06

BNWL-1552
UC-41
Special Distribution

TECHNOLOGICAL CONSIDERATIONS
IN EMERGENCY INSTRUMENTATION
PREPAREDNESS

PHASE I - CURRENT CAPABILITIES
SURVEY

J. M. Selby and C. M. Unruh

January 1971

AEC RESEARCH &
DEVELOPMENT REPORT

BNWL-1552

BATTELLE

NORTHWEST

BATTELLE MEMORIAL INSTITUTE

PACIFIC NORTHWEST LABORATORIES

3000 STEVENS DRIVE, P.O. BOX 998, RICHLAND, WASHINGTON 99352

NOTICE

This report was prepared as an account of work sponsored by the United States Government. Neither the United States nor the United States Atomic Energy Commission, nor any of their employees, nor any of their contractors, subcontractors, or their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness or usefulness of any information, apparatus, product or process disclosed, or represents that its use would not infringe privately owned rights.

PACIFIC NORTHWEST LABORATORY

RICHLAND, WASHINGTON

operated by

BATTELLE MEMORIAL INSTITUTE

for the

UNITED STATES ATOMIC ENERGY COMMISSION UNDER CONTRACT AT(45-1)-1830

3 3679 00061 7706

BNWL-1552

UC-41, Health & Safety
Special Distribution

TECHNOLOGICAL CONSIDERATIONS
IN EMERGENCY INSTRUMENTATION PREPAREDNESS

Phase I - Current Capabilities Survey

J. M. Selby and C. M. Unruh

January 1971

FIRST UNRESTRICTED
DISTRIBUTION MADE

APR 19 '71

BATTELLE MEMORIAL INSTITUTE
PACIFIC NORTHWEST LABORATORIES
RICHLAND, WASHINGTON 99352

FORWARD

The Atomic Energy Commission, through its Division of Operational Safety, established a contract with the Battelle Northwest Laboratory to conduct a study and develop technical criteria for determining the adequacy of instrumentation for use in radiological emergencies, abnormal occurrences and accidents. The program is responsive to the recommendations of the AEC Advisory Committee on Reactor Safeguards regarding accidents involving the release of radioactivity. The work has been progressing in close collaboration with the AEC's Regulatory Divisions. A technical steering committee was established comprising representation from the Divisions of Operational Safety, Reactor Licensing, Reactor Development, the Universities Division, Richland, and the Bureau of Radiological Health. This committee provides surveillance and technical direction and assures that the overall needs of the program and associated objectives are met. As a first step, the Battelle Northwest Laboratory reviewed current practices at a number of Commission owned and licensed facilities. This report provides a summary of the results of this study.

Approved:

E. J. Vallario, Chairman
Battelle Northwest, HQ
Steering Committee
Mayhue A. Bell, Chief
Reactor Safety Branch
Division of Operational
Safety

1

2

3

4

5

6

7

8

TABLE OF CONTENTS

I. INTRODUCTION	1
II. DATA ACQUISITION AND PRESENTATION	1
III. RESULTS	5
A. Summary of Capabilities	5
B. Point of Release -- Air Measurement	8
C. Boundary and Environs -- Air Measurement	13
D. Point of Release -- Liquid Measurement	16
E. Boundary and Environs -- Liquid Measurement	18
F. Miscellaneous Measurements in the Environs	20
G. Meteorological Measurements	23
H. Emergency Communications	26
I. Medical Treatment Arrangements	28
IV. CONCLUSIONS	31
V. ACKNOWLEDGEMENTS	32
APPENDIX I	33

LIST OF TABLES

I. Summary of Capabilities	7
II. Point of Release - Air Measurement	10
III. Boundary and Environs - Air Measurement	14
IV. Point of Release - Liquid Measurement	17
V. Boundary and Environs - Liquid Measurement	19
VI. Miscellaneous Measurements in the Environs	21
VII. Meteorological Measurements	24
VIII. Emergency Communications	27
IX. Medical Treatment Arrangements	29

TECHNOLOGICAL CONSIDERATIONS
IN EMERGENCY INSTRUMENTATION PREPAREDNESS
Phase I - Current Capabilities Survey

I. INTRODUCTION

The objective of the first phase of the Technological Considerations in Emergency Instrumentation Preparedness Program was to determine current capabilities of both private industry and AEC contractors to meet the radiological instrumentation needs during serious radiological emergency. This report summarizes the current status in emergency instrumentation preparedness and forms the basis for justifying the need for developing emergency instrumentation performance criteria in a Phase II part of the program.

It should be emphasized that throughout this report all of the information collected, summarized, and presented relates to emergency radiological instrumentation. No effort was made to examine any phase of the routine monitoring program other than when a single instrument provided both routine and emergency measurements. Even in these situations, only the instrument applicability under radiological emergency conditions was considered.

II. DATA ACQUISITION AND PRESENTATION

To determine current emergency instrumentation capabilities, a study method which would assure the cooperation of both industrial and contractor facilities was required. The initial phase of this study resulted in the development of a comprehensive questionnaire to determine where radiological emergency instrumentation was used and to assess its general performance characteristics. Not all questions in the questionnaire were applicable to each of the various types of facilities surveyed. The questionnaire

(Appendix I) was forwarded to a selected group of both private and contractor facilities.

A visit was made to each of the facilities after the completion of the questionnaire to observe and discuss radiological emergency instrumentation. The visits proved a valuable and necessary part of the study. During the visitation period, the appropriate questionnaire was reviewed with the facility staff and adjustments in the initial questionnaire responses were made.

Questionnaires were sent to the operating staff at 12 power reactors, 11 AEC sites, 4 test reactors, 3 research reactors, 2 fuel reprocessing plants and 1 plutonium fuel fabrication plant. The facilities contacted are listed below:

<u>Power Reactors</u>	<u>Location</u>
Humboldt Bay Station	Eureka, California
San Onofre Station	San Clemente, California
Dresden	Morris, Illinois
Palisades Park	Palisades Park, Michigan
Big Rock Point	Charlevoix, Michigan
Nine Mile Point	Oswego, New York
Ginna (Robert E.)	Brookwood, New York
Indian Point	Buchanan, New York
Connecticut Yankee	Haddam Neck, Connecticut
Peach Bottom	Peach Bottom, Pennsylvania
Oyster Creek	Oyster Creek, New Jersey
Shippingport	Shippingport, Pennsylvania
<u>AEC Sites</u>	<u>Location</u>
Mound Labs	Miamisburg, Ohio
Fernald	Cincinnati, Ohio
Oak Ridge National Laboratory	Oak Ridge, Tennessee
Savannah River Plant	Aiken, South Carolina
Oak Ridge Gaseous Diff.	Oak Ridge, Tennessee

AEC Sites (cont'd)

Lawrence Radiation Laboratory
Idaho Falls
Rocky Flats
Los Alamos Scientific Laboratory
Argonne National Laboratory
Brookhaven National Laboratory

Location

Livermore, California
Idaho Falls, Idaho
Denver, Colorado
Los Alamos, New Mexico
Argonne, Illinois
Upton, L.I., New York

Test Reactors

GE Test Reactor
Industrial Reactor Labs
Babcock & Wilcox
Plum Brook

Location

San Jose, California
Plainboro, New Jersey
Lynchburg, Virginia
Sandusky, Ohio

Research Reactors

Oregon State
Kansas State
University of Illinois

Location

Corvallis, Oregon
Manhattan, Kansas
Urbana, Illinois

Fuel Reprocessing

Mid-West Fuels
Nuclear Fuel Services

Location

Grundy County, Illinois
West Valley, New York

Pu Fuel Fabrication

Numec

Location

Apollo, Pennsylvania

In the summary tables, contractor and licensee facilities were considered separately. All facilities were classed as HIGH, MEDIUM, or LOW based on the severity of potential accidents. The probability of an occurrence was not included in this classification. The facilities placed in the HIGH severity group were those with the largest inventories of radioactive materials and includes production and power reactors, chemical processing plants, and large transuranium facilities. Similarly, the LOW severity group is comprised of those facilities with the smallest inventories, and includes research reactors, uranium fabricators, and gaseous diffusion plants. A group of facilities with inventories in the middle was identified as MEDIUM severity.

The assignment of severity grouping was not made according to a rigorous or rigid scheme but according to the discretion and professional opinion of the reviewers. The following table shows the severity classification grouping for contractors and licensees; this classification is applicable to all the summary tables except Table II, which deals with air measurement at the point of release. In this area, a single contractor site may have several installations, each with its own independent air measurement capabilities. For the purposes of Table II, each installation was categorized individually, which increased the total.

Severity Classification of Facilities Studied

<u>Severity Class</u>	<u>Number of Licensee Facilities</u>	<u>Number of Contractor Facilities</u>
HIGH	12	3
MEDIUM	5	5
LOW	2	3

Three of the licensed facilities were excluded from the summary tables because of insufficient data. Following each table, a discussion of the more pertinent observations and conclusions is presented.

There are several words used throughout the discussion and tables which should be defined to clarify their meaning. DETECT means the determination of the presence of radioactive materials while MEASURE means a quantitative determination of the quantity radioactive material present. Similarly, MONITOR is defined as the periodic or continuous surveillance of the quantity of radioactive material present. This can be accomplished by looking at the whole effluent stream or a portion of the stream. SAMPLE is the removal of a portion of the effluent stream for future analysis. The

sample can be continuous or grab. The sample is PROPORTIONAL if a known fraction of the stream volume is withdrawn and it is REPRESENTATIVE if the sample withdrawn has the same characteristics as the source.

III. RESULTS

A. Summary of Capabilities

The capabilities of the various AEC contractor and licensee facilities, as determined by the questionnaire and visits, are summarized in Table I. In general, the capabilities in terms of continuous monitoring instrumentation decrease with the potential of the facility. Most monitoring instrumentation seen during the site visits was designed and used for routine radiation protection programs. Lacking any additional instrumentation specifically designed for emergency use, the routine instrumentation should be capable of providing measurement data and early warning during an emergency situation. In most cases the routine instrumentation lacks sufficient range to characterize the conditions at the time of the radiological emergency. Moreover, selection and placement of monitoring instrumentation for normal controlled releases does not assure applicability during an emergency.

Emergency instrumentation capabilities for power reactors, particularly those concerning stack monitoring instrumentation and liquid effluent measurement instrumentation, may be unique and not readily comparable to the emergency capabilities for other commercial or AEC contractor facilities as a result of the extensive engineered safeguards which are included in these facilities. Monitoring instrumentation at the normal point of release of gaseous and liquid effluents may not provide the necessary release information in the event of an emergency at a

TABLE I
SUMMARY OF CAPABILITIES

	Licensee Facilities			Contractor Facilities		
	12 High Potential	5 Medium Potential	2 Low Potential	3 High Potential	5 Medium Potential	3 Low Potential
Gas Point of Release Monitor	12C	4C	1C	2C	5C	2C
Gas Point of Release Sample	10C	5C	1I	3C	3C 1I	2C
Gas Boundary Monitor	2C	1C	-	1C	1C	-
Gas Boundary Sample	4C	4C	-	1C	1C 1I	2C 1I
Liquid Point of Release Monitor	6C 4I	1C	-	1C	1C	-
Liquid Point of Release Sampler	1C 9I	2C 3I	2I	2C	3C 2I	1C 2I
Liquid Boundary Monitor	-	-	-	-	2C	-
Liquid Boundary Sample	3C 1I	1C 2I	1I	2I	3C 1I	2C 1I
Environs Gas Monitor	1C	-	-	1C	2C	-
Environs Gas Sampler	10C 1I	1C 1I	-	1C 1I	3C 1I	1C 2I
Environs Liquid Monitor	-	-	-	-	1C	-
Environs Liquid Sampler	3C 6I	4I	-	2I	1C 4I	2C 1I
Environs Dose Rate Monitor	4C 1I	1C	-	1C 1I	2C	1C 1I
Environs Deposition on Soil Sample	7	3	-	1	3	3
Environs Uptake Samples	11	5	-	3	3	2
Meteorological Measurements at Several Elevations	8	2	0	1	1	1
Meteorological Measurements at One Elevation	4	3	1	2	4	2
Aerial Survey Capability	2	-	-	2	4	1
Delay to Start	6-8 hrs	-	-	1-3 hrs	1-5 hrs	2 hrs
Capability for Conversion of Results to Depositions	1	-	-	2	4	1
Time Required for First Evaluation	Immediate	-	-	Immed. to 3 1/2	Immed. to 1 Wk	1 hr

TABLE I (Contd)

	Licensee Facilities			Contractor Facilities		
	12 High Potential	5 Medium Potential	2 Low Potential	3 High Potential	5 Medium Potential	3 Low Potential
Alternate Emergency Control Center	10	5	1	3	4	2
Operator Instruments Located Offsite	8	4	1	-	2	3
Civil Defense Instruments Available	-	2	-	2	1	1
Other Emergency Instruments Available	4	2	-	-	1	1
Concentration Level Action Guides	5	1	-	2	2	1
Emergency Communications in Place	12	5	1	3	5	3
Emergency Medical Assistance in Place	12	5	2	3	5	3

NOTE: C = Continuous
I = Intermittent

facility where total containment is provided. Any release of activity due to loss of containment would probably be by an unanticipated route. Nevertheless, valuable comparisons can be obtained by including data on power reactor emergency instrumentation in the summaries for the HIGH potential group.

