GE Energy
Automation Services

G-4

April 5, 2004

David Collins
Division of Nuclear Materials Safety
U.S. Nuclear Regulatory Commission, Region 1
475 Allendale Road
King of Prussia, Pennsylvania 19406-1415

03033603
X

Dear David,

Please find enclosed documentation for renewal of our NRC license # 09-28781-02, General Electric Automation Services (GE Automation Services). We will continue to provide services to customers at multiple job sites in the United States on gauging systems of several manufacturers.

Please renew this license in its entirety and delete all previous references.

This application has been written in accordance with the guidelines described in NUREG-1556, Vol. 18 Appendix C, dated November 2000.

Also, I would like to name a "Certified Official" to our license. That person will be Daward R. McNaughton, Manager of Specialty Services.

If you have questions or comments regarding this application, please contact me at (251) 666-1785 ext 280.

Sincerely,

J. R. Beaty

James R. Beaty III
Corporate Radiation Safety Officer
GE Automation Services

General Electric Company
916 Butler Dr
Mobile, AL 36693
USA

T (251) 666-1785 ext 280
F (2510 666-4769

135900

REC'D IN LAT APR - 7 2005

NMSS/RGN1 MATERIALS-002

Item 5

Sealed sources installed in the gauging systems of Valmet Automation Inc. (formerly Sentrol Systems Inc.), Honeywell/Measurex, ABB (Formerly AccuRay), and Honeywell/Lippke.
Sentrol Model BG-III Betagauges containing up to 1100 millicuries of Krypton-85
Sentrol Models 5001 and 5002 Profilographs containing up to 500 millicuries of Kripton-85
AccuRay Model 0-7 Betagauges containing up to 500 millicuries of Krypton085 or up to 1000 millicuries of Promethium-147
Measurex models 2201 Betagauges containing up to 1000 millicuries of Krypton-85, models 2201containing up to 1000 millicuries of Promethium-147, models 4203 containing up to 50 millicuries of Strontium-90, and models 2202 containing up to 50 millicuries of Strontium-90.
LFE model S070A containing up to 1000 millicuries of Krypton-85
Lippke model 2000containing up to 1000 millicuries of Krypton-85

A. Krypton-85, Gas, Sealed Source, up to 1100 millicuries
B. Promethium 147, Solid, Sealed source, up to 1000 millicuries

Item 6

To provide routine and non-routine service to contract customers for maintenance on Betagauges of Measurex, AccuRay, Sentrol, Lippke and LFE. Maintenance involves installation, relocation, repair, routine maintenance non-routine maintenance, remote electronics monitoring, servicing and testing of safety systems, and leak testing acquisition. Manufacturers or Distributors instructions and recommendations are followed for any non-routine maintenance.

Item 7.

James R. Beaty III, Corporate Radiation Safety Officer

Training:
40 hours, Radiation Safety Officer Training and gauge operations, Engelhardt and Associates. 2004.
18 years experience servicing gauging systems for routine and non-routine maintenance of AccuRay and Measurex systems.

Item 8

Before using licensed materials or performing non-routine maintenance, maintenance personnel will have successfully completed the classroom portion of the training course described in Appendix H of NUREG – 1556, Vol 18, "consolidated guidance About Material Licenses, dated November 2000.

A copy of GE Automation Services Radiation Safety Program, GEAS 100-2, "Training, Testing and Qualification of Gauging System Personnel" is attached

Item 9

No response required. No Unsealed sources will be handled

Item 10

Development and implementation of an ALARA Program	GEAS 100-6
Description of equipment and facilities adequate to protect personnel the public and the environment.	GEAS 200
Confirmation that licensed activities are conducted only by qualified individuals.	GEAS 100-2
Development and maintenance of written operating and emergency procedures	GEAS 200
Implementation of an audit program to ensure that, at least annually, the radiation safety program is reviewed.	GEAS100-3
Description of organizational structure and individuals responsible for ensuring day to day over sight of the radiation safety program.	GEAS 100-1
Establishment and management of a radiation safety and decommissioning records program.	GEAS 100-4
Methods or procedures for preventing the release of contaminated material and equipment	GEAS 200
Methods or procedures for preventing personnel contamination. Radiation safety procedures and the authorized users responsibility unique to each type of service operation.	GEAS 200/GEAS 100-9
Equipment, techniques, and corresponding radiation safety procedures associated with providing services involving either sealed sources or unsealed materials.	GEAS 200

Radiation Monitoring Instruments

"We will use instruments that meet the radiation monitoring instrument specifications published in Appendix J of NUREG–1556, Vol 18 " "Consolidated Guidance about Service Provider Licenses; Program-Specific	GEAS 200

Guidance About Service Provider Licenses," dated November 2000. We reserve the right to upgrade our survey instruments as necessary.

