UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION II
101 MARIETTA ST., N.W., SUITE 3100
ATLANTA, GEORGIA 30303

ATTACHMENT 3

DEC 30, 1980

In Reply Refer To:
RII:JPS

Mr. Heyward Shealy, Chief
Bureau of Raiological Health
South Carolina Department of Health
and Environmental Control
J. Marion Sims Building
2600 Bull Street
Columbia, South Carolina 29201

Dear Mr. Shealy:

We greatly appreciate the cooperation shown by you ard your staff in assisting with the implementation of the TLD Direct Radiation Monitoring Network at the Summer Nuclear Station. This program will provide independent measurements of radiation levels in the environs of this facility and will aid in assuring the validity of measurements made by the licensee.

Enclosure 1 is a listing of TLD station locations by direction and distance from the Summer site including the NRC designation and siting criteria satisfied by the placement of each station.

In general the siting criteria provide for an inner ring (I) and an outer ring (O) of TLD stations at one to two miles and three to five miles from the site, respectively. One inner ring and one outer ring station should be in each of the 16 sectors where practical. Provision is also made for locations of high public interest (HPI), population centers of 25,000 or more (P), populated areas of less than 25,000 (PA), sites co-located with the licensee (C) and the nearest resident (NR). Upwind controls are ordinarily situated approximately 15 to 20 miles from each site in the least frequent wind direction.

Enclosure 2 consists of a proposed route for exchanging the TLDs at the Summer site. These detailed descriptions and diagrams are meant to allow persons unfamiliar with the site to locate the TLDs in a step by step manner. The State is by no means constrained to exchange the TLDs in the order indicated in this enclosure.

The annealed environmental TLDs will be sent by NRC Region I to your office for exchange on a quarterly basis, that is, within seven days prior or seven days after the beginning of each calendar quarter. An "in transit control" TLD package will be included with the other exchange TLDs for placement at the state offices in as low background an area as you have available.

Experience shows that a certain number of TLD stations will be vandalized or otherwise lost. Should this be discovered during the quarterly exchange we request that the state replace the missing TLD cages with NRC provided spares and inform this office. This is especially important if it was necessary or expedient to move the station enough to make the exchange route write-up invalid. If for any reason discrepancies in the exchange route write-up (Enclosure 2) come to your attention, we request that we be informed.

The data generated by this program concerning the Summer Nuclear station will be made available to your office in the form of annual and quarterly reports which should commence in 1981. It is planned that the reports be sent out within a month after the end of the reporting period.

Please do not hesitate to call D. M. Montgomery (404/221-5572) of my staff should you have questions regarding this program.

Sincerely,

J. Philip Stohr, Chief
Fuel Facility and Materials
Safety Branch

Enclosures:
1. Summer TLD Stations
2. Summer TLD Exchange Route

cc w/encls 1&2:
Susan Welch, South Carolina Department
of Health and Environmental Control

ENCLOSURE 1

ENVIRONMENTAL RADIATION MONITORING STATIONS

NRC TLD NETWORK

VIRGIL C. SUMMER NUCLEAR STATION

NRC STATION	LOCATION	DESCRIPTION	*CRITERIA SATISFIED
11	N, 349°, 4.3 miles	Rt. 11, 0.7 mile East of Rt. 257	O, C**
10	N, 7°, 4.0 miles	Rt. 11, 0.7 mile West of Rt. 215	O
--	N	No Inner Ring Station, not accessible	--
9	NNE, 13°, 3.9 miles	Intersection Rt. 215 and Rt. 11 in Monticello	O, C**
8	NNE, 31°, 3.0 miles	Rt. 213/215, 0.5 mile North of Rt. 359	O
--	NNE	No Inner Ring Station, Not accessible	--
7	NE, 46°, 3.0 miles	Rt. S·20·359, 0.4 mile East of Rt. 213/215	O
6	NE, 54°, 1.5 miles	Rt. 224, 0.5 mile West of Rt. 213/215	I
16	ENE, 64°, 3.5 miles	Old Brick Church on Rt. 213	O
5	ENE, 72°, 1.8 miles	White Hall School on Rt. 213/215	I, HPI
4	E, 86°, 0.5 mile	Rt. 213/215, 0.5 mile North of Site Road	I
17	E, 98°, 3.1 miles	Rt. 247, 1.6 miles Southeast of Rt. 213	O
2	ESE, 111°, 1.0 mile	Rt. 311 (Site Road), 0.3 mile West of Rt. 215	I, NR
18	ESE, 114°, 3.5 miles	Stella Hill residence on Rt. 247	O
19	SE, 132°, 2.0 miles	Rt. 213/215, 0.2 mile North of Rt. 247	I, C**
21	SE, 133°, 4.1 miles	Rock Hill Church on Rt. 215	O, HPI
40	SE, 135°, 23.1 miles	Intersection of Rt. 321 and Buckner St. in Columbia	P
39	SE, 140°, 25.0 miles	S.C. Department of Health and Environmental Control	P
38	SSE, 148°, 20.8 miles	Majik Market near intersection of St. Andrews Road and Rt. 76 in Columbia	P
20	SSE, 152°, 4.5 miles	Lookout Tower Rd., 1.7 mile South of Rt. 215	O
22	SSE, 157°, 2.4 miles	Rt. 213, 0.7 mile West of Rt. 215	I, C**
23	S, 173°, 2.4 miles	Rt. 216 (to Parr), 0.3 mile West of Rt. 213	I
37	S, 182°, 14.8 miles	Intersection of Rt. 270 and Rt. 1254 (Libby Arial Cir)	UWC
36	S, 183°, 14.6 miles	Rt. 270, 0.5 mile South of Putnam Road	UWC
35	S, 184°, 14.1 miles	Intersection of Rt. 270 and Putnam Road near Lake Murrey Park	UWC
24	S, 185°, 3.9 miles	Mount Herman Church in Peak, South Carolina	O, PA, C** HPI

