EASTERN TECHNOLOGIES, INC. LETTER DATED JUNE 15, 2004 CONTAINING ADDITIONAL INFORMATION FOR LICENSE APPLICATION
(NRC License No. 01-30362-01; Docket No. 030-36499)

INFORMATION IMPORTANT TO SECURITY OF RADIOACTIVE MATERIAL HAS BEEN REMOVED BY THE NRC. A COMPLETE COPY OF THE DOCUMENT CAN BE FOUND AT ADAMS ACCESSION NO. ML041810660.

ETI
EASTERN TECHNOLOGIES, INC.
Post Office Box 409
Ashford, Alabama 36312

MS16
J-5

June 15, 2004

Donna Janda
United States Nuclear Regulatory Commission
Region I
Mail Control No. 13442
475 Allendale Road
King of Prussia, PA 19406-1415

01-30362-01
03036499

SUBJECT: ETI Procedures

Dear Ms. Janda:

As per our conversation I have reviewed the procedures submitted in response to NRC's letter dated 04/14/04 and subsequently revised them to remove the confidential status formally applied. Thank you for bringing this to my attention.

Sincerely,

Mark Fellows
Vice President
Eastern Technologies, Inc.

MF:mbw

134442

NMSS/RGNI MATERIALS-002

Responses to Questions

1. The following radiation safety training dates are applicable:

Annually, 1986-1991:	St. Lucie Nuclear Plant
As required, 1988-1992:	Farley Nuclear Plant Crystal River Unit 3 Zion Power Station
Annually, 1992-2003:	Eastern Technologies, Inc.

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REGION 1

In addition, I have received training in Radioactive Waste Packaging, Transportation and Disposal (1991) and Advanced Transportation of Radioactive Materials (1994). Additional training includes Health Physics Instrument and Air Monitors (1991). Copies of training documents are enclosed.

With regard to practical experience, I have been the "acting" RSO for ETI since 1990. I have been responsible for all aspects of radiation safety including but not limited to: safe work practices; decontamination efforts; security of radioactive materials; disposition of by-product material; interaction with licensing authorities; record maintenance; program audits; oversight of facility equipment and associated area surveys; personnel training; abnormal event investigation; protection of individual members of the public. I understand that my RSO duties will include but may not be limited to ensuring the following:

- Activities involving licensed material that the RSO considers unsafe are stopped;
- Radiation exposures are kept as low as is reasonably achievable (ALARA);
- Development, distribution, implementation, and maintenance of up-to-date operating and emergency procedures;
- Possession, installation, relocation, use, storage, repair and maintenance of sealed sources, devices and radioactive wastes are consistent with the limitations in the license, individual Sealed Source

and Device Registration Certificate(s), and the manufacturer's specific recommendations and instructions;

- Evaluations of occupationally exposed individuals are performed to demonstrate that individuals are not likely to receive, in one year, a radiation dose in excess of 10% of the allowable limits or personnel monitoring devices are provided;

- When necessary, National Voluntary Laboratory Accreditation Program (NVLAP)-approved personnel monitoring devices are used and exchanged at the proper intervals, and records of the results of such monitoring are maintained;

- Licensed materials are properly secured;

- Documentation is maintained to demonstrate, by measurement or calculation, that the total effective dose equivalent to the individual member of the public that is likely to receive the highest dose from the licensed operation does not exceed the annual limit for members of the public;

- Proper authorities are notified of incidents such as damage to sealed sources/devices, loss of licensed material, fire, theft, etc.;

- Unusual occurrences are investigated, cause(s) and appropriate corrective action(s) are identified, and timely corrective action(s) are taken;

- Radiation safety program audits are performed and documented at least annually;

- When the licensee identifies violation of NRC requirements or program weaknesses, the licensee develops, implements, and documents corrective actions;

- Licensed material is transported in accordance with all applicable DOT requirements;

- Licensed material is disposed of properly;

- Appropriate records are maintained;
- Up-to-date license is maintained and amendment and renewal requests are submitted in a timely manner;
- Monitoring and surveys of all areas in which radioactive material is used;
- Ordering, receipt, surveys, and delivery of by-product material;
- Packaging, labeling, surveys, etc. of all shipments of by-product material leaving the institution;
- Implementing a personnel monitoring program, including determining the need for and evaluating bioassays, monitoring personnel exposure records, and developing corrective actions for those exposures approaching maximum permissible limits;
- Effluent monitoring;
- Training personnel;
- Administering the facility waste disposal program;
- Performing/overseeing the inventory and leak testing of sealed sources;
- Overseeing decontamination activities;
- Investigating any incidents and responding to any emergencies;
- Serving as a point of contact for NRC's and licensee's management during routine operations, emergencies, or incidents;
- Maintaining records required that are necessary to support the license and satisfy NRC regulations.

2.

INFORMATION IMPORTANT TO SECURITY OF RADIOACTIVE MATERIAL HAS BEEN REMOVED BY THE NRC. A COMPLETE COPY OF THE DOCUMENT CAN BE FOUND AT ADAMS ACCESSION NO. ML041810660.

3. The portable instruments listed are manufactured by Eberline. I have attached specification sheets for each that provide model number, range, etc. The original application details how these instruments will be used, dose rate, frisker, counter or a combination of the three. Dose rate meters with internal detectors will be used for dose rate surveys of areas, packages, containers, and individual items where applicable. Friskers/counters will/may be used to survey personnel for contamination as well as survey individual items or areas for fixed and/or loose surface contamination through direct or smear survey. It should be understood that more than one company manufactures these types of instruments and ETI reserves the right to substitute equivalent instruments as required.

4. All portable survey instruments used for measuring dose rates will be calibrated annually by individuals specifically authorized by NRC or an Agreement State to perform such calibrations.

5. A. ETI will conduct physical inventories at intervals not to exceed six (6) months to account for all sealed sources and devices received and possessed under our license.

   B. ETI maintains written and electronic logs of incoming and outgoing radioactive material shipments. These logs allow for tracking of site activity to ensure compliance with license conditions. At present the written records associated with receipt, transfer and disposal of material are filed and maintained for the life of the facility. At no time will maintenance of such records be less restrictive than detailed in Table 8.3 of NUREG-1556, volume 18. Upon termination of the license and release of the facility by NRC, record storage may be terminated or shifted to another entity. It should be understood that written records may be transferred to electronic form at some point in the future.

6. Applicable drawings have been revised to detail the general location for air sample collection points, both breathing air and environmental

release. Breathing air sample collection points will be situated to ensure representative sampling of personnel's breathing air. Air sample points for environmental releases will be down stream of blowers to ensure proper mixing of filtered air prior to sampling. Drawing No. PF 004 has been revised to include manufacturer detailed air flow rates. Drawing No. PF 004 currently notes location of the sampling points. Drawing No's. PF 001, PF 002, & PF 003 have been revised to detail four (4) holding tanks.

7. Sea/Land containers used for temporary storage of radioactive waste or material will be stored within the fenced Owner Controlled Area. In addition, each sea/land container used for such purpose will be locked to restrict access by unauthorized persons.

8. The size and placement of the HP Lab (counting laboratory) can be reviewed on drawing No's PF 001 and PF 002. The lab will be shielded to reduce interference from elevated background radiation caused by materials undergoing processing. Enclosed are print outs containing specific performance information relative to counting equipment that will be used in the lab. This equipment is also detailed in section 8.10.2 of our application. As these systems have not yet been purchased calibration procedures are not yet available. Applicable procedures can be supplied prior to pre-operational inspections performed by NRC. All counting equipment will be calibrated in accordance with manufacturer's instructions or returned to the manufacturer for calibration. It should be noted that ETI reserves the right to substitute or upgrade this equipment as needed. It should also be noted that ETI does not consider lab analysis of wipe samples (smears) necessary to determine applicable radiological conditions associated with a particular sample. Analysis of such wipes (smears) with a calibrated hand held radiation detection device should be sufficient to generate the information needed. This is not to say that stationary lab counting equipment will not be used for such purposes, it may be used but ETI wishes to reserve the right to utilize other equipment capable of performing the required counting analysis. With regard to analysis of wastewater samples ETI will use gamma spectroscopy to determine the types and concentrations of isotopes present. Performance information for such a system is enclosed for your review. The system that ETI utilizes will meet or exceed the performance parameters detailed in this print out. As with other systems

ETI reserves the right to upgrade or substitute systems with like or better performance.

9. It should be understood that presses utilized for water removal from fabric type material do not pose a threat for air borne contamination due to the water content of the material being processed. Even after processing, sufficient moisture remains to eliminate any threat of air borne contamination. All water removed during this process is contained within the machine and drained away prior to removal of processed material. Any water that may exit the machine would only contain minute quantities of radioactive material and thus not pose a threat to personnel. Items processed for water removal will be low activity items previously surveyed as part of incoming shipment surveys. Procedures having specific applicability to this process are:

   ETI Emergency Procedures For Spill, etc. (Emergency Procedures-PA)

   ETI Procedure For Handling of Contaminated Liquids, etc. (Rad Handling Procedure-PA)

10. Health Physics considerations applicable to use of soiled material handling equipment include but are not limited to: elimination of situations in which contamination may be spread; ensuring proper protective clothing is worn; avoiding contact of material with uncovered skin; ensuring proper house keeping techniques are applied to limit residual contamination remaining on equipment.

11. The ETI filtration system will consist of several individual components. The first stage filtration step will be provided by a shaker screen capable of removing particles $\geq$ 44 microns in size. This first stage is utilized to remove large particulate items and mid size particulate items down to the limit of the technology which is approximately 44 microns. The second stage filtration step will be provided through the use of an indexing filter. This indexing filter utilizes an advancing filter media to remove very fine particulate matter; $\leq$ 20 micron, without adversely impacting the flow rate of the system. Based on previous experience this filtration level will be sufficient to remove suspended solids and ensure compliance with NRC designated limits for effluent discharges. As ETI will analyze all wastewater releases containing radioactive material prior to release, all

waste water not meeting applicable NRC release limits can be re-filtered utilizing the optional filtration stages depicted in Drawing No. PF 005, Revision 1. These optional filtration stages will consist of filter housings that contain increasingly restrictive disposable filter elements. Particle removal to $\leq$ 0.25 micron nominal is possible. Other technology that may be employed for use in these filter housings, if necessary, is isotope-specific filtration media.

As requested, ETI will submit any proposed modifications to the wastewater filtration system to the NRC for approval prior to any modification being performed.

The type and restriction rating of filters utilized will be based upon sampling and analysis of effluent as well as operational experience while balancing the generation of solid waste.

12. The exhaust from this unit will be exhausted into the Laundry Area. The filtration system will consist of various pre-filter stages, designed to increase the life of the HEPA filter, and a final stage consisting of high capacity HEPA type air filters. Filter conditions will be evaluated based on differential pressure across the filter. This information will, based on manufacturers' recommendations, dictate filter replacement and warn of filter failure. Based on current operational experience no monitoring of this exhaust is necessary as breathing air in the Laundry Area is sampled to ensure compliance with applicable NRC guidelines.

13. The Emergency Exposure portion of ETI's Radiation Protection Program has been removed in its' entirety. Enclosed is Rev 2 of this document for your review.

14. Based on heat stress issues relative to this industry it is advisable to allow personnel situated in non-contaminated areas (e.g.: areas having smearable contamination $\leq$ 1,000 dpm/100 cm^2) and not actively involved in handling potentially contaminated material to have access to drinking water. No other eating, drinking, smoking or chewing will be permitted inside the RCA.

15. ETI will use an Eberline PM-7 to perform whole body gross activity analysis. Should whole body counting of an individual be required to determine quantities of specific isotopes present, the individual will be

sent to an outside facility for such analysis. ETI will ensure that such facilities are licensed by the NRC or an Agreement State to perform such analysis if applicable. ETI's calibration procedure for the PM-7 is enclosed. The phantom utilized will be a water shielded phantom approximately the size and weight of the throat and trunk area of ICRP 23 "reference man".

16. During operational hours, access to the RCA will be controlled through the use of signs and doors. Additional methods of control may include gates and ropes when appropriate. The entry/exit door to the RCA will normally be controlled by a locking device that will limit access to only those individuals previously authorized for entry. The locking device may be manual or automatic and the door will automatically close after authorization personnel have safely passed through. Additional control will be provided through windows present in the HP Lab for the specific purpose of viewing the entry/exit area. Visitors wishing access to the RCA will notify on duty HP Personnel through a communications window that will be present in the HP Lab wall. Entry may be allowed only after prerequisite notifications, briefings, radiation tracking device issue, information gathering and appropriate documentation is complete.

17. There are two areas in which loose contamination remain on in-process materials, the sorting area and the washing area. In-process materials in these areas remain a potential source for airborne contamination until they are placed inside a washer/extractor or OREX processing machine. After washing or processing, remaining items have a very low chance of containing material that can be dislodged during handling. Due to this, ETI continuously monitors the breathing air in the Sorting Area and the Washing Area anytime personnel are involved in laundry or OREX processing activities. Sampling is provided through a regulated air sample pump and filter patch contained in an appropriate intake head. One sampler is provided in each work area and the intake is positioned to replicate the breathing air zone.

    Like air sampling for the breathing zone, sampling of stack effluents to the environment is performed continuously any time the exhaust equipment is operational. Sampling is performed through the use of a regulated air supply with an in-line filter holder that is connected to an intake port located inside the exhaust vent of the effluent stack. Calibration of regulated air sample pumps are performed by the

manufacturer or other authorized service provider. ETI does not at this time anticipate calibrating regulated air sampling pumps, calibration frequency shall be ≤ one (1) year. Instrumentation utilized for counting air samples will be an Eberline Mini Assay 6-20 or equivalent combined with a well counter Type 43 detector or equivalent. Information relative to this system is enclosed in response to other questions posed by NRC. Calibration frequency will be ≤ one (1) year.

18. A. ETI will not be discharging licensed materials to the sanitary sewer. Liquid releases of licensed materials will be to the Susquehanna River. To ensure a representative sample of the wastewater is collected, a sampling device will be installed on the pressurized wastewater line after the final filter, but prior to any holding tank. This device will consist of an electronic water flow monitor that calculates the presence and volume of flow and opens and closes a sampling valve in a proportion relationship to ensure representative sampling. All results from liquid effluent analysis for licensed materials will be reported in microcuries per milliliter (uCi/ml). ETI's formulas utilized for calculating isotopic concentrations are enclosed. Mathematical formulas utilized by automated gamma spectroscopy systems are part of the automated program and not adjustable by ETI. To ensure proper operation source checks utilizing a known standard are performed daily during operation periods.

B. Compliance with the dose limits for members of the public specified in 10 CFR 20.1301 will be demonstrated by ensuring that the concentration of each nuclide from the wastewater sample analysis is less than the effluent concentration limits for water specified in 10 CFR 20, Appendix B, Table 2, Column 2. This will demonstrate compliance with dose limits for individual member of the public, per 10 CFR 20.1302(b)(2). In addition, the dilution effect of the Susquehanna River, 128,149 gallons per second, will further ensure that the actual dose to individual members of the public are well below the regulatory limits with regard to wastewater discharges.

C. Enclosed please find a copy of ETI's Environment and Effluent Monitoring Report for April 2004. It details the isotopes present in wastewater discharges, the total activity released per isotope and the average concentration of each isotope in uCi/ml. It should be

remembered that ETI's wastewater releases will be some what seasonal in nature. As ETI supports spring and fall refueling and maintenance outages for commercial nuclear reactors the quantity of wastewater released will increase during these periods. The enclosed monthly report is from the peak spring season. Monthly activity released will decrease during the winter and summer periods of the year.

19. A. ETI intends to meet these requirements through the use of HEPA filtration systems. ETI's operational experience has shown that such effluent air releases to the environment do not contain measurable quantities of radioactive material after passing through such a filtration system. Measurable quantity is defined as the minimum detectable activity of the counting systems described in this submission. To further ensure compliance ETI will set an action level of 10% of the limits detailed in 10CFR20, Appendix B, Table 2, Column 1 as the level at which additional engineering controls will be put in place to reduce such releases to below 10% of the applicable limits.

    B. Operational experience at the existing ETI laundry facility demonstrates that there is no readily detectable quantities of licensed material in effluent releases to air. Utilizing counting methods and equipment described previously for analysis of air samples no releases above MDA have been noted to date at our existing facility.

20. Upon removal from the tank or area and prior to dewatering and drying, the sludge will be treated as a radioactive liquid due to its high water content and ability to flow. After dewatering and drying, the sludge will be in solid form and will not present handling hazards in excess of other radioactive materials. As with all jobs that involve radioactive materials of this type a hazard analysis will need to be performed prior to work starting. This analysis will include a dose rate and contamination survey of the work area to determine radiological hazards and any appropriate engineering controls necessary to perform the task. As the sludge material is self shielding due to its' high water content additional dose rate surveys should be performed after dewatering and drying to re-assess

radiological hazards. Updated posting should be put in place if conditions have changed.

21. Information relative to the sensitivity of the instrumentation that will be used in ETI's counting lab is enclosed. Should such material be surveyed for release gamma spectroscopy will be the method employed to determine the concentrations of radioactive material present. Based on operational experience it is very unlikely that any sludge material created as a result of ETI's laundry or Orex processing activities will meet free release criteria.

    Bulk solid material will normally mean lint or other similar material. Based on operational experience it is very unlikely that lint produced as a result of ETI's laundry or Orex processing activities will meet free release criteria.

22. Procedures detailing emergency response actions have been revised to include a detailed list of persons to be contacted in the event of an emergency.

23. Prior to removing or changing HEPA filters all associated systems will be shut down to eliminate air flows which may contain radioactive material. Additionally surveys of the associated work area will be performed to assess radiological conditions and determine protective clothing and/or equipment requirements. If required, special RWP's will be created to manage this specific task. All HEPA filters removed from systems utilized to process radioactive materials will themselves be considered radioactive material and disposed of accordingly.

24. As ETI intends to utilize automated survey equipment (i.e.: Eberline PCM-1B) as its' primary method of determining the presence of contamination on workers an alarm set point of approximately 833 dpm/100 cm^2 will be utilized. When utilizing portable non-automated survey equipment the action level (alarm set point) shall be set at 100 counts above background assuming a minimum efficiency of 10%. In reality when utilizing portable devices any readily detectable activity above background will be cause for decontamination of the worker. Notifying the RSO of contamination incidents will be accomplished in writing by providing a copy of the Radiation Incidence Report completed by the HP staff to detail and document the event.

25. Skin dose calculations will be performed through the use of the Varskin computer program or other manual method that will be identified in an applicable procedure. This procedure will be provided to NRC prior to the pre-operational inspection.

26. It should be understood that launderable OREX items may or may not be utilized. By far the largest type of OREX that will be processed will be single-use in nature. As there is no difference in protective clothing made from OREX material or standard fabric, other than the material itself, no special procedure is required for its' sorting. This is consistent with current regulated practices as no special sorting procedures are required for cotton verses poly cotton. To assist workers in their sorting duties most OREX items are labeled with the product logo or name during manufacturing thus making sorting less difficult. Given the specific look and feel of the OREX fabric any competent person will have no trouble in identifying such items.

    Should OREX items inadvertently be processed using standard laundry methods no adverse affects will occur. The melting point of OREX in water is approxiamley190° Fahrenheit. ETI uses no such wash bath temperatures in its process. If processed under standard laundry processes the only adverse effect to the OREX item will be shrinkage. Although unlikely, should an OREX item become dissolved during the washing process it will be trapped by ETI's wastewater filtration system as the OREX item has not been Oxidized and thus will not pass through the filtration system with any degree of success.

    Should a non-OREX garment go through the OREX processing system no adverse affects will occur other than possible shrinkage or discoloration to the non-OREX item. Neither situation will result in any adverse affects to the drain systems or other applicable components.

    The loading of the washer/extractors and OREX processing equipment is normally semi-automated. Loads of materials are brought to the equipment in automated or semi-automated form but workers must assist in the final loading of materials. Operational experience has shown that this manual part of the loading process does not create air borne radioactive material issues. Should the automated or semi-automated

equipment malfunction or not be available for some reason these functions will be accomplished manually.

With regard to any potential destruction of the filtration systems no concerns exist. For the most part all of the wastewater filtration system utilizes disposable filter media that can be replaced should some blinding occur. In any case, release of unoxidized OREX material into wastewater filtration system will not have negative worker safety, exposure and/or environmental release consequences.

27. All trailers or mobile units which contain radioactive material or contamination that are stored on-site will be locked to prevent access.

28. ETI will either assume that all such hard to detect beta emitters, whose identity and activity is detailed on individual incoming shipping documents, are discharged during wastewater releases associated with the processing of those items or utilize an off-site laboratory for analysis of monthly or quarterly composite samples to determine concentrations of these beta emitters in wastewater releases.