Material Receipt and Accountability

"Ordering licensed material and package receipt and opening will follow the model procedures in Appendix K of NUREG – 1556, Vol 18, 'Consolidated Guidance About Material Licenses; Program-Specific Guidance About Service Licenses, Dated November 2000 GEAS 200

Occupational Dosimetry

"We will monitor individuals in accordance with the criteria in the section entitled 'Occupational Dose' in NUREG – 1556, Vol 18, "Consolidated Guidance About Service Provider Licenses,' dated November 2000." GEAS 200

NVLAP-accredited Dosimetry (TLD will be processed by NVLAP-accredited entity. NVLAP-accredited dosimetry will be exchanged at the frequency specified in Section 8.10.4 of NUREG – 1556, Vol 18. GEAS 200

Operating and Emergency Procedures

We will follow the manufacturer's procedures for inspection, maintenance, source exchange, and operations that involve access to the sealed source(s) and safety systems, if applicable. GEAS 200

Leak Test

"Leak test, when required by the license, will be performed at intervals approved by the NRC or and agreement state and specified in the sealed source and Device Registration Sheet. Leak test will be performed according to each manufacturers requirements using a leak test kits supplied by an organization authorized to provide leak test kits to other licensees and according to the kit supplier's instructions." GEAS 200

Maintenance

"We will implement and maintain procedures for conduction routine and non-routine maintenance of devices under our control according to manufacturer's written recommendations and instructions. GEAS 200

Only Qualified Persons, as identified in GEAS 100-2, will be allowed to perform non-routine maintenance. Gauging System Trainees may perform routine maintenance, but non-routine maintenance must be performed under

the direct guidance of a qualified Person, or the CRSO.

"We only use replacement parts or components provide by the original manufacturer for any repair to the source assembly.

Before being returned to normal use, the sealed source will be tested to verify that it functions as designed and source integrity is not compromised.

Each job site will have a survey meter that meets the criteria in "Radiation Safety Program – Instruments in NUREG-1556, Vol 18, 'Consolidated Guidance about Material Licenses; Program-Specific Guidance about Service Provider License,' dated November 2000."

"Records will be maintained for at least 3 years from the date of the radiation survey as required by 10 CFR 20.2013."

All personnel engaged in Gauging system maintenance, either route or non-routine, for GE Automation Services will wear whole body and extremity monitoring devices while performing such maintenance.

Waste Management

We will use the model waste procedures published in Appendix N of NUREG-1556, Vol 18, "Consolidated Guidance About Material Licenses; Program-Specific Guidance About Service Provider Licenses,' Dated November 2000"

Since the sources are in possession of the General License Holder, our customer, we do not anticipate having any waste for disposal. We will assist the General License Holder with the proper Procedures for Waste Disposal as required.

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NRC FORM 313 **U.S. NUCLEAR REGULATORY COMMISSION**
(4-2004)
10 CFR 30, 32, 33, 34, 35, 36, 39, and 40

APPLICATION FOR MATERIAL LICENSE

APPROVED BY OMB: NO. 3150-0120 **EXPIRES: 10/31/2005**

Estimated burden per response to comply with this mandatory collection request: 7 hours. Submittal of the application is necessary to determine that the applicant is qualified and that adequate procedures exist to protect the public health and safety. Send comments regarding burden estimate to the Records and FOIA/Privacy Services Branch (T-5 F52), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by internet e-mail to infocollects@nrc.gov, and to the Desk Officer, Office of Information and Regulatory Affairs, NEOB-10202, (3150-0120), Office of Management and Budget, Washington, DC 20503. If a means used to impose an information collection does not display a currently valid OMB control number, the NRC may not conduct or sponsor, and a person is not required to respond to, the information collection.

INSTRUCTIONS: SEE THE APPROPRIATE LICENSE APPLICATION GUIDE FOR DETAILED INSTRUCTIONS FOR COMPLETING APPLICATION. SEND TWO COPIES OF THE ENTIRE COMPLETED APPLICATION TO THE NRC OFFICE SPECIFIED BELOW.