34	SSW, 192°, 9.3 miles	Intersection of Rt. 76 and Clark St. in Chapin, SC	PA
1	SSW, 199°, 3.7 miles	Wicker's Store, Rt. 28 and Rt. 213	O, C**
25	SSW, 210°, 3.3 miles	Rt. 28, 0.8 mile North of Rt. 213	O
--	SSW	No inner ring station, not accessible	--
26	SW, 217°, 3.3 miles	Rt. 28, 1.2 miles North of Rt. 213	O
33	SW, 218°, 9.0 miles	Intersection of Rt. 202 and Rt. 76 in Little Mountain, SC	PA
27	SW, 231°, 3.1 miles	Rt. 28, 2.1 miles north of Rt. 213	
--	SW	No inner ring station, not accessible	--
31	WSW, 244°, 3.6 miles	Rt. 33, 0.8 mile west of Rt. 28	O
32	WSW, 247°, 6.2 miles	Pomaria Fire Department on Rt. 107	PA
14	WSW, 255°, 2.8 miles	Rt. 28 at Cannons Creek	O
--	WSW	No inner ring station, not accessible	--
28	W, 267°, 2.7 miles	Rt. 28, 1.6 miles north of Rt. 33	I
29	W, 276°, 3.4 miles	Rt. 98, 0.5 mile west of Rt. 28	O, C**
30	WNW, 293°, 3.8 miles	Rt. 28 at Parr reservoir access area	O
--	WNW	No inner ring station, not accessible	--
15	NW, 308°, 5.6 miles	Intersection Rt. 28 and Rt. 97	O
12	NW, 323°, 5.0 miles	Rt. 651, 2.2 miles west of Rt. 257	O
--	NW	No inner ring station, not accessible	--
13	NNW, 333°, 3.0 miles	Rt. 257, 2.3 miles south of Rt. 383	O
3	NNW, 340°, 4.1 miles	Intersection of Rt. 257 and Rt. 383	O, C**
--	NNW	No inner ring station, not accessible	--

*Criteria: I - Inner Ring; O - Outer Ring; P - Population Center; HPI - High Public Interest; UWC - Upwind Control; C - Co-located with licensee; NR - Nearest Residence; PA - Populated Area (less than 25,000)

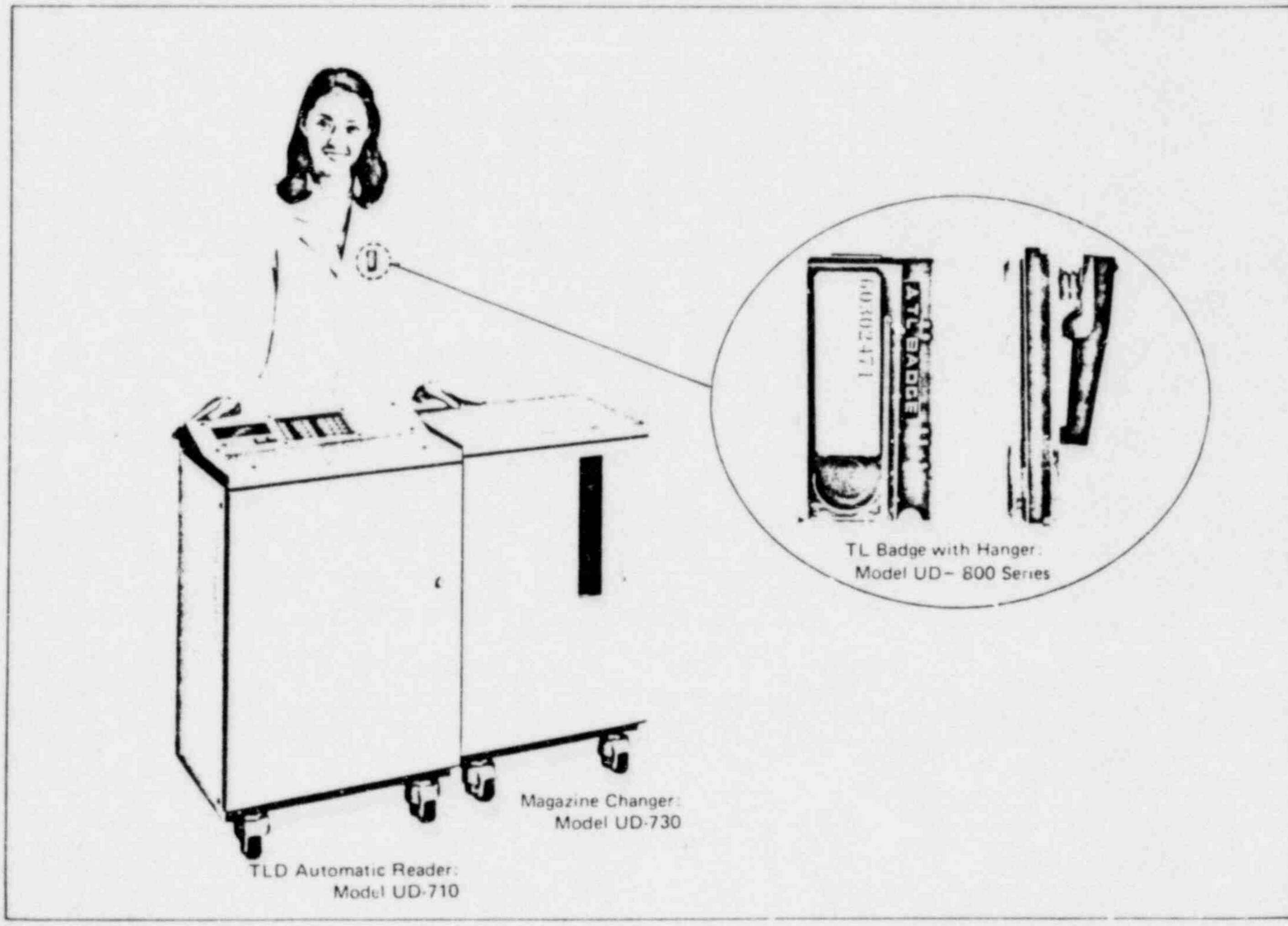
**Candidate Stations for co-location with the licensee. SCE&G will co-locate with five out of the eight devices indicated when they implement their expanded TLD Program.

ATTACHMENT 4

Panasonic

New TLD "TL Badge System"

TL Badge: Model UD-800 Series
Automatic Reader: Model UD-710 Series
Magazine changer: Model UD-730 Series



This system can be used for periodical personnel monitoring of people who work in a field of radiation.