29. Unrestricted areas outside the RCA but within the confines of the facility will be surveyed on a schedule of $\leq$ monthly. Contamination levels exceeding detectable activity, when using standard counting methods described in this license submission, are not considered to be acceptable and will necessitate decontamination of the applicable area. Acceptable radiation dose rates will be dose rates in which individuals will not meet or exceed 100 mr/year based on a work year consisting of 2,600 hours. This is more conservative than a standard work year which consists of 2,080 hours and thus takes into account the possibility of overtime house up to 520 per year. Long-term area dose rates will be monitored through the use of TLD's exchanged $\leq$ quarterly.

30. ETI has modified its' Radiation Protection Program to reflect internal dose assessment and action levels based on 10 CFR 20, Appendix B, Table I, Column 3 values.

CHEM-NUCLEAR SYSTEMS, INC.

Presents this certificate of training to

MARK STEVEN FELLOWS

for Attending the CNSI Workshop:

November 18 - 22, 1991

#1

Radioactive Waste Packaging, Transportation, & Disposal

Michael J. Cole
President

Carl Smith
Workshop Coordinator

Eberline A subsidiary of **Thermo Instrument** Systems Inc.

This Certifies That

MARK S. FELLOWS

Has Successfully Completed Our Prescribed Course In

HEALTH PHYSICS INSTRUMENTS AND AIR MONITORS

This 14TH day of JUNE 1991

Instructor

President

CHEM-NUCLEAR SYSTEMS, INC.

Presents this certificate to

MARK S. FELLOWS

for satisfactorily completing the course of instruction and training for the

CNSI Advanced Transportation Seminar

July 18 through July 25, 1994

CHEM NUCLEAR SYSTEMS INC

INSTRUCTOR

RM-25
Radiation Counter

Radiation Measurement & Protection

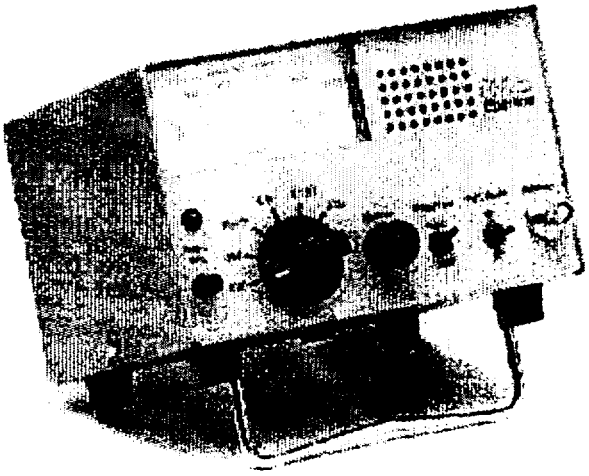
The Model RM-25 is a versatile radiation counter, which may be connected to a variety of different radiation detectors to display the activity levels and provide alarm capability. The unit is AC powered with battery back-up to facilitate either bench-top or portable applications.

- **Computer Setup & Calibration**
- **Variable High Voltage**
- **CPM or CPS Scales**
- **Dead Time Correction**
- **Rugged Construction**
- **Low Cost**
- **Works with GM, Scintillator or Proportional type detectors**

#3

General

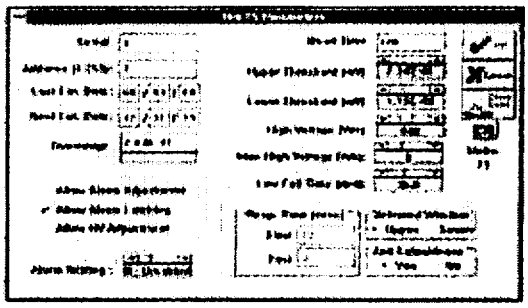
Behind the tough metal cover of the RM-25 lies a microprocessor, facilitating setup and calibration, that offers a more expedient and cost effective operational instrument.



The RM-25 is supplied with either Counts per Minute (standard) or Counts per Second (option RM-25OPT2) units on the analog meter display. The wide range high voltage supply supports a variety of different detector probes.

Panel controls are the range switch, volume control, fast/slow response switch, high voltage and alarm set switch and an alarm acknowledge button.

The panel switch for adjusting the alarm set point and high voltage setting may be locked out.



The RM-25 is equipped with an RS-232 serial port for connection to a PC where it can be controlled via Windows™ software. This software provides controls over the instrument configuration in addition to calibrating the instrument and its probe. Key features include automatic plateau determination, setting both the high voltage and thresholds via computer control, performing diagnostics check and running in a simulator mode for training and setting system level parameters. All settings are under password control.

SPECIFICATIONS

Detector Connector:	MHV.
Serial Connection:	25 pin DB25S connector, RS-232.
Meter:	3" (76 mm) scale, 50 divisions, 0 - 500 CPM or 0 - 5 CPS linear scale.
Panel Controls:	Range Switch: Off, High Voltage, Alarm Set point, x1, x10, x100, x1K, Alarm Acknowledge, Speaker Volume Control, Fast/Slow Response Switch, High Voltage / Alarm Switch.
Response Time:	Fast and slow, each programmable between 1 - 255 seconds.
Linearity:	Within 5% of full scale.
Dead Time Correction:	1 to 999 microseconds.
Alarm Point:	Adjustable from 0 - 100% full meter scale.
Alarm Latching:	User programmable to be latching or non-latching alarms.
Low Count Fail:	User adjustable 0 - 255 minutes (10 minutes default setting).
Overrange Alarm:	Adjustable from 1 to 1010 cps (106 cps default setting).
Audible Alarm:	2.5 kHz tone, independent of volume setting.
Visual Alarm:	Red LED.
Speaker:	2 " (50 mm) diameter, volume control (does not affect alarm volume).
High Voltage:	500 to 2500 Vdc.
Sensitivity:	Lower Threshold: 0 - 5.1 mV.
Upper Threshold:	0 - 60 mV.
Anti-coincidence:	Programmable switch permits discrimination between beta and alpha pulses.
Power:	110 - 130 Vac, 60 Hz, < .25 Amp (220 Vac optional).
Temperature:	32° to 122° F (0° to 50° C).
Storage Temperature:	-4° to 185° F (-20° to 85° C).
Dimensions:	7.18" wide x 5.00" high x 6.88" deep (182 mm x 127 mm x 175 mm).
Weight:	4.4 lbs (2 Kg).
Outputs:	RS-232.
Battery Backup:	Standard, approximately 8 hours operation.

OPTIONS

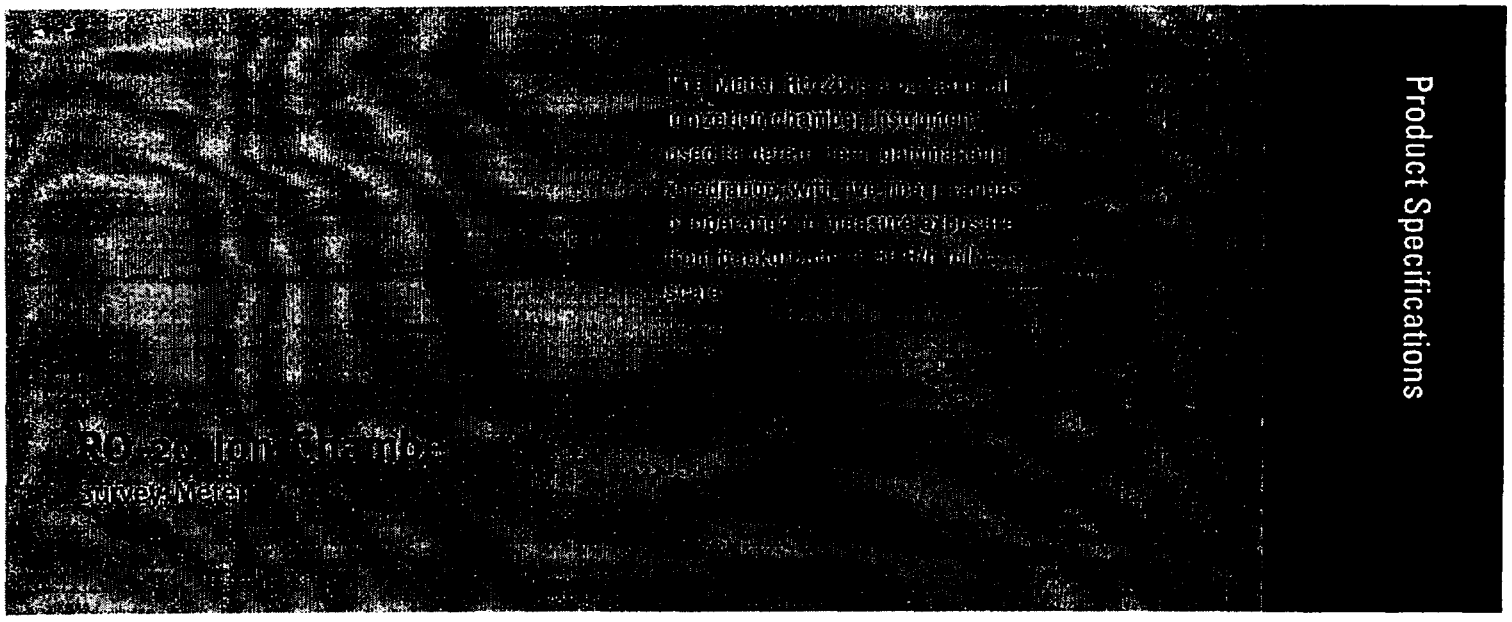
- RM25OPT2 CPS Scale
- RM25OPT3 220 Vac Operation
- RM25OPT4 Calibration Software/PC Cable
- RM25OPT5 Relay Contact Output
- RM25OPT6 0 - 1 mA Analog Output

DETECTORS:

Any GM, scintillator or proportional counter supported by 500 - 2500 volts operation.

DETECTOR CABLES:

CA-15-36: MHV to MHV (36")
CA-15-60: MHV to MHV (60")
CA-16-36: MHV to BNC (36")



Product Specifications

Measures gamma or x-ray exposure rate

Temperature compensated measurements

Sliding shield for beta measurements

Large, backlit display

5 ranges up to 50 R/h

Extended battery life

Non-mechanical range switching

The ionization chamber is vented to atmospheric pressure and is specifically designed to have a flat energy response into the x-ray region. The detector is fully temperature compensated, eliminating any need for temperature correction. Each instrument is factory calibrated to gamma radiation.

A single rotary switch turns the instrument off, checks the batteries, checks the zero setting, and selects the range of operation. An ergonomically located switch illuminates the meter. Internal switching of ranges is accomplished with reed relays, eliminating the mechanical swing arms typically used with portable ion chamber survey instruments.

Detector

The RO-20 detector is an air-filled ionization chamber. It has a diameter of 7.32 cm (2.88") and a volume of 220 cm^3 (13.4 in^3). The detector has 640 mg/cm^2 phenolic walls inside a 1.6 mm (0.063") aluminum wall case for a total thickness of approximately 1,000 mg/cm^2. A 7.9 mm (5/16") thick phenolic sliding beta shield with a positive friction lock is mounted on the bottom of the chamber. The shield thickness is approximately 1,000 mg/cm^2. The chamber window is comprised of two layers (one on the chamber, one on the can) 25 micron (0.001") mylar, approximately 7 mg/cm^2 total.

System Specifications

Energy Response

Photon Response:	Reference to ^{137}Cs measured through the bottom with the slide closed, the energy response is: ± 30% from 8 keV to 1.3 MeV with the open slide facing the source. ± 15% from 33 keV to 1.3 MeV with the closed slide facing the source. ± 15% from 55 keV to 1.3 MeV through the side of the instrument.
Beta Response:	Uranium Slab: 30% of true mrad/h field behind 7 mg/cm² window with RO-20 resting on slab, slide open. $^{90}Sr^{90}Y$: Approximately 93% of true mrad/h field at 30 cm with slide open.
Fast Neutron Response (PuBe):	Reads approximately 8% in mR/h of true neutron field in mrem/h.

Radiological

Radiation Detected:	Beta, gamma, and x-ray.
Ranges:	Five linear ranges: 0-5, 0-50, 0-500 mR/h and 0-5, 0-50 R/h.
Meter:	Scale length, approx. 7.6 cm (3"), 2% accuracy. Linear markings from 0 to 5 in 50 minor increments. The meter is back-lit.
Response Time:	90% of final reading within 5 seconds; see options below for faster response.
Linearity:	Within ± 5% of full scale.
Battery Dependence:	Reading is independent of battery voltage when the battery check indication is in the green arc.
External Controls:	Range switch, including Off, Zero, and Battery checking positions. Zero knob used to set meter to zero when Zero position of range switch is selected or when in no significant radiation field. Light switch, for meter light.
Internal Controls:	Five calibration controls, one for each range.
Batteries:	Main power: Five "C" cells.
Chamber Bias:	Ten 3 volt lithium coin cells, 30 volts.
Battery Life:	"C" cells, widely variable according to RO-20 usage and battery type. Typical ZnC: mR/h ranges, 2900 hrs. All other ranges, 150 hrs. Typical Alkaline: mR/h ranges, 6900 hrs. All other positions, 350 hrs. Frequent or continuous use of the light will reduce battery life significantly. Thirty volt chamber bias battery life: Totally dependent upon the usage of "Battery 2" position of the range switch. The battery capacity should allow for at least 50,000 five second battery checks. The battery drain is negligible on all other positions of the range switch
Temperature:	Operable from -40 °C to 60 °C (-40 °F to 140 °F). For operation below -18 °C (0 °F), alkaline or nickel-cadmium "C" cells should be used.
Temperature Compensation:	The detector is fully compensated over the operational temperature range for output accuracy within 10% ± 0.5 mR/h.
Moisture:	Seals used at openings for dust and water resistance. Detector is protected by a silica-gel dryer.
Humidity:	Operable from 0 to 95%, non-condensing
Weight:	Approximately 3.6 pounds (1.63 kg) with alkaline C cells.
Size:	201 L x 107 W x 196 H mm (7.9" L x 4.2" W x 7.7" H), including handle.
Testing:	The RO-20 has been successfully tested to ANSI N42.17A and is CE Certified to European standard EN50082-1 (EN61000-4-2 & EN61000-4-3).
Options:	^{137}Cs gamma check source: CS-7A Carrying strap: ZP11466031

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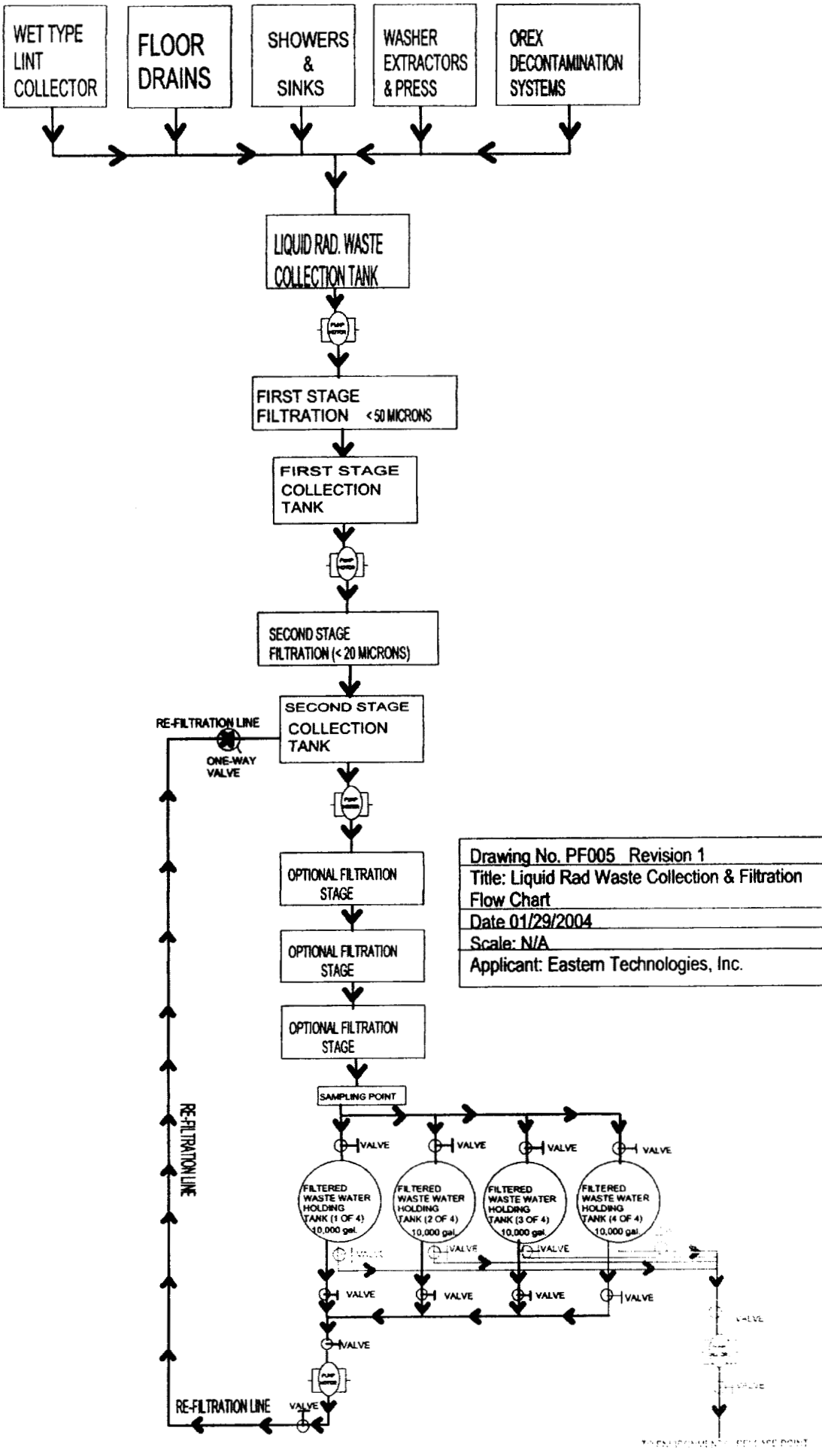
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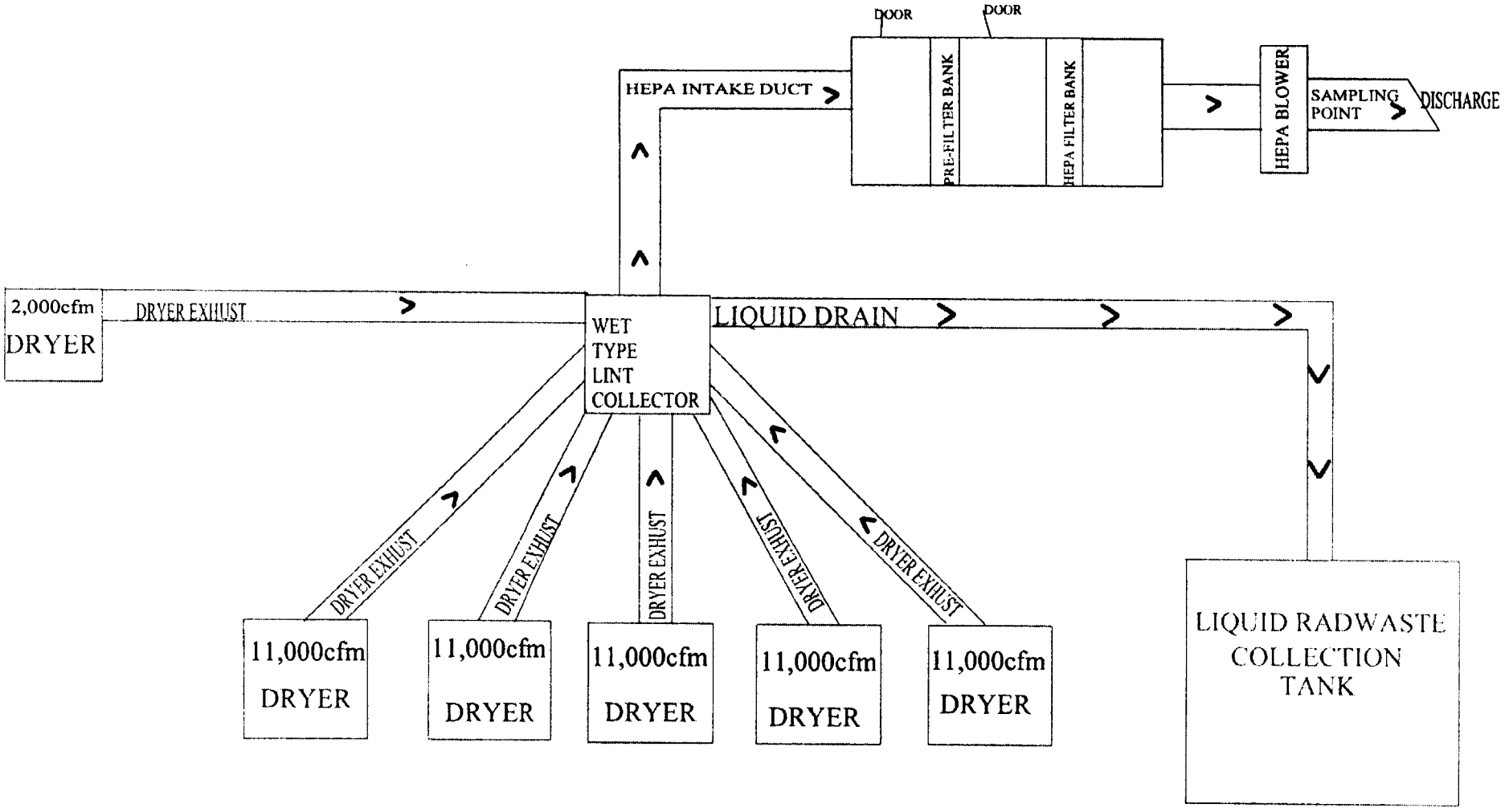
FLOOR DRAINS
SHOWERS & SINKS
WASHER EXTRACTORS & PRESS
OREX DECONTAMINATION SYSTEMS
LIQUID RAD. WASTE COLLECTION TANK
FIRST STAGE FILTRATION <50 MICRONS
FIRST STAGE COLLECTION TANK
SECOND STAGE FILTRATION (< 20 MICRONS)
SECOND STAGE COLLECTION TANK
RE-FILTRATION LINE
ONE-WAY VALVE
OPTIONAL FILTRATION STAGE
OPTIONAL FILTRATION STAGE
OPTIONAL FILTRATION STAGE
SAMPLING POINT
VALVE
FILTERED WASTE WATER HOLDING TANK (1 OF 4) 10,000 gal.
FILTERED WASTE WATER HOLDING TANK (2 OF 4) 10,000 gal.
FILTERED WASTE WATER HOLDING TANK (3 OF 4) 10,000 gal.
FILTERED WASTE WATER HOLDING TANK (4 OF 4) 10,000 gal.
RE-FILTRATION LINE
RE-FILTRATION LINE
Drawing No. PF005 Revision 1
Title: Liquid Rad Waste Collection & Filtration Flow Chart
Date 01/29/2004
Scale: N/A
Applicant: Eastern Technologies, Inc.