APPLICATION FOR DISTRIBUTION OF EXEMPT PRODUCTS FILE APPLICATIONS WITH:

DIVISION OF INDUSTRIAL AND MEDICAL NUCLEAR SAFETY
OFFICE OF NUCLEAR MATERIALS SAFETY AND SAFEGUARDS
U.S. NUCLEAR REGULATORY COMMISSION
WASHINGTON, DC 20555-0001

ALL OTHER PERSONS FILE APPLICATIONS AS FOLLOWS:

IF YOU ARE LOCATED IN:

ALABAMA, CONNECTICUT, DELAWARE, DISTRICT OF COLUMBIA, FLORIDA, GEORGIA, KENTUCKY, MAINE, MARYLAND, MASSACHUSETTS, MISSISSIPPI, NEW HAMPSHIRE, NEW JERSEY, NEW YORK, NORTH CAROLINA, PENNSYLVANIA, PUERTO RICO, RHODE ISLAND, SOUTH CAROLINA, TENNESSEE, VERMONT, VIRGINIA, VIRGIN ISLANDS, OR WEST VIRGINIA, SEND APPLICATIONS TO:

LICENSING ASSISTANCE TEAM
DIVISION OF NUCLEAR MATERIALS SAFETY
U.S. NUCLEAR REGULATORY COMMISSION, REGION I
475 ALLENDALE ROAD
KING OF PRUSSIA, PA 19406-1415

IF YOU ARE LOCATED IN:

ILLINOIS, INDIANA, IOWA, MICHIGAN, MINNESOTA, MISSOURI, OHIO, OR WISCONSIN, SEND APPLICATIONS TO:

MATERIALS LICENSING BRANCH
U.S. NUCLEAR REGULATORY COMMISSION, REGION III
2443 WARRENVILLE ROAD, SUITE 210
LISLE, IL 60532-4352

ALASKA, ARIZONA, ARKANSAS, CALIFORNIA, COLORADO, HAWAII, IDAHO, KANSAS, LOUISIANA, MONTANA, NEBRASKA, NEVADA, NEW MEXICO, NORTH DAKOTA, OKLAHOMA, OREGON, PACIFIC TRUST TERRITORIES, SOUTH DAKOTA, TEXAS, UTAH, WASHINGTON, OR WYOMING, SEND APPLICATIONS TO:

NUCLEAR MATERIALS LICENSING BRANCH
U.S. NUCLEAR REGULATORY COMMISSION, REGION IV
611 RYAN PLAZA DRIVE, SUITE 400
ARLINGTON, TX 76011-4005

03033603

PERSONS LOCATED IN AGREEMENT STATES SEND APPLICATIONS TO THE U.S. NUCLEAR REGULATORY COMMISSION ONLY IF THEY WISH TO POSSESS AND USE LICENSED MATERIAL IN STATES SUBJECT TO U.S.NUCLEAR REGULATORY COMMISSION JURISDICTIONS.

1. THIS IS AN APPLICATION FOR *(Check appropriate item)*
   - [ ] A. NEW LICENSE
   - [ ] B. AMENDMENT TO LICENSE NUMBER
   - [x] C. RENEWAL OF LICENSE NUMBER 09-28781-02

2. NAME AND MAILING ADDRESS OF APPLICANT *(Include ZIP code)*
   GE Automation Services
   8301 Scenic Highway
   Pensacola, Florida 32514

3. ADDRESS WHERE LICENSED MATERIAL WILL BE USED OR POSSESSED
   Licensed material will not be possessed by GE Automation Services.

4. NAME OF PERSON TO BE CONTACTED ABOUT THIS APPLICATION
   James R. Beaty III
   TELEPHONE NUMBER
   (251) 666-1785

SUBMIT ITEMS 5 THROUGH 11 ON 8-1/2 X 11" PAPER. THE TYPE AND SCOPE OF INFORMATION TO BE PROVIDED IS DESCRIBED IN THE LICENSE APPLICATION GUIDE.

5. RADIOACTIVE MATERIAL
   a. Element and mass number; b. chemical and/or physical form; and c. maiximum amount which will be possessed at any one time.