Only two of the licensees reported aerial survey capability. Seven of the 11 AEC contractors reported an aerial survey capability. Sixteen of the licensee and 9 of the AEC facilities have established alternate emergency control centers. Contamination level action guides were reported established by six of the licensees and five of the AEC contractors. Eighteen of the licensees and all of the AEC contractors reported emergency medical assistance in place.

B. Point of Release - Air Measurement

A summary of the stack gaseous effluent instrumentation capabilities is included in Table II. Some of the AEC contractors included data for several facilities at their site; thus, in this table the AEC contractor facilities total 23 rather than 11 in the other tables.

Six of the 18 licensees who reported that a Design Basis Accident (DBA) had been postulated indicated that an unfiltered release was possible. Postulated DBA's were reported for only 14 AEC contractor facilities and the potential for unfiltered releases was reported for 16 contractor facilities.

Seventy-two percent (16 licensee and 14 contractor) of the installations have a continuous monitoring capability while 79% (17 licensee and 16 contractor) of the installations have a continuous sampling capability. Not all potential points of release of airborne

TABLE II
POINT OF RELEASE - AIR MEASUREMENT

	Licensee Facilities			Contractor Facilities		
	12 High Potential	5 Medium Potential	2 Low Potential	3 High Potential	5 Medium Potential	3 Low Potential
Has the DBA Been Defined?	12 Yes	5 Yes	1 Yes	3 Yes	7 Yes 2 No	4 Yes 1 No
Is an Unfiltered Release Possible?	3 Yes 8 No	2 Yes 3 No	1 Yes	3 Yes 2 No	8 Yes 2 No	5 Yes 3 No
Number of Stacks Used.	1 to 3	1 to 15	1	1 to multiple	1 to 21	1 to 62
Stack Measurement Program is for Routine or Emergency.	8 Routine 4 Both	5 Routine	1 Both	5 Routine	10 Routine	4 Routine 4 Both
Will the Measurement System Function During DBA?	9 Yes 1 Ques. 2 No	2 Yes 3 No	1 No	3 Yes	4 Yes 2 No	5 Yes 2 No
Is a Proportional Measurement Obtained?	6 Yes 6 No	4 Yes 1 No	1 Yes	4 Yes 1 No	7 Yes 3 No	4 Yes 4 No
Are Stack Concentrations Related to Ground Depositions?	11 Yes	4 Yes 1 No	1 No	3 Yes 2 No	8 Yes 2 No	6 Yes 2 No
Is Emergency Power Available to the System?	12 Auto.	4 Auto. 1 Yes	1 No	3 Auto. 1 Manual	7 Auto. 3 No	6 Auto. 2 No
Is Health Physics Approval Required for System Outage?	10 Yes 2 No	5 Yes	1 Yes	5 Yes	9 Yes 1 No	7 Yes 1 No
Is There a Backup Measurement Plan?	11 Yes 1 No	5 Yes	1 Yes	5 Yes	9 Yes 1 No	8 Yes
What Sampling is Done?	10C	5C	1I	4C	6C 3I	4C 1I
Gas or Particulates Sampled.	1 Particulate 9 Both	2 Particulate 2 Both	1 Particulate	2 Particulate 1 Gas 1 Both	3 Particulate 6 Both	3 Particulate 1 Both
What Analysis is Made?	10 Isotopic 2 Gross	4 Isotopic 1 Gross	1 Gross	1 Isotopic 4 Gross	6 Isotopic 3 Gross	2 Isotopic 6 Gross
What Monitoring is Done?	12C	4C	1C	4C	9C	7C
Gas or Particulates Monitored?	1 Particulate 11 Both	4 Both	1 Both	1 Particulate 2 Gas 1 Both	2 Gas 7 Both	2 Particulate 1 Gas 4 Both
Is Remote Readout Provided?	9 Yes 3 No	3 Yes 2 No	1 Yes	2 Yes 2 No	4 Yes 6 No	4 Yes 3 No

TABLE II (Contd)

	Licensee Facilities			Contractor Facilities		
	12 High Potential	5 Medium Potential	2 Low Potential	3 High Potential	5 Medium Potential	3 Low Potential
Is There a High Level Alarm?	12 Yes	4 Yes 1 No	1 No	3 Yes 1 No	7 Yes 2 No	3 Yes 4 No
How Many False Alarms Last Year?	0 to 6	0 to 4	-	0 to 2	0 to 24	0 to 3
Is the System Fail-Safe?	10 Yes 2 No	3 Yes 2 No	1 No	2 Yes 2 No	9 No	3 Yes 4 No
System Calibrated with Sources or by Lab Comparison?	5 Sources 4 LC 3 Both	4 Sources 1 LC	1 LC	5 Sources	7 Sources 2 Both	7 Sources
How Often is the System Calibrated?	Daily to Annually	Daily to Semiannually	As Required	Weekly to Annually	Daily to Quarterly	Weekly to Monthly
What Percent of the Time is Instrument Found Off Calibration?	0 to 33%	0 to 10%	0%	<5 to <20%	0 to 100%	0 to 10%

Note: C = Continuous
I = Intermittant
LC = Lab Comparison

radioactive material resulting from an accident are covered by the sampling and monitoring programs. Most process systems are exhausted through a centralized stack(s) equipped with measurement instrumentation. In several instances the room air, which may be adversely affected in the event of an accident involving a process, was exhausted through separate vents not equipped with measurement capabilities.

The problem of obtaining a representative sample from the stack is one which should be considered if a result obtained during an accident is to be meaningful. Twenty-six out of the 42 installations (62%) attempt to obtain a stack sample proportional to stack discharge by the use of carefully designed isokinetic sample probes. Several items noted, such as extremely long sample lines, sharp bends, wide variety of materials used in the lines (tygon, aluminum and copper with diameters ranging from 3/8 inch to 2 inches I.D.) may adversely affect the ability to obtain a representative sample. Continuous air monitors (CAM) designed for room monitoring are used in a number of installations as in-line stack monitors. Obtaining a representative sample may be difficult with some of these because of leakage of room air into the sample chamber. This is permissible if the CAM is used as a room monitor; however, when used as a stack monitor, determination of the dilution is almost impossible, and low results will be obtained if no correction is made.

Few facilities reported particle size analysis capability and none reported routine particle size analyses. Analysis of particle size distributions in waste streams and at the measurement point may be important to characterize the consequences of an accidental release and to assure that a representative sample can be obtained during an accident.

Most monitoring and sampling systems are not reliable enough for emergency purposes. Twenty percent of the stack monitoring and sampling instruments (3 licensee and 6 contractor) are not on emergency power and thirty-five percent (6 licensee and 9 contractor) of the instruments are not equipped to properly alert personnel in the event of a failure. Some commercial nuclear facilities are using dual systems in order to provide an improved degree of reliability. Coincidence circuitry requiring an alarm signal from 2 of our detectors located in a stack is also utilized to provide reliability in a few cases.

Remote readout of stack monitoring equipment is limited almost entirely to "control rooms". In a few places, readout is also provided in the health physics office. Almost without exception remote readout of monitoring devices is not provided at an emergency control center unless the control room serves as the emergency control center. Calibration frequencies for the monitoring instruments varied from daily to annually and some instruments were found out of calibration every time upon recalibration.

With the exception of those few sites which have installed high range and adequately calibrated ionization chambers or scintillation detectors on or in the stack, the monitoring instruments in use appear incapable, because of their limited range, to determine the quantity of material (Q) emitted to the atmosphere in event of an accident. Even for the few sites with "high-range" instrumentation, it is questionable whether appropriate calibrations are available to arrive at a value of "Q".

C. Boundary and Environs - Air Measurement

Boundary air monitoring and sampling instrumentation data summarized in Table III apply to any location onsite but away from the source facility; the environs air monitoring instrumentation data apply to locations outside the boundary. Forty-two percent of the licensee (8) and 64% of the contractor facilities (7) have air measurement instrumentation at or within the boundary. Several of the licensee sites have sizable land holdings and their measurement instrumentation is actually located close to the operating facilities rather than directly at the boundary. Measurements at the boundary were limited primarily to contractor sites.

Sixty-eight percent of the licensee (13) and all of the contractor facilities reported air measurement capabilities in the environs. Air sampling was the choice in most cases. Only 27% (4 licensee and 4 contractor) of the facilities reported an air monitoring capability either at the boundary or in the environs, with four of these facilities (1 licensee and 3 contractor) reporting air monitoring instruments only in the environs. Most sites have an environmental air sampling program, which in many instances, is operated by "volunteers". Many of the licensee facilities obtain environmental air sampling and analysis from firms providing this service. In several cases, the questionnaires were incomplete because personnel from the licensee facilities were not well acquainted with the capabilities and procedures of the commercial contractors hired for this purpose.

TABLE III
BOUNDARY AND ENVIRONS - AIR MEASUREMENT

	Licensee Facilities			Contractor Facilities		
	12 High Potential	5 Medium Potential	2 Low Potential	3 High Potential	5 Medium Potential	3 Low Potential
Location of Measurement.	1 Boundary 8 Environs 3 Both	2 Boundary 2 Both	None	1 Environs 2 Both	3 Environs 2 Both	3 Both
Measurement for Routine or Emergency.	10 Routine 2 Both	2 Routine 2 Both		2 Routine	5 Routine	2 Routine 1 Emergency
Will the Measurement System Function During the DBA?	9 Yes 1 No	4 Yes 1 No		1 Yes 1 No	2 Yes	?
Is Emergency Power Available to the System?	1 Manual 10 No	4 No		1 Auto. 2 No	1 Auto. 5 No	1 Manual 2 No
Is Health Physics Approval Required for System Outage?	7 Yes 4 No	3 Yes 1 No		3 Yes	4 Yes 1 No	3 Yes
What Sampling is Done?	11C 1I	4C 1I		2C 1I	3C 2I	2C 1I
Is Gas or Particulate Sampled?	Boundary - 2 Particulate 2 Both Environs - 5 Particulate 5 Both	2 Particulate 2 Both		1 Particulate 2 Both	3 Particulate 2 Both	2 Particulate 1 Both
What Analysis is Made?	6 Isotopic 5 Gross	3 Isotopic 1 Gross		1 Isotopic 2 Gross	4 Isotopic 1 Gross	2 Isotopic 1 Gross
What Monitoring is Done?	3C	1C		2C	2C	None
Gas or Particulates Monitored?	2 Particulates 1 Gas	1 Both		1 Particulate 1 Both	1 Particulate 1 Both	
Is a Remote Readout Provided?	3 No	1 No		2 Yes	1 Yes 1 No	
Is There a High Level Alarm?	3 No	1 No		1 Yes 1 No	2 No	

TABLE III (Contd)

	Licensee Facilities			Contractor Facilities		
	12 High Potential	5 Medium Potential	2 Low Potential	3 High Potential	5 Medium Potential	3 Low Potential
How Many False Alarms Last Year?	-	-		12	-	
Is the System Fail-Safe?	1 Yes 2 No	1 No		2 No	1 Yes 2 No	
System Calibrated with Sources or by Lab Comparison?	3 Sources	1 Source		1 Source 1 LC	3 Sources	
How Often is the System Calibrated?	Daily to Semiannually	Semiannually		3 per Year	Daily to Every 5 Weeks	
What Percent of the Time is the Instrument Found off-Calibration?	<1% to <10%	<10%		-	Seldom	

NOTE: C = Continuous

I = Intermittant

LC = Lab Comparison

Reliability of the measurement instrumentation for emergency purposes appears to be a problem. Air monitoring equipment at only three contractor sites included a remote readout capability. The air sampling and monitoring installations were provided with emergency power at only one licensee and three contractor sites. Calibration frequencies of the air monitoring systems varied from daily to semiannual.