Drawing No. PF004 Revision 2
Title: Dryer Exhaust Filtration & H.E.P.A. System
Date: 05/18/2004
Scale: N/A
Applicant: Eastern Technlolgies, Inc.



#15

EASTERN TECHNOLOGIES, INC.

OPERATION AND CALIBRATION OF THE EBERLINE PERSONNEL MONITOR PM-7

Approved By: Mark Fellows

1.0 Purpose

To provide instruction in the proper operation and calibration of the Eberline Instrument Corporation Model PM-7 Personnel Monitor.

2.0 References

2.1 PM-7 Technical Manual

3.0 Limitations

The normal operating temperature band is 0° C (32° F) to 50° C (122° F). The monitor will normally be removed from service if the operating temperature exceeds or falls below the above parameters.

4.0 Test Equipment

4.1 Computer IBM-PC/XT/AT or Compatible

4.2 Serial cable

4.3 ^{60}Co Calibration source

4.4 ^{137}Cs Calibration source

5.0 Prerequisites

5.1 A 90-130 VAC power supply must be connected to instrument.

5.2 If portal monitor has "Out of Service" light, remove the monitor from service, and notify the HP Foreman or Plant Manager.

6.0 Procedure

Routine operation of the PM-7 is accomplished in accordance with Appendix A. Appendix A may be placed on the monitor.

7.0 Calibration Frequency

$\leq$ 1 year

8.0 Calibration

8.1 PC-Based Calibration/Configuration Program

8.1.1 Power up PM-7 Calibration Computer.

8.1.2 Verify that the correct date and time is stored in the computer.

8.1.2.1 If the date is incorrect, type DATE and press the <Enter> key. Type the correct date using the format mm-yy-dd, press the <Enter> key.

8.1.2.2 If the time is incorrect, type TIME and press the <Enter> key. Type the correct time using the format hh:mm:ss, press the <Enter> key.

Note: Date and Time entry may be modified for varying operating software.

8.1.3 Connect the computer to the portal monitor using the serial cable. The cable will connect to the DB-9 connector in one of the hinged doors of the PM-7 and to serial port #1 (COM 1) on the computer.

8.1.4 DOS prompt reads C: then type cd (space bar) pm7 <Enter> then type pm7calv2.exe <Enter>. This opens the program. Next enter password (EBERLINE) and connect, go to calibrate and press <Enter>.

8.1.5 The computer will prompt the used to enter a password. Type Eberline and press the <Enter> key.

8.1.6 The computer will compare disk files to the actual portal monitor parameters, if they agree "Calibrate" will be displayed on the submenu, from this submenu select "Edit" and press the <Enter> key. If the disk files and the portal monitor files differ, the user may select "F1" to accept disk parameters, "F2" to accept portal monitor parameters, or "F3" to Quit or Abort.

8.1.7 The portal monitor will normally have the following parameters entered:

Reliable Detector Activity (RDA) 100nCi
RDA Confidence Level – 95%
Sigma Factor – 3.5
Maximum Count Time – 15 sec.
Alarm Hold Time – 3 sec.

The RDA is the alarm activation level. The RDA confidence level is the unit's reliability factor for alarming at the RDA.

Note: PM7 parameters may change as deemed necessary by HP Supervision.

If the listed parameters are not correct on the portal, they may be edited by moving the cursor to the desired parameter and pressing "F1" to edit, type the change and press the <Enter> key. Press F2 to save/exit.

8.1.8 Submenu will be displayed, select the "Calibrate" option and press the <Enter> key.

8.1.9 The computer will prompt used to enter "Serial Number of Monitor". Enter serial number of portal monitor and press the <Enter> key.

8.1.10 The computer will prompt user to "Enter Operator ID:" Type name of individual performing calibration and press the <Enter> key.

8.1.11 Press any other key to continue or "F1" to re-edit the information.

8.1.12 Submenu will be displayed with "Plateaus" in reverse video. Press the <Enter> key.

8.1.13 The computer will prompt user to "Enter Source Number", select source number or press "5" to enter new source data. Press the <Enter> key.

8.1.13.1 If "5" was selected type source I.D., which will normally be Cs^{137} for plateau calculation. Press the <Enter> key.

8.1.13.2 Type current activity of source in μCi's. Press the <Enter> key.

8.1.14 The computer will prompt user to clear portal for background plateau.

Note: Clear portal of personnel and radiation sources prior to performing background. Sources should be placed no less than 10' from monitor.

8.1.15 Press any other key to continue. Computer will run background plateau.

8.1.16 Press any other key to continue.

8.1.17 The computer will prompt user to run "Source Plateau for Portal #". Place the Cs^{137} gamma source in the center of the portal monitor.

Note: Center includes vertical and horizontal planes. Utilize a source holding device to perform this function.

8.1.18 Run source plateau by pressing any other key.

8.1.19 Press "F1" to rerun plateau or press any other key to continue. The computer will remind user to remove source from the portal and to press any key to continue.

8.1.20 The computer will display "Figure of Merit Calculation for Portal #". Press "F1" to edit high voltage, press "F2" to use suggested settings, or "F3" to use current setting.

8.1.21 Press "F2" to use suggested settings.

8.1.22 Select "efficiencies" and press the <Enter> key.

8.1.23 The computer will give the user the option to use plateau data to calculate efficiencies. Type "N" for NO.

8.1.24 Type "Y" to calculate new efficiencies.

8.1.25 The computer will prompt user to "Enter Source Number"; Select source or press "5" to enter new source data. Press the <Enter> key.

8.1.25.1 If "5" was selected type source I.D., which will normally be Co^{60} for efficiency calculations. Press the <Enter> key.

8.1.25.2 Type current source activity. Press the <Enter> key.

8.1.26 The computer will display count time in sec. Enter count time of 60 sec. And press the <Enter> key.

8.1.27 The computer will prompt user to enter a detector number 1-6 or "0" for overall (all detectors). Type "0", press the <Enter> key.

8.1.28 The computer will prompt the user to "clear the portal for a background reading". Press any other key to continue.

8.1.29 Upon completion of background reading, the computer will prompt the user to position source in the center of the portal. Press any key to continue.

Note: Center includes vertical and horizontal planes. Utilize a source holding device to perform this function.

8.1.30 Upon completion of "Overall" efficiency calculation, the computer display will read, "Efficiency Measurement Complete". Press any other key to advance to next detector.

8.1.31 The computer will prompt the user to type the No# of the detector. Type "1" for detector #1 and press the <Enter> key. Position the source ≈3" away from and in the center of the selected detector. Press any other key to obtain efficiencies. The source will be placed on contact in center of footplate for the foot detector.

8.1.32 Repeat step 8.1.31 for remaining detectors.

Note: The head detector and the four side detectors should have their efficiencies measured with the source placed 3" away from the detector and along its centerline. For Cs^{137}, the head detector should exhibit an efficiency of approximately 6%; the side detectors should produce approximately 7% efficiency to Cs^{137}. The efficiencies should be about doubled when Co^{60} is used. Detector #6 (foot) should have its efficiency measured with the source in contact with the tread plate and centered over the detector. If Cs^{137} is used, an efficiency of approximately 9-11% should result and Co^{60} should yield an efficiency of 18-22%. Overall efficiencies will normally run around 4% for Cs^{137} and 8% for Co^{60}. If efficiency results do not fall within the above detailed

parameters, contact manufacture to ensure proper operation will result with current efficiencies.

8.1.33 Press "F3" to save efficiencies.

8.1.34 The computer will prompt the user to remove source from portal monitor. Press any other key to continue.

8.1.35 Select "Shield Factors" from the submenu and press the <Enter> key.

Note: Shield factors are necessary to compensate for the shielding produced by an individual's body when standing in the portal monitor.

8.1.36 Enter count time of 60 sec. Press the <Enter> key.

8.1.37 The computer will prompt user to clear the portal monitor for unshielded readings. Press any other key to continue.

8.1.38 Upon completion of unshielded readings, press any other key to continue. The computer will again prompt the user to press any other key to continue, and then step into portal monitor to obtain shielded readings.

8.1.39 Press any other key to return to submenu's select "Quit". Press the <Enter> key. The computer will display "Calibrated Parameters for Portal #".

8.1.40 Press "F2" to save calibration.

8.1.41 If a printer is connected to the computer, press "F1" to print report, if not press any other key to exit.

8.1.42 Select "Quit" from the submenu. Press the <Enter> key.

8.1.43 Select "Quite" from the main menu. Press the <Enter> key.

8.1.44 The computer will display "Exit to DOS" Yes or No, Select "Yes". Press the <Enter> key.

8.1.45 Change default drive to C by typing C: and press the <Enter> key.

8.1.46 Remove diskette, turn off computer, disconnect computer from portal monitor, and unplug power supply.

Note: Performance verification must be completed prior to placing the unit into service.

9.0 Calibration Reports

9.1 Generation of Calibration reports using IBM-PC/XT/At or Compatible

9.1.1 Ensure computer is turned on and operating in the MS DOS mode.

9.1.2 Insert the program diskette into the "A" drive and make "A" the default drive by typing A: and pressing the <Enter> key.

9.1.3 Ensure printer is connected to computer and is on-line.

9.1.4 Select "Reports" from the Main Menu. Press the <Enter> key.

9.1.5 The computer will prompt the user to "Enter Portal Number". Type the number and press the <Enter> key.

9.1.6 The computer will generate report. Select "Quit". Press the <Enter> key.

9.1.7 The computer will display "Exit to DOS" Yes or No; Select "Yes". Press the <Enter> key.

Note: Performance verification must be completed prior to placing the unit into service.

10.0 Performance Verification

Note: Performance verification must be completed prior to placing the unit into service.

10.1 Place Cs^{137} source in center of throat and trunk phantom. Ensure center placement accounts for vertical and front to rear planes.

Note: Source utilized should be a Cs^{137} source 1uCi or less in activity. Note source used and decay corrected activity on appropriate document.

10.2 Place throat and trunk phantom containing source into portal monitor. Ensure phantom is elevated to replicate appropriate placement given a "reference man" height of 5'10".

10.3 Activate counting cycle and detail positive or negative alarm activation.

10.4 Repeat step 10.3 for a total of ten (10) count cycles. Detail positive or negative alarm activation for each cycle.

10.5 Remove phantom from portal monitor.

Note: 1. Positive activation of alarm must occur in ten out of ten count cycles for the portal monitor to meet applicable guidelines for use as a gross activity whole body counter. Ensure proper information is documented and affixed to standard calibration reports.

2. Performance verification must be performed after each calibration and/or any time the unit is serviced or repaired.

11.0 Daily Response Check

11.1 Obtain Co^{60} source for response checking PM7.

11.2 Ensure the green "Ready" lamp is lit, step into the PM7 with the Co^{60} Source. The yellow "Counting" lamp should now be lit.

11.3 Upon completion of the count cycle, the red "Contaminated" lamp should be lit. Ensure that all detectors (1-6) respond to the Co^{60} Source. If any detectors fail the response check, remove the monitor from service. Notify the HP Foreman or Plant Manager.

APPENDIX A

OPERATION OF THE EBERLINE PM7 PERSONNEL MONITOR

1. The green "Ready" lamp of the PM7 will remain lit when the monitor is updating background.

2. Enter your ID# (which will be issued to you at the time you are hired and have completed ALL training requirements) before entering the PM-7. Example (030 Enter). Then enter the portal monitor by steeping into the center and standing still until you hear a chime sound and all lights go out.

   a. If the object is removed from the portal before the count cycle is complete, the white "Recount" light will be lit and the horn will sound intermittently.

   b. If no contamination is detected at the end of the count cycle, all lights will be out.

   c. If contamination is detected, the Yellow Count lamp is extinguished. The red "Contaminated" lamp is lit and the horn will sound continuously for the selected alarm hold time or until the "ACK" button is pressed.

   d. If a contamination Alarm occurs, repeat the count cycle, if the contamination alarm goes off again **NOTIFY HEALTH PHYSICS!!!**

DSA-1000 Desktop Spectrum Analyzer

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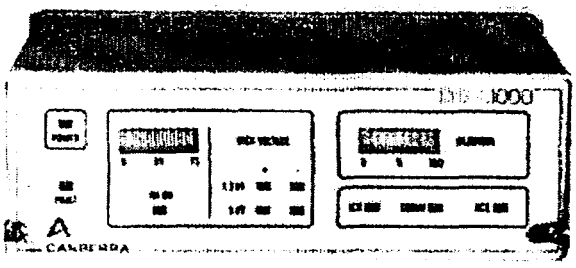
#8



Features

- Integrated desktop MCA based on Digital Signal Processing (DSP)
- Ideal for single input applications where networking is not required
- Excellent count rate and temperature stability
- Wide range of processing time parameters to allow precise match to detector characteristics and ap
- 16K Channel conversion gain/spectrum memory
- USB and RS-232 host interfaces allow simple connection to computer - no plug-in board or PC bus
- Convenient small form-factor desktop package
- Full set of front panel indicators for HV, dead time and system status
- Performs pulse height analysis (PHA) or multi-channel scaling (MCS)
- Digital oscilloscope to assist with setup
- Built-in power up diagnostics
- Supported by the Genie 2000 spectroscopy software

Description

The DSA-1000 is a full featured 16K channel integrated Multichannel Analyzer based on advanced digital techniques (DSP). When paired with the computer of choice, the DSA-1000 becomes a complete spectro: capable of highest quality acquisition and analysis. The instrument interfaces to all existing detector techn Si(Li), CdT or Cd(Zn)Te.

In many laboratories today, spectroscopists are finding themselves constrained both in terms of available space. The DSA-1000 offers cost effective, no-compromise DSP-quality spectroscopy in a very compact p

The DSA-1000 is operated through the Genie 2000 spectroscopy software which provides the user with u range of application specific software options are available under the Genie 2000 family.

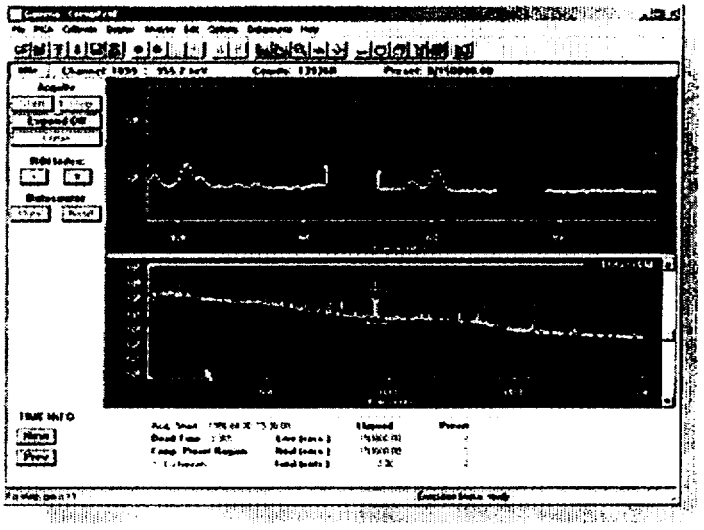
The excellent performance of the DSA-1000 derives from the application of DSP technology. Earlier analc were prone to count rate and environmental instabilities that required continual adjustment of the signal pr and often compromised analysis results. With the DSA-1000, these problems are dramatically reduced, w NIM bins.

The heart of the DSA-1000 is the Digital Signal Processor subsystem. Unlike conventional systems, whicl the end of the signal processing chain, the DSA-1000 digitizes the preamplifier signals at the front of the s This approach minimizes the amount of analog circuitry resulting in increased stability, accuracy and repr

The use of DSP technology also improves the overall signal acquisition performance. Signal filtering funct implemented in traditional analog electronics are limited. DSP allows filtering functions and pulse shapes using conventional analog processing techniques. The result is a more efficient trapezoidal filter function, processing time, less sensitivity to ballistic deficit, and superior resolution. With trapezoidal filtering, the pu more rapidly and accurately, so the spectrum resolution is enhanced while throughput is increased.

The DSA-1000 offers peak gain stability in some cases a factor of two to three times better than past gen while Zero drift is barely measurable over the full operating temperature range of the instrument.

The DSA-1000 supports both the traditional Pulse Height Analysis (PHA) mode as well as a multichannel time varying applications. The MCS mode can display data from either an external TTL input, a full spectr of Interest (ROI).



Two methods of host communications are supported. The preferred method is the Universal Serial Bus (U provides fast host communications at 12 Mbits/second. USB provides the additional capability of having m a single host/port via a USB hub. USB requires the use of either Windows® 98, Windows Me or Windows environments.

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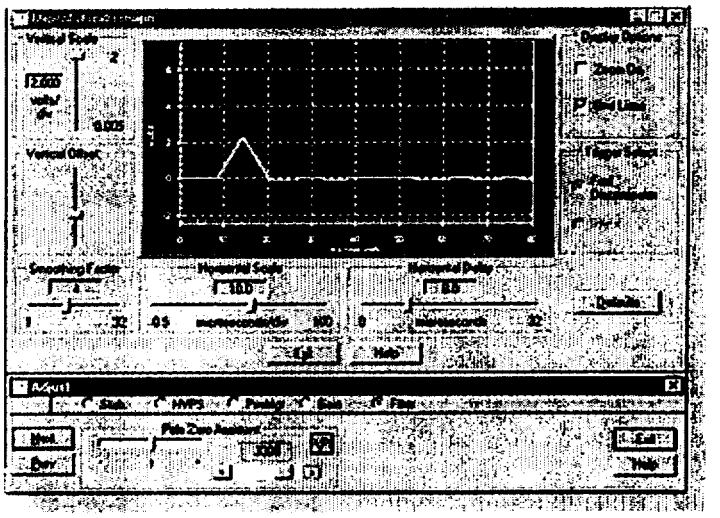

To facilitate optimal pole/zero adjustment, the DSA-1000 is equipped with a Pole/Zero Assistant (PZA) fea the user to adjust the pole/zero cancellation circuit while the DSA-1000 analyzes and displays the degree undershoot exhibited by the filtered signal. The user simply moves the P/Z control until the PZA indicator i optimal adjustment.

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Upon initial power up, the DSA-1000 executes a set of internal diagnostic analyses, checking the status o and its components as well as the signal processing logic.