6. PURPOSE(S) FOR WHICH LICENSED MATERIAL WILL BE USED.

7. INDIVIDUAL(S) RESPONSIBLE FOR RADIATION SAFETY PROGRAM AND THEIR TRAINING EXPERIENCE.

8. TRAINING FOR INDIVIDUALS WORKING IN OR FREQUENTING RESTRICTED AREAS.

9. FACILITIES AND EQUIPMENT.

10. RADIATION SAFETY PROGRAM.

11. WASTE MANAGEMENT.

12. LICENSE FEES *(See 10 CFR 170 and Section 170.31)*
    FEE CATEGORY 3N AMOUNT ENCLOSED $

13. CERTIFICATION. *(Must be completed by applicant)* THE APPLICANT UNDERSTANDS THAT ALL STATEMENTS AND REPRESENTATIONS MADE IN THIS APPLICATION ARE BINDING UPON THE APPLICANT.

THE APPLICANT AND ANY OFFICIAL EXECUTING THIS CERTIFICATION ON BEHALF OF THE APPLICANT, NAMED IN ITEM 2, CERTIFY THAT THIS APPLICATION IS PREPARED IN CONFORMITY WITH TITLE 10, CODE OF FEDERAL REGULATIONS, PARTS 30, 32, 33, 34, 35, 36, 39, AND 40, AND THAT ALL INFORMATION CONTANED HEREIN IS TRUE AND CORRECT TO THE BEST OF THEIR KNOWLEDGE AND BELIEF.

WARNING: 18 U.S.C. SECTION 1001 ACT OF JUNE 25, 1948 62 STAT. 749 MAKES IT A CRIMINAL OFFENSE TO MAKE A WILLFULLY FALSE STATEMENT OR REPRESENTATION TO ANY DEPARTMENT OR AGENCY OF THE UNITED STATES AS TO ANY MATTER WITHIN ITS JURISDICTION.

CERTIFYING OFFICER – TYPED/PRINTED NAME AND TITLE	SIGNATURE	DATE
James R. Beaty III Corporate Radiation Safety Officer	J. R. Beaty III	04/04/2005

FOR NRC USE ONLY

TYPE OF FEE	FEE LOG	FEE CATEGORY	AMOUNT RECEIVED	CHECK NUMBER	COMMENTS
			$		
APPROVED BY				DATE	

135900

Appendix C

Suggested Format for Providing Information Requested in Items 5 through 11 of NRC Form 313

Suggested Format for Providing Information Requested in Items 5 through 11 of NRC Form 313

Appendix C is designed to be used for all types of applicants requesting a service license. Because of the varied types of service applications it is necessary to make this appendix sufficiently broad in scope to handle most applications. Services such as commercial nuclear laundries and waste management applicants may need to provide additional information once the necessary pre-licensing visit(s) are completed. Maintaining close coordination during the early licensing phase with the NRC licensing staff can be beneficial to both the NRC staff and applicant.

Using this appendix successfully requires the applicant to do an initial review of the NUREG and preplan its answers. We suggest that applicants read the entire appendix from beginning to end. The next step is to select the individual elements that apply to the individual types of service(s) requested. Highlight or circle Item Nos, or in some other way identify the areas that require specific information. Provide the information on the specific elements that you identified as requiring input for obtaining authorization for the requested services.

After selecting the applicable items that need to be addressed in Appendix C, refer to the corresponding sections in the NUREG. It is only necessary for applicants to provide the level of detail required for the individual types of service(s) requested in the application. Note that providing information for very limited licenses, e.g., leak test service provider, requires less information than would be required for a commercial nuclear laundry or a waste management license. Applicants for service licenses requiring authorization for types and quantities of material specific for broad scope licenses should refer to NUREG-1556, Vol. 11, "Consolidated Guidance About Material Licenses: Program-Specific Guidance About Licenses of Broad Scope," and NUREG-1556, Vol. 7, "Consolidated Guidance About Material Licenses: Program-Specific Guidance About Academic, Research and Development, and Other Licenses of Limited Scope."

Item No.	Title and Criteria	Use Table(s) Below	Description Attached

5	**RADIOACTIVE MATERIAL** **Sealed Sources and Devices**		
	• Identify each radionuclide that will be used in each sealed source/device.	☑	☐
	• Identify the manufacturer or distributor and model number of each sealed source/device.	☑	☐
	• Confirm that each sealed source/device combination is listed and approved in the SSD registry for the purpose intended.	☑	☐
	• Confirm that the activity per source/maximum activity per device specified in the SSD registration certificate will not be exceeded.	☑	☐

Sealed Sources

Radioisotope	Manufacturer/ Model No.	Quantity	Yes	No
		Not to exceed the maximum activity per source/device as specified in the Sealed Source and Device Registration Sheet	☑	☐
		Not to exceed the maximum activity per source/device as specified in the Sealed Source and Device Registration Sheet	☑	☐
		Not to exceed the maximum activity per source/device as specified in the Sealed Source and Device Registration Sheet	☑	☐