D. Point of Release - Liquid Measurement

Most licensee and contractor facilities use hold-up tanks and batch disposal rather than continuous discharge of liquid effluents. Measurement programs consist primarily of the collection and analysis of grab samples when the tanks are full. About two-thirds of the waste streams having a high contamination potential are provided with monitors, mostly on a continuous basis. Some of the sites have an effluent monitor downstream from the hold-up tank to provide a record of material being dumped. A summary of the data on point of release - liquid measurement instrumentation is included in Table IV. Approximately 90% of the licensee and 82% of the contractor facilities reported their liquid effluent measurement program being conducted for routine purposes only. Forty-seven percent of the facilities (10 continuous licensee and 3 contractor) reported the use of liquid effluent monitoring instrumentation. One contractor facility has a monitor that analyzes both clean water and contaminated effluent simultaneously, with a differential analyzer to determine the amount of activity present in the waste stream.

Most of the effluent monitors are designed to measure releases at or near concentration limits. During an accident, these monitors would effectively provide an alarm; however, due to the sensitivity

TABLE IV
POINT OF RELEASE - LIQUID MEASUREMENT

	Licensee Facilities			Contractor Facilities		
	12 High Potential	5 Medium Potential	2 Low Potential	3 High Potential	5 Medium Potential	3 Low Potential
Measurement for Routine or Emergency	1 No Disposal 9 Routine 2 Both	5 Routine	2 Routine	2 Routine 1 Emergency	5 Routine	2 Routine 1 Both
Will the Measurement System Function During DBA?	6 Yes 3 No	5 Yes	-	2 Yes	1 Yes 1 No	?
Is Emergency Power Available to the System?	9 Auto. 2 No	2 Auto. 3 No	-	2 Auto. 1 No	1 Auto. 4 No	1 Manual 2 No
Is Health Physics Approval Required for System Outage?	7 Yes 4 No	3 Yes 1 No	-	3 Yes	1 Yes 1 No	2 Yes 1 No
What Sampling is Done?	2C 9 Grab	2C 3 Grab	2 Grab	3C	3C 2 Grab	1C 2 Grab
Is a Proportional Sample Obtained?	2 Yes 8 No	2 Yes 2 No	2 No	3 Yes	2 Yes 3 No	1 Yes 2 No
What Analysis is Made?	7 Isotopic 3 Gross	4 Isotopic 1 Gross	1 Isotopic 1 Gross	2 Isotopic 1 Gross	3 Isotopic 2 Gross	2 Isotopic 1 Gross
What Monitoring is Done?	6C 4I	1C	None	2C	1C	None
Particles or Solute Monitored?	10 Both	1 Both		2 Both	1 Both	
Is a Remote Readout Provided?	7 Yes 3 No	1 Yes		1 Yes 1 No	1 Yes	
Is There a High Level Alarm?	9 Yes	1 Yes		1 Yes 1 No	1 Yes	
How Many False Alarms Last Year?	0-1	4		?	2 per week	
Is the System Fail-Safe?	6 Yes 3 No	1 Yes		1 Yes 1 No	1 No	
System Calibrated with Sources or by Lab Comparison?	6 Sources 1 LC 3 Both	1 LC		2 Sources	1 LC	
How Often is the System Calibrated?	Monthly-Each Refueling	Variable		Monthly	?	
What Percent of the Time is the Instrument Found Off-Calibration?	0-50%	10%		<10-100%	?	

NOTE: C = Continuous
I = Intermittent
LC = Lab Comparison

necessary to measure releases encountered during normal operation, releases during an accident would probably exceed the capability of the instruments. Remote readout is provided at only eight licensee and 2 contractor installations, and is limited to those which require the instrumentation for operating purposes. Dual systems are utilized at a few locations to provide continuity of service. Emergency power is provided for liquid effluent measurement instrumentation at 50% (11 licensee and 4 contractor) of the facilities. The calibration frequency varies from monthly to each refueling. Some instruments were reported to be out of calibration every time upon recalibration.

E. Boundary and Environs - Liquid Measurement

Summary data on boundary and environs liquid measurement instrumentation are included in Table V. Forty-two percent of the licensees (8) and 82% of the contractors (9) reported a measurement program at the boundary but only two boundary liquid monitoring instruments were found. The remaining 15 installations utilize a continuous sampling program. Only one site reported monitoring instrumentation in the environs. Forty-three percent of the sites (7 licensee and 6 contractor) have continuous samplers, but most programs are limited primarily to grab sampling.

Two power reactor facilities measure activity in a body of water adjacent to the plant site from samples of the cooling water brought into the reactors. Problems concerning the reliability of the measurement instrumentation in these cases are similar to those found in other categories. Only ten percent of the sites reported the availability of emergency power.

TABLE V
BOUNDARY AND ENVIRONS - LIQUID MEASUREMENT

	Licensee Facilities			Contractor Facilities		
	12 High Potential	5 Medium Potential	2 Low Potential	3 High Potential	5 Medium Potential	3 Low Potential
Location of Measurement	3 Bdy. 1 Both 8 Environs	1 Environs 3 Both	1 Boundary	1 Environs 2 Both	1 Environs 4 Both	3 Both
Measurement for Routine or Emergency	10 Routine 2 Both	4 Routine	1 Routine	2 Routine 1 Both	5 Routine 1 Both	2 Routine 1 Both
Will the Measurement System Function During the DBA?	5 Yes	4 Yes	1 Yes	2 Yes 1 No	3 Yes 3 Questionable	1 Yes
Is Emergency Power Available to the System?	2 Auto. 3 No	1 No	1 No	2 No	1 Auto. 3 No	1 No
Is Health Physics Approval Required for System Outage	3 Yes	1 Yes	?	1 Yes	3 Yes 1 No	1 Yes
What Sampling is Done?	6C 6 Grab	1 C 3 Grab	1 Grab	1 C 2 Grab	3C 4 Grab	2C 1 Grab
Is Proportional Sample Obtained	1 Yes 2 No	2 No	1 No	2 Yes 1 No	2 Yes 2 No	1 Yes 1 No
What Analysis is Made?	6 Isotopic 5 Gross 1 Tritium	3 Isotopic 1 Gross	1 Gross	2 Isotopic 1 Gross	3 Isotopic 1 Gross 1 Tritium	2 Isotopic 1 Gross
What Monitoring is Done?	None	None	None	None	2C	None
Particles or Solute Monitored?					2 Both	
Is a Remote Readout Provided?					2 Yes	
Is There a High Level Alarm?					1 Yes 2 No	
How Many False Alarms Last Year?					0	
Is the System Fail-Safe?					2 Yes 1 No	
System Calibrated with Sources or by Lab Comparison?					2 Both	
How Often is the System Calibrated?					Weekly	
What Percent of the Time is the Instrument Found Off- Calibration?					<5%	

NOTE: C = Continuous

F. Miscellaneous Measurements in the Environs

Data concerning dose rate, integrated dose, environmental deposition, and uptake measurements are summarized in Table VI. Thirty percent (5 licensee and 4 contractor) of the facilities monitor dose rates continuously in the environs. At one facility, data from the monitors are telemetered to a central location. The detectors in this case are insensitive enough to be useful in providing dose rate information during a serious accident. Seventy-seven percent of the facilities are measuring non-occupational external dose using film or thermoluminescence (TL) dosimeters.

Less than 10% of the measurement systems were reported to be capable of functioning during DBA. Emergency power was reported to be available at only three contractor sites. One instrument was reported to be fail-safe and one instrument was reported to include a high-level alarm. Calibration frequencies varied from weekly to semiannual, and out-of-calibration conditions were reported as frequently as 50% of the times that instruments were recalibrated.

No unique monitoring or sampling instrumentation was found for deposition or uptake measurements. Most of the sites rely on the collection of miscellaneous samples such as milk, soil, vegetation, etc., in addition to air and water samples to provide a measure of contamination levels. Sixty-three percent of the 16 licensees who reported an environmental deposition and uptake measurement program are relying on a commercial contractor to do the analyses.

TABLE VI
MISCELLANEOUS MEASUREMENTS IN THE ENVIRONS

	Licensee Facilities			Contractor Facilities		
	12 High Potential	5 Medium Potential	2 Low Potential	3 High Potential	5 Medium Potential	3 Low Potential
Is a Nonoccupational External Dose Assessment Made?	12 Yes	2 Yes 3 No	2 No	2 Yes 1 No	3 Yes 2 No	2 Yes 1 No
What Dose Rate Monitoring is Done?	4C 1I	1C	2 None	1C 1I	2C	1C 1I
Detector Type	2 Ion Chamber 1 GM 3 Scintil.	1 Ion Chamber		1 Scintil. 1 Ion Chamber	1 Ion Chamber 1 Scintil. 2 GM	1 GM 1 Ion Chamber
What is Measured?	4 Beta-Gamma 1 Gamma	1 Gamma		2 Beta-Gamma	2 Beta-Gamma	1 Beta-Gamma 1 Gamma
Will the Measurement System Function During the DBA?	4 Yes	1 Yes		2 Yes	1 Yes	1 Yes
Is There a High Level Alarm?	4 No	1 No		1 Yes 1 No	2 No	2 No
How Many False Alarms Last Year?	-	-		?	-	-
Is Emergency Power Available to the System?	5 No	1 No		2 No	1 Auto. 1 No	2 Manual
Is the System Fail-Safe?	1 Yes 4 No	?		2 No	1 No	2 No
Is Health Physics Approval Required for System Outage?	2 Yes 1 No	?		1 Yes 1 No	2 Yes	2 Yes
System Calibrated with Sources or by Lab Comparison?	5 Sources	1 Source		1 Source 1 LC	2 Sources	2 Sources
How Often is the System Calibrated?	Weekly to Semiannual	?		Semiannual	Quarterly to Semiannual	Weekly to Monthly
What Percent of the Time is the Instrument Found Off-Calibration?	0 to 50%	<10%		?	<5%	<10 to <50%
What Detectors are Used in the Dose Measurement Program?	10 Film 6 TLD 3 Ion Chamber	1 Film 3 TLD	2 None	1 TLD	1 TLD	2 None

TABLE VI (Contd)

	Licensee Facilities			Contractor Facilities		
	12 High Potential	5 Medium Potential	2 Low Potential	3 High Potential	5 Medium Potential	3 Low Potential
Program Conducted By?	6 Commercial 6 Self	2 Self	2 None	Self	Self	-
Commercial Contractor Results to be Used in Emergency Assessment?	5 Yes 1 No	-		-	-	-
Frequency of Environmental Deposition and Uptake Measurements?	Weekly to Emergency Only	Variable to Semiannually		Weekly	Variable	Variable to Each 2 Years
Program Conducted By?	9 Commercial 2 Self	3 Commercial 2 Self		2 Self	2 Self	3 Self
Commercial Contractor Results to be Used in Emergency Assessment?	6 Yes 1 No 1 Possibly	2 Yes		-	-	-
What Media are Sampled?	7 Soil 9 Milk 8 Veg. 1 Misc.	3 Soil 5 Veg. 1 Milk		2 Veg. 2 Milk 2 Misc.	1 Soil 1 Milk	3 Soil 2 Veg. 1 Milk
What Analysis is Made?	11 Isotopic	5 Isotopic		2 Isotopic	2 Isotopic	2 Gross 1 Isotopic

NOTE: C = Continuous
I = Intermittent
LC = Lab Comparison

One site reported a problem in obtaining comparable environmental analyses from the different commercial environmental contractors it has used during its operation. The results from these contractors are not easily compared because of differences in analytical procedures and detection limits. Such variation in results also reportably exists among state and other governmental agencies providing analyses for the same sample.