A complete set of front panel indicators provides real-time information on the DSA-1000's HV setting, syst overall system status.

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Models

- DSA-1000: Desktop Spectrum Analyzer

Rec

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CANBERRA

Model DSA-1000 Digital Spectrum Analyzer

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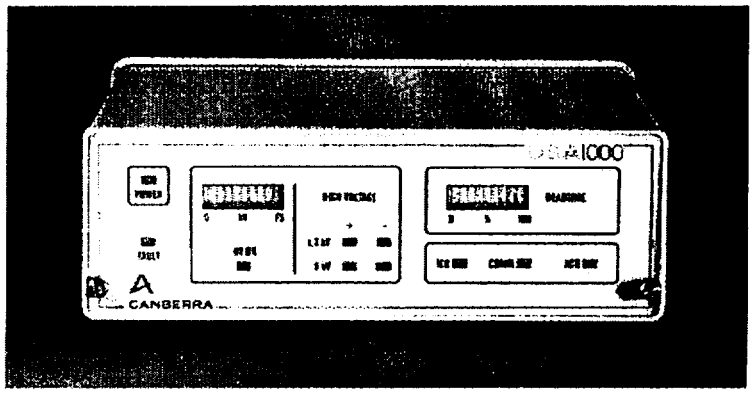

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Phone contact information

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Model DSA-1000 Digital Spectrum Analyzer

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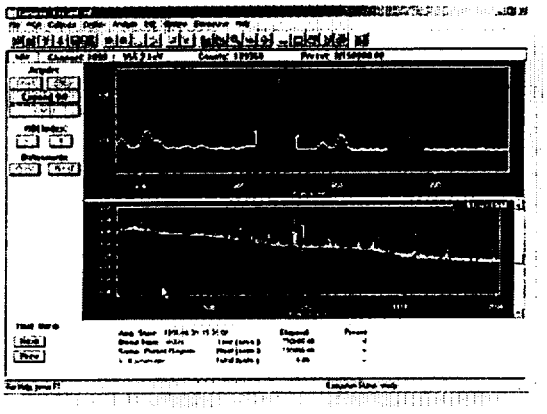

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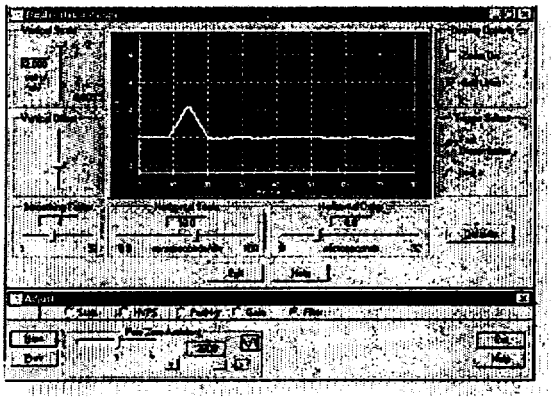

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Model DSA-1000 Digital Spectrum Analyzer

Specifications

INPUTS/OUTPUTS

AMP IN
Accepts positive or negative signals from an associated detector preamplifier; amplitude for full scale conversion ±10 V divided by selected gain; maximum input (signal +dc) for linear operation is dependent on the Input Attenuator setting; Attenuator OFF (x1): ±4 V, Attenuator ON (x 0.25): ±12 V, dc coupled and protected to ±24 V maximum; rise time: less than the selected Rise Time + Flat Top settings; acceptable preamplifier decay time constant: 45 μs to infinity; Z_{in} is 1.3 kΩ; rear panel BNC connector.

RESET
Accepts a standard TTL Logic signal; functionality is dependent on the Reset Preamp Inhibit mode selected; disables pulse processing, extends the system dead time, resets the pileup rejector and gates off the baseline restorer; rear panel BNC connector.

Auto:
System is gated off for the greater of the external RESET signal "OR" the Internal Inhibit time.

Manual:
Functionality same as Auto mode except the signal processor is inhibited for the greater of the user selected Inhibit Setting "OR" the Internal Inhibit Time "OR" the external RESET signal.

Positive true or negative true signal polarities, user selectable; minimum pulse width is 100 ns; logic high ≥+2 V, logic low ≤+0.8 V; maximum input voltage +5.5 V.

HV INH
Accepts input from the detector preamplifier to shut down the HVPS in the event of a detector warm-up; polarity is user selectable to match the preamplifier; rear panel BNC connector.

Positive polarity: for all Canberra preamplifiers; Enable condition (cold detector) is an open circuit or active high ≥+1.2 V to +24 V; Inhibit condition (warm detector) is –24 V to <+1.2 V or ground.

Negative polarity: for all preamplifiers and LN monitors where enable condition (cold detector) is –24 V to <+1.2 V; Inhibit condition (warm detector) is open circuit or active high ≥+1.2 V to +24 V.

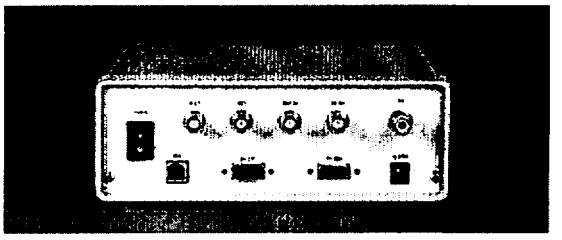
With Negative selected an open input will disable the high voltage.

MCS
MCS counts input; TTL compatible; maximum rate ≤1 MHz; minimum pulse width ≥20 ns; logic low ≤+0.8 V, logic high ≥+2 V; rear panel BNC connector.

DC PWR
DC power input from supplied ac adapter; 2.5/5.5 mm rear panel connector; Nominal 7.5 V dc at 0.75 amps, +8.5 V maximum.

HV
Dual range and polarity high voltage power supply; voltage range and polarity selected by programming modules: ±10 to ±1300 V dc or ±1300 to ±5000 V dc; rear panel SHV connector.

Low end of the 5000 V range is limited to 1300 V by software.



RS-232
RS-232 interfaces to host personal computer; software selectable baud rate, 2.4K to 115K supported; rear panel 9-pin male D connector.

USB
High Speed USB interface for host communication; rear panel USB Series B connector. The maximum cable length supported by USB is 5 m.

PREAMP
Provides ±24 V (±5%), ±12 V (±5%) and ground for standard preamplifiers; overload protected.

- +24 V at 40 mA max
- –24 V at 20 mA max
- +12 V at 80 mA max
- –12 V at 30 mA max

Rear panel 9-pin female D connector.

FRONT PANEL INDICATORS

POWER
Green LED, indicates that the DSA-1000 is switched on.

FAULT
Yellow LED, indicates a diagnostic failure at power-up or high voltage fault.

HV ON
Green LED, indicates HVPS status or HV fault condition, constant on indicates HVPS is on and high voltage may be present at the rear panel SHV connector. Blinks for a fault condition such as a high voltage overload or inhibit due to a detector warm up if connected.

HV LEVEL
Green LED bar graph indicating that high voltage is present at the rear panel HV connector. The bar graph full scale (FS) depends on the selected HV range (1.3 kV or 5 kV).

HIGH VOLTAGE RANGE AND POLARITY
Four green LEDs indicating the selected HV range and polarity.

ACQ
Green LED, indicates MCA is acquiring.

COMM
Green LED, indicates USB or RS-232 activity.

ICR
Green LED, indicates incoming count rate; blink rate proportional to count rate.

DEAD TIME
Green LED bar graph providing a real-time display of the system's dead time in percent; range: 0% – 100%, linear.

Model DSA-1000 Digital Spectrum Analyzer

CONTROLS

Power

Power to the DSA-1000 is enabled when the switch is set ON ("I") position, OFF for the ("O") position; rocker switch located on rear panel.

PROGRAMMABLE CONTROLS

Gain

The combination of Coarse Gain, Fine Gain and Super Fine Gain (SFG) set the overall system gain to match the requirements of the detector and energy application; overall gain is continuously adjustable from x2.24 to x2438.

COARSE GAIN
x2.5, x5, x10, x20, x40, x80, x160, x320, x640, x1280.

FINE GAIN
Range is x0.9 to x1.9.

SUPER FINE GAIN
Range is x0.9975 to x1.0025.

GAIN ATTENUATOR
ON/OFF; When ON (selected) enables a divide by four input attenuator to minimize overload due to preamp signals with large dc offsets and Reset Preamps with large output ramp dynamic range; Coarse Gain settings displayed include the effects of the attenuator, the Coarse Gain selections reduce from 10 to 8 covering a range of x2.5 to x320. When OFF is selected the signal attenuation is removed.

MCA/INPUT SIZE

PHA MODE: Selections of 256, 512, 1024, 2048, 4096, 8192 or 16 384 channels. Support for two memory groups of 8192 or less channels.

MCS MODE: Selections of 256, 512, 1024, 2048, 4096 or 8192 channels, support for two memory groups of 8192 or less channels.

LLD MODE: Selects Automatic or Manual LLD mode; AUTOMATIC: the LLD cutoff is automatically set just above the spectral noise threshold; MANUAL: allows the LLD cutoff to be set manually as a percentage of the full scale spectral size or range.

LLD SETTING
Active when the Manual LLD mode is selected, sets the minimum input acceptance level, range is 0 to 100%.

INP POLARITY
Selects either POSITIVE or NEGATIVE input polarity.

INH POLARITY
Selects either Active High or Active Low Reset Preamp Inhibit polarity.

PUR GUARD
Selects Guard Time (GT) multiplier in increments of 1.1, 1.3, 1.5, 1.7, 1.9, 2.1, 2.3, and 2.5 to reject trailing edge pile-up in the event of detector/preamp anomalies.

FDISC SHAPING
Selects NORMAL or LOW ENERGY to optimize the fast discriminator shaping for the selected detector type; NORMAL: The Fast Discriminator shaping is optimized for Ge detectors and general gamma spectroscopy, the fast discriminator filter rise time is set to 40 ns; LOW ENERGY: the Fast Discriminator filter rise time is set proportional to the slow shaping rise time selection.

FDISC MODE
Sets the Fast Discriminator Threshold mode. AUTO: the threshold is optimized automatically above the system noise level; MANUAL: allows threshold to be adjusted manually.

FDISC SETTING
Active when manual FDISC mode is selected; sets the Fast Discriminator threshold level, range is 0 to 100%; the front panel ICR LED serves as a user aid when manually setting the Fast Discriminator threshold.

INHIBIT MODE
Selects AUTO or MANUAL Reset Preamp Inhibit Modes; disables pulse processing, extends the system dead time, reinitializes the pileup rejector and gates off the baseline restorer.

AUTO: System is gated off for the greater of the external RESET signal "OR" the Internal Inhibit Time.

MANUAL: functionality same as Auto mode except the signal processor is inhibited for the greater of the user selected Inhibit Setting "OR" the external RESET signal "OR" the Internal Inhibit Time.

INHIBIT SETTING
Active when the MANUAL Reset Preamp Inhibit Mode is selected, sets the Inhibit Time, range 0 to 160 μs in increments of 1 μs.

LTC MODE
ON/OFF; ON: Enables pileup rejector and live time corrector (LTC). LTC generates dead time to extend the acquisition time to compensate for events that are piled up and rejected; OFF: pileup rejector and LTC disabled.

LT TRIM
Allows adjustment of the trapezoidal pulse evolution time or dead time to optimize Live Time Correction (LTC) performance. The adjustment range is 0 to 1000; the default value of 500 provides good LTC performance for a wide range of applications.

Filter

Note: Filter output (Trapezoid Signal) may be displayed on the Host computer using the digital oscilloscope feature.

RISE TIME
40 rise and fall times ranging from 0.4 to 38 μs.

FLAT TOP
21 flat top time selections ranging from 0 to 3 μs.

BLR MODE

AUTO, HARD, MEDIUM, SOFT; AUTO: The baseline restorer is automatically optimized as a function of trapezoid shaping time and count rate; HARD, MEDIUM, or SOFT: Sets the baseline restorer to fixed rates as selected.

POLE/ZERO
Pole/zero is adjusted by computer control; range: 45 μs to infinity; a digital oscilloscope and Pole/Zero Assistant is provided as a user aid when optimizing the pole/zero setting. The Pole/Zero Assistant measures and analyzes the tail of the trapezoid signal and provides visual feedback showing the quality of the pole/zero adjustment via a simulated null meter or Pole/Zero Quality Indicator.

PREAMP TYPE
RC, RESET; selects the pole/zero mode; RC: pole/zero can be adjusted manually by computer command; range: 45 μs to infinity; RESET: Sets pole/zero at infinity for use with pulsed charged restoration (RESET) preamplifiers.

Model DSA-1000 Digital Spectrum Analyzer

Digital Oscilloscope
Allows examination of the digital trapezoid signal reconstructed in time to assist and verify instrument setup, pole/zero optimization and manual Reset Preamp INHIBIT adjustments.

HVPS

VOLTAGE RANGE
(Programmable Modules) Output voltage range and polarity selected by plug-in programming modules: +10 to +1300 V dc, +1300 to +5000 V dc, –10 to –1300 V dc and –1300 to –5000 V dc, HV setup is read by firmware and displayed on the front panel and through the host application; Low end of the 5000 V range is limited to 1300 V.

VOLTAGE LIMIT
Sets maximum voltage limit of voltage range selected; +10 to +1300 V dc, +1300 to +5000 V dc, –10 to –1300 V dc or –1300 to –5000 V dc. Voltage range and polarity selected by plug-in programming modules.

STATUS
ON, OFF; sets the HVPS ON or OFF.

VOLTAGE
Allows adjustment of the HVPS output over the voltage range selected by the HV module type and voltage limit selections.

HVPS RESET
Resets a power supply fault, after a fault condition has occurred.

INH SIGNAL
Sets the polarity sense of the High Voltage Inhibit input.

Positive setting: for all Canberra preamplifiers; Enable condition (cold detector) is an open circuit or active high ≥+1.2 V to +24 V; Inhibit condition (warm detector) is –24 V to <+1.2 V or ground.

Negative setting: all preamplifiers and LN monitors where enable condition (cold detector) is –24 V to <+1.2 V; Inhibit condition (warm detector) is open circuit or active high ≥+1.2 V to +24 V.

With Negative selected an open input will disable the high voltage.

Stabilizer

GAIN MODE
ON, OFF, HOLD; ON/OFF: enables or disables the Gain Mode; HOLD: disables the stabilizer Gain Mode, but maintains the current Gain correction factor; Centroid (0 to 16 376 channels), Window (1 to 128 channels), Spacing (2 to 512 channels), Ratio (0.01 to 100), Rate Div (1 to 16); Correction Range of 1% for Ge and 10% for NaI detectors.

MCS

MODES
TTL, Integral, ROI Discrimination. Events are counted for the duration of a programmed number of sweeps. Each SWEEP incorporates a programmed number of channels. Each channel represents a DWELL duration.

TTL: TTL pulses counted from MCS IN connector.

Integral: Total gamma events counted from DSP spectrum.

ROI: Discriminated Gamma events counted if they occur within the programmed ROI window.

PROGRAMMABLE SETTINGS

Dwell Time Settings
5.00 ms to 10.0 s in 14 steps: 5.00 ms, 10.0 ms, 20.0 ms, 40.0 ms, 80.0 ms, 100.0 ms, 200.0 ms, 400.0 ms, 800 ms, 1.0 s, 2.0 s, 4.0 s, 8.0 s and 10.0 s.

Dwell Time Resolution – Less than 10 µs.

Sweep Counter – 65 535 sweeps.

ROI Disc Window – 1 to 8192 channels.

Sweep Mode – Sweep Counter or Sweep Forever.

MCS Channel Range – 256 to 8192.

Start/Stop control – through software.

PERFORMANCE

Signal Processing

SPECTRUM BROADENING
The FWHM of ^{60}Co 1.33 MeV gamma peak for an incoming count rate of 2 kcps to 100 kcps will typically change less than 6% for 2.8 µs rise/fall time, 0.8 µs flat top and proper P/Z matching. These results may not be reproducible if the associated detector exhibits an inordinate amount of long rise time signals.

INTEGRAL NON-LINEARITY
≤±0.025% of full scale over the top 99% of selected range.

DIFFERENTIAL NON-LINEARITY
≤±1% over the top 99% of the range including the effects from integral non-linearity.

GAIN DRIFT
≤35 ppm/°C after 15 minutes of operation.

ZERO DRIFT
≤3 ppm/°C after 15 minutes of operation. Typically, less than 1 channel over full temperature range (8K Spectrum).

OVERLOAD RECOVERY
Recovers to within 1% of full scale output from x1000 overload in 2.5 non overlapped pulse widths at full gain, at any shaping (processing time), and with pole/zero properly set.

Pileup Rejection/Live Time Correction

PULSE PAIR RESOLUTION
Better than 500 ns with NORM Detector Type selected.

DEAD TIME CORRECTION
Extended live time correction, accuracy of reference peak area changes 5% (3% typical) at up to 50% system dead time with a setting of 5.6 µs rise time and 0.8 µs flat top.

Acquisition

DATA MEMORY GROUPS
1–16K (PHA) Channels or 2–8K (PHA) channels (single mode only); 28 bits per channel, 10 year data retention (power loss). Divisible into halves, quarters, eighths, and sixteenths. 2–8K (MCS) channels; 28 bits per channel, 10 year data retention (power loss).

STORAGE MODE
PHA or MCS.

Note: Simultaneous operation of PHA/MCS is not supported.

PRESET MODES

PHA Mode: Live or True Time, Counts in single channel, Counts in ROI, Counts in multiple ROIs.

MCS Mode: Sweeps, Count greater or equal to preset Counts, Count greater or equal to preset ROI Counts.

TIME RESOLUTION
0.01 s live and true time. 0.02.

PRESET TIME
1 to >4 x10^7 s.

PRESET SWEEPS
1 to 65 535.

Model DSA-1000 Digital Spectrum Analyzer

HVPS
Plug-in programming modules select the maximum voltage range and polarity. The actual HV range and polarity is displayed on the front panel and reported by the software.

1300 Volt Range
+10 V to +1300 V or –10 V to –1300 V dc at 300 μA.

5000 Volt Range
+1300 V to +5000 V dc or –1300 V to –5000 V dc at 20 μA.

ADJUSTMENT RESOLUTION
1 part in 4096, all modules.

RIPPLE
±1300 V dc range; ≤25 mVpp in 50 MHz bandwidth at maximum voltage and full load.

±5000 V dc range; ≤50 mVpp in 50 MHz bandwidth at maximum voltage and full load.

TEMP. COEFFICIENT
≤±50 ppm/°C after 15 minute warm-up.

OUTPUT STABILITY
Long term drift of output voltage is ≤0.01%/h and ≤0.02%/8 h at constant load and ambient temperature after 15 minute warm-up.

VOLTAGE ACCURACY
±5% of setting.

REGULATION
≤5% variation in output voltage over the load range at constant ambient temperature.

OVERLOAD PROTECTION
The high voltage power supply will withstand any overload, including a short circuit for an indefinite period.

CABLES

RS-232 (provided)
Used for connecting the instrument to an industry standard computer (9-pin) serial port; 3 m (10 ft); baud rates supported are 2400, 4800, 9600, 14.4 k, 19.2 k, 28.8 k, 38.4 k, 57.6 k, and 115.2 k.

USB (provided)
Used to connect the host industry standard computer USB port to the DSA-1000 rear panel USB port; 3 m (10 ft); shielded cable.

PHYSICAL

Metal and plastic enclosure.

SIZE:
7.1 x 19.1 x 22.6 cm (2.8 x 7.5 x 8.9 in.) H x W x D.

WEIGHT:
1.3 kg (2.8 lb).

ENVIRONMENTAL

OPERATING TEMPERATURE

RANGE: 0 to 50 °C.

HUMIDITY: Up to 80% non-condensing.

ORDERING INFORMATION

Requires Genie 2000 V2.0A or later.