Source Material

☐ Depleted Uranium	_____	Kilograms
☐ Uranium-238	_____	Kilograms
☐ Thorium-232	_____	Kilograms
☐ Other: Specify	_____	Kilograms

Special Nuclear Material

Radioisotope	Manufacturer/ Model No.	Quantity	Yes	No

❒ Uranium-234 ❒ Uranium-235 ❒ Plutonium-238 ❒ Plutonium-239 ❒ Other: Specify		Not to exceed the maximum activity per source/device as specified in the Sealed Source and Device Registration Sheet	❒	❒

Unsealed or Uncontained Materials

Identify each individual isotope requested:

Radioisotope	Chemical or Physical Form				Total Activity Requested
	❒ Gas	❒ Liquid	❒ Solid	❒ Other: Specify	
	❒ Gas	❒ Liquid	❒ Solid	❒ Other: Specify	
	❒ Gas	❒ Liquid	❒ Solid	❒ Other: Specify	
	❒ Gas	❒ Liquid	❒ Solid	❒ Other: Specify	

OR

Identify your request for Type B or Type C quantities of material by filling out the table below:

Radioisotope	Yes	No
• Any radioisotope identified in 10 CFR 33.100, Schedule A, Column I — (Type B License of Broad Scope)	❒	❒
OR		
• Any radioisotope identified in 10 CFR 33.100, Schedule A, Column II — (Type C License of Broad Scope)	❒	❒

AND IF APPLICABLE

Identify *individual isotopes* identified in 10 CFR 33.100 Schedule A, Column I or II, that requested quantities exceeding amounts authorized in Column I or II.

Radioisotope	Chemical or Physical Form				Total Activity Requested
	❒ Gas	❒ Liquid	❒ Solid	❒ Other: Specify	
	❒ Gas	❒ Liquid	❒ Solid	❒ Other: Specify	
	❒ Gas	❒ Liquid	❒ Solid	❒ Other: Specify	
	❒ Gas	❒ Liquid	❒ Solid	❒ Other: Specify	

AND

Identify any uncontained source or special nuclear materials that should be included in the license:

Source Material		
❒ Depleted Uranium	_____	Kilograms
❒ Uranium-238	_____	Grams
❒ Thorium-232	_____	Grams
❒ Other:	_____	Grams
Special Nuclear Material Less than Critical Mass Quantities		
❒ Uranium-234	_____	Grams
❒ Uranium-235	_____	Grams
❒ Plutonium-238	_____	Grams
❒ Plutonium-239	_____	Grams

For those individuals who will provide commercial services on sealed sources/devices and will be required to *take possession of materials incident to providing services*:

Sealed Sources/Devices Possessed Incident to Providing Services				
Radioisotope	**Manufacturer/ Model No.**	**Quantity**	**Yes**	**No**
		Not to exceed the maximum activity per source/device as specified in the Sealed Source and Device Registration Sheet	❒	❒
		Not to exceed the maximum activity per source/device as specified in the Sealed Source and Device Registration Sheet	❒	❒

Source Material		
❒ Uranium-238	_____	Kilograms
❒ Thorium-232	_____	Grams
❒ Other:	_____	Grams
❒ Depleted Uranium	_____	Kilograms

Special Nuclear Material Less than Critical Mass Quantities		
❒ Uranium-234	_____	Grams
❒ Uranium-235	_____	Grams
❒ Plutonium-238	_____	Grams
❒ Plutonium-239	_____	Grams

For those individuals who will provide commercial services involving unsealed or uncontained material and will be required to take possession of these materials incident to providing services:

Unsealed or Uncontained Materials

Identify each individual isotope requested:

Radioisotope	Chemical or Physical Form				Total Activity Requested
	❒ Gas	❒ Liquid	❒ Solid	❒ Other: Specify	
	❒ Gas	❒ Liquid	❒ Solid	❒ Other: Specify	
	❒ Gas	❒ Liquid	❒ Solid	❒ Other: Specify	
	❒ Gas	❒ Liquid	❒ Solid	❒ Other: Specify	

OR

Identify your request for Type B or Type C quantities of materials by filling out the table below:

Radioisotope	Yes	No
• Any radioisotope identified in 10 CFR 33.100, Schedule A, Column I — (Type B License of Broad Scope)	❒	❒
OR		
• Any radioisotope identified in 10 CFR 33.100, Schedule A, Column II (Type C License of Broad Scope)	❒	❒

AND IF APPLICABLE

Identify *individual isotopes* identified in 10 CFR 33.100 Schedule A, Column I or II, that requested quantities exceeding amounts authorized in Column I or II.

