0 mrem/year infant thyroid at Station F with Q = 0.5 Ci/yr

The actual dose, however, would be higher than for the simple calculation for cattle grazing year around every 30 days. Assuming a more or less constant source of ^{129}I emission to the air, the ^{129}I should build up during the winter months when the cattle are not grazing on pasture. There should be an ^{129}I spike in the spring during the first grazing and in the first cutting of stored feed. If the early environmental half-life of ^{129}I is indeed about 0.53 yrs, much of the year-around deposition on the pasture would be consumed as well as much of the year-around deposition on the stored feed crop. Thus the total ^{129}I consumed by the cattle would be about twice that calculated from year-around grazing on pasture. We can calculate the net effective concentration and dose as follows.

Effective Concentration and Dose:

Assume cattle graze 6 months per year and are on stored feed 6 months per year.

Assume cattle graze on pasture every 30 days during the growing season.

There would be 3 and at most 4 cuttings of stored feed per growing season. Assume it is 4.

During the first grazing the cattle would be exposed to 215 days (i.e. 7 mo.) of deposition of ^{129}I. During the second to sixth grazing the cattle would be exposed to 30 days of deposition each grazing. The first cutting of stored feed would be exposed to 230 days (6 mo. + 45 days) of deposition of ^{129}I. The second through fourth cuttings would be exposed to 45 days of deposition of ^{129}I.

Assume the environmental half-life of 0.53 years. $\text{Lambda}_E = 3.6\text{ E-3 d}^{-1}$.

$$C_{fF\text{ 1st grazing}} = 7.8 \times 10^{-2}\text{ pCi/kg d} \times \frac{(1 - e^{-215 \times 3.6\text{ E-3}})}{(3.6\text{ E-3 d}^{-1})}$$

$$= 11.7\text{ pCi/kg}$$

$$C_{fF\text{ 2nd through 6th grazing}} = 0.078\text{ pCi/kg d} \times \frac{(1 - e^{-30 \times 3.6\text{ E-3}})}{(3.6\text{ E-3 d}^{-1})}$$

$$= 2.2\text{ pCi/kg}$$

$$C_{fF\text{ 1st cutting}} = 0.078\text{ pCi/kg d} \times \frac{(1 - e^{-230 \times 3.6\text{ E-3}})}{(3.6\text{ E-3 d}^{-1})}$$

$$= 12.2\text{ pCi/kg}$$

$$C_{fF\text{ 2nd through 4th cutting}} = 0.078\text{ pCi/kg d} \times \frac{(1 - e^{-45 \times 3.6\text{ E-3}})}{(3.6\text{ E-3 d}^{-1})}$$

$$= 4.2\text{ pCi/kg}$$

$$C_{fF\text{ net effective}} = ((1/12)11.7 + (5/12)2.2 + (1/8)12.2 + (3/8)4.2)\text{ pCi/kg wet}$$

$$= 5.0\text{ pCi/kg wet}$$

Therefore, $D_{ija}(F)$ = 6.7 mrem/year infant thyroid at Station F with Q = 0.5 Ci/yr.

Thus the effective concentration is increased by a factor of 2.3 from the value of 2.2 pCi/kg calculated above.

It is difficult to harmonize the results of parts 1 through 4 with the low concentrations of ^{129}I measured in milk in 1986, the year of the highest recorded release of ^{129}I. Note the milk dose calculation following.

5. 1986 Sagemoor Milk Dose

Sagemoor Area Composite had the highest measured ^{129}I milk concentration in the Hanford vicinity in 1986. The maximum concentration was 0.034 pCi/L (Ref. 6).

$$D_{ija}(\text{Sagemoor}) = \frac{(330\text{ L})}{\text{yr}}\frac{(0.034\text{ pCi})}{\text{L}}\frac{(1.33 \times 10^{-2}\text{ mrem})}{\text{pCi}}$$

$$= 0.15\text{ mrem/ year infant thyroid}$$

This measured result is much lower than the doses modeled from source terms and measured grass concentrations. It is even an order of magnitude lower than the Battelle draft modeling from the source term (see Table C-2 below) distributed at a meeting with the task force.

Table C-2

PNL Calculated Radiation Dose to the Thyroid of an Infant at Riverview From I-129 released from the PUREX Plant Stack

Item	Starting Point for Dose Calculation: Release	Air Conc.	Milk Conc.
Release, Ci/yr	0.5[a]	--	--
Air, pCi/m^3	1.2 E-4	1.5 E-5[a]	--
Grass, pCi/kg	0.32	0.039	--
Milk, pCi/L	0.17	0.021	0.013[a]
1st-Yr Dose, mrem	0.88	0.11	0.066
50-Yr Dos, mrem[b]	1.36	0.17	0.10

[a] Measured value, others were calculated.
[b] As calculated by the food chain model, ignoring migration away from the root zone. The contribution from soil uptake in each of the 50 years amounts to 1.08% of the 1st-yr dose. Therefore the ratio of 50-yr dose to 1st-yr dose is 1.54.