ISO 9001 SYSTEM CERTIFIED

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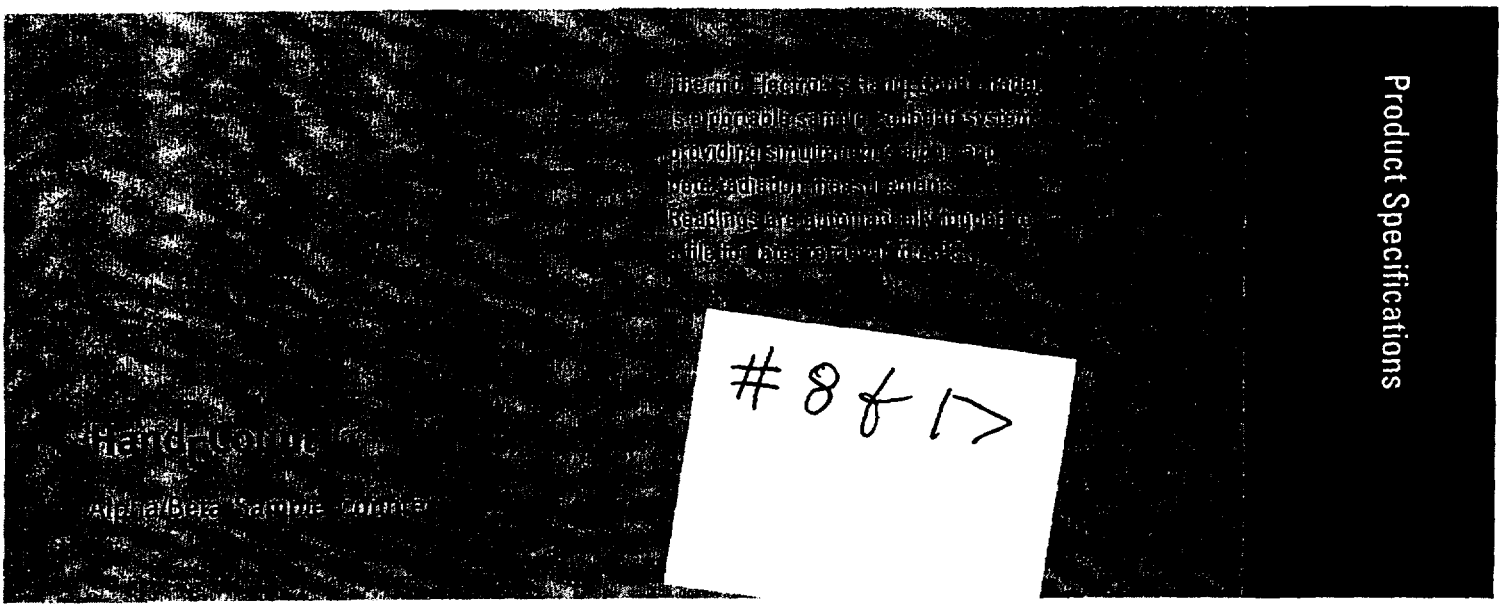
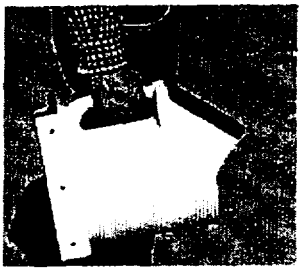
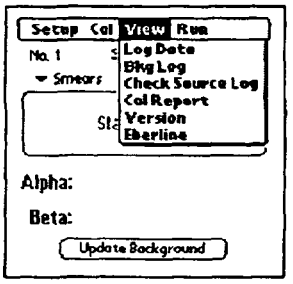




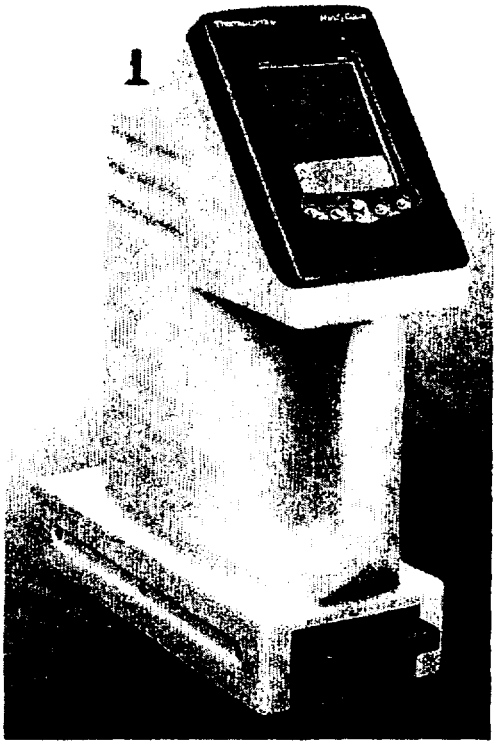
- Simultaneous alpha/beta measurements
- Background subtraction
- 8 hour battery operation
- Built-in calibration routine
- Non-volatile data storage



This system is controlled by a Palm™ hand-held computer that communicates with a modular detector board to perform counting operations. The Palm™ computing platform provides cost-effective advantages over other systems; notably the informative color screen, controls, internal clock and powerful database capabilities.

The Hand$_E$Count system incorporates a 2" (5 cm) dual scintillation phosphor mated to a sliding drawer accommodating a 2" (5 cm) diameter sample. The drawer uses a height-adjustable sampling area to permit use with different sample types. The sample drawer must slide fully to the rear to make switch contact to initiate counting. The enclosure is a rugged, durable plastic.

Battery operation, together with the built-in handle, allow for portability with field use of up to eight hours between battery charges. All measurement results are automatically stored to a database that can be viewed directly on the Palm™ or sent, via the built-in RS-232C interface, to a PC running a Windows™ application. In addition to the measurement database the



Hand$_E$Count also supports a database comprising all the background and check source updates. A separate database references all radiation sources employed for checking and calibrating the instrument. All sources are automatically decay-corrected to simplify and maintain accuracy in these functions.

A built-in calibration routine permits calibration of the instrument and displays the results. Two levels of password control prevent unauthorized access to editing and calibration functions. All calibration results are stored in a calibration-reporting database for review on the Palm™ or for later retrieval by a PC. The Palm™ comes equipped with a Flash card to store accumulated data as well as the Hand$_E$Count operating program in the event the Palm's™ internal battery dies.

Hand$_E$Count Specifications

Detector:	5 cm (2") Diameter alpha and beta sensitive scintillator.
Efficiency:	Alpha ^{239}Pu: > 90% (2 pi). Beta ^{99}Tc: > 25% (2 pi). ^{90}Sr-^{90}Y: > 40% (2 pi).
Background:	<60 counts per minute (cpm) in the beta channel and < 3 cpm in the alpha channel in a background of 25 µR/h gamma.
Cross-talk:	Alpha to beta and beta to alpha cross-over corrections are automatically corrected with parameters established in the calibration process.
Sample Drawer:	51.6 mm (2.03") diameter x 9.6 mm (0.38") thick maximum. The sample thickness can be adjusted between 3.2 mm (5/16") to 7.9 mm (1/8"). The sample holder and slide are black anodized for ease of decontamination.
Mechanical:	Single package design to allow for portability.
Display/Controls:	Palm™ hand-held computer, Model m515.
Units:	Counts, CPM, CPS, Bq, DPM, DPS.
Count Time:	User selectable count time between 1 second and several hours.
Background Update:	User selectable count time 1 second to 60 minutes utilized in background subtraction of sample counts.
Alarms:	User-defined alarm limits on samples; Out of calibration.
Calibration:	Menu driven calibration routine to optimize HV, alpha/beta thresholds and cross-talk values. Efficiencies are automatically computed based upon user-defined sources. Program includes a user-defined database of sources for quick selection. Automatic decay corrections of sources are calculated. All calibration data are protected in non volatile memory. The next calibration date is automatically computed based upon the user-defined frequency. The Hand$_E$Count2 program provides advance warning of upcoming calibration dates.
Power Supply:	110 VAC, 60 Hz standard, optional 220 VAC, 50 Hz.
Check Source:	Software routine permitting quick verification and operability of the instrument to user-defined acceptance criteria.
Passwords:	Protect setup and calibration information via two levels of password controls.
Count Storage:	Data log samples using sequential numbering or user input identification via the Palm™. Graffiti™ interface for approximately 5000 samples. Each data point will include sample ID, sample count type, sample count result, counter serial number, time, date, instrument status etc.
Temperature:	0 to 50° C (32 to 122° F).
Humidity:	10 to 90% non-condensing.
Count Range:	1 to 1.2 million cpm.
Audible:	The Palm™ audible output is used to signal: - Countdown timer. - When the sample has completed its count. - Whenever an alarm occurs (when activated).
Size:	38.1 x 12.1 x 30.5 cm (15" x 4.75" x 12").
Weight:	5 Kg (11 lbs). (~6 kg (13 lbs) with battery option).
Testing:	CE Approved. ANSI N42.17

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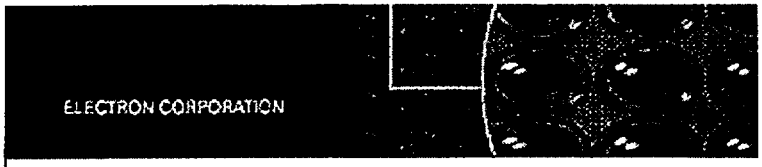

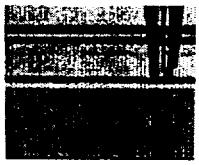

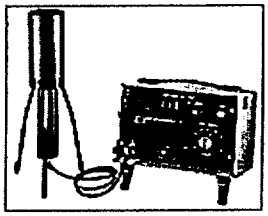

MiniAssay 6-20 Gamma Counter

The MiniAssay 6-20 is the ideal lab unit for specific applications, or excellent as an add-on gamma counter.

Product Detail

The Mini-Assay type 6-20 comprises a high voltage supply, discriminator, and scaler with crystal controlled timer in a single unit. The illustration shows the instrument connected to the type 43 well scintillation probe supported by the demountable stand together with a lead shield. This combination makes an ideal unit for either a small RIA laboratory or back up to a multiple counting system.

For use in Microbiology labs where counting periods are in minutes rather than seconds you require the Model Type H.

MiniAssay 6-20 Gamma Counter

Product #	Product Description	
Mini-Assay 6-20	Gamma counter	Select
Mini-Assay 6-20H	Gamma counter (counts in minutes)	Select

Details All Product Numbers

Related Products

Product Name	
Well Counter Type 43	Select

Details All Product N

Purchase Details

Rc

Contact Us

Sales

North America 1-800-274-

Specifications:

Size	220 r high :
Weight	3.5 k
Mains Supply	Eithe 250 \ interr
Power Consumption	15 wa
EHT Generated	200-: by sc front resist
Connector	PET t EHT s input
Readout	5 of 1 with and r suppr maxi
Highest Regular Input Pulse Rate	1 Mh: 5 Mh:
Counting Times Available	**Type** 100, secor **Type** 2m, 5 unlim
Timing Accuracy	200 p 4.194
Input Sensitivity	Nega less t with thres
Input Impedance	Appr Ohms

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Well Counter Type 43

The Type 43 Well Detectors are the most sensitive gamma counter designs available, providing high quality data and minimizing counting time.

Product Detail

Well Counter Type 43
This detector is similar in construction to the scintillation probes types 41 and 42 as used in our portable contamination meters. The integral lead shield provides adequate shielding for RIA determinations so in conjunction with the Mini-Assay type 6-20 the combination becomes a transportable gamma counter. Disposable plastic liners are available for the well.

Purchase Details

Re

Contact Us

Sales

North America 1-800-274-

Specifications:

Crystal	25 m long : well 1 20 m
Photomultiplier	25 m 9924
Screening	Integ mm ¥
Background	2-10 locale
Maximum Random Counting Rate	5,00(appr(count
Output	Nega excee ampli Ohms
Pulse Length	Appr(micr(
Dynode Chain Resistance	68.5
Well Counter Sensitivity in Percentage Counts per Disintegration	^{125}I ; ^{131}I : ^{57}CO ^{75}Se ^{99m}T
Weight	0.63
Additional Lead Shield	Nomi mm
Size	120 r diam
Weight	2.5 k

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18A

EASTERN TECHNOLOGIES, INC
MONITORING AND/OR SURVEY REQUIREMENTS
FOR

I. LIQUID RELEASES TO UNRESTRICTED AREAS
II. AIR RELEASES TO UNRESTRICTED AREAS
III. OWNER CONTROLLED AREA
IV. UNRESTRICTED AREA

APPROVED BY: Mark Fellows
MARK FELLOWS
VICE PRESIDENT

I. LIQUID RELEASES TO UNRESTRICTED AREAS

A. Minimum Requirements For Release

If a liquid release from the RCA to an unrestricted area is required, it must be performed in the following manner.

1. Obtain required sample.

2. Analyze sample to determine types and quantities of radioactive material present.

3. Evaluate against applicable NRC regulations.

   Notes: 1. If quantities of radioactive material present exceed 75% of the limits of Appendix B, Table II, Column 2 of 10 CFR 20 the release can only be authorized by Plant Manager, HP Supervisor or RSO.

   2. Each month's average concentration for individual isotopes should not exceed 90% of the values detailed in Appendix B, Table II, Column 2 of 10 CFR 20. Month to date isotopic concentrations should be reviewed to ensure that the release will not cause the month end average concentrations to exceed ALARA goals.

4. Receive proper permission.

   Notes: 1. If quantities of radioactive material present are < 75% of the limits of Appendix B, Table II, Column 2 of 10 CFR 20 the Assistant Plant Manager or HP Technician can authorize releases.

   2. Each month's average concentration for individual isotopes should not exceed 90% of the values detailed in Appendix B, Table II, Column 2 of 10 CFR 20. Month to date isotopic concentrations should be reviewed to ensure that the release will not cause the month end average concentrations to exceed ALARA goals.

5. If directed by supervision (e.g.: President, Vice President, Plant Manager, or HP Supervisor) implement proper methods to reduce quantities of material present to < 75% of allowable NRC limits.

6. Ensure all documentation is in order.

7. Make release.

B. Laboratory Procedures For Analysis Of Liquid Sample

The following guidelines should be followed for analyzing liquid samples. The information obtained can then be used to determine processing techniques and disposal methodology.

1. Gross Beta/Gamma Activity Analysis via GM Tube and Scaler/Counter or Equivalent Instrument

   a. Collect sample in appropriate container.

      Note: Ensure large liquid sample is thoroughly mixed in container prior to transferring liquid to smaller receptacle.

   b. Transport sample to lab area in accordance with proper practices and procedures.

   c. Transfer 100 ml of sample to proper container for evaporation.

   d. Evaporate (boil) sample to provide "residue" in planchette for counting.

      Note: During evaporation process other non-contaminated liquid may be added to the mix to wash down container surfaces so that all residual materials (radioactive material) will be located in planchette.

   e. After complete evaporation, count sample as per appropriate procedure.

   f. Properly document results of sample analysis.

g. Ensure that all laboratory and sampling containers are properly cleaned.

2. Gross Alpha Activity Analysis via Eberline SAC-4 or Equivalent Instrument

a. Collect sample in appropriate container.

b. Transport sample to lab area in accordance with proper practices and procedures.

c. Transfer 100 ml of sample to proper container for evaporations.

Note: Ensure sample is thoroughly mixed before and during transfer.

d. Evaporate (boil sample to provide "residue" in planchette for counting.

Note: During evaporation process other non-contaminated liquid may be added to the mix to wash down container surfaces so that all residual materials (radioactive material) will be located in planchette.

e. After complete evaporation, count sample using as per appropriate procedure.

f. Properly document results of sample analysis.

g. Ensure that all laboratory and sampling containers are properly cleaned.

3. Activity Analysis via Gamma Spectroscopy

a. Obtain required sample.

Note: Ensure large liquid sample is thoroughly mixed in container prior to transferring to subsequent container or analysis apparatus.

b. Transport samples to lab area in accordance with proper practices and procedures.

c. If appropriate, transfer liquid into proper container for analysis.

d. Analyze sample as per appropriate procedure.

e. Properly document results of sample analysis.

f. Ensure that all laboratory and sampling containers are properly cleaned.

II. AIR RELEASES TO UNRESTRICTED AREAS

If air releases from the RCA are required, the following guidelines and minimum requirements must be followed.

A. Insure release point has proper sampling equipment installed (i.e.: regulated air sampler).

Note: Insure that sampler utilized is within its calibration period.

B. If utilizing an alarming air monitor ensure alarm levels do not exceed effluent concentrations for air detailed in Appendix B, Table II, Column 1 of 10 CFR 20.

III. OWNER CONTROLLED AREA

A. Area Controlled Area around Radiologically Controlled Areas will be monitored via Thermo Luminescent Dosimeters (TLD's). Locations and minimum quantities of TLD's are to be as follows:

Location	Quantity
Northern Boundary	1
Southern Boundary	1
Eastern Boundary	1
Western Boundary	1
Shipping & Receiving	1

Note: TLD's will be exchanged quarterly. Results will be documented and filed.

B. Area Contamination Survey

1. Surface Surveys

Surveys of the outside surfaces of the facility are to be taken on a quarterly basis. The results of the related analysis will be documented on the appropriate survey map.

Note: Periods of non-operation ≥ survey interval negates requirement for survey.

2. Soil Samples

Soil samples of the owner controlled area are to be taken and analyzed quarterly. Samples are to be representative of the four (4) sides of the facility (i.e.: North, South, East, West) and must be taken from or near the same location each time. Samples may be analyzed through gross activity analysis or Gamma Spectroscopy. If gross activity analysis is utilized results are to be compared to initial baseline sample. Increases in differential activity of more than 50% will require investigation to determine if additional and/or more accurate analysis or corrective action is required. If Gamma Spectroscopy is utilized samples having an MPC greater than 25% of the value determined by the NRC to be acceptable for free release shall require investigation to determine if additional analysis or corrective action is required. All results must be documented and filed.

Note: Periods of non-operation ≥ survey interval negates requirement for survey.

IV. UNRESTRICTED AREAS

A. Facility

1 Area Dose Rate Monitoring

Dose rate surveys of the unrestricted areas inside the facility will be performed ≤ monthly. In addition, TLD's placed on boundary

walls between the RCA and unrestricted areas of the facility shall be used to track associated dose accumulation. Additional TLD's may be used at the discretion of the RSO or HP Supervisor to monitor unrestricted work areas typically inhabited by employees. Dose rates that will result in annual accumulation in excess of 100 mr/year are not acceptable and must be corrected.

2 Area Contamination Survey

Contamination surveys of the unrestricted areas within the facility will be performed ≤ monthly. Contamination levels in excess of the MDA values of friskers and/or scaler/counters are not acceptable and must be corrected.

B. Owner Occupied Property

1 Area Dose Rate Monitoring

Unrestricted areas surrounding Owner Controlled Area will not be monitored for associated dose rates unless required by ETI management and/or appropriate licensing agencies.

2 Soil Samples

Soil samples of the unrestricted areas surrounding the owner-controlled area will not be taken unless required by ETI management and/or the USNRC and permission from property owner can be obtained for sample collection.

WATER SAMPLE ACTIVITY CALCULATION SHEET

Instrument : _____ **Date/Time:** _____

MDA: _____ **Collected By:** _____

Tank # & Release #	ETI Incoming Ship #	Shelf #	Bkg (cpm)	Net (cpm)	Det Eff	Total Volume (samp)	Gross Act (uci/ml)	Isotope	% Abd	Act/ Isotope (uci/ml)	%MPC
								Total % MPC =			

Gross Act Sample (uci/ml) = $\frac{\text{Gross (cpm) - Bkg (cpm)}}{\text{Det. Eff.}} \times \frac{\text{uci}}{\text{2.22x106dpm}}$ / **Sample Volume (mls)**

#18A

Activity Per Isotope = Gross Act (uci/ml) X % Abundance

% MPC = $\frac{\text{Act/Isotope}}{\text{MPC for Det Isotope}} \times 100$

Total % MPC = % MPC Isotope A + % MPC Isotope B + etc.

ETI Ashford Service Center

Environment and Effluent Monitoring Report

Monthly From **4/1/04** To **4/30/04**

#18C

Nuclide	Total Activity uCi	Average Consentration	Percent
CO-60	1.2544E+03	2.27E-07	0.76%
CS-137	5.4766E+03	9.93E-07	9.93%
MN-54	2.5363E+03	4.60E-07	0.15%
CE-144	1.8008E+02	3.27E-08	0.11%
CO-58	3.9666E+03	7.19E-07	0.36%
ZN-65	0.0000E+00	0.00E+00	0.00%
ZR-95	0.0000E+00	0.00E+00	0.00%
CS-134	0.0000E+00	0.00E+00	0.00%
AG-110	0.0000E+00	0.00E+00	0.00%
SB-125	0.0000E+00	0.00E+00	0.00%
SB-124	0.0000E+00	0.00E+00	0.00%
SN-113	0.0000E+00	0.00E+00	0.00%
FE-59	0.0000E+00	0.00E+00	0.00%
CR-51	0.0000E+00	0.00E+00	0.00%
CO-57	2.2750E+01	4.13E-09	0.00%
NB-95	0.0000E+00	0.00E+00	0.00%
CE-141	2.7017E+01	4.90E-09	0.00%
U-234	0.0000E+00	0.00E+00	0.00%
U-235	0.0000E+00	0.00E+00	0.00%
U-238	0.0000E+00	0.00E+00	0.00%
TH-234	0.0000E+00	0.00E+00	0.00%
		Total Percent MPC	11.31%

Total Activity Released (uCi): 1.35E+04

Total Waste Water Discharged (gallons): 1456960

Average Gross Beta Minus Consentration (uCi/mL) 1.26E-06

Average Gross Alpha Consentration (uCi/mL): 0.00E+00

#13 & 22

EASTERN TECHNOLOGIES, INC.