Radioisotope	Chemical or Physical Form				Total Activity Requested
	❒ Gas	❒ Liquid	❒ Solid	❒ Other: Specify	
	❒ Gas	❒ Liquid	❒ Solid	❒ Other: Specify	
	❒ Gas	❒ Liquid	❒ Solid	❒ Other: Specify	
	❒ Gas	❒ Liquid	❒ Solid	❒ Other: Specify	

AND

Identify any uncontained source or special nuclear materials that should be included in the license:

Source Material		
❒ Depleted Uranium	_____	Kilograms
❒ Uranium-238	_____	Grams
❒ Thorium-232	_____	Grams
❒ Other:	_____	Grams
Special Nuclear Material		
❒ Uranium-234	_____	Grams
❒ Uranium-235	_____	Grams
❒ Plutonium-238	_____	Grams
❒ Plutonium-239	_____	Grams

Item No.	Title and Criteria	Yes	No	N/A	Description Attached
5	**RADIOACTIVE MATERIAL** **Financial Assurance and Recordkeeping For Decommissioning** • Pursuant to 10 CFR 30.35(g), we shall maintain drawings and records important to decommissioning and transfer these records to a new licensee before licensed activities are transferred, or assign the records to the appropriate NRC Regional Office before the license is terminated. **OR** • If financial assurance is required, submit evidence.	❒	❒		❒

Item No.	Title and Criteria	Yes	No	N/A	Description Attached
6	**PURPOSE(S) FOR WHICH LICENSED MATERIAL WILL BE USED**				
	• Leak Test Analysis	☐	☐		
	• Environmental Sample Analysis	☐	☐		
	• Instrument/Dosimeter Calibration	☐	☐		
	• Instruction	☐	☐		
	Possession Incident to Performing the Following Services on Sealed Sources and Devices			☐	
	• Installation	☑	☐		☑
	• Radiation Surveys	☑	☐		☑
	• Removal	☑	☐		☑
	• Disposal	☐	☑		☐
	• Relocation	☑	☐		☑
	• Repair	☑	☐		☑
	• Source Exchange	☐	☑		☐
	• Routine Maintenance	☑	☐		☑
	• Non-routine Maintenance	☑	☐		☑
	• Source Retrieval	☐	☑		☐
	• Transportation	☐	☑		☐
	• Packaging	☐	☑		☐
	• Leak Test Sample Acquisition	☑	☐		☑
	• Customer Training	☐	☑		☐
	• Other Services not identified above, excluding activities involving critical mass quantities of special nuclear material: Specify.	☐	☑		☐

Item No.	Title and Criteria	Yes	No	N/A	Description Attached
6	**PURPOSE(S) FOR WHICH LICENSED MATERIAL WILL BE USED** ***(Cont'd.)***				
	Possession Incident to Performing Commercial Services Utilizing Unsealed or Uncontained Licensed Material:			☑	
	Nuclear Laundry	❒	❒		
	Waste Management Services:				
	• Commercial Incineration	❒	❒		
	• Commercial Compaction/Super Compaction	❒	❒		
	• Commercial Solidification/Vitrification	❒	❒		
	• Packaging, Repackaging, and Transportation of Radioactive Waste	❒	❒		
	• Decontamination	❒	❒		
	• Decommissioning	❒	❒		
	• Site Characterization	❒	❒		
	• Radiation protection or health physics training and instruction	❒	❒		
	• Other Services not identified above, excluding activities involving critical mass quantities of special nuclear material: Specify.				❒

Item No.	Title and Criteria	Yes	No	N/A	Description Attached
7	**INDIVIDUAL(S) RESPONSIBLE FOR RADIATION SAFETY PROGRAM AND THEIR TRAINING EXPERIENCE** **Radiation Safety Officer** • The name of the proposed RSO: **AND EITHER** • The specific training and experience of the RSO; **OR** • Alternative information demonstrating that the proposed RSO is qualified by training and experience, e.g., listed by name as an authorized user or the RSO on an NRC or Agreement State license that requires a radiation safety program of comparable size and scope.				☑ ☐