The first-year dose modeled from the source term in Battelle's calculations is 0.88 mrem to the thyroid of an infant at Riverview from ^{129}I. The dose calculated from the measured air concentration at Riverview was 0.11 mrem, while the dose as calculated from the milk concentration was 0.066 mrem. This is more than an order of magnitude difference between the dispersion modeling and the calculated milk value. But the Battelle modeling included the traditional 14-day environmental half-life. The extensive data in Ref. 1 indicates that the environmental system operates on a significantly longer environmental half-life than 14 days. This means that under equilibrium conditions, i.e., when the PUREX Plant is continuously operating, there may be an additional contributing factor, namely the buildup in the soil and then perhaps microbial volatilization of the ^{129}I from the soil and subsequent deposition on the grass. There was only 3.2 half-lives in the grass at station F in the first 1.7 years after the shutdown of the separations plant in 1972. This is an average half-life of 0.53 years. Using this half-life increases the computed dose by about a factor of 1.9. Correcting the dose calculations for 6 month pasturing and 6 months feeding with stored feed increases the calculated dose even more. Thus there appears to be a conflict between the modeling results and the Battelle 1986 ^{129}I milk data (Ref. 6).

The data, therefore, show a significant difference between doses based upon modeling from a source term and doses based upon field data. Note that the above table does not provide a calculated dose based upon grass concentration. Thus it leaves open to question whether the relatively high concentrations seen in past years in some grass and agricultural products are representative or merely anomalous data. The above task force calculations, based upon the limited grass data, indicate higher doses would be predicted for the pasture grass-cow-milk pathway and thus, presumably, for other edible vegetation subject to iodine deposition. There is, therefore, some question on the adequacy of milk data, considered a key indicator for environmental levels of ^{129}I concentrations in pasture grass and some edible vegetation such as leafy vegetables and fruits.

Another major problem of consistency in past and present calculations of ^{129}I dose is that 0.5 Ci/year release in 1986 (Ref. 6) resulted in a maximum dose, based on milk data, of only 0.15 mRem/year infant thyroid (see Part 5 this Appendix), whereas only 0.00045 Ci/year estimated to be released in 1972 (Ref. 1) resulted in a calculated dose, based upon pasture grass, of 1.6 mRem/year infant thyroid (see Part 4 this Appendix). If 0.5 Ci/year results in 0.15 mRem/year, then 1.6 mRem/year should come from 5.3 Ci/year instead of 0.00045 Ci/year. This is an inconsistency on the order of 10,000. It appears that the old release estimates based on scaling to I-131 may have been grossly low in the years 1945-1972. The 1985 and 1986 releases were reported as more than all the other years put together. Furthermore, it would seem reasonable that the pre-1972 airborne emission rates from PUREX would be at least as large as releases of the recent past.

The present order-of-magnitude discrepancy between modeling from source term and modeling from air and milk data could arise either from overestimation of the source term or incorrect modeling from field data. The air data would seem to confirm the milk data and thus the computed dose. However, this then conflicts with the dose based upon the source term and the dose based upon vegetation data from pre-shutdown emissions, which were probably comparable to recent emissions, notwithstanding the estimates listed in Appendix A.

In any case, the ^{129}I doses in the Hanford vicinity appear to range from 0.1 to 10 mRem to the infant thyroid, which is below the Clean Air Act standard for DOE facilities of 75 mRem/year to the thyroid.

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2. Robert C. Aldrich and Leotta J. Stanfield, "Radioactivity in Gaseous Waste Discharged from the Separations Facilities during 1985," Rockwell International, Richland, Washington, RHO-HS-SR-85-2 4Q GAS P, February 25, 1986, p. 43.

3. F. P. Brauer and N. E. Ballou, "Isotopic Ratios of Iodine and Other Radio-Nuclides as Nuclear Power Pollution Indicators," Battelle, Pacific Northwest Laboratories, Richland, Washington, October 1, 1974, BNWL-SA-5006, IAEA-SM-191-20, p. 9.