RADIAITON PROTECTION PROGRAM

APPROVED BY: Mark Fellows

MARK FELLOWS
VICE PRESIDENT

I. INTRODUCTION

A. PURPOSE

The purpose of this Radiation Protection Program-PA manual is to describe Eastern Technologies, Inc.'s method of compliance with applicable regulations, licenses, industry standards and company policy.

ETI's Radiation Protection Program-PA is implemented in detail by and through this manual and other specific procedures.

B. REFERNECES

1. 10 CFR 20, Standards for Protection Against Radiation.

2. 10 CFR 19, Notices, Instructions, and Reports to Workers; Inspection.

3. Regulatory Guide 8.8, Information Relevant to Ensuring that Occupational Exposures at Nuclear Power Stations Will Be as Low as is Reasonably Achievable.

4. Regulatory Guide 8.10, Operating Philosophy for Maintaining Occupational Radiation Exposures As Low as is Reasonably Achievable.

5. NUREG-0041, Manual of Respiratory Protection Against Airborne Radioactive Materials.

6. Regulatory Guide 8.13, Prenatal Exposure.

7. Regulatory Guide 8.15, Acceptable Programs for Respiratory Protection.

C. RESPONSIBILITES

The success of the Radiation Protection Program-PA depends largely on the training, self-discipline and cooperation of each individual. Each individual must commit himself to protection policies by obeying applicable provisions of NRC regulations, procedures and practices, and recognizing and reporting any condition, which may lead to unnecessary exposure to radiation or radioactive material or cause a violation of regulations and/or licenses.

II. RADIATION PROTECTION STANDARDS

A. GENERAL

1. Scope

This section prescribes the maximum permissible exposure to external and internal radiation as set forth in reference 1 and company limits. The exposure limits and regulations prescribed in this manual shall be applicable to all persons employed by Eastern Technologies, Inc.

2. Responsibilities

a. Individuals

1. Take reasonable precaution to avoid unnecessary exposure and minimize those exposures that are considered necessary.

2. Report to Supervision, as soon as possible, known or suspected high exposures due to external radiation or internal contamination.

3. Report promptly to Supervision all injuries that involve radioactive contamination.

4. Report to supervisor any sickness or physical condition which might alter ones capability for work in a radiation area or RCA.

5. Report to ETI management any new or unusual situation, which could lead to unnecessary exposure.

6. Understand their 'rights' as defined in 10 CFR 19 "Notices, Instruction, and Reports to Workers; Inspections" and/or other applicable sections of 10 CFR.

7. Know and follow the requirements of Radiation Work Permits.

8. Report to Supervision any known or anticipated radiation exposure including medical exposure (external or internal) prior to each days work.

b. Supervisor Personnel

1. Ensure that employees are informed of radiation hazards in their work area and frequently check with employees to ensure that radiation protection measures are being utilized.

2. Take all reasonable steps in planning each job to avoid unnecessary exposure of employees.

3. Limit the accumulation of high individual exposures by distributing workloads and assigned duties.

4. Be alert for new or unusual situations, which might lead to unnecessary exposure.

c. Management

1. Establish and apply radiation protection standards and practices for maintaining occupational radiation exposures A.L.A.R.A.

2. Inform the Vice President of Eastern Technologies, Inc. of the current radiation exposure status of each employee via periodic reports.

3. Collect data and prepare reports on radiation incidents such as high exposures, inadvertent releases and spills.

B. EXPOSURE LIMITS FOR PERSONNEL

1. Definitions

a. Intake

Amount of radioactive material that the individual is exposed to via airborne activity.

b. Uptake

Amount of radioactive material that actually enters the body's transfer compartment (e.g.: blood).

c. Deep Dose Equivalent (DDE)

Applies to external whole body exposure. It is the dose equivalent at a tissue depth of 1 cm. (1,000 mg/cm^2)

d. Shallow Dose Equivalent (SDE)

Applies to the external exposure to the skin or any extremity and is taken as the dose equivalent at a tissue depth of 0.007 centimeter (7 mg/cm^2) averaged over an area of one square centimeter.

e. Lens Dose Equivalent (LDE)

The external exposure to the lens of they eye that is taken as the dose equivalent at a tissue depth of 0.3 centimeters (300 mg/cm^2)

f. Committed Dose Equivalent (CDE)

The dose equivalent, to organs or tissues of reference (Gonads, Breast, Red Bone Marrow, Lung Thyroid, Bone Surfaces, others), that will be received from an intake of radioactive material by an individual during the 50-year period following the intake.

g. Committed Effective Dose Equivalent (CEDE)

The sum of the products of the weighting factors applicable to each of the body organs that are irradiated and the committed dose equivalent to these organs or tissues.

h. Total Organ Dose Equivalent (TODE)

The sum of the deep dose equivalent (external) and the committed dose equivalent (internal) to the maximally exposed organ other than the eye.

i. Total Effective Dose Equivalent (TEDE)

The sum of the deep dose equivalent (for external exposures) and the committed effective dose equivalent (for internal exposures).

2. Exposure Limits

a. Annual Exposure

TEDE	5 rem/yr
TODE	50 rem/yr
Lens of the Eye	15 rem/yr
Skin/Extremities	50 rem/yr
Embryo/Fetus	0.5 rem/yr
Public	0.1 rem/yr

b. Planned Special Exposure

Subject to 10 CFR 20.1206 no planned special exposure shall be authorized that would cause an individual to receive a dose from all planned special exposures and all doses in excess of the limit to exceed:

1. The numerical values of any of the dose limits in 10 CFR 20.1201.

2. Five times the annual dose limits in 10 CFR 20.1201 during the individuals' lifetime.

3. Internal Exposure

a. The staff will, as a precautionary procedure, use process or other engineering controls, to the extent practicable, to limit concentrations of radioactive materials in air below the limits defined in 10 CFR 20 Appendix B, Table I, Column 3. When it is impracticable to apply process or other engineering controls to limit concentrations of radioactive materials in air to less than 10% of the limits, other precautionary measures, such as increased surveillance, reduction in working times, or use of respiratory protective equipment will be considered to minimize the intake of

radioactive materials by any individual.

b. No individual under 18 years of age shall be exposed to airborne radioactive materials in an average concentration in excess of 10% of the limits specified in 10 CFR 20 Appendix B, Table I, Column 3.

C. ACCUMULATION OF RADIATION EXPOSURE

1. Medical Exposure

Significant exposure to ionizing radiation for medical reasons should be reported. Therefore, each employee is required to notify Supervision of therapeutic radiation treatment or diagnostic radiation (excluding annual chest x-rays and routine dental x-rays). Supervision will determine if the medical exposure will affect the status of any individual.

2. Radiation Exposure at Various Locations

An individual working for ETI, who visits other nuclear facilities where he may be exposed to radiation, shall notify Supervision prior to departure and as soon as possible upon return. An up to date estimate of the exposure received at the facility must be given to ETI supervision before resuming work at ETI facility.

3. Other Non-Employment Related Exposure

An individual shall not cause himself to be exposed off the job site to ionizing radiation for other than medical reasons. When not on the job, exposure (including accidental exposure) received off the job shall be reported to Supervision as soon as is practical or upon return to work whichever is earliest.

D. DOSIMETRY RECORDS

Personnel who have a signed, current statement of occupational dose may receive up to 5 REM for the current year; this includes any occupational dose for the current year prior to working for ETI. Dosimetry will be issued to an individual after he has provided a signed statement of his occupational dose for the current year.

III. PERSONNEL MONITORING

A. GENERAL INFORMATION

1. Scope

This section describes required personal monitoring devices (PMD's), urinalysis sampling and whole body counts.

2. Responsibility

a. It is the responsibility of each radiation worker to wear personal monitoring devices (PMD's) in the prescribed manner and to assure their safekeeping. The loss, damage or contamination of any PMD requires the immediate notification of Supervision.

b. ETI Supervision will administer the personal monitoring program consistent with the requirements of 10 CFR 20.

B. DOSIMETRY

1. Issuance

a. Thermo Luminescent Dosimeters (TLD's)

Individuals requiring long term and/or continuous access to the radiation-controlled area (RCA) shall be monitored for radiation exposure via thermo luminescent dosimeters (TLD's). Prior to issuance and at termination of permanent TLD, urinalysis, gross activity analysis, or a whole body count must be performed on the individual in question, unless otherwise authorized by ETI supervision.

Notes:

1. Documented whole body counts from other facilities may be utilized in lieu of this requirement.

2. Visitors are exempt fro bioassay testing requirements unless otherwise required by ETI supervision.

3. Issuance of TLD's to visitors is not required unless otherwise specified by ETI supervision.

b. Self Reading Dosimeters (SRD's)

Individuals requiring access to the RCA must at a minimum be issued a Self Reading Dosimeter in addition to any other monitoring device required.

Note: The dose limit for visitors utilizing an SRD for entry is $\leq$ 30 mr for the entire visit. Additionally no High Radiation and/or Airborne Activity Areas may be entered.

c. Special Purpose Dosimeters

Special purpose dosimeters (e.g.: extremity badges, multibadge packs, etc.) will be issued as required by associated radiological conditions and ETI supervision.

2. Processing

a. Thermo Luminescent Dosimeters

<u>Permanent Issue:</u> Permanently issued TLD's will be exchanged/processed quarterly.

<u>Temporary Issue:</u> Temporarily issued TLD's will be processed as needed to verify exposure.

b. Self Reading Dosimeters

Self-reading dosimeters will be processed (read) for documentation purposes, upon each exit of the RCA or upon the individuals transfer to another RWP, whichever occurs first.

c. Special Purpose Dosimeters

Special purpose dosimeters will be processed as needed to verify exposure.

3. PMD Placement

PMD's, except extremity dosimeters, (i.e. finger rings, etc.), shall be worn on the front of the body at or above the waist and below the shoulders except as designated by the HP supervisor or the Radiation Safety Officer for specific instances.

The PMD should be worn in a plainly visible manner unless there is a significant possibility of loss or contamination. For harsh working conditions PMD's may be worn inside the coveralls or inside any suitable protective covering as determined appropriate by the HP supervisor or the Radiation Safety Officer. In such cases, utilization of a skin dose correction factor may be required.

C. BIOASSAY

1. Whole Body Gross Activity Analysis

Whole Body Gross Activity Analysis will be the primary method for establishing concentrations of internally deposited radionuclides. Analysis is required prior to issuance, annually, and upon termination of permanent dosimetry (TLD), unless otherwise authorized by the Radiation Safety Officer. After initial analysis subsequent testing will be preformed annually or radiation workers with permanently issued dosimetry. Special case testing may be required by supervision when deemed appropriate.

Notes:

1. Visitors are exempt form bioassay testing.

2. Urinalysis may be utilized in lieu of whole body gross activity analysis.

3. Documented whole body counts performed by ETI or other facilities may be utilized in lieu of whole body gross activity analysis or urinalysis.

2. Urinalysis

Urinalysis testing, via gamma spectroscopy, will be the secondary method of establishing concentrations of internally deposited radionuclides. Sample collection is required prior to issuance and upon termination of permanent dosimetry (TLD), unless otherwise authorized by the Radiation Safety Officer. After initial urinalysis, subsequent testing will be performed annually on radiation workers with permanently issued dosimetry. Special case testing may be required by supervision when deemed appropriate.

Notes:

1. Visitors are exempt form urinalysis testing.

2. Documented whole body gross activity analysis may be utilized in lieu of urinalysis testing.

3. Whole Body Counting

Whole body counting will be the follow up method of establishing concentrations of internally deposited radionuclides. Whole body counts will be preformed, as required; to verify and quantify findings of internally deposited radionuclides discovered through whole body gross activity analysis or urinalysis. Whole body counts will also be performed as per RSO or management requirements.

Notes:

1. Whole body counts may be used in lieu of whole body gross activity analysis or urinalysis testing.

2. Documented whole body counts performed by ETI or other nuclear facilities may be utilized to fulfill whole body counting requirements.

4. Other Analysis

Analysis of body excreta (e.g. fecal analysis) or tissue (biopsy) may be performed as deemed necessary by the Radiation Safety Officer or medical consultant.

D. MEDICAL EXAMINATIONS

1. Required

Individuals whose job functions will require them to use respiratory protection equipment require an initial and annual lung function test.

2. Optional

The following medical examinations may be required by the RSO, Supervisor or medical consultants.

a. Complete or partial physical for persons involved in incidents where regulatory limits may have been exceeded.

b. Special testing such as blood count may be required for individuals whose exposure exceeds regulatory limits.

IV. RADIATION EXPOSURE CONTROL

A. GENERAL INFORMATION

1. Scope

This section covers procedures, practices and measures, which apply to the Radiation Controlled Area (RCA).

2. Responsibilities

a. It is each individual radiation worker's responsibility to obey all Radiation Work Permits and to report to his respective work supervisor any circumstances where there is doubt as to the radiological safety of an operation.

b. It is the work supervisor's responsibility to assign personnel and plant work in such a manner that personnel exposure is kept ALARA.

c. It is the Radiation Safety Officer's and/or HP supervisor's responsibility to designate areas according to radiological

hazards present and prescribe precautionary measures to be taken when working in these areas.

3. Special Instructions

a. No eating, drinking, smoking or chewing is permitted inside the RCA unless the Radiation Safety Officer allows such behavior on a case-by-case basis.

b. There shall be no unprotected wounds present on the body. Serious wounds shall be sealed with a suitable bandage prior to entry. HP supervision shall determine on a case-by-case basis what work restrictions, if any, shall apply to individuals having wounds. Depending upon wound severity, work restrictions may include exclusion from the RCA.

B. RCA POSTING CLASSIFICATIONS

Each area within the Radiation Controlled Area shall be surveyed and conspicuously posted with appropriate caution signs as required by the following criteria:

1. Radiation Area

An area, accessible to individuals, in which radiation levels could result in an individual receiving a dose equivalent in excess of 0.005 rem (5 millirem) (0.05 msv) in one hour at 30 centimeters from the radiation source or from the surface that the radiation penetrates.

2. High Radiation Area

An area, accessible to individuals, in which radiation levels could result in an individual receiving a dose equivalent in excess of 0.1 rem (100 millirem) (1 msv) in one hour at 30 centimeters from the radiation source or from any surface that the radiation penetrates.

3. Airborne Radioactivity Area

A room, enclosure or area in which airborne radioactive materials,

composed wholly or partly of licensed material, exist in concentrations:

a. In excess of the derived air concentrations (DACs) specified in Appendix B, to 10 CFR 20.1001-20.2401 or,

b. To such a degree that an individual present in the area without respiratory protective equipment could exceed, during the hours the individual is present in a week, an intake of 0.6 percent of the annual limit of intake (ALI) or 12 DAC-hours.

4. Radioactive Materials Area

Any area or room which there is used or stored an amount of licensed or registered radioactive material exceeding 10 times the quantity of such material specified in Appendix C of 10 CFR 20.

5. Contaminated Area

Any area or room, which contains significant removable surface radioactive contamination. (e.g.: > 1,000 dpm/100 cm^2 Beta/Gamma or > 150 dpm/100 cm^2 alpha).

6. Radiological Restricted Area

Any area posted for the purpose of controlling or restricting access to that area for radiation protection purposes. These areas will normally be areas of inaccessibility (e.g.: ventilation filter housings, etc.) and will not require a survey except during special entry.

C. RADITION WORK PERMIT

1. General Information

The Radiation Work Permit (RWP) is the primary administrative control for insuring that surveys are performed and that adequate safeguards have been established to govern work in areas where significant radiation hazards may exist. Any entry into an RCA must be governed by at least one RWP. Each person entering the RCA shall assure himself that he knows the RWP requirements for

the job. Persons working intermittently in a particular area or on a particular job will ensure that RWP requirements are known and have not changed prior to re-entry. All personnel shall frisk themselves at the nearest frisking station after crossing a step off pad. Personnel working under the authority of an RWP shall not deviate from the requirements of the RWP unless from the requirements of the RWP unless specifically authorized by ETI supervision.

2. RWP Types and Related Requirements

a. Special Radiation Work Permit (SRWP)

An SRWP is a RWP issued for a specific task or related series of tasks. A SRWP is require for:

1. Entry into areas posted SPECIAL RADIATION WORK PERMIT REQUIRED.

2. Job assignments where whole body exposure to any individual is likely to exceed one hundred (100) mrem/day.

3. Job assignments (i.e.: grinding, cutting, etc.) involving activities that have the potential for significantly increasing radiation or contamination

4. Entry into Posted High Radiation Areas.

Note: Special RWP's are initiated by the work supervisor. The HP Supervisor or RSO then completes the appropriate portions and then approves the work. The Special RWP is considered terminated when covered tasks are completed or cancelled or the radiological conditions change unexpectedly.

b. Routine Radiation Work Permit (RWP)

Routine RWP's are for those areas in which radiological hazards are stable and/or predictable and routine entries are necessary for operation of the facility. A routine RWP is required for:

1. Entry into any RCA.

2. Job assignments involving activities within any area of the RCA.

   Note: In special cases the presence of supervisory personnel may be substituted for an RWP with the approval of HP Supervisor or RSO.

D. RESPIRATORY PROTECTION

1. General Information

The primary objective of the respiratory protection program is to minimize or eliminate the inhalation of radioactive material. This will be accomplished through the application of engineering controls such as contaminant and ventilation equipment in addition to pre-planning of work. However, if it is necessary that some work function be performed in confined or localized areas where the levels of airborne radioactive material warrant protection and other controls are not feasible, respiratory protection devices may be used to provide necessary protection as per 10 CFR 20, so long as the use of respiratory protection is ALARA.

Note: For the purpose of Radiological Protection, nuisance dust masks are not considered to be respiratory protection devices.

2. Responsibility

ETI Supervision is responsible for administering the respiratory protection program inside RCA's. This includes issue, cleaning, decontamination, inspection, maintenance, sanitizing, repairs, and storage of respiratory protection equipment. Additional responsibilities include required training of personnel and performance of pulmonary function tests as required by procedure.

3. General Guidelines

Respiratory protection devices will be provided to protect personnel from airborne radioactivity in accordance with 10 CFR 20. Respirators may be utilized provided they do not increase exposure (e.g.: respirator use must be ALARA) cause significant discomfort, create a safety hazard or unduly restrict an individual in the performance of his work. These requirements will be evaluated and modified as the radiological work conditions dictate. Personnel who are required to wear respirators must be clean-shaven in the area where the mask seals with the face. Facial conditions must remain the same as when the individual was fitted and qualified and the individual must have been certified able to wear a respirator via a lung function test.

4. Notification of Required Use

The requirement for respiratory protection devices will be specified on the applicable RWP.

5. Post Use Analysis

To check the effectiveness of respiratory protection devices used for protection against airborne radioactivity, nasal smears shall be taken and analyzed after each respirator use.

E. RADIATION INCIDENT REPORT

Violations of ETI Radiation Control and Protection Procedures, potential or actual over-exposures or actions which involve potential or actual unnecessary radiation exposure are documented by a Radiation Incident Report (RIR).

The RIR will be used as a means of documenting identified problems and the resulting corrective action(s).

V. RADIOACTIVE MATERIAL CONTROL WITHIN THE RCA

A. TOOLS

Any tools or material brought into the radiation controlled area (RCA) shall be considered contaminated and shall not be removed from the RCA

unless surveyed ad released by appropriate personnel. Tools not meeting fixed activity release criteria or tools that contain smearable contamination shall be held for decontamination and/or restricted for use only within the RCA.

If it becomes necessary to utilize un-contaminated tools within a contaminated area the tools should be protected, if possible or practical, to reduce the change of contamination the tool. After the use, the tools shall be wiped down and/or cleaned so as to remove any contamination deposited on the tool during use. If decontamination efforts are not successful and fixed contamination remains above levels allowed by release criteria, then the tool shall be restricted for use only within the RCA. Restricted use tools should be stored in areas designated by supervision. As a precaution, tools having a fixed radiation level ≥ 2.5 mr/hr shall be conspicuously marked, prior to initial placement into restricted use inventory, to allow for easy identification.