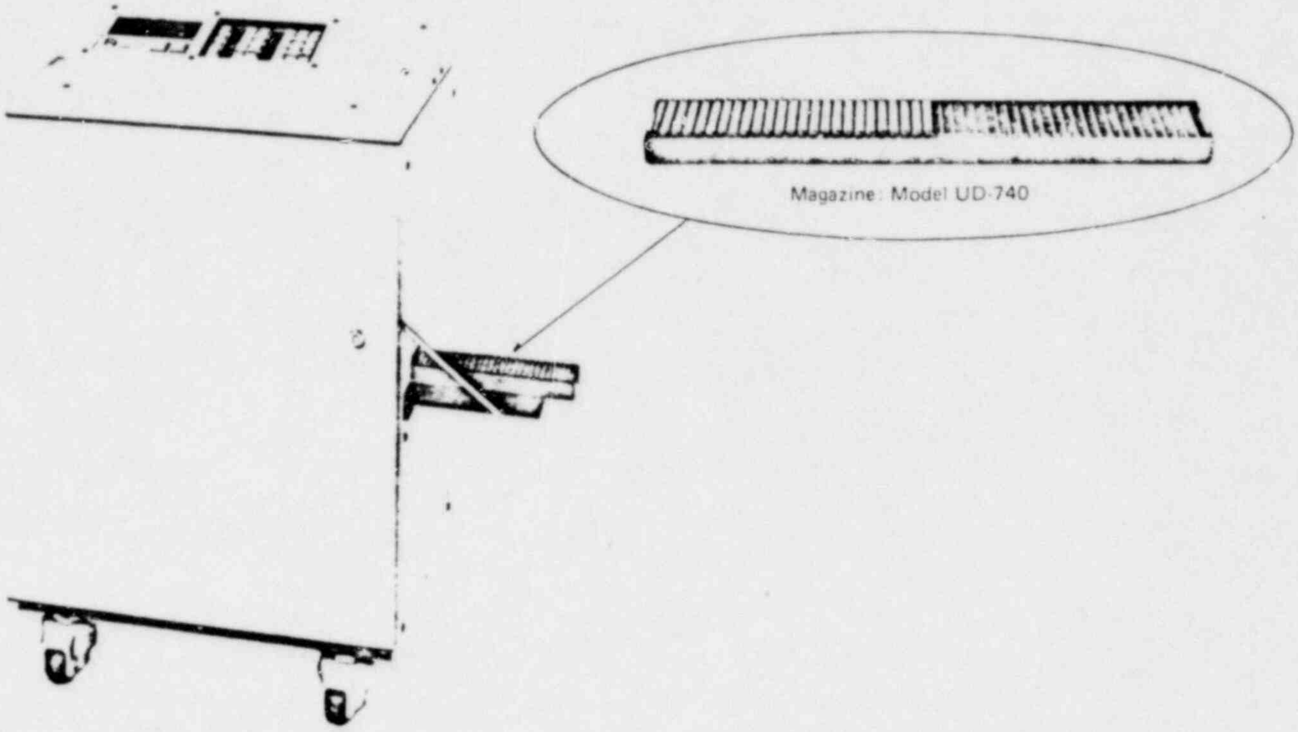
This is suitable for use not only in large facilities, such as a nuclear power plant, but in middle or small size facilities such as a hospital or a laboratory.

As the detectors of the TL badge, tissue-equivalent material ($Li_2B_4O_7$:Cu)* and highly sensitive material ($CaSO_4$:Tm) are used, making it possible to precisely measure various kinds of radiation in a wide range.

By utilizing the optical-heating method*, the reader is designed to measure the TL badges quite easily and quickly.

* Patent pending

TLD Automatic Reader: Model UD-710 Series



Magazine: Model UD-740

TLD Automatic Reader: Model UD-710

By the optical-heating method, the reader can measure many TL badges at high spe[illegible]ith stability. One thin TLD element can be heated in [illegible] by the flashing light of a tungsten lamp. Both the [illegible]on-counting method and the current integration method are employed to precisely detect the thermoluminescence throughout a wide range from low doses to high doses.

The reader is equipped with a microcomputer which controls self-checking functions and all automatic functions, such as annealing of the TL badges for repeat use, reading of the ID code, and sensitivity adjustment for correction by the built-in reference light source. The processing time is greatly shortened, so that total time for one badge (4 elements) is only 20 seconds. Furthermore, by using a magazine changer (optional), 500 badges can be measured in 3 hours without manual operation. The measured data is displayed on the display panel of the reader, and the reader is also equipped with an interface for transmitting the data to outside equipment such as a computer or a printer.

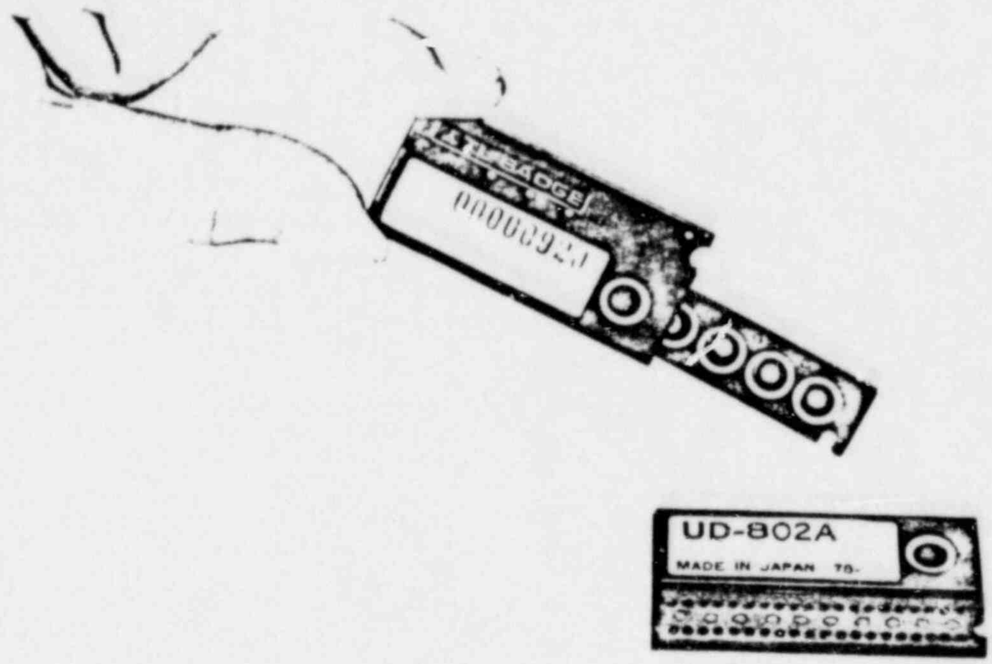
Features

- TL Badges can be fed into the reader without the necessity for manual operations such as opening the case and taking out the elements.
- Large processing capability and high speed measurement.
- Equipped with self-checking functions.