G. Meteorological Measurements

Table VII contains a summary of meteorological measurement capabilities. Only one licensee site reported no meteorology capabilities. Forty-three percent (10 licensee and 3 contractor) of the facilities reported a capability to measure wind speed, wind direction, and temperature at several elevations. A few sites, primarily contractors, have extensive capabilities including weather radar, while seven sites rely on outside help for meteorological information during an accident. Eight of the facilities have contracts for routine meteorological assistance, including preparation of isodose summaries for the environs based on air sample results and meteorological conditions.

At least one licensee had an extensive meteorological capability which was removed after several years of experience. Sixty percent of the sites with large radioactive inventories have a usable model and trained personnel available to make dispersion calculations in the event of an accident. Five licensee and one contractor facilities in the HIGH severity group did not report having this capability.

TABLE VII
METEOROLOGICAL MEASUREMENTS

	Licensee Facilities			Contractor Facilities		
	12 High Potential	5 Medium Potential	2 Low Potential	3 High Potential	5 Medium Potential	3 Low Potential
Is There a Meteorology Program?	12 Yes	5 Yes	1 Yes 1 No	3 Yes	5 Yes	3 Yes
Wind Direction Measurements (Elevations)	8 Mult. 4 Single	2 Mult. 3 Single	1 Single	1 Mult. 2 Single	1 Mult. 4 Single	1 Mult. 2 Single
Wind Speed Measurements (Elevations)	8 Mult. 4 Single	2 Mult. 3 Single	1 Single	1 Mult. 2 Single	1 Mult. 4 Single	1 Mult. 2 Single
Wind Speed and Direction Variance Measurement (Elevations)	4 Mult. 1 Single	1 Single	None	1 Mult. 2 Single	1 Mult. 3 Single	1 Mult.
Temperature Measurements (Elevations)	8 Mult. 3 Single	2 Mult. 3 Single	1 Single	1 Mult. 2 Single	1 Mult. 3 Single	1 Mult. 2 Single
Humidity Measurements (Elevations)	1 Single	2 Single	1 Single	1 Mult. 2 Single	1 Mult. 3 Single	1 Mult.
Dew Point Measurements (Elevations)	2 Mult.	2 Single	None	1 Mult.	1 Mult. 3 Single	1 Mult.
Is a Remote Readout Provided?	9 Yes 3 No	3 Yes 2 No	1 No	2 Yes 1 No	1 Yes 4 No	2 Yes 1 No
Is There a Process Alarm?	12 No	5 No	1 No	3 No	5 No	3 No
How Many False Alarms Last Year?	-	-	-	-	-	-
Is Emergency Power Available to the System?	1 Auto. 9 No	1 Auto. 4 No	1 No	1 Auto. 2 No	2 Auto. 3 No	1 Auto. 1 No 1 Manual
Who Calibrates the Equipment?	5 Factory 6 Self	3 Factory 2 Self	1 Self	1 Factory 2 Self	1 Factory 3 Self 1 None	2 Self
Is Facility Operation Dependent on Observations?	8 Yes 4 No	1 Yes 4 No	1 Yes	1 Yes 2 No	2 Yes 3 No	3 No
Do You Have Dispersion and Deposition Calculation Capability?	7 Yes 5 No	4 Yes 1 No	1 Yes	2 Yes 1 No	5 Yes	3 Yes
Do You Have a Plan to Track a Cloud?	7 Yes 5 No	4 Yes 1 No	?	3 Yes	4 Yes 1 No	3 Yes

TABLE VII (Contd)

	Licensee Facilities			Contractor Facilities		
	12 High Potential	5 Medium Potential	2 Low Potential	3 High Potential	5 Medium Potential	3 Low Potential
Do You Plan to Make Measurements from Aircraft?	1 Yes 11 No	1 Yes 4 No	1 No	2 Yes 1 No	2 Yes 3 No	3 No
Meteorological Program Conducted By?	3 Commercial 9 Self	5 Self	1 Commercial	2 Commercial 1 Self	5 Self	2 Commercial 1 Self
Are Commercial Contractor Results to be Used in Emergency Assessment?	2 Yes 1 No	-	1 Yes	2 Yes	-	2 Yes

Emergency power for meteorological instrumentation is provided at 23% of the sites (2 licensee and 5 contractor). Remote readouts are provided at 56% of the sites. Sixty-three percent of the sites plan to track a cloud in the event of a severe airborne release. Of these, six would use smoke bombs; five, calculations; six, monitoring instruments; and four, wind direction.

H. Emergency Communications

Data associated with emergency communication capabilities are summarized in Table VIII. Eighty-four percent of the facilities have emergency control centers which are established primarily for that purpose. A reactor control room which could be occupied during an accident serves as an emergency center for most of the reactors. Effluent or dose rate monitoring instrumentation readouts are provided at the control room or at an emergency center at several facilities. Seventy-seven percent of the licensee facilities and all contractors use mobile two-way radios, and two-fifths of these use "Page Boy" type receivers. There are four licensee sites which would be dependent on telephone or direct communications in the event of an emergency from these centers.

Twenty-three percent of the 30 facilities (5 licensee and 2 contractor) reported that emergency communication plans were not routinely tested. Communication channels were reported established by 90% of the facilities with local law enforcement agencies, by 70% of the facilities with local government authorities, by 83% of the facilities with a medical center and management staff and by 47% of the facilities with public information media.

TABLE VIII
EMERGENCY COMMUNICATIONS

	Licensee Facilities			Contractor Facilities		
	12 High Potential	5 Medium Potential	2 Low Potential	3 High Potential	5 Medium Potential	3 Low Potential
Do You Own Emergency Communications Equipment?	9 Yes 3 No	5 Yes	1 Yes 1 No	3 Yes	5 Yes	3 Yes
Do You Use Portable 2-Way Radios? (Walkie-Talkie)	7 Yes 5 No	4 Yes 1 No	1 Yes	2 Yes 1 No	3 Yes 2 No	3 Yes
Do You Use Mobile 2-Way Radio?	8 Yes 4 No	4 Yes 1 No	1 Yes	3 Yes	5 Yes	3 Yes
Do You Use "Page Boy" Radios?	3 Yes 9 No	2 Yes 3 No	1 No	1 Yes	3 Yes 2 No	1 Yes 2 No
Have Emergency Communication Channels Been Established with Local Law Enforcement Agencies?	12 Yes	4 Yes	1 Yes 1 No	3 Yes	4 Yes 1 No	3 Yes
Have Emergency Communication Channels Been Established with Local Governmental Authorities?	8 Yes 4 No	2 Yes 2 No	2 No	3 Yes	5 Yes	3 Yes
Have Emergency Communication Channels Been Established with a Medical Center?	12 Yes	3 Yes 1 No	1 Yes 1 No	2 Yes 1 No	4 Yes 1 No	3 Yes
Have Emergency Communication Channels Been Established with Your Management Staff	10 Yes 2 No	4 Yes	1 Yes 1 No	2 Yes 1 No	4 Yes 1 No	3 Yes
Have Emergency Communication Channels Been Established with Public Information Media?	5 Yes 7 No	1 Yes 3 No	2 No	2 Yes 1 No	3 Yes 2 No	3 Yes
Are Your Emergency Communications Plans Routinely Tested?	10 Yes 2 No	4 Yes 1 No	2 No	3 Yes	4 Yes 1 No	2 Yes 1 No

I. Medical Treatment Arrangements

Data on medical treatment arrangements are summarized in Table IX. Eighty-seven percent of sites reported radiation monitoring instruments located at the offsite hospital but only 33% of the sites (5 licensee and 5 contractor) reported the presence of high range radiation monitoring instruments.

Seven licensee sites rely on commercial services for whole body counting or bioassay analyses and a few have contracts for complete medical services with a commercial company providing emergency medical services.

TABLE IX
MEDICAL TREATMENT ARRANGEMENTS

	Licensee Facilities			Contractor Facilities		
	12 High Potential	5 Medium Potential	2 Low Potential	3 High Potential	5 Medium Potential	3 Low Potential
Do You Have Emergency Medical Treatment Facilities "On-Plant"?	4 Yes 8 No	1 Yes 4 No	2 Yes	2 Yes 1 No	4 Yes 1 No	3 Yes
Have Arrangements Been Made for Medical Assistance?	12 Yes	5 Yes	2 Yes	3 Yes	5 Yes	2 Yes 1 No
Is Medical Assistance Available "On-Plant"?	5 Yes 7 No	3 Yes 2 No	2 No	3 Yes	2 Yes 3 No	2 Yes 1 No
Have Training Sessions Been Held With Medical Support Personnel?	9 Yes 3 No	4 Yes 1 No	1 Yes 1 No	1 Yes 2 No	2 Yes 3 No	1 Yes 2 No
Do You Plan to Use Outside Consultants?	12 Yes	5 Yes	1 Yes 1 No	3 Yes	3 Yes 2 No	2 Yes 1 No
Have Arrangements Been Made With Outside Consultants?	11 Yes 1 No	5 Yes	1 No	3 Yes	3 Yes 1 No	2 Yes
Do You Provide Transportation to Off-Plant Medical Treatment Facilities?	10 Yes 2 No	5 Yes	2 Yes	3 Yes	5 Yes	3 Yes
Who Will Provide Health Physics Support at Off-Plant Medical Treatment Facilities?	7 Self 5 Hospital or Commercial	5 Self	1 Self 1 Hospital	3 Self	3 Self 1 Hospital 1 Both	2 Self 1 Both
Does the Off-Plant Medical Facilities Have a Radiologist on its Staff?	11 Yes 1 No	5 Yes	2 Yes	3 Yes	5 Yes	3 Yes
Do You Feel the Staff of the Off-Plant Medical Facility is Qualified in Radiation Protection?	10 Yes 1 No	5 Yes	2 Yes	3 Yes	5 Yes	3 Yes
Have You Reviewed Plans for Information Release with Staff or Off-Plant Medical Facilities?	6 Yes 6 No	4 Yes 1 No	1 Yes 1 No	2 Yes 1 No	3 Yes 2 No	2 Yes 1 No
Does The Off-Plant Medical Facility Have Radiation Monitoring Instruments?	9 Yes 3 No	4 Yes 1 No	2 Yes	3 Yes	5 Yes	3 Yes

TABLE IX (Contd)

	Licensee Facilities			Contractor Facilities		
	12 High Potential	5 Medium Potential	2 Low Potential	3 High Potential	5 Medium Potential	3 Low Potential
Do You Have Radiation Monitoring Instruments Stored at the Off-Plant Medical Facility?	6 Yes 5 No	1 Yes 4 No	1 Yes 1 No	3 No	2 Yes 3 No	3 No
Is High Range Equipment Present at the Facility?	2 Yes 5 No	2 Yes 2 No	1 Yes	1 Yes	2 Yes 1 No	2 Yes
How Often Are the Radiation Monitoring Instruments Calibrated?	Monthly to Annually	Monthly	Semiannual	Semiannual	Quarterly	Semiannual
Does the Off-Site Medical Facility Have Shielding Material Available?	5 Yes 7 No	2 Yes 2 No	1 No	2 Yes	2 Yes 3 No	2 Yes
What Backup Personnel Dosimetry Facilities Are Available?	5 Commercial 6 Hospital 1 Self	2 Commercial 2 Hospital 1 Government	1 Hospital	3 Self	5 Self	1 Self 2 Government
How Soon Could Whole Body Counter or Bioassay Results be Obtained?	2 hrs to 2 days	Immediate to 7 days	Few Hours	Immediate to 24 hrs	Immediate to few Hours	Immediate to 2 hrs

IV. CONCLUSIONS

The radiological emergency instrumentation currently in place at a selected number of contractor and private nuclear facilities was reviewed. Some twelve power reactors, eleven AEC sites, four test reactors, three research reactors, two fuel reprocessing plants and one plutonium fuel fabrication plant were included in the survey. A wide variation was observed in the types and performance capabilities of the radiological emergency instrumentation currently installed.

Radiological emergency instrumentation was found to be deficient to some degree at all facilities visited. Much of the instrumentation observed was designed and installed primarily for use in routine monitoring operations and hence was applicable only for the measurement of normally anticipated releases of radioactive materials. The deficiencies in emergency instrumentation were principally attributable to inadequately designed instrumentation, improper installation, inadequate calibrations or limited response ranges.

We conclude that all nuclear facilities need performance criteria for radiological emergency instrumentation to provide a sound basis to define the specific needs for and to evaluate the adequacy of such instrumentation. These emergency instrumentation performance criteria would also be of value in assessing a facility's overall instrumentation preparedness to meet radiological emergencies and would assist licensing groups in determining emergency instrumentation requirements and capabilities.