If, due to special circumstances, it becomes necessary to utilize tools containing smearable contamination in an uncontaminated area of the RCA these tools shall be contained within a bag or other protective covering, except when in use. Additionally, permission for such activity must be granted by appropriate supervision prior to movement of any contaminated tool or material into an un-contaminated area. Immediately upon completion of the task, the tools will be returned to the protective enclosure and transported to the appropriate storage area. The work area must also be surveyed for contamination and if appropriate, decontaminated before the area is released for general entry.

B. COMPONENTS

Components are considered, valves, fittings, parts, special tools, equipment, etc., that are contaminated. It does not include waste, mops, or other related items.

Components removed from a contaminated system or area shall be surveyed for radiation and contamination levels and labeled appropriately. Decontamination of the item will be undertaken if appropriate, possible and/or practical. HP supervision will ensure that the item is properly packaged, if required, and tagged. HP will also ensure that the tag contains the required information. After processing and tagging, the item shall be stored as per supervisory directives.

C. PROTECTIVE CLOTHING

For work inside the permanent RCA, protective clothing requirements will be listed on the governing RWP. Protective clothing will be stored in an area designated for that purpose. Protective clothing will not be removed from the permanent RCA without the approval of HP, RSO or other appropriate supervision. Should protective clothing be required for work inside of a temporary RCA it shall remain within the confines of that RCA until returned to the permanent RCA. Protective clothing may not be worn outside an RCA unless permission is granted on a case-by-case basis by HP, RSO or other appropriate supervision.

VI. RCA EMERGENCIES

A. INJURIES

1. Minor Injury

In cases of minor injury, personnel will leave the work area immediately and have appropriate supervisory personnel check the wound for contamination. If contamination is found, decontamination will be attempted by appropriate personnel as first aid is administered. Bioassay samples may be required to check for possible uptake of radioactive contamination at the discretion of ETI supervision. As soon as practical notify the Plant Manager, Assistant Plant Manager, HP Supervisor and the RSO.

2. Major Illness or Injury

In case of major illness or injury the following guideline should be followed:

a. The individual who discovers the affected person will render any first-aid for which he is qualified and notify Supervision.

b. As soon as practical notify the Plant Manager, Assistant Plant Manager, HP Supervisor and the RSO.

c. First-aid personnel will determine the extent of the injury or illness and perform emergency first-aid.

d. Protective clothing will be removed and if required, decontamination will be performed, if possible, without aggravating the patient's condition. LIFE SAVING MEDICAL ATTENTION HAS TOP PRIORITY.

e. The patient will be transported to the hospital as per received instructions if appropriate.

B. FIRE AND MAJOR EMERGENCY

The following actions should be taken for fires located in

1. Minor Fires

a. Instructions to Workers

- Immediately attempt to put out the fire by approved methods (i.e.: fire extinguisher) if other fire hazards or radiation hazards are not present. If the fire is in or related to a system, equipment or component turn off if possible.

- Notify all persons present to vacate the area and have one individual immediately call the fire department and RSO, Plant Manager, Assistant Plant Manager and HP Supervisor.

- Once the fire is out, isolate the area to prevent the spread of possible contamination.

- Survey all persons involved in combating the fire for possible contamination.

- Decontaminate personnel by removing contaminated clothing and flushing contaminated skin with lukewarm water, then washing with a mild soap.

- In consultation with the RSO and/or HP Supervisor, determine a plan of decontamination and the types of protective devices and survey equipment that will

be necessary to decontaminate the area.

- Allow no one to return to work in the area unless approved by the RSO or HP Supervisor.
- Cooperate with RSO/RSO Staff (e.g.: investigation of root cause, provision of requested bioassay samples).
- Follow the instructions of the RSO/RSO Staff (e.g.: decontamination techniques, surveys, provision of bioassay samples, requested documentation).

b. Reminders to RSO and HP Supervisor

- Supervise decontamination activities.
- If decontamination of personnel was not fully successful, consider inducing perspiration by covering the area with plastic. Then wash the affected area again to remove any contamination that was released by the perspiration.
- Consult with fire safety officials to assure that there are no other possibilities of another fire starting.
- Determine cause and needed corrective actions; consider need for bioassays if licensed material may have been ingested, inhales, and/or absorbed through the skin. Document incident.
- If necessary, notify the NRC.

2. Fires, Explosions, or Major Emergencies

a. Instruction to Workers

- Notify all persons in the area to leave immediately.
- Notify the Fire Department.

- Notify the RSO, Plant Manager, Assistant Plant Manager, HP Supervisor and other safety personnel.

- Upon arrival of firefighters, inform them where radioactive materials are stored or where radioisotopes were being used; inform them of the present location of the licensed material and the best possible entrance route to the radiation area, as well as any precautions to avoid exposure or risk of creating radioactive contamination by use of high pressure water, etc.

- Cooperate with RSO/RSO Staff (e.g.: investigation of root cause, provision of requested bioassay samples).

- Allow no one to return to work in the area unless approved by the RSO.

- Follow the instructions of the RSO/RSO Staff (e.g.: decontamination techniques, surveys, provision of bioassay samples, requested documentation).

b. Reminders to RSO and HP Supervisor

- Coordinate activities with facility's safety committee and with local fire department.

- Consult with the firefighting personnel and set up a controlled area where the firefighters can be surveyed for contamination of their protective clothing and equipment after the fire is extinguished.

- Once the fire is extinguished, do not allow the firefighters to enter the radiation area until a thorough evaluation and survey are performed to determine the extent of the damage to the licensed material use and storage areas.

- Perform thorough contamination surveys of the firefighters and their equipment before they leave the controlled area and decontaminate, if necessary.
- Supervise decontamination activities.
- Consider bioassays if licensed material may have been ingested, inhaled, and/or absorbed through the skin. Document incident.
- If necessary, notify NRC.

C. UNSUSPECTED HIGH RADIATION LEVELS

If unusual or unsuspected high radiation levels are detected in work areas, occupied by personnel, the following procedure should be followed:

1. Clear the area.
2. Notify Plant Manager, Assistant Plant Manager, HP Supervisor and the RSO immediately.
3. Check dosimeter readings of all personnel involved.
4. Survey the area and evaluate the hazard.
5. Place barricades and radiation caution signs as required.
6. Determine cause of high radiation.
7. Determine mitigating actions required
8. Implement mitigating actions.
9. Repost area with regard to current conditions.

Note: Action #1 and #2 may be performed by any individual involved in the incident. Other actions should be performed and/or directed by appropriate supervisory personnel.

D. RADIOACTIVE MATEIRAL SPILLS

1. Minor Spills of Liquids and Solids

Note: Minor spills are defined as spills involving minor radiation hazards to personnel.

a. Instructions to Workers

- Notify persons in the area that a spill has occurred.
- Prevent the spread of contamination by covering the spill with an absorbent. (Absorbent should be dampened if solids are spilled)
- Clean up the spill, wearing gloves and using absorbent.
- Carefully place spilled material and absorbent in a plastic bag for transfer to a radioactive waste container. Place disposable items and other contaminated material in the bag. Launderable protective clothing should be placed in an appropriate receptacle.
- Survey the area with an appropriate low-range radiation detector survey meter or other appropriate technique. Check the area around the spill for contamination. Also check hands, clothing, and shoes for contamination.
- Report the incident to one or more of the following: Plant Manager, Assistant Plant Manager, Facility Foreman, HP Supervisor, HP Technician, or RSO.
- Allow no one to return to work in the area unless approved by the HP Supervisor, HP Technician or RSO.

- Cooperate with HP Supervisor and/or RSO/RSO Staff (e.g.: investigation of root cause, provision of requested bioassay samples).

- Follow the instruction of the RSO/RSO Staff (e.g.: decontamination techniques, surveys, provision of bioassay samples, requested documentation).

b. Reminders to RSO and HP Supervisor

- Follow up on the decontamination activities and document the results.

- As appropriate, determine cause and corrective actions needed; consider bioassays if licensed material may have been ingested, inhaled, and/or absorbed through the skin.

- If necessary, notify NRC.

2. Major Spills of Liquids and Solids

Note: Major spills are defined as spills involving major radiation hazard to personnel.

a. Instruction to Workers

- Clear the area. If appropriate, survey all persons not involved in the spill and vacate the room.

- Prevent the spread of contamination by covering the spill with an absorbent. (Absorbent should be dampened if solids are spilled), but do not attempt to clean it up. To prevent the spread of contamination, limit the movement of all personnel who may be contaminated.

- Shield the source only if it can be done without further contamination or significant increase in radiation exposure.

- Close the room and lock or otherwise secure the area to prevent entry. Post the room with a sign to warn anyone trying to enter that a spill of radioactive material has occurred.

- Notify the RSO, HP Supervisor, Plant Manager and Assistant Plant Manager immediately.

- Survey all personnel who could possibly have been contaminated. Decontaminate personnel by removing contaminated clothing and flushing contaminated skin with lukewarm water and then washing with a mild soap.

- Allow no one to return to work in the area unless approved by the RSO or HP Supervisor.

- Cooperate with RSO/RSO Staff (e.g.: decontamination techniques, surveys, provision of bioassay samples, requested documentation).

b. Reminder to RSO and HP Supervisor

- Confirm decontamination of personnel. If decontamination of personnel was not fully successful, consider inducing perspiration by covering the area with plastic. Then wash the affected area again to remove any contamination that was released by the perspiration.

- Supervise decontamination activities and document the results. Documentation should include location of surveys and decontamination results.

- Determine cause and needed corrective actions; consider need for bioassays if licensed material may have been ingested, inhaled, and/or absorbed through the skin.

- If necessary, notify NRC.

VII. CORPORATE ALARA PROGRAM

A. PHILOSOPHY AND COMMITMENT

The intent of this chapter is to define a corporate management philosophy for maintaining occupational exposure "As Low As Reasonable Achievable" (ALARA).

It is ETI's intention to ensure that all activities be conducted in a manner such that occupational exposure will be kept ALARA.

If it can be shown in a reasonable fashion that the radiation exposure is "truly unavoidable" or the "cost" of reducing radiation exposure is unreasonable in comparison with the commensurate benefits, then it is by definition ALARA. Maintaining occupational radiation exposure ALARA is a management commitment and designated individuals within the company will be charged with the responsibility of implementing it. To be achieved successfully, ALARA must be practiced by employees, contractors and visitors. To fulfill the commitment, a basic management ALARA program will be defined and implemented. This program will recognize that future design; modifications and operating experience are interrelated. Equivalent designs, when applicable, will be reviewed against radiation exposure information to determine potential impact.

B. OBJECTIVES

The objectives of corporate management's program of keeping occupational doses ALARA are:

1. To maintain the annual dose (REM) to individual personnel ALARA.

2. To maintain the annual integrated dose (man-rem) to all personnel at the plant ALARA.

C. GUIDELINES

When evaluating proposed ALARA radiation exposure reduction measures, a cost of $6,000.00 for each 1 man-rem/year of occupational radiation exposure reduction will be considered cost effective. A higher cost per man-rem/year may be justified in specific cases.

D. RESPONSIBILITY

1. Management

The ALARA program will be implemented under the direction of the Vice President or his designee. Responsibilities include program development, implementation and management.

2. Supervision

Responsibilities include:

a. Ensuring all personnel in their group comply with the ALARA Program guidelines.

b. Ensuring suitable advanced planning, management notification and special training and performed prior to jobs involving radiation exposure.

c. Identify to the Radiation Safety Officer work activities, which have the potential for resulting in 5 man-rem or greater of exposure or activities, which the Supervisor believes merits an ALARA review.

3. All personnel

All ETI personnel are responsible for identifying radiation exposure problems and corrective measures, which may be taken to reduce radiation exposure.

VIII. ANNUAL RP PROGRAM REVIEW

The ETI Radiation Protection Program shall be reviewed at least annually. The review should evaluate the content and implementation of the program to ensure compliance with applicable regulations and terms of conditions of the facility radioactive material license. The review should also assess occupational doses and doses to members of the public to ensure they are ALARA.

The annual review may be conducted by ETI staff or by consultants. Individuals conducting the review should be knowledgeable of applied radiation protection practices and applicable regulations. Results of the review shall be documented. The documentation should include the date of the review, names(s) of the

person(s) conducting the review, persons contacted by the reviewer, areas reviewed, review findings, corrective actions and follow-up.

If, during the course of the review, violations of regulatory requirements or license conditions are identified, the safety significance of each violation should be evaluated to set priorities and determine resources necessary to correct the violations. The violations should also be evaluated for required notification of and/or reporting to applicable regulatory agencies.

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EASTERN TECHNOLOGIES, INC.
EMERGENCY ACTION GUIDE
FOR
TRANSPORTATION OF RADIOACTIVE MATEIRALS

I. MANAGEMENT ACTIONS
II. CARRIER ACTIONS

APPROVED BY: Mark Fellows
Mark Fellows
Vice President

I. MANAGEMENT ACTIONS

Upon notification that an accident has occurred involving shipment of radioactive materials owned or transported by ETI the following management actions should be taken:

A. Determination

1. Determine if the accident requires reportability. (See Attached Copy of 49 CFR 171.15 & 171.16)

2. Determine if a container holding radioactive material has been breached.

B. Notification

The following agencies and individuals should be notified immediately.

1. The ETI Emergency Response Committee (President, Vice President, Plant Manager, Assistant Plant Manager, HP Supervisor, RSO, RSO Staff)

2. Proper State agency in which the accident occurred.

3. Department of Transportation. (Per 49 CFR 171.15)

4. Particular facility to which the material belongs.

5. Pennsylvania Division of the NRC.

C. Response

The proper management personnel (e.g.: President, Vice President, Plant Manager, Assistant Plant Manager, HP Supervisor, RSO, RSO Staff) must immediately take the following actions.

Note: These actions apply in circumstances in which a container holding radioactive material has been breached or appropriate authorities required assistance in determining current site radioactive conditions.

1. Gather appropriate equipment (e.g.: monitoring devices, postings, barriers, boundaries, protective apparel, smears, personal monitoring devices, etc.).

2. Transport or arrange for transport of the appropriate equipment and personnel to the accident site.

3. Travel to accident site as soon as possible.

4. Once on site, determine and implement definitive protection and mitigation measures in accordance with applicable guidelines and regulations.

5. Cooperate at all times with appropriate authorities.

II. CARRIER ACTIONS

The following type specific emergency instructions should be followed by the driver or drivers of the vehicle involved in an accident:

III. EMERGENCY INSTRUCTIONS

A. Radioactive Material, Low Specific Activity, N.O.S., 7, US2912

1. Potential Hazards

   a. Health Hazards

      Fire may produce irritating or poisonous gases. Radioactive material; degree of hazard will vary from little to moderate, depending on type and quantity of radioactive material. Runoff from fire control or dilution water may cause pollution.

   b. Fire or Explosion

      Some of these materials may burn, but none of them ignites readily.

2. Emergency Actions

a. General

Keep unnecessary people at least 150 feet upwind of spill. Isolate hazard area and deny entry. Limit entry to shortest possible time. Self-contained breathing apparatus (SCBA) and structural firefighter's protective clothing will provide limited protection. Delay clean up until arrival or instruction of qualified Radiation Authority. CALL CHEMTREC AT 1-800-424-9300 FOR EMERGENCY ASSISTANCE. If water pollution occurs, notify the appropriate authorities.

b. Fire

Do not move damaged containers; move undamaged containers out of fire zone. Small fires: Dry chemical, CO2, Halon, water spray or standard foam. Large fires: Water spray, fog or standard foam is recommended.

c. Spill or Leak

Do not tough damaged containers or spilled material. Large spills: Dike far ahead of liquid spill for later disposal. Cover powder spill with plastic sheet or tarp to minimize spreading.

d. First Aid

Use first aid treatment according to the nature of the injury. If not affecting injury, remove and isolate contaminated clothing and shoes; wrap victim in blanket before transporting. If not injured, remove and isolate contaminated clothing and shoes; shower victim with soap and water. Advise medical personnel that injured persons may be contaminated with radioactive material.

B. Radioactive Material, N.O.S., 7, US2982

1. Potential Hazards

a. Health Hazards

External radiation from unshielded radioactive material. Internal radiation from inhalation, ingestion, or skin absorption. Radioactive material; degree of hazard will very greatly, depending on type any quantity of radioactive material. Runoff from control or dilution water may cause pollution.

b. Fire or Explosion

Some of these materials may burn, but none of them ignites readily.

2. Emergency Action

a. General

Keep unnecessary people at least 150 feet upwind; greater distances may be necessary if advised by qualified Radiation Authority. Isolate hazard area and deny entry. Enter spill area only to save life; limit entry to shortest possible time. Self Contained Breathing Apparatus (SCBA) and structural firefighter's protective clothing will provide limited protection for short-term exposure to these materials. Detain uninjured persons and equipment exposed to radioactive material until arrival or instruction of qualified Radiation Authority. Delay clean up until arrival on instruction of qualified Radiation Authority. CALL CHEMTREC AT: 1-800-424-9300 FOR EMERGENCY ASSISTANCE. If water pollution occurs, notify the appropriate authorities.

b. Fire

Do not move damaged containers; move undamaged containers out of fire zone. Small fires: Dry chemical; CO2, Hallon, water spray or standard foam. Large fires: water spray, fog (flooding amounts). For massive fire in cargo area, use unmanned hose holder or monitor nozzles. Fight fire from maximum distance. Stay away from ends of tanks.

c. Spill or Leak

Do not touch damaged tanks or spilled material. Damage to outer container may not affect primary inner container. Small liquid spills: Take up with sand, earth or other noncombustible absorbent material. Large spills: Dike far ahead of spill for later disposal.

d. First Aid

Call emergency medical care. If not affecting injury, remove and isolate contaminated clothing and shoe; wrap victim in blanket before transporting. If not injured, remove and isolate contaminated clothing and shoes; shower victim with soap and water. Except for the injured, detain persons and equipment exposed to radioactive materials until arrival or instruction of Radioactive Authority. Advise medical care personnel that injured persons may be contaminated with radioactive material.

C. Radioactive Material, Excepted Package-Limited Quantity of Material, 7, UN2910

Radioactive Materials, Excepted Package-Instruments or Articles, 7, UN2910; Radioactive Material, Excepted Package-EMPTY Packaging, 7, UN2910

1. Potential Hazards

a. Health Hazards

Fire may produce irritating or poisonous gases. Low-level radioactive material; little personal hazard.

b. Fire or Explosion

Some of these materials may burn, but none of them ignites readily.

2. Emergency Actions

a. General

Keep unnecessary people away. Isolate hazard area and deny entry. Self Contained Breathing Apparatus (SCBA) and structural firefighter's protective clothing will provide limited protection. Delay clean up until arrival on instruction of qualified Radiation Authority. CALL CHEMTRC AT 1-800-424-9300 AS SOON AS POSSIBLE. Especially if there is no local hazardous material team available.

b. Fire

Move container from fire area if you can do it without risk. Small fires: Dry chemical, CO2, Halon, water spray or standard foam.

c. Spill or Leak

Do not touch damaged containers or spilled material. Small Liquid Spills: Take up with sand, earth, or other noncombustible, absorbent material.

d. First Aid

Use first aid treatment according to the nature of the injury. Advise medical care personnel that injured persons may be contaminated with radioactive material.

CODE OF FEDERAL REGULATIONS
49 CFR CH. 1 (10-1-95 EDITION)
§171.15 IMMEDIATE NOTICE OF CERTAIN HAZARDOUS MATERIALS INCIDENTS

(a) At the earliest practicable moment, each carrier who transports hazardous materials (including hazardous wastes) shall give notice in accordance with paragraph (b) of this section after each incident that occurs during the course of transportation (including loading, unloading and temporary storage) in which-

(1) As a direct result of hazardous materials-
  (i) A person is killed; or
  (ii) A person received injuries requiring his or her hospitalization; or
  (iii) Estimated carrier or other property damage exceeds $50,000; or
  (iv) An evacuation of the general public occurs lasting one or more hours; or
  (v) One or more major transportation arteries or facilities are closed or shut down for one hour or more; or
  (vi) The operational flight pattern or routine of an aircraft is altered or

(2) Fire, breakage, spillage, or suspected radioactive contamination occurs involving shipment of radioactive material (see also §174.45, 175.45, 176.48, and 177.807 of this subchapter); or

(3) Fire, breakage, spillage or suspected contamination occurs involving shipment of infectious substances (etiologic agents); or

(4) There has been a release of a marine pollutant in a quantity exceeding 450 L (119 gallons) for liquids or 400 kg (882 pounds) for solids; or

(5) A situation exists of such a nature (e.g., a continuing danger to life exists at the scene of the incident) that, in the judgment of the carrier, it should be reported to the Department even through it does not meet the criteria of paragraph (A) (1), (2) or (3) of this section.