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7. F. P. Brauer, J. K. Soldat, H. Tenney, R. S. Strebin, Jr., "Natural Iodine and Iodine-129 in Mammalian Thyroids and Environmental Samples Taken From Locations in the United States," Procedings of a Symposium of Environmental Surveilance Around Nuclear Installations Held in Warsaw Poland, November 5-9, 1973, Volume 2, pp. 43-46: IAEA Vienna, BNWLSA-4694, Table VIII.

Modeling Data were taken from the following sources:

8. U.S. Nuclear Regulatory Guide 1.109.

9. J. K. Soldat, "Radiation Doses From Iodine-129 in the Environment," Health Physics (Northern Ireland: Pergamon Press, 1976), Vol. 30 (Jan.), pp. 61-70.

10. The pasture wet weight to dry weight ratio of 4:1 was taken from a phone call conversation with Joe Soldat, August 31, 1987.

11. John E. Till and H. Robert Meyer, Radiological Assessment (Washington, D.C.: U.S. Nuclear Regulatory Commission, September 1983), NUREG/CR-3332, ORNL-5968.

12. D. B. Turner, Workbook of Atmospheric Dispersion Estmates, EPA, pp. 9, 38.

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STATUS OF REQUIREMENTS FOR RESTART OF DC-24

- o THE DOCUMENTATION, DEMONSTRATING COMPLETION OF HOLD POINTS 1 & 3 FROM THE EXPEDITED SPECIAL CASE HAVE BEEN TRANSMITTED TO DOE
  - o HOLD POINT 1 RESTART OF DRILLING DC-24
  - o HOLD POINT 3 RESTART OF DRILLING DC-25

- o THE TREATMENT OF IODINE-129 IS UNDER STUDY, A FINAL DECISION WILL BE MADE PRIOR TO RESTART OF DRILLING

- o THE STATE OF WASHINGTON HAS NOT YET ISSUED A WATER RIGHTS PERMIT

- o THE TWO DRILL RIGS FOR DC-24 & 25 ARE ON STANDBY READY STATUS.

BWIP HYDROCHEMISTRY STUDIES - IODINE-129
OCTOBER 1987

IODINE-129 STUDIES

CURRENT

- o COMPLETE ANALYSIS OF SAMPLES FROM DC-18, DB-11 - OCTOBER 1987
- o ANALYZE ADDITIONAL EXISTING SAMPLES (McGEE, ST. MICHELLE, DC-23, ETC.)
  - o ESTABLISH SAMPLE SELECTION CRITERIA

PLANNED

- o SAMPLE DRILLING FLUIDS FROM DC-24, DC-25, DC-32, AND DC-33
  - o SAMPLE AND TEST AT 12 HORIZONS
  - o SAMPLE MAKE-UP WATER OR MUD
  - o EVALUATE POTENTIAL FOR CLASSIFYING MUD AS HAZ. WASTE
  - o HYDROCHEMICAL IMPACTS OF DRILLING

- o SAMPLE WATER FROM LHS PUMP TESTS AT RRL-2B
  - o EVALUATE IODINE-129 CONCENTRATION IN RRL NATIVE WATERS

- o SAMPLE WELLS IN RRL VICINITY
  - o DETERMINE BACKGROUND CONCENTRATIONS

^{129}I STRATEGY FOR PRE-ES GEOHYDROLOGY PROGRAM

OBJECTIVES:

1. MINIMIZE CONTAMINATION OF DEEP BASALTS FROM DRILLING PRE-ES PIEZOMETER FACILITIES.

2. OBTAIN LATERAL AND VERTICAL ^{129}I, ^{127}I, ^{3}H, ^{14}C, ^{99}TC, MAJOR ANIONS, CATIONS AND STABLE ISOTOPE DATA.

3. MINIMIZE INTERFERENCE WITH IMPLEMENTATION OF PRE-ES GEOHYDROLOGY PROGRAM.

PROGRAM HIGHLIGHTS

PROGRAM

1. DRILL USING COLUMBIA RIVER WATER

   A. INVESTIGATE USE OF ALTERNATE WATER SOURCES, DRILLIING TECHNIQUES FOR POST-ES SITE CHARACTERIZATION PROGRAM.

   B. CHANGE DRILLING FLUIDS AFTER EACH STRING OF CASING IS RUN.

2. BASELINE DRILLING FLUID CHEMISTRY (INCLUDES I)

3. SAMPLE SELECTED EXISTING FACILITIES OUTSIDE OF CASZ

4. TAG DRILLING FLUIDS WITH CHEMICAL TRACER AND DEVELOP OPEN HOLE FOR CLEAN-UP BALANCED AGAINST BASELINE IMPACTS AND FUTURE DATA SOURCES

5. ANALYZE ARCHIVED SAMPLES

6. UTILIZE OPPORTUNISTIC TESTS SUCH AS DC-18

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I STRATEGY

PROBLEM STATEMENT

Introduction of unknown concentrations and quantities of ^{129}I into basalt groundwaters may preclude the future evaluation of the insitu concentrations of ^{129}I. This may limit the usefulness of ^{129}I as an indicator of the potential presence of a disqualifying condition, specifically groundwater travel time less than 1,000 years.