Specifications

TLD Automatic Reader: Model UD-710 Series	
Badge-feed system	With magazines (50 badges/magazine)
Reading method Heating TL Measurement	 Optical-heating method Pulse-counting method (for small signals) current method (for large signals)
Pre-heating and Annealing	Pre-heating and annealing functions are incorporated.
ID code reading	Optical reading
Processing speed	20 seconds/badge 3 hours/500 badges (utilizing magazine changer)
Self-checking functions	Checking of optical path, sensitivity of PM tube, heating stability, etc.
Output interface	RS-232C
Dimensions and Weight	543(W) x 830(H) x 380(D) mm 77kg
Magazine Changer: Model UD-730 Series	
Capacity	10 magazines (500 badges)
Dimensions and Weight	485(W) x 790(H) x 346(D) mm 61kg

TL Badge: Model 800 Series



TL Badge: Model UD – 802A

This is a small, very reliable dosimeter which is designed not only for superior characteristics as a dosimeter but also to include all desirable points, such as easy handling, cleanliness, resistance to mechanical impact, etc.
In the detection part, a newly developed phosphor ($Li_2B_4O_7$:Cu) and a highly sensitive phosphor ($CaSO_4$:Tm), both formed to a thin element, are used. They are also especially designed for optical heating.
$Li_2B_4O_7$:Cu has a radiation response characteristic which is very close to that of human tissue, and responds precisely to X rays and γ rays in a wide range from low energy to high energy. Furthermore, because the element is very thin, the skin dose can be measured.
On the other hand, $CaSO_4$:Tm has very high sensitivity, and a very small dose can be detected with this phosphor. Furthermore, low-energy X rays and γ rays can be detected separately by utilizing the energy characteristics of the phosphor.
Elements are encased in a holder. The ID number is coded by punched holes, and they are read automatically by the reader. A hanger with clip is used for wearing.

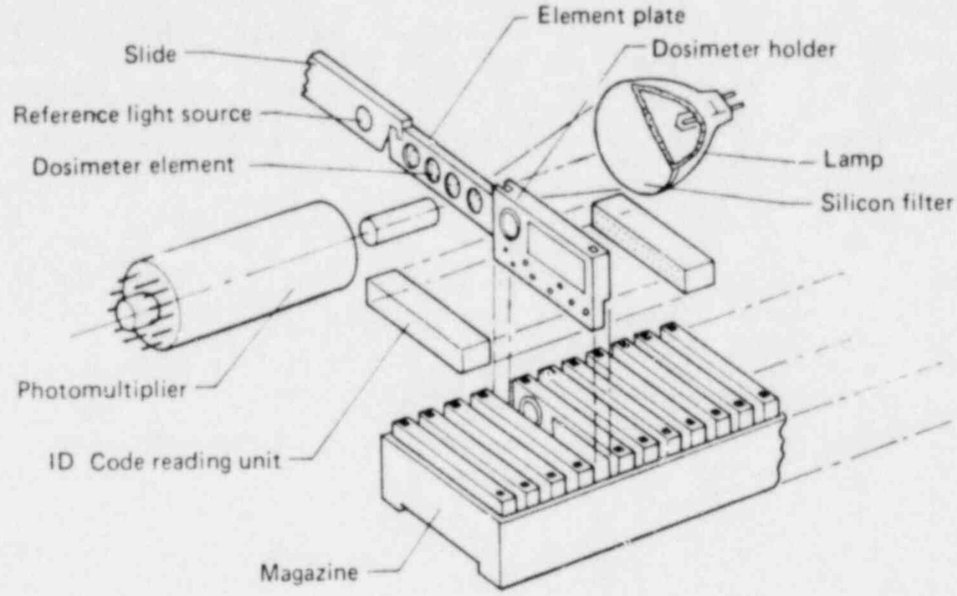
Features

- Energy dependence is small and sensitivity is high.
- Skin doses can be measured.
- Small and lightweight.
- ID codes of large capacity can be punched.
- The lock mechanism prevents accidental contamination of detection part.