V. ACKNOWLEDGEMENTS

The efforts of J. P. Corley, K. R. Heid, E. D. McFall, C. E. Newton, Jr., A. J. Stevens and E. C. Watson, Jr., in visiting the participating facilities and L. A. Carter, R. L. Kathren and Lois Peter in preparing the report are greatly appreciated.

APPENDIX

INSTRUMENTATION FOR RADIATION EMERGENCIES

QUESTIONNAIRE

Facility

Location

Completed By

Date

Return to: Carl M. Unruh
Battelle-Northwest Laboratory
P. O. Box 999
Richland, Washington 99352

INSTRUMENTATION FOR RADIATION EMERGENCIES
QUESTIONNAIRE

Objective: To determine the availability, location and performance parameters of emergency instrumentation that is currently in place at nuclear facilities to measure and to evaluate the consequences of accidental radionuclide releases to the public domain.

Introduction

This questionnaire consists of two parts. The first part contains general questions to determine the basic types of radiation emergency instrumentation used by your facility to measure and to evaluate the consequences of accidental radionuclide releases to the public domain. The second part is the appendices which consists of the detailed questions which provide the opportunity to describe your radiation emergency instrumentation and systems.

Only those parts of the appendices required by your responses to the initial questions need be prepared. Most of the questions can be answered with a "Yes" or "No" or a number. Any written responses should be brief. They may be made on the back of these pages or additional pages may be attached.

It is not anticipated that any one facility will need to respond to more than a few of the appendices. They are provided to cover all possible environmental emergency monitoring approaches so each site may respond to a questionnaire relative to their emergency instrumentation philosophy.

When questions refer to effluents in this questionnaire it should be clear we are interested in radionuclide content and radioactivity levels, not engineering properties such as heat content. By environs or environment we mean lands beyond your property boundaries.

Part I

GENERAL QUESTIONS

Part I

General Questions

- 1) Are stacks monitored to determine the radionuclide content of the gaseous effluent releases? Yes _____ No _____. If the answer is Yes, complete questions in Appendix A, Stack Gaseous Effluent Instrumentation.
- 2) Are gaseous effluents monitored at your facility boundary? Yes _____ No _____. If the answer is Yes, complete questions in Appendix B, Boundary Air Monitoring Instrumentation.
- 3) Are gaseous effluents monitored in the environs (beyond your facility boundaries)? Yes _____ No _____. If the answer is Yes, complete questions in Appendix C, Environs Air Monitoring Instrumentation.
- 4) Are liquid effluents monitored at their point of discharge to determine their radionuclide content at the time of release? Yes _____ No _____. If the answer is Yes, complete Appendix D, Liquid Effluent Discharge Monitoring Instrumentation.
- 5) Are liquid effluents monitored at your facility boundary? Yes _____ No _____. If the answer is Yes, complete Appendix E, Boundary Liquid Monitoring Instrumentation.
- 6) Are liquid effluents monitored in the environs? Yes _____ No _____. If the answer is Yes, complete Appendix F, Environs Liquid Monitoring Instruments.
- 7) Are the dose rates monitored in the environs? Yes _____ No _____. If the answer is Yes, complete Appendix G, Dose Rate Monitoring Instrumentation in the Environs.
- 8) Are the contamination levels monitored in the environs? Yes _____ No _____. If the answer is Yes, complete Appendix H, Contamination Level Monitoring Instrumentation in the Environs.
- 9) Is a meteorological station maintained at or very near your facility? Yes _____ No _____. If the answer is Yes, complete Appendix I, Meteorological Station Instrumentation.
- 10) Have arrangements been made for emergency communications? Yes _____ No _____. If the answer is Yes, complete Appendix J, Communication Arrangements.
- 11) Have arrangements been made with non-plant operated medical facilities for emergency medical support? Yes _____ No _____. If the answer is Yes, complete Appendix K, Medical Treatment Arrangements.
- 12) Are radionuclide materials shipped or transferred on-plant by plant forces between various buildings? Yes _____ No _____. If the answer is Yes, complete Appendix L, On-Plant Radioactive Material Shipments.
- 13) Is aerial survey instrumentation available, calibrated and tested? Yes _____ No _____
- 14) Can the aerial survey results be directly related to ground concentration levels? Yes _____ No _____

- 15) Estimated time till an aerial survey could be commenced under emergency conditions?

- 16) Estimated time from start of aerial survey to first analysis of ground level concentrations?

- 17) Have you established a Relocation Control Center for directing emergency evaluation and recovery programs? Yes_____ No_____. Where?_____
- 18) What equipment for emergency monitoring is available at your relocation control center?

- 19) Have you adopted contamination level values for the environment that would call for specific responses such as confiscation of crops, evacuation of people? Yes_____ No_____. What action values are established?_____
- 20) Have you given special consideration toward providing emergency monitoring instrumentation in the direction of population centers? Yes_____ No_____. What was done?

- 21) How do you test your containment pressure relief valves to assure they operate correctly?

- 22) How do you plan to monitor for possible radionuclide leakage through containment penetrations or building breaks?

Part II

APPENDICES

APPENDIX A

Stack Gaseous Effluent Instrumentation

1) Methods of Release

- a) Are stacks used for normal effluent discharge? Yes _____ No _____
- b) How many stacks are used? _____
- c) What other means of effluent escape could occur under the Design Basis Accident (DBA)? _____
- d) Provide a physical description of each stack.
 - Height _____
 - Top I.D. _____
 - Air Flow Rate _____
- e) Can stack flow rates be adjusted? Yes _____ No _____. Within what range? _____
- f) Under serious accident conditions is it possible to inadvertently release radio-nuclides through unfiltered building vents? Yes _____ No _____. Explain briefly.

2) Method of Monitoring

- a) Are stack effluents monitored continuously? Yes _____ No _____. Intermittently? Yes _____ No _____
- b) If stack monitoring is intermittent, what is the frequency? _____
- c) Is the sample proportional to stack discharge flow rate? Yes _____ No _____
- d) Are both particulates and gases monitored? Yes _____ No _____
- e) What method is used to differentiate gaseous from particulate activity? _____
- f) What method of sampling collection is used?
 - Filter paper _____ Type _____
 - Charcoal _____
 - Solution _____
 - Others _____
- g) What method is used to monitor effluent?
 - Gaseous effluent _____
 - Particulate effluent _____

h) Identify detection system for effluent contamination:

- Gaseous effluent _____
- Particulate effluent _____

i) What is range of response of detectors identified under (h) above? (Give range in concentration units) _____

j) Is a spot sampling method used to augment data derived from the continuous stack monitoring system? Yes _____ No _____

k) If yes to (j) above, identify the method _____

l) Is this monitoring instrumentation used routinely or just for emergency conditions? Identify specifically any instrumentation used for emergencies only.

3) Analyses

a) Do you monitor only for gross radioactivity? Yes _____ No _____

b) What method of analyses do you use for (a) above? _____

c) Are particle size determinations made routinely? Yes _____ No _____

d) List radionuclide composition by percent of total activity associated with normal effluent discharge. _____

e) What is the anticipated radionuclide composition by percent of total activity under accident conditions? _____

f) What is time lapse between sampling and analyses? _____

g) Is radioactivity computed to time zero? Yes _____ No _____

h) Can stack radionuclide concentrations be converted to ground depositions at various distances from the facilities? Yes _____ No _____

i) Are the results readout at a remote location? Yes _____ No _____. Where?

4) Accuracy and Reliability

a) How are the effluent monitoring systems calibrated? Explain briefly _____

b) What radioactivity sources are used for calibration and what is the calibration frequency? _____

- c) Upon recalibration, what percentage of the time do the instruments require calibration adjustments? _____
- d) Other than (a) and (b) above, how is the monitoring system checked for operational capability? _____
- e) How frequently are operational checks provided? _____
- f) Have effluent monitors been located in positions where optimum accuracy and reliability can be achieved? Yes _____ No _____
- g) For your Design Basis Accident, what assurance do you have that the monitoring system will not be subjected to adverse environmental factors which would effect its functions? _____
- h) Is the monitoring system connected to process alarms? Yes _____ No _____
- i) Is the monitoring system fail-safe? Yes _____ No _____. Explain _____
- j) How many false alarms were experienced last year? _____
- k) Do you have an emergency power supply? Yes _____ No _____
- l) Does emergency power supply come on automatically or is manual activation required? _____
- m) What provisions have been made to prevent fallout build-up on monitoring equipment? _____
- n) Is it permissible to deactivate the monitoring system without approval of your health physics staff? Yes _____ No _____

5) Physical Properties

- a) Is this instrumentation installed or is it portable? _____
- b) If commercially available instruments are used, give manufacturer's name and model number. _____
- c) Give a brief description of your effluent monitoring system including susceptibility to damage from:
- fire damage	- pressure
- humidity	- chemicals
- water	- nearby radiation source
- fog spray	- power loss
- steam	- electronic failure
- heat	

- d) What are the anticipated radiation levels for the DBA at positions where the monitoring readouts are located? _____
- e) If it is anticipated that radiation levels would be significantly high under (d) above, what provisions are being made to relocate readouts at locations that could be occupied under any set of circumstances? _____

6) Others

- a) Are you generally satisfied with your stack monitoring emergency instrumentation?
Yes _____ No _____
- b) Do you have plans for changes or improvements? Yes _____ No _____ Describe _____
- c) When will the changes be made? _____
- d) Any additional comments about your system or present or future requirements for emergency instrumentation? _____

APPENDIX B

Boundary Air Monitoring Instrumentation

1) Method of Monitoring

- a) Is the air at the boundary of your facility monitored continuously? Yes _____
No _____ Intermittently? Yes _____ No _____.
- b) If boundary air monitoring is intermittent, what is the frequency? _____

- c) Are both particulates and gases monitored? Yes _____ No _____.
- d) What method is used to differentiate gaseous from particulate activity? _____

- e) What method of sample collection is used:
- Filter Paper _____ Type _____
 - Charcoal _____
 - Solution _____
 - Others _____
- f) What method is used to monitor effluent contamination:
- Gaseous effluent _____
 - Particulate effluents _____
- g) Identify detection system for
- Gaseous effluent _____
 - Particulate effluent _____
- h) What is range of response of detectors identified under (g) above? (Give range in concentration units) _____
- i) Is a spot sampling method used to augment data derived from the continuous stack monitoring system? Yes _____ No _____
- j) If yes to (i) above, identify the method. _____
- k) Is this monitoring instrumentation used routinely or just for emergency conditions? Identify specifically any instrumentation used for emergencies only.

2) Analyses

- a) Do you monitor only for gross radioactivity? Yes _____ No _____
- b) What method of analyses do you use for (1a) above? _____
- c) Are particle size analyses made routinely? Yes _____ No _____

- d) List radionuclide composition by percent of total activity associated with normal effluent discharge. _____
- e) What is the anticipated radionuclide composition by percent of total activity under accident conditions? _____
- f) What is time lapse between sampling and analyses? _____
- g) Is radioactivity computed to time zero? Yes _____ No _____
- h) Can radionuclide concentrations at the boundary be converted to ground depositions at various distances from the facilities? Yes _____ No _____
- i) Are the results read out at a remote location? Yes _____ No _____ Where _____

3) Accuracy and Reliability

- a) How are the effluent monitoring systems calibrated? Explain briefly.
- b) What radioactivity sources are used for calibration and what is the calibration frequency? _____
- c) Upon re-calibration, what percentage of the time do the instruments require calibration adjustment? _____
- d) Other than (a) and (b) above, how is the monitoring system checked for operational capability? _____
- e) How frequently are operational checks provided? _____
- f) Have effluent monitors been located in positions where optimum accuracy and reliability can be achieved? Yes _____ No _____
- g) For your Design Basis Accident, what assurance do you have that the monitoring system will not be subjected to adverse environmental factors which would effect its functions? _____
- h) Is the monitoring system connected to process alarms? Yes _____ No _____
- i) Is the monitoring system fail-safe? Yes _____ No _____ Explain _____
- j) How many false alarms were experienced last year? _____
- k) Do you have an emergency power supply? Yes _____ No _____

- l) Does emergency power supply come on automatically or is manual activation required? _____
- m) What provisions have been made to prevent fallout build up on monitoring equipment? _____
- n) Is it permissible to deactivate the monitoring system without approval of your health physics staff? Yes _____ No _____

4) Physical Properties

- a) Is this instrumentation installed or is it portable? _____
- b) If commercially available instrumentation is used, give manufacturer's name and model numbers. _____
- c) Give a brief description of your effluent monitoring system including susceptibility to damage from:
- fire damage	- power loss
- humidity	- chemicals
- water	- nearby radiation source
- heat	- electronic failure
- d) What are the anticipated radiation levels for the Design Basis Accident at positions where the monitoring readouts are located? _____
- e) If it is anticipated that radiation levels would be significantly high under (d) above, what provisions are being made to relocate readouts at locations that could be occupied under any set of circumstances?