BACKGROUND

The vertical and areal distribution of concentrations of ^{129}I and other species in and around the CASZ can be indicative of vertical hydraulic communication. ^{129}I has a long half-life, exhibits conservative behavior and can thus be used as a tracer to determine whether hydraulic communication between the unconfined and confined aquifers exists, thus providing a potential measure of radionuclide transport from the repository to the accessible environment.

The iodine data must be interpreted in terms of the associated occurrence of stable and unstable isotopes, introduced and natural tracers, geologic structure, and the hydraulic regime.

Fluids from the unconfined and confined aquifers, up and down gradient from the proposed repository location will be analyzed for ^{129}I and associated species. Samples for iodine analyses should be from (existing and future) wells developed under appropriate conditions for optimal clean up. Well yield must be sufficient to provide adequate sample size to achieve the required analytical sensitivity. A geochemical baseline of drilling fluids will also be developed while drilling and developing new monitoring facilities to use in interpreting future hydrochemical samples.

In implementing this strategy the Project will attempt to provide a reasonable balance between obtaining "perishable" hydraulic data identified in the Options Paper and data pertinent to the iodine concern. Acquiring these data is part of the hydrologic and hydrochemical characterization programs.

I EVALUATION PROPOSAL

This proposal addresses questions raised about the presence of ^{129}I in Hanford groundwater and provides information during the Pre-ES Geohydrology program to initiate resolution of these questions. Recommendations include sampling suitable wells throughout the reservation, collecting and analyzing drilling fluid, analyzing existing samples, and completing drilling and sampling of borehole DC-18.

The objectives of this program are:

(1) minimize, to the extent practicable, contaminating the basalt aquifers with ^{129}I from activities associated with the pre-ES geohydrology program through appropriate drilling, development and construction practices,

(2) obtain aerial and vertical ^{129}I data in the near-term to begin defining the ^{129}I baseline throughout the Hanford Reservation within the deep basalts. In addition to ^{129}I, ^{127}I, ^{3}H, ^{14}C, ^{99}Tc and a comprehensive suite of major anions, cations and stable isotopes will be analyzed; and,

(3) minimize interference with the implementation of the pre-ES geohydrology program.

(4) differentiate, as much as is practicable, among the possible sources of ^{129}I that may be present in the deep ground water (see attachment).

It is possible to achieve analytical sensitivities in off-site laboratories as low as 10^{-7} to 10^{-8} pCi/L from samples of 1 to 10 L in volume. Onsite laboratories may achieve sensitivities of 10^{-5} pCi/L. Analysis for ^{129}I is a complex chemical process at the trace level concentrations expected and may require a minimum of 2 months to complete. The ^{129}I results, therefore, of samples taken during drilling will not be available for real-time decisions during well construction and development. Details of the proposed program are presented below:

1. Tentative plan to use Hanford System water ($^{129}I = 10^{-6}$ to 10^{-5} pCi/L), for the drilling and installation of the piezometers. Alternate sources of drilling fluid make-up water will be investigated and used if practicable and significantly lower in ^{129}I than current plant sources. Alternate sources may include groundwater from borehole DB-11 or the McGee Well. Investigations will include expedited analysis of the ground water from these wells for ^{129}I. Consultation and concurrence with DOE-HQ is required prior to initiating drilling with Hanford system water

   If the decision is made to use Columbia River water for the drilling of wells in the Pre-ES testing program, planning will immediately begin to mitigate the contamination of deep basalt aquifers that has resulted from drilling activities in the post-ES program and to verify that any residual contamination will not significantly interfere with the ability to successfully perform the hydrochemistry program. As part of this program, alternate sources of drilling fluids will be investigated, alternate drilling procedures will be investigated and experiments will be carried out to assess the potential for the degree of contamination that could be expected from surface-based activities associated with drilling; increases in contamination due to drilling will be addressed through monitoring drilling fluids while drilling DC-24, etc.. These plans will be incorporated into the appropriate Study Plans.

1.5 To mitigate the contamination of deep basalt aquifers in the pre-ES program, new drilling fluids will be used after each string of casing is installed in DC-24, DC-25, DC-32 and DC-33.