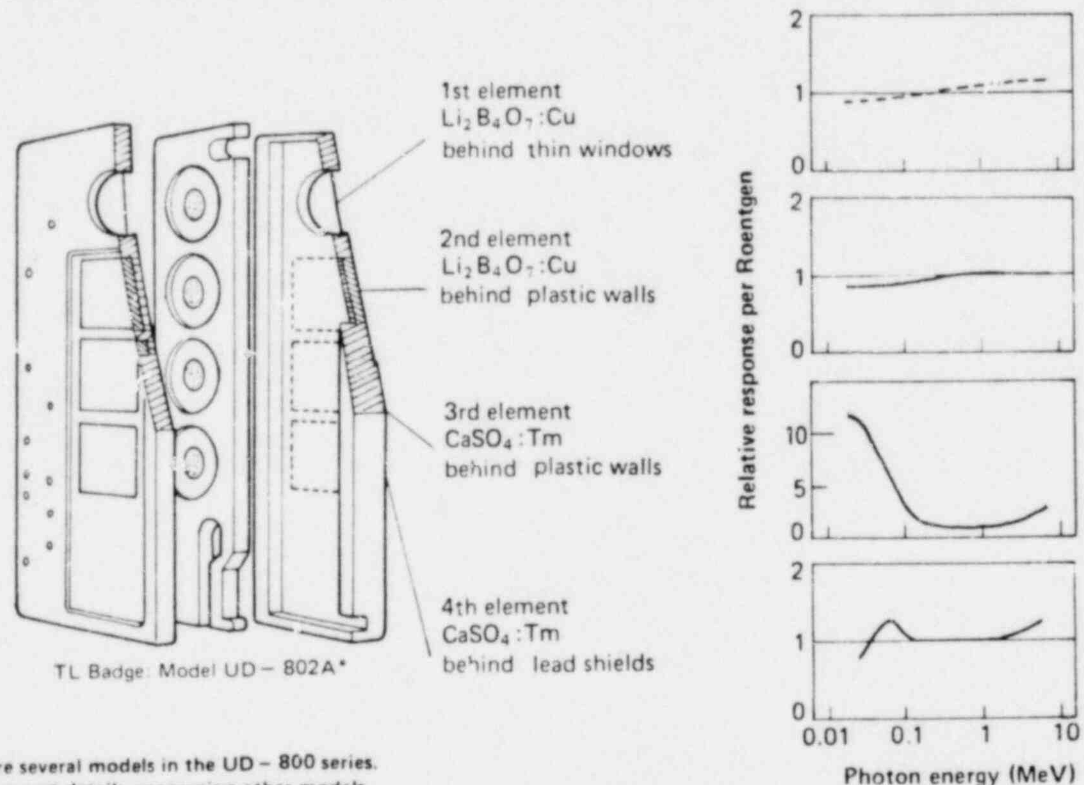
Specifications

TL Badge: Model UD-800 Series	
Type	Composite type of 2 to 4 elements.
Number code	**Punched holes, 7 digits (28 bits)**
Elements: Phosphors	$Li_2B_4O_7$:Cu $CaSO_4$:Tm (diameter 3mm x 15 mg/cm^2)
Measurable rays	X rays, γ rays; 10KeV ~ 10MeV Skin dose
Measurement range	1mR ~ 1000R
Fading (at room temperature)	$Li_2B_4O_7$:Cu < 10%/month $CaSO_4$:Tm < 1%/month
Spurious signal	Undetectably small
Dimensions and Weight (with hanger)	49 x 23 x 6mm 7g (13g)

Reading method and construction



Construction of the model UD-802A, a typical TL badge, and the energy responses of each element.



TL Badge: Model UD – 802A*

* There are several models in the UD – 800 series. Please request details concerning other models.

Specifications are subject to change without notice for further improvement

Panasonic

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Revision 1
November 1979

Branch Technical Position

Background

Regulatory Guide 4.8, Environmental Technical Specifications for Nuclear Power Plants, issued for comment in December 1975, is being revised based on comments received. The Radiological Assessment Branch issued a Branch Position on the radiological portion of the environmental monitoring program in March, 1978. The position was formulated by an NRC working group which considered comments received after the issuance of the Regulatory Guide 4.8. This is Revision 1 of that Branch Position paper. The changes are marked by a vertical line in the right margin. The most significant change is the increase in direct radiation measurement stations.

10 CFR Parts 20 and 50 require that radiological environmental monitoring programs be established to provide data on measurable levels of radiation and radioactive materials in the site environs. In addition, Appendix I to 10 CFR Part 50 requires that the relationship between quantities of radioactive material released in effluents during normal operation, including anticipated operational occurrences, and resultant radiation doses to individuals from principals pathways of exposure be evaluated. These programs should be conducted to verify the effectiveness of in-plant measures used for controlling the release of radioactive materials. Surveillance should be established to identify changes in the use of unrestricted areas (e.g., for agricultrual purposes) to provide a basis for modifications in the monitoring programs for evaluating doses to individuals from principal pathways of exposure. NRC Regulatory Guide 4.1, Rev. 1, "Programs for Monitoring Radioactivity in the Environs of Nuclear Power Plants," provides an acceptable basis for the design of programs to monitor levels of radiation and radioactivity in the station environs.

This position sets forth an example of an acceptable minimum radiological monitoring program. Local site characteristics must be examined to determine if pathways not covered by this guide may significantly contribute to an individual's dose and should be included in the sampling program.

AN ACCEPTABLE RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

Program Requirements

Environmental samples shall be collected and analyzed according to Table 1 at locations shown in Figure 1.[1] Analytical techniques used shall be such that the detection capabilities in Table 2 are achieved.

The results of the radiological environmental monitoring are intended to supplement the results of the radiological effluent monitoring by verifying that the measurable concentrations of radioactive materials and levels of radiation are not higher than expected on the basis of the effluent measurements and modeling of the environmental exposure pathways. Thus, the specified environmental monitoring program provides measurements of radiation and of radioactive materials in those exposure pathways and for those radionuclides which lead to the highest potential radiation exposures of individuals resulting from the station operation. The initial radiological environmental monitoring program should be conducted for the first three years of commercial operation (or other period corresponding to a maximum burnup in the initial core cycle). Following this period, program changes may be proposed based on operational experience.

The specified detection capabilities are state-of-the-art for routine environmental measurements in industrial laboratories.

Deviations are permitted from the required sampling schedule if specimens are unobtainable due to hazardous conditions, seasonal unavailability, malfunction of automatic sampling equipment and other legitimate reasons. If specimens are unobtainable due to sampling equipment malfunction, every effort shall be made to complete corrective action prior to the end of the next sampling period. All deviations from the sampling schedule shall be documented in the annual report.

The laboratories of the licensee and licensee's contractors which perform analyses shall participate in the Environmental Protection Agency's (EPA's) Environmental Radioactivity Laboratory Intercomparisons Studies (Crosscheck) Program or equivalent program. This participation shall include all of the determinations (sample medium-radionuclide combination) that are offered by EPA and that also are included in the monitoring program. The results of analysis of these crosscheck samples shall be included in the annual report. The participants in the EPA crosscheck program may provide their EPA program code so that the NRC can review the EPA's participant data directly in lieu of submission in the annual report.

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[1] It may be necessary to require special studies on a case-by-case and site specific basis to establish the relationship between quantities of radioactive material released in effluents, the concentrations in environmental media, and the resultant doses for important pathways.

If the results of a determination in the EPA crosscheck program (or equivalent program) are outside the specified control limits, the laboratory shall investigate the cause of the problem and take steps to correct it. The results of this investigation and corrective action shall be included in the annual report.

The requirement for the participation in the EPA crosscheck program, or similar program, is based on the need for independent checks on the precision and accuracy of the measurements of radioactive material in environmental sample matrices as part of the quality assurance program for environmental monitoring in order to demonstrate that the results are reasonably valid.

A census shall be conducted annually during the growing season to determine the location of the nearest milk animal and nearest garden greater than 50 square meters (500 sq. ft.) producing broad leaf vegetation in each of the 16 meteorological sectors within a distance of 8 km (5 miles).[2] For elevated releases as defined in Regulatory Guide 1.111, Rev. 1., the census shall also identify the locations of <u>all</u> milk animals, and gardens greater than 50 square meters producing broad leaf vegetation out to a distance of 5 km. (3 miles) for each radial sector.