5) Others

- a) Are you generally satisfied with your boundary monitoring emergency instrumentation? Yes _____ No _____
- b) Do you have plans for changes or improvements? Yes _____ No _____ Describe.
- c) When will the changes be made? _____
- d) Any additional comments about your system or present or future requirements for emergency instrumentation? _____

•

•

•

•

•

•

•

•

APPENDIX C

Environs Air Monitoring Instrumentation

1) Method of Monitoring

- a) Is the air in the environs monitored continuously? Yes _____ No _____
Intermittently? Yes _____ No _____
- b) If environmental air monitoring is intermittent, what is the frequency? _____
- c) Are both particulates and gases monitored? Yes _____ No _____
- d) What method is used to differentiate gaseous from particulate activity? _____

- e) What method of sampling collection is used?
- Filter paper _____ Type _____
 - Charcoal _____
 - Solution _____
 - Others _____
- f) What method is used to monitor effluent?
- Gaseous effluent _____
 - Particulate effluent _____
- g) Identify detection system for effluent contamination?
- Gaseous effluent _____
 - Particulate effluents _____
- h) What is range of response of detectors identified under (g) above? (Give range in concentration limits) _____
- i) Is a spot sampling method used to augment data derived from the continuous stack monitoring system? Yes _____ No _____
- j) If yes to (i) above, identify the method. _____
- k) Is this monitoring instrumentation used routinely or just for emergency conditions? Identify specifically any instrumentation used for emergencies only.

2) Analyses

- a) Do you monitor only for gross radioactivity? Yes _____ No _____
- b) What method of analyses do you use for (a) above? _____

- c) Are particle size analyses made routinely? Yes_____ No_____
- d) List radionuclide composition by percent of total activity associated with normal effluent discharge. _____
- e) What is the anticipated radionuclide composition by percent of total activity under accident conditions? _____
- f) What is time lapse between sampling and analyses? _____
- g) Is radioactivity computed to time zero? Yes_____ No_____
- h) Can radionuclide concentrations in the environs air be converted to ground depositions at various distances from the facilities? Yes_____ No_____
- i) Are the results read out at a remote location? Yes_____ No_____ Where? _____

3) Accuracy and Reliability

- a) How are the effluent monitoring systems calibrated? Explain briefly.
- b) What radioactivity sources are used for calibration and what is the calibration frequency? _____
- c) Upon re-calibration, what percentage of the time do the instruments require calibration adjustments? _____
- d) Other than (a) and (b) above how is the monitoring system checked for operational capability? _____
- e) How frequently are operational checks provided? _____
- f) Have effluent monitors been located in positions where optimum accuracy and reliability can be achieved? Yes_____ No_____
- g) For your Design Basis Accident, what assurance do you have that the monitoring system will not be subjected to adverse environmental factors which would effect its functions? _____
- h) Is the monitoring system connected to process alarms? Yes_____ No_____
- i) Is the monitoring system fail safe? Yes_____ No_____ Explain. _____
- j) How many false alarms were experienced last year? _____

- k) Do you have an emergency power supply? Yes _____ No _____
- l) Does emergency power supply come on automatically or is manual activation required? _____
- m) What provisions have been made to prevent fallout build up on monitoring equipment? _____
- n) Is it permissible to deactivate the monitoring system without approval of your health physics staff? Yes _____ No _____

4) Physical Properties

- a) Is this instrumentation installed or is it portable? _____
- b) If commercially available instrumentation is used, give manufacturer's name and model numbers. _____
- c) Give a brief description of your effluent monitoring system including susceptibility to damage from:
- fire damage	- chemicals
- humidity	- nearby radiation source
- water	- power loss
- heat	- electronic failure
- d) What are the anticipated radiation levels for the Design Basis Accident at positions where the monitoring readouts are located? _____
- e) If it is anticipated that radiation levels would be significantly high under (d) above, what provisions are being made to relocate readouts at locations that could be occupied under any set of circumstances?

5) Others

- a) Are you generally satisfied with your environs air monitoring instrumentation? Yes _____ No _____
- b) Do you have plans for changes or improvements? Yes _____ No _____
Describe. _____
- c) When will the changes be made? _____
- d) Any additional comments about your system or present or future requirements for emergency instrumentation. _____

APPENDIX D

Liquid Effluent Discharge Monitoring Instrumentation

1) Method of Monitoring

- a) Are liquid effluents monitored at their point of discharge continuously?
Yes_____ No_____. Intermittently? Yes_____ No_____
- b) If liquid monitoring is intermittent, what is the frequency? _____
- c) Is the sample monitored proportional to the discharge flow rate? Yes_____ No_____
- d) Are both particulates and solutes monitored? Yes_____ No_____
- e) What method is used to differentiate solute from particulate activity?
- f) What method of sample collection is used:
- Continuous _____
 - Proportional _____
 - Grab sample _____
 - Scrubber sample _____
 - Others _____
- g) What method is used to monitor effluent?
- Solute effluent _____
 - Particulate effluent _____
- g) What method is used to monitor effluent?
- Solute effluent _____
 - Particulate effluent _____
- h) Identify detection system for effluent contamination.
- Solute effluent _____
 - Particulate effluent _____
- i) What is range of response of detectors identified under (h) above? (Give range in concentration units) _____
- j) Is a spot sampling method used to augment data derived from the continuous discharge monitoring system? Yes_____ No_____
- k) If yes to (j) above, identify the method. _____

- 1) Is this monitoring instrumentation used routinely or just for emergency conditions? Identify specifically any instrumentation used for emergencies only. _____

2) Analyses

- a) Do you monitor only for gross radioactivity? Yes _____ No _____
- b) What method of analyses do you use for (a) above? _____
- c) Are particle size analyses made routinely? Yes _____ No _____
- d) List radionuclide composition by percentage of total activity associated with normal effluent discharge. _____
- e) What is the anticipated radionuclide composition by percentage of total activity under accident conditions? _____
- f) What is time lapse between sampling and analyses? _____
- g) Is radioactivity computed to time zero? Yes _____ No _____
- h) Can liquid effluent radionuclide concentrations be converted to anticipated concentrations at various distances from the facilities? Yes _____ No _____
How? _____
- i) Are the results readout at a remote location? Yes _____ No _____ Where _____

3) Accuracy and Reliability

- a) How are the effluent monitoring systems calibrated? Explain briefly. _____
- b) What radioactivity sources are used for calibration and what is the calibration frequency? _____
- c) Upon re-calibration, what percentage of the time do the instruments require calibration adjustment? _____
- d) Other than (a) and (b) above, how is the monitoring system checked for operational capability? _____
- e) How frequently are operational checks provided? _____
- f) Have effluent monitors been located in positions where optimum accuracy and reliability can be achieved? Yes _____ No _____

- g) For your Design Basis Accident (DBA), what assurance do you have that the monitoring system will not be subjected to adverse environmental factors which would effect its functions? _____
- h) Is the monitoring system connected to process alarms? Yes _____ No _____
- i) Is the monitoring system fail safe? Yes _____ No _____. Explain. _____
- j) How many false alarms were experienced last year? _____
- k) Do you have an emergency power supply? Yes _____ No _____
- l) Does emergency power supply come on automatically or is manual activation required? _____
- m) What provisions have been made to prevent fallout build up on monitoring equipment? _____
- n) Is it permissible to deactivate the monitoring system without approval of your health physics staff? Yes _____ No _____

4) Physical Properties

- a) Is this instrumentation installed or is it portable? _____
- b) If commercially available instrumentation is used, give manufacturer's name and model numbers. _____
- c) Give a brief description of your effluent monitoring system including susceptibility to damage from:
- fire damage	- heat
- humidity	- pressure
- water	- chemicals
- fog spray	- nearby radiation source
- steam	- power loss
	- electronic failure
- d) What are the anticipated radiation levels for the DBA at positions where the monitoring readouts are located? _____
- e) If it is anticipated that radiation levels would be significantly high under (d) above, what provisions are being made to relocate readouts at locations that could be occupied under any set of circumstances?

5) Others

- a) Do you or does someone outside of your company provide an environmental monitoring program? Who? _____
- b) Are the measurements of the outside organization to be utilized in your emergency situation assessment? Yes _____ No _____
- c) Are you generally satisfied with your liquid effluent discharge monitoring emergency instrumentation? Yes _____ No _____
- d) Do you have plans for changes or improvements? Yes _____ No _____ Describe.
- e) When will the changes be made? _____
- f) Any additional comments about your system or present or future requirements for emergency instrumentation? _____

APPENDIX E

Boundary Liquid Monitoring Instrumentation

1) Method of Monitoring

- a) Are liquid effluents monitored at the boundary of your facility continuously?
Yes_____ No_____. Intermittently? Yes_____ No_____
- b) If liquid monitoring is intermittent, what is the frequency?_____
- c) Is the sample monitored proportional to the discharge flow rate? Yes_____ No_____.
- d) Are both particulates and solutes monitored? Yes_____ No_____
- e) What method is used to differentiate solute from particulate activity?_____
- f) What method of sample collection is used?
- Continuous_____
 - Proportional_____
 - Grab sample_____
 - Scrubber sample_____
 - Others_____
- g) What method is used to monitor effluent?
- Solute effluent_____
 - Particulate effluent_____
- h) Identify detection system for effluent contamination?
- Solute effluent_____
 - Particulate effluent_____
- i) What is range of response of detectors identified under (h) above? Give range in concentration units_____
- j) Is a spot sampling method used to augment data derived from the continuous boundary effluent monitoring system? Yes_____ No_____
- k) If yes to (j) above, identify the method._____
- l) Is this monitoring instrumentation used routinely or just for emergency conditions? Identify specifically any instrumentation used for emergencies only._____

2) Analyses

- a) Do you monitor only for gross radioactivity? Yes_____ No_____

- b) What method of analyses do you use for (a) above? _____
- c) Are particle size analyses made routinely? Yes _____ No _____
- d) List radionuclide composition by percent of total activity associated with normal effluent discharge. _____
- e) What is the anticipated radionuclide composition by percent of total activity under accident conditions? _____
- f) What is time lapse between sampling and analyses? _____
- g) Is radioactivity computed to time zero? Yes _____ No _____
- h) Can liquid effluent radionuclide concentrations be converted to anticipated concentrations at various distances from the facilities? Yes _____ No _____
How? _____
- i) Are the results readout at a remote location? Yes _____ No _____ Where? _____

3) Accuracy and Reliability

- a) How are the effluent monitoring systems calibrated? Explain briefly.
- b) What radioactivity sources are used for calibration and what is the frequency?