2. Baseline all drilling fluid used (mud and water).

   - Sample drilling fluid pit prior to cycling through borehole
   - Sample fluid returns while drilling through 12 horizons

   • Data will be used to evaluate hydrochemistry data in future tests where evaluation criteria of Option Paper will be applied

3. Sample selected existing facilities outside the CASZ for ^{129}I and other information as described in objective 2 above. Wells to be evaluated for sampling include those listed below:

   • Enyeart or Ford wells (Rosalia)
   • DC-6 [composite Grande Ronde (mainly from top of N2/R2 break)]
   • DC-14 (two flows below the Umtanum)
   • DB-15 (Wanapum)
   • DB-7 (Mabton)
   • DB-15 (Grande Ronde)
   • Four wells east of Columbia River near Ringold (upper to middle Saddle Mountains)

     - Webber Ranch (12/29-30 J1)
     - Ringold Association (12/29-32 R1)
     - Sunset Association (11/29-16A1)
     - White Bluffs Association (11/29-20N1)

4. The drilling fluids for DC-24, 25, 32 and 33 and the drilling fluids used in the deepening of RRL-23 will be tagged with an appropriate chemical tracer (e.g. Lithium Bromide) to provide real-time time-series clean-up data during well development. Wells will be developed sufficiently to provide future hydrochemical, including

^{129}I, data of sufficient quality to evaluate insitu conditions is practicable, balanced against baseline needs and future data sources. To assure adequate development, time series tracer samples, including ^{129}I, will be taken during pumping.

During LHS testing at RRL-2B, time-series groundwater samples will be taken to determine clean-up success and for evaluation of insitu conditions (which may have been impacted by previous activities).

5. Analysis and evaluation of existing samples and data will be performed. Archived samples such as those listed below will be evaluated for analysis:

- DC-23 GR (Rosalia, Sentinel Gap, Ginkgo and Umtanum)
- DC-18 (Wanapum)
- RRL-2C (Development samples from composite Grande Ronde [mainly the Birkett flow top]).

Analytical results (as opposed to achievable analytical sensitivity) are a function of (1) borehole development (i.e., cleanup), and (2) the respective ^{129}I concentrations of the insitu groundwater and the contaminated drilling fluid injected into formations.

6. The program will utilize opportunistic tests to obtain further data such as drilling, sampling and analysis at DC-18.

Approve: ____________________ Ralph Stein, Director
Engineering and Geotechnology Division

Date: ____________________

Approve: ____________________ John Anttonen, Assistant Manager
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ATTACHMENT

DIFFERENTIATION OF POSSIBLE SOURCES OF ^{129}I IN DEEP GROUNDWATER

Groundwater geochemistry, including Iodine-129, will be used to differentiate between native groundwater and water that may have been introduced from other systems. The sources of water other than native groundwater include groundwater that has infiltrated through the geologic system from overlying contaminated units, water introduced through previous drilling activities that has carried foreign chemistries into the lower aquifers, and waters that may be introduced through planned drilling activities. The specific question that should be answered is:

How will BWIP differentiate Iodine-129 contaminated waters from the following sources:

A. Naturally occurring iodine in ~~the~~ deep confined aquifers,

B. Groundwater infiltrating through the rock system from the unconfined aquifer,

C. Contaminated water and drilling fluids introduced during past drilling?

D. Potentially contaminated water to be used during planned drilling?

Response should not be limited to Iodine solely, but should include any companion elements or nuclides that may be used to differentiate between groundwaters on the Hanford Site.

Naturally Occurring Iodine

Naturally occurring iodine-129 ~~in the deep confined~~ aquifers should be found at levels significantly less than 1 x 10-5 pCi/L. Accompanying low levels of iodine-129 should be relatively high elemental iodine concentrations in the part per million range. Tritium and recent carbon-14 should be absent from these waters.

Downward Migrating Groundwater

Groundwater infiltrating through the rock system from the unconfined aquifer may contain defense waste leachates. In this case, the iodine-129 activity can be well over ~~one~~ pCi/L. In addition, nitrate and sulfate may be present. Other isotopic tracers that may be present include tritium, technetium-99 and carbon-14 because of the recent age of the groundwaters. The concentration of elemental iodine in these waters can be on ~~the~~ order of several parts per billion, due to flushing ~~of~~ salts from the rocks by actively flowing groundwater.

Previous Drilling Operations

Water introduced to the confined aquifers by previous drilling operations should be identifiable on the basis of the iodine-129 to elemental iodine

see pocket 5
for enclosure

WM Record File 101

WM Project 10

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