If it is learned from this census that the milk animals or gardens are present at a location which yields a calculated thyroid dose greater than those previously sampled, or if the census results in changes in the location used in the radioactive effluent technical specifications for dose calculations, a written report shall be submitted to the Director of Operating Reactors, NRR (with a copy to the Director of the NRC Regional Office) within 30 days identifying the new location (distance and direction). Milk animal or garden locations resulting in higher calculated doses shall be added to the surveillance program as soon as practicable.

The sampling location (excluding the control sample location) having the lowest calculated dose may then be dropped from the surveillance program at the end of the grazing or growing season during which the census was conducted. Any location from which milk can no longer be obtained may be dropped from the surveillance program after notifying the NRC in writing that they are no longer obtainable at that location. The results of the land-use census shall be reported in the annual report.

The census of milk animals and gardens producing broad leaf vegetation is based on the requirement in Appendix I of 10 CFR Part 50 to "Identify changes in the use of unrestricted areas (e.g., for agricultural purposes) to permit modifications in monitoring programs for evaluating doses to individuals from principal pathways of exposure." The consumption of milk from animals grazing on contaminated pasture and of leafy vegetation contaminated by airborne

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[2] Broad leaf vegetation sampling may be performed at the site boundary in a sector with the highest D/Q in lieu of the garden census.

radioiodine is a major potential source of exposure. Samples from milk animals are considered a better indicator of radioiodine in the environment th[illegible] vegetation. If the census reveals milk animals are not present or are unavailable for sampling, then vegetation must be sampled.

The 50 square meter garden, considering 20% used for growing broad leaf vegetation (i.e., similar to lettuce and cabbage), and a vegetation yield of 2 kg/m^2, will produce the 26 kg/yr assumed in Regulatory Guide 1.109, Rev 1., for child consumption of leafy vegetation. The option to consider the garden to be broad leaf vegetation at the site boundary in a sector with the highest D/Q should be conservative and that location may be used to calculate doses due to radioactive effluent releases in place of the actual locations which would be determined by the census. This option does not apply to plants with elevated releases as defined in Regulatory Guide 1.111, Rev. 1.

The increase in the number of direct radiation stations is to better characterize the individual exposure (mrem) and population exposure (man-rem) in accordance with Criterion 64 - Monitoring radioactivity releases, of 10 CFR Part 50, Appendix A. The NRC will place a similar amount of stations in the area between the two rings designated in Table 1.

Reporting Requirement

A. Annual Environmental Operating Report, Part B, Radiological.

A report on the radiological environmental surveillance program for the previous calendar year shall be submitted to the Director of the NRC Regional Office (with a copy to the Director, Office of Nuclear Reactor Regulation) as a separate document by May 1 of each year. The period of the first report shall begin with the date of initial criticality. The reports shall include a summary (format of Table 3), interpretations, and an analysis of trends for the results of the radiological environmental surveillance activities for the report period, including a comparison with operational controls, preoperational studies (as appropriate), and previous environmental surveillance reports and an assessment of the observed impacts of the station operation on the environment.

In the event that some results are not available the report shall be submitted noting and explaining the reasons for the missing results. The missing data shall be submitted as soon as possible in a supplementary report.

The reports shall also include the following: a summary description of the radiological environmental monitoring program; a map of all sampling locations keyed to a table giving distances and directions from one reactor; the results of land use censuses; and the results of licensee participation in a laboratory crosscheck program if not participating in the EPA crosscheck program.

B. Nonroutine Radiological Environmental Operating Reports

"If a confirmed[3] measured radionuclide concentration in an environmental sampling medium averaged over any quarter sampling period exceeds the reporting level given in Table 4, a written report shall be submitted to the Director of the NRC Regional Office (with a copy to the Director, Office of Nuclear Reactor Regulation) within 30 days from the end of the quarter. If it can be demonstrated that the level is not a result of plant effluents (i.e., by comparison with control station or preoperational data) a report need not be submitted, but an explanation shall be given in the annual report. When more than one of the radionuclides in Table 4 are detected in the medium, the reporting level shall have been exceeded if:

$$\frac{\text{concentration (1)}}{\text{reporting level (1)}} + \frac{\text{concentration (2)}}{\text{reporting level (2)}} + \ldots \geq 1$$

If radionuclides other than those in Table 4 are detected and are due from plant effluents, a reporting level is exceeded if the potential annual dose to an individual is equal to or greater than the design objective doses of 10 CFR Part 50, Appendix I. This report shall include an evaluation of any release conditions, environmental factors, or other aspects necessary to explain the anomalous result.

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[3] A confirmatory reanalysis of the original, a duplicate, or a new sample may be desirable, as appropriate. The results of the confirmatory analysis shall be completed at the earliest time consistent with the analysis, but in any case within 30 days.

TABLE 1

OPERATIONAL RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

Exposure Pathway and/or Sample	Number of Samples[a] and Locations	Sampling and Collection Frequency[a]	Type and Frequency and Analysis
AIRBORNE			
Radioiodine and Particulates	Samples from 5 locations. 3 samples from offsite locations (in different sectors) of the highest calculated annual average groundlevel D/Q. 1 sample from the vicinity of a community having the highest calculated annual average ground-level D/Q. 1 sample from a control location 15-30 km (10-20 miles) distant and in the least prevalent wind direction[d]	Continuous sampler operation with sample collection weekly or as required by dust loading, whichever is more frequent[e]	Radioiodine Cannister: analyze weekly for I-131 Particulate Sampler: Gross beta radio-activity following filter change,[b] composite (by location) for gamma isotopic[c] quarterly
DIRECT RADIATION[f]	40 stations with two or more dosimeters or one instrument for measuring and recording dose rate continuously to be placed as follows: 1) an inner ring of stations in the general area of the site boundary and an outer ring in the 4 to 5 mile range from the site with a station in each sector of each ring (16 sectors x 2 rings = 32 stations). The balance of the stations, 8, should be place in special interest areas such as population centers, nearby residences, schools, and in 2 or 3 areas to serve as control stations.	Monthly or quarterly	Gamma dose monthly or quarterly