- c) Upon re-calibration, what percentage of the time do the instruments require calibration adjustments? _____
- d) Other than (a) and (b) above, how is the monitoring system checked for operational capability? _____
- e) How frequently are operational checks provided? _____
- f) Have effluent monitors been located in positions where optimum accuracy and reliability can be achieved? Yes _____ No _____
- g) For your Design Basis Accident (DBA), what assurance do you have that the monitoring system will not be subjected to adverse environmental factors which would effect its functions? _____
- h) Is the monitoring system connected to process alarms? Yes _____ No _____
- i) Is the monitoring system fail safe? Yes _____ No _____ Explain. _____

- j) How many false alarms were experienced last year? _____
- k) Do you have an emergency power supply? Yes _____ No _____
- l) Does emergency power supply come on automatically or is manual activation required? _____
- m) What provisions have been made to prevent fallout build up on monitoring equipment? _____
- n) Is it permissible to deactivate the monitoring system without approval of your health physics staff? Yes _____ No _____
- 4) Physical Properties
- a) Is this instrumentation installed or is it portable? _____
- b) If commercially available instrumentation is used, give manufacturer's name and model numbers. _____
- c) Give a brief description of your effluent monitoring system including susceptibility to damage from:
- fire damage	- chemicals
- humidity	- nearby radiation source
- water	- power loss
- heat	- electronic failure
- d) What are the anticipated radiation levels for the DBA at positions where the monitoring readouts are located? _____
- e) If it is anticipated that radiation levels would be significantly high under (c) above, what provisions are being made to relocate readouts at locations that could be occupied under any set of circumstances?
- 5) Others
- a) Do you or does someone outside of your company provide an environmental monitoring program? Yes _____ No _____
- b) Are the measurements of the outside organization to be utilized in your emergency situation assessment? Yes _____ No _____
- c) Are you generally satisfied with your boundary liquid monitoring emergency instrumentation? Yes _____ No _____
- d) Do you have plans for changes or improvements? Yes _____ No _____
Describe. _____

- e) When will changes be made? _____
- f) Any additional comments about your system or present or future requirements
for emergency instrumentation? _____

APPENDIX F

Environs Liquid Monitoring Instrumentation

1) Method of Monitoring

- a) Are liquid effluents monitored in the environs continuously? Yes _____ No _____
Intermittently? Yes _____ No _____
- b) If liquid monitoring is intermittent, what is the frequency? _____
- c) Are both particulates and solutes monitored? Yes _____ No _____
- d) What method is used to differentiate solute from particulate activity? _____

- e) What method of sampling collection is used?
- Continuous _____
 - Proportional _____
 - Grab sample _____
 - Scrubber sample _____
 - Others _____
- f) What method is used to monitor effluent?
- Solute effluent _____
 - Particulate effluent _____
- g) Identify detection system for effluent contamination?
- Solute effluent _____
 - Particulate effluent _____
- h) What is range of response of detectors identified under (g) above? (Give range in concentration units) _____
- i) Is a spot sampling method used to augment data derived from the continuous effluent monitoring system? Yes _____ No _____
- j) If yes to (i) above, identify the method. _____
- k) Is this monitoring instrumentation used routinely or just for emergency conditions? Identify specifically any instrumentation used for emergencies only.

2) Analyses

- a) Do you monitor only for gross radioactivity? Yes _____ No _____
- b) What method of analyses do you use for (a) above? _____

- c) Are particle size analyses made routinely? Yes _____ No _____
- d) List radionuclide composition by percent of total activity associated with normal effluent discharge. _____
- e) What is the anticipated radionuclide composition by percent of total activity under accident conditons? _____
- f) What is time lapse between sampling and analyses? _____
- g) Is radioactivity computed to time zero? Yes _____ No _____
- h) Can liquid effluent radionuclide concentrations be converted to anticipated concentrations at various distances from the facilities? Yes _____ No _____
How? _____
- i) Are the results readout at a remote location? Yes _____ No _____ Where? _____

3) Accuracy and Reliability

- a) How are the effluent monitoring systems calibrated? Explain briefly.
- b) What radioactivity sources are used for calibration and what is the frequency?

- c) Upon re-calibration, what percentage of the time do the instruments require calibration adjustments? _____
- d) Other than (a) and (b) above, how is the monitoring system checked for operational capability? _____
- e) How frequently are operational checked provided? _____
- f) Have effluent monitors been located in positions where optimum accuracy and reliability can be achieved? Yes _____ No _____
- g) For your Design Basis Accident (DBA), what assurance do you have that the monitoring system will not be subjected to adverse environmental factors which would effect its functions? _____
- h) Is the monitoring system connected to process alarms? Yes _____ No _____
- i) Is the monitoring system fail safe? Yes _____ No _____ Explain. _____

- j) How many false alarms were experienced last year? _____
- k) Do you have an emergency power supply? Yes _____ No _____
- l) Does emergency power supply come on automatically or is manual activation required? _____
- m) What provisions have been made to prevent fallout build up on monitoring equipment? _____
- n) Is it permissible to deactivate the monitoring system without approval of your health physics staff? Yes _____ No _____

4) Physical Properties

- a) Is this instrumentation installed or is it portable? _____
- b) If commercial instrumentation is used, give manufacturer's name and model numbers. _____
- c) Give a brief description of your effluent monitoring system including susceptibility to damage from:
- fire damage	- chemicals
- humidity	- nearby radiation source
- water	- power loss
- heat	- electronic failure
- d) What are the anticipated radiation levels for the DBA at positions where the monitoring readouts are located? _____
- e) If it is anticipated that radiation levels would be significantly high under (d) above, what provisions are being made to relocate readouts at locations that could be occupied under any set of circumstances? _____

5) Others

- a) Do you or does someone outside of your company provide an environmental monitoring program? Yes _____ No _____ Who? _____
- b) Are the measurements of the outside organization to be utilized in your emergency situation assessment? Yes _____ No _____
- c) Are you generally satisfied with your environmental liquid monitoring emergency instrumentation? Yes _____ No _____

-60-

- d) Do you have plans for changes or improvements? Yes_____ No_____ Describe.

- e) When will the changes be made? _____
- f) Any additional comments about your system or present or future requirements for
emergency instrumentation? _____

APPENDIX G

Dose Rate Monitoring Instrumentation in the Environs

1) Method of Monitoring

- a) Are dose rates in the environs monitored continuously? Yes _____ No _____
Intermittently? Yes _____ No _____
- b) If dose rate monitoring is intermittent, what is the frequency? _____
- c) Are both photon and beta components of the dose rate contributions monitored?
Yes _____ No _____
- d) What method of dose measurement is used?
	<u>Range in Dose Rate</u>
- G.M. tube _____	_____
- Ionization chamber _____	_____
- Scintillation crystal _____	_____
- Proportional chamber _____	_____
- Film dosimeter _____	_____
- Thermoluminescent dosimeter _____	_____
- Radiophosphorescence dosimeter _____	_____
- e) What method is used to differentiate photon from beta dose contributions? _____
- f) How will the dose to off-site personnel be evaluated? _____

2) Accuracy and Reliability

- a) How are the dose rate monitoring systems calibrated? Explain briefly _____
- b) What radioactivity sources are used for calibration and what is the frequency?

- c) Upon recalibration, what percentage of the time do the instruments require calibration adjustments? _____
- d) Other than (a) and (b) above, how is the dose rate monitoring system checked for operational capability? _____
- e) How frequently are operational checks provided? _____
- f) Have dose rate monitoring instruments been located in positions where optimum accuracy and reliability can be achieved? Yes _____ No _____
- g) For your Design Basis Accident (DBA), what assurance do you have that the monitoring system will not be subjected to adverse environmental factors which would effect its functions? _____

- h) Is the monitoring system connected to process alarms? Yes _____ No _____
- i) Is the monitoring system fail-safe? Yes _____ No _____ Explain _____
- j) How many false alarms were experienced last year? _____
- k) Do you have an emergency power supply? Yes _____ No _____
- l) Does emergency power come on automatically or is manual activation required?

- m) What provisions have been made to prevent fallout build-up on monitoring equipment?

- n) Is it permissible to deactivate the monitoring system without approval of your health physics staff? Yes _____ No _____

3) Physical Properties

- a) Give a brief description of your dose rate monitoring system including susceptibility to damage from:
- fire damage	- chemicals
- humidity	- nearby radiation source
- water	- power loss
- heat	- electronic failure
- b) If commercially available equipment is used, give manufacturer's name and model number. _____
- c) What are the anticipated radiation levels for the DBA at positions where the monitoring readouts are located? _____
- d) If it is anticipated that radiation levels would be significantly high under (c) above, what provisions are being made to relocate readouts at locations that could be occupied under any set of circumstances? _____

4) Others

- a) Do you or does someone outside of your company provide an environmental dose rate monitoring program? Yes _____ No _____. Who? _____
- b) Are the measurements of the outside organization to be utilized in your emergency situation assessment? Yes _____ No _____
- c) Are you generally satisfied with your dose rate emergency instrumentation? Yes _____ No _____

- d) Do you have plans for changes or improvements? Yes_____ No_____. Describe
- e) When will the changes be made?_____
- f) Any additional comments about your system or present or future requirements for emergency instrumentation?_____

APPENDIX H

Contamination Level Monitoring
Instrumentation in the Environs

1) Method of Monitoring

- a) Are contamination levels in the environs monitored continuously? Yes _____
No _____. Intermittently? Yes _____ No _____
- b) If contamination levels are monitored intermittently, what is the frequency?

- c) What contaminants are monitored?
- Gross gamma-beta _____
 - Noble gases _____
 - Mixed fission product _____
 - Tritium _____
 - ^{131}I _____
 - ^{137}Cs _____
 - Others--Identify _____
- d) What method of contaminant monitoring is used?
- Soil collection _____
 - Vegetation collection _____
 - Milk collection _____
 - Others _____
- e) What is range of response of detectors used for analysis (d) above? _____

2) Analyses

- a) Do you monitor only for gross radioactivity? Yes _____ No _____
- b) What method of analyses do you use for (a) above? _____
- c) List radionuclide composition by percent of total activity associated with normal effluent discharge. _____
- d) What is the anticipated radionuclide composition by percent of total activity under accident conditions? _____
- e) What is time lapse between sampling and analyses? _____
- f) Is radioactivity computed to time zero? Yes _____ No _____

3) Accuracy and Reliability

- a) How are the contamination level monitoring systems calibrated? Explain briefly

- b) What radioactivity sources are used for calibration and what is the frequency?

- c) Upon recalibration, what percentage of the time do the instruments require calibration adjustments? _____
- d) Other than (a) and (b) above, how is the monitoring system checked for operational capability? _____
- e) How frequently are operational checks provided? _____
- f) Has contamination level monitoring been performed in positions where optimum accuracy and reliability can be achieved? Yes _____ No _____
- g) For your Design Basis Accident (DBA) what assurance do you have that the monitoring system will not be subjected to adverse environmental factors which would effect its functions? _____
- h) Is the monitoring system connected to process alarms? Yes _____ No _____
- i) Is the monitoring system fail-safe? Yes _____ No _____. Explain _____
- j) How many false alarms were experienced last year? _____
- k) Do you have an emergency power supply? Yes _____ No _____
- l) Does emergency power come on automatically or is manual activation required?

4) Physical Properties

- a) Give a brief description of your contamination level monitoring system including susceptibility to damage from:
- fire damage	- nearby radiation source
- humidity	- power loss
- water	- electronic failure
- chemicals	
- b) If commercially available instruments are used, give manufacturer's name and model numbers. _____
- c) What are the anticipated radiation levels for the DBA at positions where the monitoring readouts are located? _____
- d) If it is anticipated that radiation levels would be significantly high under (c) above, what provisions are being made to relocate readouts at locations that could be occupied under any set of circumstances? _____

5) Others

- a) Do you or does someone outside of your company provide an environmental monitoring program? Yes _____ No _____. Who? _____
- b) Are the measurements of the outside organization to be utilized in your emergency situation assessment? Yes _____ No _____
- c) Are you generally satisfied with your contamination level emergency instrumentation? Yes _____ No _____
- d) Do you have plans for changes or improvements? Yes _____ No _____. Describe _____
- e) When will the changes be made? _____
- f) Any additional comments about your system or present or future requirements for emergency instrumentation? _____

APPENDIX I

Meteorological Station Instrumentation

1) Method of Monitoring

- a) Are local meteorological conditions monitored continuously? Yes _____ No _____
- b) If intermittently, what is the frequency? _____
- c) What measurements are taken?
- Wind direction _____
 - Wind speed _____
 - Wind speed and direction variability _____
 - Temperature _____
 - Humidity _____
 - Dew point _____
 - Atmospheric stability _____
 - Others _____
- d) At what elevations above grade are the observations made? _____
- e) Do you plan to use smoke bombs or balloons to help determine the course of any gaseous releases? Yes _____ No _____
- f) How do you plan to follow the course of any gaseous release cloud? _____
- g) Are you prepared to perform air monitoring with aircraft? Yes _____ No _____

2) Analyses

- a) What methods of readout are used? _____
- b) Where are readouts reported? _____
- c) Are they shown continuously at an always-occupied location? Yes _____ No _____
Where? _____
- d) Are some of your facility operating procedures dependent on the meteorological observations? Yes _____ No _____. What? _____
- e) Is your staff capable of making dispersion and deposition calculations?
Yes _____ No _____
- f) What methods do they use?
- Models _____
 - Deposition velocities _____
 - Rainout factors _____