Item No.	Title and Criteria	Yes	No	N/A	Description Attached
8	**TRAINING FOR INDIVIDUALS WORKING IN OR FREQUENTING RESTRICTED AREAS**				
	Authorized Users				
	• "Before using licensed material, authorized users will receive the training described in Appendix H of NUREG-1556, Vol. 18, 'Consolidated Guidance About Materials Licenses: Program-Specific Guidance About Service Provider Licenses,' dated November 2000."	☑	☐		
	OR				
	• A description of the training and experience for proposed authorized users.				☐
	Ancillary Personnel				
	• "Before using licensed materials, ancillary personnel will have successfully completed the classroom training portion of the training course described in Appendix H of NUREG-1556, Vol. 18, 'Consolidated Guidance About Materials Licenses: Program-Specific Guidance About Service Provider Licenses,' dated November 2000."	☐	☐		
	OR				
	• A description of the radiation safety training program, including topics covered, groups of workers, assessment of training, qualifications of instructors, and the method and frequency of training.				☐

Item No.	Title and Criteria	Yes	No	N/A	Description Attached
9	**FACILITIES AND EQUIPMENT** **Permanent Facilities Specifically Identified on the License**				
	• Leak Test and Environmental Sample Analysis Providers: No response required for facilities. (Equipment is discussed in Item 10, Radiation Safety Program.)	No Response is Necessary for this Section			
	• Instrument Calibration: If only sealed sources are possessed in registered devices designed to emit a collimated beam for the purpose of instrument calibration, no response required. (Equipment is discussed in Item 10, Radiation Safety Program.)	No Response is Necessary for this Section			
	• Services that involve handling of sealed sources in a shielded container: No response required. (Equipment is discussed in Item 10, Radiation Safety Program.)	No Response is Necessary for this Section			
	• Services that involve handling of sealed sources outside a shielded container:	❒	❒		
	– Submit a drawing or sketch of the proposed permanent facility identifying areas where radioactive materials, including radioactive wastes, will be used or stored.				❒
	– Show in the drawings the relationship and distance between restricted areas and adjacent unrestricted areas.				❒
	– Specify in the drawings shielding materials (concrete, lead, etc.) and means for securing radioactive materials from unauthorized removal.				❒
	– Drawings, sketches, diagrams, etc. should indicate the scale or include dimensions on each drawing or sketch.				❒
	– Describe engineered safety systems, e.g., area monitors, interlocks, alarms, etc.				❒

Item No.	Title and Criteria	Yes	No	N/A	Description Attached
9	**FACILITIES AND EQUIPMENT** ***(Cont'd.)***				
	Permanent Facilities Specifically Identified on the License Requesting the Use of Unsealed or Uncontained Material				
	• Leak Test and Environmental Sample Analysis Providers: No response required for facilities. (Equipment is discussed in Item 10, Radiation Safety Program.)	No Response is Necessary for this Section			
	• Other services that involve handling of unsealed radioactive material at permanent facilities or field stations identified on the license:	❒	❒		
	– Describe the permanent facilities and equipment to be made available at each location where unsealed radioactive material will be used or handled.			❒	❒
	– Include a description of the area(s) assigned for the receipt, storage, security, preparation, handling, waste storage and measurement of radioactive materials.			❒	❒
	– Submit a facility diagram showing the proximity of licensed materials to unrestricted areas.	❒	❒	❒	❒
	– Drawings, sketches, diagrams, etc. should indicate the scale, or include dimensions on each drawing or sketch.			❒	
	– Submit a diagram, sketch, or drawing, when applicable, that identifies areas where radioactive materials may become airborne. The diagram should contain descriptions of the ventilation systems, with pertinent airflow rates, filtration equipment, sample collection points, and monitoring systems.			❒	❒
	– Submit a diagram of radioactive waste handling equipment that includes incinerators, compactors, solidification equipment, hold-up tanks, sample collection points, etc.			❒	❒

Item No.	Title and Criteria	Yes	No	N/A	Description Attached
9	**FACILITIES AND EQUIPMENT** ***(Cont'd.)***				
	Permanent Facilities Specifically Identified on the License Requesting the Use of Unsealed or Uncontained Material ***(Cont'd.)***				
	– Describe proposed laundry facilities, if applicable, used for contaminated protective equipment and clothing. Specify how the contaminated waste water from the laundry machines or sinks is disposed. Operating and emergency procedures should address decontamination of the laundry area and equipment.			❒	❒
	– Describe protective clothing (such as rubber gloves, coveralls, respirators, and face shields), auxiliary shielding, absorbent materials, secondary containers for waste water storage for decontamination purposes, plastic bags for storing contaminated items, etc., that will be available.			❒	❒
	– Identify specialized handling tools, facility interlocks designed to prevent operation of systems in the event that operation of the system could result in accidental exposure or release of material (e.g., HEPA filters, ventilation system, etc.) or equipment.			❒	❒
	Temporary Job Site Locations				
	• No facility description is required for use of materials at temporary job sites.	Need Not Be Submitted With Application			