TABLE 1 (Continued)

Exposure Pathway and/or Sample	Number of Samples[a] and Locations	Sampling and Collection Frequency[a]	Type and Frequency of Analysis
WATERBORNE			
Surface[g]	1 sample upstream 1 sample downstream	Composite sample over one-month period[h,i]	Gamma isotopic analysis monthly. Composite for tritium analyses quarterly
Ground	Samples from 1 or 2 sources only if likely to be affected[j]	Quarterly	Gamma isotopic and tritium analysis quarterly
Drinking	1 sample of each of 1 to 3 of the nearest water supplies could be affected by its discharge 1 sample from a control location	Composite sample over two-week period[i] if I-131 anlysis is performed, monthly composite otherwise	I-131 analysis on each composite when the dose calculated for the consumption of the water is greater than 1 mrem per year.[k] Composite for Gross β and gamma isotopic analyses monthly. Composite for tritium analysis quarterly
Sediment from Shoreline	1 sample from downstream area with existing or potential recreational value	Semiannually	Gamma isotopic analyses semiannually
INGESTION			
Milk	Samples from milking animals in 3 locations within 5 km distant having the highest dose potential. If there are none, then, 1 sample from milking animals in each of 3 areas between 5 to 8 km distant where doses are calculated to be greater than 1 mrem per year[k]	Semimonthly when animals are on pasture, monthly at other times	Gamma isotopic and I-131 analysis semimonthly when animals are on pasture; monthly at other times.

TABLE 1 (Continued)

Exposure Pathway and/or Sample	Number of Samples[a] and Locations	Sampling and Collection Frequency[a]	Type and Frequency of Analysis
Milk (cont'd)	1 sample from milking animals at a control location (15-30 km distant and in the least prevalent wind direction)		
Fish and Invertebrates	1 sample of each commercially and recreationally important species in vicinity of discharge point	Sample in season, or semianually if they are not seasonal	Gamma isotopic analysis on edible portions
	1 sample of same species in areas not influenced by plant discharge		
Food Products	1 sample of each principal class of food products from any area which is irrigated by water in which liquid plant wastes have been discharged	At time of harvest[1]	Gamma isotopic analysis on edible portion.
	3 samples of broad leaf vegetation grown nearest offsite locations of highest calculated annual average ground-level D/Q if milk sampling is not performed	Monthly when available	
	1 sample of each of the similar vegetation grown 15-30 km distant in the least prevalent wind direction if milk sampling is not performed	Monthly when available	

TABLE 1 (Continued)

[a]The number, media, frequency and location of sampling may vary from site to site. It is recognized that, at times, it may not be possible or practical to obtain samples of the media of choice at the most desired location or time. In these instances suitable alternative media and locations may be chosen for the particular pathway in question and submitted for acceptance. Actual locations (distance and direction) from the site shall be provided. Refer to Regulatory Guide 4.1, "Programs for Monitoring Radioactivity in the Environs of Nuclear Power Plants."

[b]Particulate sample filters should be analyzed for gross beta 24 hours or more after sampling to allow for radon and thoron daughter decay. If gross beta activity in air or water is greater than ten times the yearly mean of control samples for any medium, gamma isotopic analysis should be performed on the individual samples.

[c]Gamma isotopic analysis means the identification and quantification of gamma-emitting radionuclides that may be attributable to the effluents from the facility.

[d]The purpose of this sample is to obtain background information. If it is not practical to establish control locations in accordance with the distance and wind direction criteria, other sites which provide valid background data may be substituted.

[e]Canisters for the collection of radioiodine in air are subject to channeling. These devices should be carefully checked before operation in the field or several should be mounted in series to prevent loss of iodine.

[f]Regulatory Guide 4.13 provides minimum acceptable performance criteria for thermoluminescence dosimetry (TLD) systems used for environmental monitoring. One or more instruments, such as a pressurized ion chamber, for measuring and recording dose rate continuously may be used in place of, or in addition to, integrating dosimeters. For the purposes of this table, a thermoluminescent dosimeter may be considered to be one phosphor and two or more phosphors in a packet may be considered as two or more dosimeters. Film badges should not be used for measuring direct radiation. The 40 stations is not an absolute number. This number may be reduced according to geographical limitations, e.g., at an ocean site, some sectors will be over water so that the number of dosimeters may be reduced accordingly.

[g]The "upstream sample" should be taken at a distance beyond significant influence of the discharge. The "downstream" sample should be taken in an area beyond but near the mixing zone. "Upstream" samples in an estuary must be taken far enough upstream to beyond the plant influence.

[h]Generally, salt water is not sampled except when the receiving water is utilized for recreational activities.

[i]Composite samples should be collected with equipment (or equivalent) which is capable of collecting an aliquot at time intervals which are very short (e.g., hourly) relative to the compositing period (e.g., monthly).

[j]Groundwater samples should be taken when this source is tapped for drinking or irrigation purposes in areas where the hydraulic gradient or recharge properties are suitable for contamination.

[k]The dose shall be calculated for the maximum organ and age group, using the methodology contained in Regulatory Guide 1.109, Rev. 1., and the actual parameters particular to the site.

[l]If harvest occurs more than once a year, sampling should be performed during each discrete harvest. If harvest occurs continuously, sampling should be monthly. Attention should be paid to including samples of tuberous and root food products.

Note: In addition to the above guidance for operational monitoring, the following material is supplied for guidance on preoperational programs.

Preoperational Environmental Surveillance Program

A Preoperational Environmental Surveillance Program should be instituted two years prior to the institution of station plant operation.

The purposes of this program are:

1. To measure background levels and their variations along the anticipated critical pathways in the area surrounding the station.