(b) Each notice required by paragraph (A) of this section shall be given to the Department by telephone (toll free) on 800-424-8802. Notice involving infectious substances (etiologic agents) may be given the Director, Center for Disease Control, U.S. Public Health Service, Atlanta, GA., 800-232-0124, in place of the notice to the Department or (toll call) on 202-267-2675. Each notice must include the following information:

(1) Name of reporter.
(2) Name and address of carrier represented by reporter.
(3) Phone number where reporter can be contacted.
(4) Date, time, and location of incident.
(5) The extent of injuries, if any.
(6) Classification, name, and quantity of hazardous materials involved, if such information is available.
(7) Type of incident and nature of hazardous material involvement and whether a continuing danger to life exists at the scene.

(c) Each Carrier making a report under this section shall also make the report required by §171.16.

Note: Under 40 CFR 302.6 EPA required persons in charge of facilites (including transport vehicles, vessels and aircraft) to report any release of a hazardous substance in a quantity equal to or greater than its reportable quantity, as soon as that person has knowledge of the release, to the U.S. Coast Guard National Response Center at (toll free) 800-424-8802 or (toll) 202-267-2675.

[Amdt. 171-7, 35 FR 16837, Oct. 3, 1970]

EDITORIAL NOTE: For Federal Register citations affecting §171.15, see the List of CFR Sections Affected appearing in the Finding Aids section of this volume.

CODE OF FEDERAL REGULATIONS
49 CFR CH. 1 (10-1-95 EDITION)
§171.16 DETAILED HAZARDOUS MATERIALS INCIDENTS REPORTS

(a) Each carrier who transports hazardous materials shall report in writing, in duplicate, on DOT Form F 5800.1 (Rev. 6/89) to the Department within 30 days of the date of discovery, each incident that occurs during the course of transportation (including loading, unloading, and temporary storage) in which any of the circumstances set forth in §171.15(a) occurs or there has been an unintentional release of hazardous materials from a package (including a tank) or any quantity of hazardous waste has been discharged during transportation. If a report pertains to a hazardous waste discharge:

(1) A copy of the hazardous waste manifest for the waste must be attached to the report; and

(2) An estimate of the quantity of the waste removed from the scene, the name and address of the facility to which it was taken, and the manner of disposition of any removed waste must be entered in Section IX of the report form (Form F 5800.1) (Rev. 6/89).

(b) Each carrier making a report under this section shall send the report under this section shall send the report to the Information Systems Manager, DHM-63, Research and Special Programs Administration, Department of Transportation, Washington, DC 20590-0001; a copy of the report shall be retained, for a period of two years, at the carrier's principal place of business, or at other places as authorized and approved in writing by an agency of the Department of Transportation.

(c) Except as provided in paragraph (d) of this section, the requirements of paragraph (a) of this section do not apply to incidents involving the unintentional release of hazardous materials being transported under the following proper shipping names:

(1) Consumer commodity.

(2) Battery, electric storage, wet, filled with acid or alkali.

(3) Paint and paint related material when shipped in packaging of five gallons or less.

(d) The exceptions to incident reporting provided in paragraph (c) of this section do not apply to:

(1) Incidents required to be reported under §171.15(a);

(2) Incidents involving transportation aboard aircraft; nor

(3) Incidents involving the transportation of hazardous waste.

Note: A guideline document for assisting in the completion of DOT Form F 5800.1 (Rev. 6/89) may be obtained from the Office of Hazardous Materials Transportation, DHM-51, U.S. Department of Transportation, Washington, DC 20590-001.

[Amdt. 171-7, 35 FR 16837, Oct. 3, 1970, as amended by Amdt. 171-56, 45 FR 73683, Nov. 6, 1980; Amdt. No. 171-65, 47 FR 24584, June 7, 1982; Amdt. 171-72, 48 FR 17095, Apr. 21, 1983; Amdt. 171-101, 54 FR 25813, June 19, 1989; Amdt. 171-101, 54 FR 25813, June 19, 1989; Amdt. 171-109, 55 FR 39978, Oct. 1, 1990]

EASTERN TECHNOLOGIES, INC.

EMERGENCY PRCEDURES
FOR

I. SPILLS
II. ACCIDENTAL RELEASE OR LOSS OF MATERIAL
III. ACCIDENTAL CONTAMINIATION OF PERSONNEL
IV. FIRE

APPROVED BY: Mark Fellows
MARK FELLOWS
VICE PRESIDENT

I. SPILLS

A. Minor Spills of Liquids and Solids

Note: Minor spills are defined as spills involving minor radiation hazards to personnel.

1. Instructions to Workers

- Notify persons in the area that a spill has occurred.
- Prevent the spread of contamination by covering the spill with an absorbent. (Absorbent should be dampened if solids are spilled)
- Clean up the spill, wearing gloves and using absorbent.
- Carefully place spilled material and absorbent in a plastic bag for transfer to a radioactive waste container. Place disposable items and other contaminated material in the bag. Launderable protective clothing should be placed in an appropriate receptacle.
- Survey the area with an appropriate low-range radiation detector survey meter or other appropriate technique. Check the area around the spill for contamination. Also check hands, clothing, and shoes for contamination.
- Report the incident to one or more of the following: Plant Manager, Assistant Plant Manager, Facility Foreman, HP Supervisor, HP Technician, or RSO.
- Allow no one to return to work in the area unless approved by the HP Supervisor, HP Technician or RSO.
- Cooperate with HP Supervisor and/or RSO/RSO Staff (e.g.: investigation of root cause, provision of requested bioassay samples).
- Follow the instruction of the RSO/RSO Staff (e.g.: decontamination techniques, surveys, provision of bioassay samples, requested documentation).

2. Reminders to RSO and HP Supervisor

- Follow up on the decontamination activities and document the results.

- As appropriate, determine cause and corrective actions needed; consider bioassays if licensed material may have been ingested, inhaled, and/or absorbed through the skin.

- If necessary, notify NRC.

B. Major Spills of Liquids and Solids

Note: Major spills are defined as spills involving major radiation hazard to personnel.

1. Instruction to Workers

- Clear the area. If appropriate, survey all persons not involved in the spill and vacate the room.

- Prevent the spread of contamination by covering the spill with an absorbent. (Absorbent should be dampened if solids are spilled), but do not attempt to clean it up. To prevent the spread of contamination, limit the movement of all personnel who may be contaminated.

- Shield the source only if it can be done without further contamination or significant increase in radiation exposure.

- Close the room and lock or otherwise secure the area to prevent entry. Post the room with a sign to warn anyone trying to enter that a spill of radioactive material has occurred.

- Notify the RSO, HP Supervisor, Plant Manager and Assistant Plant Manager immediately.

- Survey all personnel who could possibly have been contaminated. Decontaminate personnel by removing contaminated clothing and flushing contaminated skin with lukewarm water and then washing with a mild soap.

- Allow no one to return to work in the area unless approved by the RSO or HP Supervisor.

- Cooperate with RSO/RSO Staff (e.g.: decontamination techniques, surveys, provision of bioassay samples, requested documentation).

2. Reminder to RSO and HP Supervisor

- Confirm decontamination of personnel. If decontamination of personnel was not fully successful, consider inducing perspiration by covering the area with plastic. Then wash the affected area again to remove any contamination that was released by the perspiration.

- Supervise decontamination activities and document the results. Documentation should include location of surveys and decontamination results.

- Determine cause and needed corrective actions; consider need for bioassays if licensed material may have been ingested, inhaled, and/or absorbed through the skin.

- If necessary, notify NRC.

II. INCIDENTS INVOLVING RADIOACTIVE DUSTS, MISTS, FUMES, ORGANIC VAPORS, AND GASES

A. Instructions to Workers

- Notify all personnel to vacate the room immediately.

- Shut down ventilation system, if appropriate, to prevent the spread of contamination throughout system and other parts of facility.

- Vacate the room. Seal the area, if possible.

- Notify the RSO, HP Supervisor, Plant Manager and Assistant Plant Manager immediately.

- Ensure that all access doors to the area are closed and posted with radiation warning signs, or post guards (trained) at all access doors

to prevent accidental opening of the doors or entry to the area.

- Survey all persons who could have possibly been contaminated. Decontaminate as directed by the RSO and/or HP Supervisor.
- Promptly report suspected inhalations and ingestions of licensed material to the RSO and HP Supervisor.
- Decontaminate the area only when advised and/or supervised by the RSO or HP Supervisor.
- Allow no one to return to work in the area unless approved by the RSO or HP Supervisor.
- Cooperate with RSO/RSO Staff (e.g.: investigation of root cause, provision of requested bioassay samples).
- Follow the instructions of the RSO/RSO Staff and HP Supervisor (e.g.: decontamination techniques, surveys, provision and collection of bioassay samples, requested documentation).

B. Reminders to RSO and HP Supervisor

- Supervise decontamination activities.
- Perform air sample surveys in the area before permitting resumption of work with licensed material.
- Provide written directions to potentially contaminated individuals about providing and collecting urine, breath, blood, or fecal samples, etc.
- Consider need for medical exam and/or whole body count before permitting involved individuals to return to work with licensed material.
- Determine cause and corrective actions needed; consider need for bioassays if licensed material may have been ingested, inhales, and/or absorbed through the skin. Document incident.
- If necessary, notify NRC.

III. ACCIDENTAL RELEASE OR LOSS OF RADIOACTIVE MATERIAL

A. Liquid

For accidental release of contaminated liquid

1. Stop release.
2. Notify all of the following: Plant Manger, Assistant Plant Manager, HP Supervisor and RSO.
3. Determine quantities and levels of release.
4. Evaluate release against regulations.
5. Report if necessary.
6. Implement mitigating actions.

B. Solid

For accidental loss of contaminated material

1. Notify all of the following: Plant Manger, Assistant Plant Manager, HP Supervisor and RSO.
2. Implement search for lost material.
3. Determine hazards involved.
4. Investigate causes for loss of material.
5. Evaluate against regulations.
6. Report if necessary.

C. Airborne

For accidental release of airborne radioactive material

1. Stop or reduce release as much as possible.

2. Notify all of the following: Plant Manger, Assistant Plant Manager, HP Supervisor and RSO.

3. Evaluate against regulations.

4. Report if necessary.

IV. ACCIDENTAL CONTAMINATION OF PERSONNEL

A. External Contamination

1. Monitor personnel to determine extent of external contamination.

2. Notify one or more of the following: Plant Manger, Assistant Plant Manager, HP Supervisor, HP Technician, and the RSO.

3. Evaluate extent of hazard to individual.

4. If contamination is localized, gently clean area using warm water and a mild cleansing agent.

5. If gross contamination exists individual must shower to clean effected areas.

6. Care should be used during any decontamination activity to ensure that contamination does not enter the eyes and that the skin is not abraised during cleaning.

7. After appropriate decontamination, survey to ensure that contamination has been removed.

8. Repeat steps as necessary.

9. Report if necessary.

B. Internal Contamination

1. Notify all of the following: Plant Manger, Assistant Plant Manager, HP Supervisor and RSO.

2. Determine amount ingested or inhaled (whole body count).

3. Track progress through body (urinalysis and fecal analysis).

4. Determine if radioactive material voiding techniques should be used to decrease retention time.

5. Report if necessary.

V. FIRES AND MAJOR EMERGENCIES

The following actions should be taken for fires located in

A. Minor Fires

1. Instructions to Workers

- Immediately attempt to put out the fire by approved methods (i.e.: fire extinguisher) if other fire hazards or radiation hazards are not present. If the fire is in or related to a system, equipment or component turn off if possible.

- Notify all persons present to vacate the area and have one individual immediately call the fire department and RSO, Plant Manager, Assistant Plant Manager and HP Supervisor.

- Once the fire is out, isolate the area to prevent the spread of possible contamination.

- Survey all persons involved in combating the fire for possible contamination.

- Decontaminate personnel by removing contaminated clothing and flushing contaminated skin with lukewarm water, then washing with a mild soap.

- In consultation with the RSO and/or HP Supervisor, determine a plan of decontamination and the types of protective devices and survey equipment that will be necessary to decontaminate the area.

- Allow no one to return to work in the area unless approved by the RSO or HP Supervisor.

- Cooperate with RSO/RSO Staff (e.g.: investigation of root cause, provision of requested bioassay samples).

- Follow the instructions of the RSO/RSO Staff (e.g.: decontamination techniques, surveys, provision of bioassay samples, requested documentation).

2. Reminders to RSO and HP Supervisor

- Supervise decontamination activities.

- If decontamination of personnel was not fully successful, consider inducing perspiration by covering the area with plastic. Then wash the affected area again to remove any contamination that was released by the perspiration.

- Consult with fire safety officials to assure that there are no other possibilities of another fire starting.

- Determine cause and needed corrective actions; consider need for bioassays if licensed material may have been ingested, inhales, and/or absorbed through the skin. Document incident.

- If necessary, notify the NRC.

B. Fires, Explosions, or Major Emergencies

1. Instruction to Workers

- Notify all persons in the area to leave immediately.

- Notify the Fire Department.

- Notify the RSO, Plant Manager, Assistant Plant Manager, HP Supervisor and other safety personnel.

- Upon arrival of firefighters, inform them where radioactive materials are stored or where radioisotopes were being used; inform them of the present location of the licensed material and the best possible entrance route to the radiation area, as well as any precautions to avoid exposure

or risk of creating radioactive contamination by use of high pressure water, etc.

- Cooperate with RSO/RSO Staff (e.g.: investigation of root cause, provision of requested bioassay samples).

- Allow no one to return to work in the area unless approved by the RSO.

- Follow the instructions of the RSO/RSO Staff (e.g.: decontamination techniques, surveys, provision of bioassay samples, requested documentation).

2. Reminders to RSO and HP Supervisor

- Coordinate activities with facility's safety committee and with local fire department.

- Consult with the firefighting personnel and set up a controlled area where the firefighters can be surveyed for contamination of their protective clothing and equipment after the fire is extinguished.

- Once the fire is extinguished, do not allow the firefighters to enter the radiation area until a thorough evaluation and survey are performed to determine the extent of the damage to the licensed material use and storage areas.

- Perform thorough contamination surveys of the firefighters and their equipment before they leave the controlled area and decontaminate, if necessary.

- Supervise decontamination activities.

- Consider bioassays if licensed material may have been ingested, inhaled, and/or absorbed through the skin. Document incident.

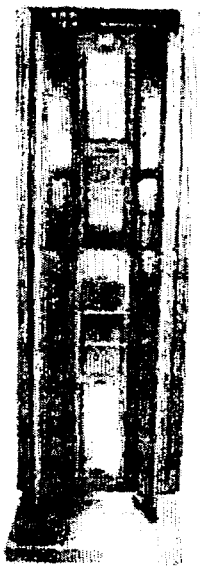
- If necessary, notify NRC.

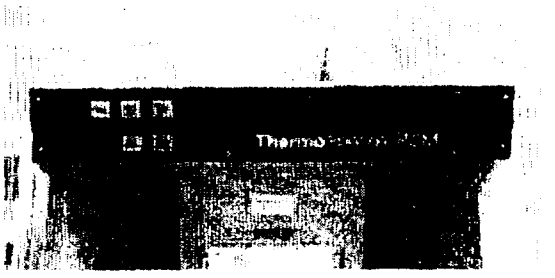
PCM-1C
Personnel Contamination Monitor

Radiation Measurement & Protection

The Thermo Electron Personnel Contamination Monitor (PCM) series is a popular automated system offering consistent measurement results.

- **Replaces hand-frisking**
- **Microcomputer controlled**
- **Automatic background subtraction**
- **Automatic gas supply system**
- **Pre-set alarms**
- **Networkable**





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General

The Model PCM-1C Personnel Contamination Monitor is a two-step, microcomputer-based system that replaces hand frisking for contamination control. The PCM-1C uses fifteen (15) gas flow proportional detectors, an ultrasonic motion sensor, a photoelectric occupant sensor, a microcomputer, support hardware, and an automatic changeover P-10 gas supply system.

The advantage of gas flow proportional detectors is the minimized interference from variable and elevated background gamma radiation. The microcomputer provides an overall means of acquiring and manipulating data, while alphanumerically displaying operational parameters and alarms. In the two-step counting process, one side of an individual is counted, then the other side. This effectively monitors contamination over essentially all of the body in a small fraction of the time it takes to frisk personnel. The user presets alarms.

The PCM-1C detects and continuously subtracts background. It also tracks backgrounds for all detectors combined and subtracts this value from the sum of the counts in all channels. The 15 detectors are positioned for optimal detection of contamination, and the location of contamination is noted on the alphanumeric display.

To reduce the effective dead zones between detectors, the software is set to sum background counts of adjacent detectors, and calculate an alarm level based on the summed counts and a user selectable sum-zone sigma factor. PCM-1C's can also be networked throughout a nuclear facility.

SPECIFICATIONS

DETECTOR

Detector:	Aluminum housing.
Protective Screen:	Etched sheet stainless steel, 83 percent open.
Dimensions:	17" long x 7" wide (432 x 178 mm).
Sensitive area:	78 in^2 (5030 mm^2).
Operating Voltage, Beta:	1000 to 3000 V.
Gas Connections:	Quick connect, Hansen B1-T10, two per detector.
HV Connector:	MHV, Amphenol-27025.
Window Density:	0.85 mg/cm2 aluminized Mylar.
Anode Wire:	0.0001-" diameter (0.025 mm) stainless steel.

Efficiency:

Typical detector efficiency is 38% for ^{99}Tc, and 54% for $^{90}Sr/^{90}Y$, based upon a 2 beta particle surface emission rate from a 1 7/8-inch-diameter disc source in contact with the screen. Efficiency for contamination on skin or clothing depends on the distance from the detector.

For example, at 5 cm from the screen the $^{90}Sr/^{90}Y$ counting efficiency is 28 % of the 2 pi beta particle surface emission rate. Detector efficiencies and shield factors may be calculated automatically or entered manually.

Background Response:	105,000 cpm/ mR/h for ^{137}Cs typical
	135,000 cpm/ mR/h for ^{60}Co typical

PCM-1C Minimum Detectable Activity (MDA):

Sensitivity or MDA is a complex function involving the background level, false alarm rate, counting time, and the location and the resultant counting efficiency of the contaminating radionuclide(s).

With a $^{90}Sr/^{90}Y$ source 5 cm from the detector, a false alarm rate of one out of 500 persons monitored, and a background of 0.02 mR/h (200 nSv/h), the MDA is 1.0 nanoCurie (37 Bq) for a 50 percent alarm probability and a 10 second count time. Beta-gamma contamination >$5x10^3$ dpm/100 cm^2 can be detected on most body surfaces. The PCM-1C can be set to alarm at this level in mode 3.

The reliable detectable activity (RDA) for which the confidence factor is menu selectable is calculated and displayed as a channel parameter for each detector channel using the current operating parameters.

SYSTEM

Exterior Dimensions:	89.6" high, 29.5" wide, 44" deep (2.28 x 0.74 x 1.12 m), PCM-1CN is 33" deep (0.84 m).
Weight:	550 pounds (249 kg) excluding gas cylinders.
Temperature:	The normal operating temperature is from 50 to 120 °F (10 to 49 °C) and the unit is operational from 10 to 95 percent relative humidity.
Power:	105 to 125 VAC, 47 to 63 Hz, 1A.

ACCESSORIES

-Magnetic Source Holders
-Calibration Source Sets
-Small Hole Foot Plate
-Spare Detector
-PCM1C Simulator

OPTIONS FOR THE PCM-1C

PCM1C OPT1	Printer-External RS-232C printer and software
PCM1C OPT1LP	Printer Option without Printer
PCM1C OPT2	Hand Interlock
PCM1C OPT3	Foot Sensor Assembly
PCM1C OPT4	Turnstile Annunciator Board
PCM1C OPT5	Gas Bottle Dolly
PCM1C OPT6	Original Screens
PCM1C OPT7	3-Channel Alpha Option (new instruments only)
PCM1C OPT7A	3-Channel Alpha Retrofit
PCM1C OPT8	15-Channel Alpha option (new instruments only)
PCM1C OPT9	Printer Sharer
PCM1C OPT10	ICI Bar Code Reader
PCM1C OPT11	Computer Identics Bar Code Reader
PCM1C OPT12	RS-232C Serial Port
PCM1C OPT13	Silhouette Option (Alarm Annunciation)
PCM1C OPT14	Enhancement Module
PCM1C OPT14A	XICO Magnetic Card Reader
PCM1C OPT14B	Computer Identics Card Reader
PCM1C OPT14C	Remote Annunciator
PCM1C OPT14D	Remote Annunciator Wall Bracket
PCM1C OPT14E	RS-485 Host Communications
PCM1C OPT15	Gas Management System
PCM1C OPT15	Gas Management System to Enhancement Module