3) Accuracy and Reliability

- a) How are the meteorological instruments calibrated? _____
- b) Other than (a) above, how is the monitoring system checked for operational capability? _____
- c) How frequently are operational checks provided? _____
- d) Have meteorological stations been located in positions where optimum accuracy and reliability can be achieved? Yes _____ No _____
- e) For your Design Basis Accident (DBA), what assurance do you have that the monitoring system will not be subjected to adverse environmental factors which would effect its functions? _____
- f) Is the monitoring system connected to process alarms? Yes _____ No _____
- g) Is the monitoring system fail-safe? Yes _____ No _____. Explain _____
- h) How many false alarms were experienced last year? _____
- i) Do you have an emergency power supply? Yes _____ No _____
- j) Does emergency power come on automatically or is manual activation required? _____

4) Physical Properties

- a) Give a brief description of your meteorological station including susceptibility to damage from:
 - fire damage
 - humidity
 - water
 - heat
 - chemicals
 - nearby radiation source
 - power loss
 - electronic failure
- b) If commercially available instruments are used, give manufacturer's name and model numbers _____

5) Others

- a) Do you or does someone outside of your company provide a meteorological monitoring program? Yes _____ No _____. Who? _____
- b) Are the measurements of the outside organization to be utilized in your emergency situation assessment? Yes _____ No _____

- c) Are you generally satisfied with your meteorological monitoring program?
Yes _____ No _____
- d) Do you have plans for changes or improvements? Yes _____ No _____. Describe
- e) When will the changes be made? _____
- f) Any additional comments about your system or present or future requirements
for meteorological instrumentation? _____

•

•

•

•

•

•

•

•

APPENDIX J

Communication Arrangements

- 1) How will field survey results be reported back to your emergency control center?

- 2) What communication equipment do you own and operate?
 - Walkie-talkies _____, How many? _____
 - Two-way radios _____, How many? _____
 - "Page Boy" call system _____, How many? _____
 - Other _____
- 3) Have you established communication channels with:
 - Local police _____
 - Local government _____
 - Medical centers _____
 - Management staff _____
 - Public information media _____
 - Others _____
- 4) Have you established communications to obtain emergency assistance? Yes _____
No _____
- 5) Do you routinely test your communications arrangements by practices? Yes _____
No _____
- 6) Are you generally satisfied with your communications arrangements? Yes _____
No _____
- 7) Do you have plans for changes or improvements? Yes _____ No _____. Describe

- 8) When will the changes be made? _____
- 9) Any additional comments about your system or present or future requirements for
communications arrangements? _____

APPENDIX K

Medical Treatment Arrangements

- 1) Do you have your own medical treatment facilities in addition to industrial first aid stations? Yes _____ No _____
- 2) Have you made firm arrangements for medical assistance? Yes _____ No _____
- 3) Is it planned to bring a medical assistance staff on plant for emergency treatments? Yes _____ No _____
- 4) Do you provide transportation to off-site medical treatment facilities? Yes _____ No _____
- 5) Does the off-site medical facility have radiation detection equipment? Yes _____ No _____. Describe briefly _____
- 6) Does the off-site medical facility have radiation detection equipment? Yes _____ No _____. Describe briefly _____
- 7) Does the off-site medical facility have shielding materials on hand? Yes _____ No _____. Describe briefly _____
- 8) What instrumentation or special equipment do you have stored at the off-site medical facility? _____
- 9) How often are the instruments at the off-site medical facility calibrated? _____
- 10) Who performs the calibration? _____
- 11) What is the dose rate range of the instrument? _____
- 12) Are check sources provided so that the instrument response can be checked prior to each use? Yes _____ No _____
- 13) Is the off-site medical facility to provide health physics technical support or are you? _____
- 14) Do you feel the off-site medical support staff to be sufficiently knowledgeable in radiation protection so as to avoid unwarranted reactions? Yes _____ No _____
- 15) What arrangements have been made regarding radio communications for medical assistance? _____
- 16) Have emergency training sessions been conducted with the local medical support personnel? Yes _____ No _____

- 17) Has the subject of medical information releases been reviewed between you and the off-site medical facility? Yes_____ No_____
- 18) Are backup personnel dosimetry facilities available, such as whole body counting, bioassay? Yes_____ No_____. Where?_____
- 19) How soon could whole body counting and bioassay results be obtained?_____
- 20) Is the use of outside consultants contemplated? Yes_____ No_____
- 21) Do your potential consultants realize you may be calling them? Yes_____ No_____
- 22) Are you generally satisfied with your medical treatment arrangements? Yes_____ No_____
- 23) Do you have plans for changes or improvements? Yes_____ No_____. Describe_____
- 24) When will the changes be made?_____
- 25) Any additional comments about your system or present or future requirements for medical treatment arrangements?_____

APPENDIX L

On-Plant Radionuclide Material Shipments

- 1) Are shipments of radioactive materials between facilities on your plant accompanied by radiation monitors? Yes _____ No _____
- 2) Are radiation monitoring instruments always present on shipment vehicles? Yes _____ No _____
- 3) What is the dose rate range of instruments accompanying shipments? _____
- 4) Is the shipment crew trained in the proper use and interpretation of the instrument? Yes _____ No _____
- 5) How would the occurrence of an on-plant accident be discovered? _____
- 6) Are you generally satisfied with your on-plant radionuclide material shipment arrangements? Yes _____ No _____
- 7) Do you have plans for changes or improvements? Yes _____ No _____. Describe _____
- 8) When will the changes be made? _____
- 9) Any additional comments about your system or present or future requirements for on-plant shipment arrangements? _____

DISTRIBUTION

No. of
Copies

AEC HEADQUARTERS TECHNICAL STEERING COMMITTEE

32	<u>Division of Operational Safety</u> M. A. Bell (10) E. J. Vallario (20) C. R. Van Niel (2)
15	<u>Division of Reactor Licensing</u> D. Thompson
5	<u>Division of Reactor Development & Technology</u> R. Feit
2	<u>Environmental Protection Agency (HEW)</u> J. Martin
2	<u>AEC Richland Operations Office</u> D. K. Jones

OFFSITE

1	<u>AEC Albuquerque Operations Office</u> J. R. Raeder
1	<u>AEC Brookhaven Office</u> G. E. Stubbings
1	<u>AEC Chicago Operations Office</u> D. M. Gardiner
1	<u>AEC Chicago Patent Group</u> G. H. Lee
1	<u>AEC Dayton Area Office</u> W. B. Creamer
2	<u>AEC Division of Space Nuclear Systems Safety Branch</u> R. S. Decker G. P. Dix

No. of
Copies

2	<u>AEC Division of Technology Information Extension</u>
1	<u>AEC Grand Junction Office</u> R. J. Gidney
3	<u>AEC Idaho Operations Office</u> C. W. Bills J. R. Hovan R. E. Tiller
1	<u>AEC Nevada Operations Office (Las Vegas)</u> W. J. Larkin
1	<u>AEC New York Operations Office</u> J. Allentuck
1	<u>AEC Oak Ridge Operations Office</u> J. A. Lenhard
1	<u>AEC Pittsburgh Naval Reactors Office</u> W. A. Reese
1	<u>AEC San Francisco Operations Office</u> R. W. Hughey
1	<u>AEC Savannah River Operations Office</u> P. J. Hagelston
1	<u>AEC Schenectady Naval Reactors Office</u> G. H. Harris
1	<u>AEC Shippingport Branch Office</u> P. O. Box 11 Shippingport, Pennsylvania 15077 W. M. Maloney
1	<u>AEC Space Nuclear Propulsion Office (NRDS)</u> P. O. Box 1 Jackass Flats, Nevada 89023 J. W. Lake

No. of
Copies

- 1 AEC Space Nuclear Propulsion Office, Cleveland
 R. A. Hartfield
- 1 Argonne National Laboratory (AEC)
 V. H. Munnecke
- 1 Argonne National Laboratory
 P. O. Box 2528
 Idaho Falls, Idaho 83401
 E. D. Graham
- 1 Babcock and Wilcox
 W. M. Breazeale
- 1 Brookhaven National Laboratory
 Associated Universities, Inc
 G. H. Vineyard
- 1 Commonwealth Edison Company
 P. O. Box 767
 Chicago, Illinois 60690
 H. E. Bliss
- 1 Connecticut Yankee Atomic Power Company
 P. O. Box 270
 Hartford, Connecticut 06101
 D. C. Switzer
- 1 Consolidated Edison Company of New York, Inc
 4 Irving Place
 New York, New York 10003
 W. J. Cahill, Jr.
- 1 Consumers Power Company
 212 West Michigan Avenue
 Jackson, Michigan 49201
 R. D. Allen
- 1 Dow Chemical Company
 C. W. Piltingsrud

No. of
Copies

- 1 duPont Company, Aiken (AEC)
 C. M. Patterson
- 1 General Electric Company
 Midwest Fuel Recovery Plant
 P. O. Box 219-B
 Monis, Illinois 60450
 S. G. Smolen
- 1 General Electric Company
 Nuclear Energy Division
 Vallecitos Nuclear Center
 P. O. Box 846
 Plesanton, California 94566
 W. H. King
- 1 Idaho Nuclear Corporation (AEC)
 J. W. McCaslin
- 1 Industrial Reactor Laboratory
 Plainsboro, New Jersey 08536
 T. C. Weeks
- 1 Jersey Central Power and Light Company
 Madison Avenue at Punchbowl Road
 Morristown, New Jersey 07960
 G. H. Ritter
- 1 Kansas State University (AEC)
 R. W. Clack
- 2 Lawrence Radiation Laboratory, Livermore (AEC)
 University of California
 J. L. Olsen
 R. E. Yoder
- 1 Los Alamos Scientific Laboratory (AEC)
 University of California
 J. N. P. Lawrence
- 1 Mound Laboratory (AEC)
 Monsanto Research Corporation
 D. R. Storey

No. of
Copies

- 1 NASA, Lewis Research Center, Sandusky
 H. B. Barkley, Jr.
- 1 National Lead Company of Ohio (AEC)
 C. L. Karl
- 1 Niagara Mohawk Power Corporation
 300 Erie Blvd. West
 Syracuse, New York 13202
 M. Pratt
- 1 Nuclear Fuels Services, Inc.
 P. O. Box 124
 West Valley, New York 14171
 J. P. Duckworth
- 1 Nuclear Materials and Equipment Corporation (AEC)
 Manager, Health, Safety and Licensing
- 1 Oak Ridge National Laboratory (AEC)
 Alvin M. Weinberg
- 1 Oregon State University
 Corvallis, Oregon 97331
 C. H. Wang
- 1 Pacific Gas and Electric Company
 245 Market Street
 San Francisco, California 94106
 R. H. Peterson
- 1 Philadelphia Electric Company
 1000 Chestnut Street
 Philadelphia, Pennsylvania 19105
 V. P. McDevitt
- 1 Rochester Gas and Electric Company
 89 East Avenue
 Rochester, New York 14604
 E. J. Nelson

No. of
Copies

- 1 Southern California Edison Company
 P. O. Box 351
 Los Angeles, California 90053
 J. B. Moore
- 1 Union Carbide Corporation (ORGDP) (AEC)
 R. G. Jordan
- 1 University of Illinois
 Nuclear Engineering Program
 216 Nuclear Engineering Laboratory
 Urbana, Illinois 61801
 M. E. Wyman

ONSITE

- 1 AEC Chicago Patent Group
 R. M. Poteat
- 2 AEC Richland Operations Office
 W. E. Lotz
 M. R. Schneller
- 1 Atlantic Richfield Hanford
 G. E. Backman
- 1 Douglas United Nuclear
 C. D. Corbit
- 2 RDT Assistant Director for Pacific
 Northwest Programs
- 1 WADCO Corporation
 A. J. Stevens
- 165 Battelle-Northwest
L. A. Carter	W. D. Richmond
J. P. Corley	L. C. Schwendiman
K. R. Heid	J. M. Selby (100)
R. L. Kathern	J. H. Soehnlein
H. V. Larson	C. M. Unruh
E. D. McFall	E. C. Watson
C. E. Newton	R. K. Woodruff
R. S. Paul	Technical Information (5)
	Technical Publication (2)