2. To train personnel

3. To evaluate procedures, equipment and techniques

The elements (sampling media and type of analysis) of both preoperational and operational programs should be essentially the same. The duration of the preoperational program, for specific media, presented in the following table should be followed:

Duration of Preoperational Sampling Program for Specific Media

6 months	1 year	2 years
. airborne iodine	. airborne particulates	. direct radiation
. iodine in milk (while animals are in pasture)	. milk (remaining analyses)	. fish and invertebrates
	. surface water	. food products
	. groundwater	. sediment from shoreline
	. drinking water	

TABLE 2

Detection Capabilities for Environmental Sample Analysis[a]

	Lower Limit of Detection (LLD)[b]					
Anaysis	Water (pCi/l)	Airborne Particulate or Gas (pCi/m3)	Fish (pCi/kg,wet)	Milk (pCi/l)	Food Products (pCi/kg, wet)	Sediment (pCi/kg, dry)
gross beta	4	1×10^{-2}				
^{3}H	2000					
^{54}Mn	15		130			
^{59}Fe	30		260			
$^{58,60}Co$	15		130			
^{65}Zn	30		260			
^{95}Zr	30					
^{95}Nb	15					
^{131}I	1[c]	7×10^{-2}		1	60	
^{134}Cs	15	5×10^{-2}	130	15	60	150
^{137}Cs	18	6×10^{-2}	150	18	80	180
^{140}Ba	60			60		
^{140}La	15			15		

Note: This list does not mean that only these nuclides are to be detected and reported. Other peaks which are measurable and identifiable, together with the above nuclides, shall also be identified and reported.

TABLE 2

NOTES

[a]Acceptable detection capabilities for thermoluminescent dosimeters used for environmental measurements are given in Regulatory Guide 4.13.

[b]Table 2 indicates acceptable detection capabilities for radioactive materials in environmental samples. These detection capabilities are tabulated in terms of the lower limits of detection (LLDs). The LLD is defined, for purposes of this guide, as the smallest concentration of radioactive material in a sample that will yield a net count (above system background) that will be detected with 95% probability with only 5% probability of falsely concluding that a blank observation represents a "real" signal.

For a particular measurement system (which may include radiochemical separation):

$$LLD = \frac{4.66\ s_b}{E \cdot V \cdot 2.22 \cdot Y \cdot \exp(-\lambda\Delta t)}$$

where

LLD is the "a priori" lower limit of detection as defined above (as pCi per unit mass or volume). (Current literature defines the LLD as the detection capability for the instrumentation only, and the MDC, minimum detectable concentration, as the detection capability for a given instrument, procedure, and type of sample.)

s_b is the standard deviation of the background counting rate or of the counting rate of a blank sample as appropriate (as counts per minute)

E is the counting efficiency (as counts per disintegration)

V is the sample size (in units of mass or volume)

2.22 is the number of disintegrations per minute per picocurie

Y is the fractional radiochemical yield (when applicable)

λ is the radioactive decay constant for the particular radionuclide

Δt is the elasped time between sample collection (or end of the sample collection period) and time of counting

The value of S_b used in the calculation of the LLD for a particular measurement system should be based on the actual observed variance of the background counting rate or of the counting rate of the blank samples (as appropriate) rather than on an unverified theoretically predicated variance.

In calculating the LLD for a radionuclide determined by gamma-ray spectrometry, the background should include the typical contributions of other radionuclides normally present in the samples (e.g., potassium-40 in milk samples). Typical values of E, V, Y and Δt should be used in the calculation.

It should be recognized that the LLD is defined as an a priori (before the fact) limit representing the capability of a measurement system and not as a posteriori (after the fact) limit for a particular measurement.*

[c]LLD for drinking water samples.

* For a more complete discussion of the LLD, and other detection limits, see the following:

(1) HASL Procedures Manual, HASL-300 (revised annually).

(2) Currie, L. A., "Limits for Qualitative Detection and Quantitative Determination - Application to Radiochemistry" Anal. Chem. 40, 586-93 (1968).

(3) Hartwell, J. K., "Detection Limits for Radioisotopic Counting Techniques," Atlantic Richfield Hanford Company Report ARH-2537 (June 22, 1972).

TABLE 3

ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM ANNUAL SUMMARY

Name of Facility ______________________ Docket No. __________

Location of Facility ______________________ Reporting Period __________

(County, State)

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed	Lower Limit of Detection[a] (LLD)	All Indicator Locations Mean (f)[b] Range	Location with Highest Annual Mean: Name Distance & Direction	Location with Highest Annual Mean: Mean (f)[b] Range	Control locations Mean (f)[b] Range	Number of Nonroutine Reported Measurements
Air Particulates (pCi/m^3)	Gross β 416	0.01	0.08(200/312) (0.05-2.0)	Middletown 5 miles 340°	0.10 (5/52) (0.08-2.0)	0.08 (8/104) (0.05-1.40)	1
	γ-Spec. 32						
	^{137}Cs	0.01	0.05 (4/24) (0.03-0.13)	Smithville 2.5 miles 160°	0.08 (2/4) (0.03-2.0)	<LLD	4
	^{131}I	0.07	0.12 (2/24) (0.09-0.18)	Podunk 4.0 miles 270°	0.20 (2/4) (0.10-0.31)	0.02 (2/4)	1
Fish pCi/kg (wet weight)	γ-Spec. 8						
	^{137}Cs	130	<LLD	-	<LLD	90 (1/4)	0
	^{134}Cs	130	<LLD	-	<LLD	<LLD	0
	^{60}Co	130	180 (3/4) (150-225)	River Mile 35	See Column 4	<LLD	0

[a] See Table 2, note b.

[b] Mean and range based upon detectable measurements only. Fraction of detectable measurements at specified locations is indicated in parentheses. (f)

Note: The example data are provided for illustrative purposes only.

TABLE 4

REPORTING LEVELS FOR NONROUTINE OPERATING REPORTS

Reporting Level (RL)

Analysis	Water (pCi/l)	Airborne Particulate or Gases (pCi/m³)	Fish (pCi/Kg, wet)	Milk (pCi/l)	Broad Leaf Vegetation (pCi/Kg, wet)
H-3	2×10^{4} (a)				
Mn-54	1×10^{3}		3×10^{4}		
Fe-59	4×10^{2}		1×10^{4}		
Co-58	1×10^{3}		3×10^{4}		
Co-60	3×10^{2}		1×10^{4}		
Zn-65	3×10^{2}		2×10^{4}		
Zr-Nb-95	4×10^{2}				
I-131	2	0.9		3	1×10^{2}
Cs-134	30	10	1×10^{3}	60	1×10^{3}
Cs-137	50	20	2×10^{3}	70	2×10^{3}
Ba-La-140	2×10^{2}			3×10^{2}	

[a] For drinking water samples. This is 40 CFR Part 141 value.

Figure 1

(This figure shall be of a suitable scale to show the distance and direction of each monitoring station. A key shall be provided to indicate what is sampled at each location.)