Item No.	Title and Criteria	Yes	No	N/A	Description Attached
10	**RADIATION SAFETY PROGRAM**				
	The applicant is required to establish and submit its radiation protection program. Each item listed below should be addressed in the corresponding sections of this guide.				
	• Development and implementation of an ALARA program.	☑	☐	☐	☑
	• Description of equipment and facilities adequate to protect personnel, the public and the environment.	☑	☐	☐	☑
	• Confirmation that licensed activities are conducted only by individuals qualified by training and experience.	☑	☐	☐	☑
	• Development and maintenance of written operating and emergency procedures.	☑	☐	☐	☑
	• Implementation of an audit program to ensure that, at least annually, the radiation safety program is reviewed.	☑	☐	☐	☑
	• Description of organization structure and individuals responsible for ensuring day-to-day oversight of the radiation safety program.	☑	☐	☐	☑
	• Establishment and management of a radiation safety and decommissioning records system.				
	• Methods or procedures for preventing the release of contaminated material and equipment.	☐	☐	☑	☐
	• Methods or procedures for preventing personnel contamination. Radiation safety procedures and the authorized users responsibilities unique to each type of service operation requested in the application.	☐	☐	☑	☐
	• Radiation safety procedures.	☑	☐	☐	☐
	• Equipment, techniques, and corresponding radiation safety procedures associated with providing services involving either sealed sources or unsealed materials.	☑	☐	☐	☐
	Audit Program	Need Not Be Submitted With Application			

Item No.	Title and Criteria	Yes	No	N/A	Description Attached
10	**RADIATION SAFETY PROGRAM** ***(Cont'd.)***				
	Radiation Monitoring Instruments				
	• A description of the instrumentation described in Section 8.10.2 of NUREG-1556, Vol. 18, "Consolidated Guidance About Materials Licenses: Program-Specific Guidance About Service Provider Licenses," dated November 2000, that will be used to perform required surveys. "We will use instruments that meet the radiation monitoring instrument specifications published in Appendix J of NUREG-1556, Vol. 18, 'Consolidated Guidance About Materials Licenses: Program-Specific Guidance About Service Provider Licenses,' dated November 2000.' We reserve the right to upgrade our survey instruments as necessary."	☑	☐		☑
	OR				
	• A description of the instrumentation described in Section 8.10.2 of NUREG-1556, Vol. 18, "Consolidated Guidance About Materials Licenses: Program-Specific Guidance About Service Provider Licenses," dated November 2000, that will be used to perform required surveys. "We will use instruments that meet the radiation monitoring instrument specifications published in Appendix J of NUREG-1556, Vol. 18, 'Consolidated Guidance About Materials Licenses: Program-Specific Guidance About Service Provider Licenses,' dated November 2000. Additionally, we will implement the model survey meter calibration program published in Appendix J of NUREG-1556, Vol. 18, 'Consolidated Guidance About Materials Licenses: Program-Specific Guidance About Service Provider Licenses,' dated November 2000. We reserve the right to upgrade our survey instruments as necessary."				☐

Item No.	Title and Criteria	Yes	No	N/A	Description Attached
10	**RADIATION SAFETY PROGRAM** ***(Cont'd.)***				
	Radiation Monitoring Instruments ***(Cont'd.)***				
	OR				
	• A description of alternative equipment and/or procedures for ensuring that appropriate radiation monitoring equipment will be used during licensed activities and that proper calibration and calibration frequency of survey equipment will be performed. The statement, "We reserve the right to upgrade our survey instruments as necessary," should be added to the response.				❒
	Material Receipt and Accountability				
	• "Ordering licensed material and package receipt and opening will follow the model procedures in Appendix K of NUREG-1556, Vol. 18, 'Consolidated Guidance About Materials Licenses: Program-Specific Guidance About Service Provider Licenses,' dated November 2000."	❒	❒		
	OR				
	• Submit a description of procedure(s) for ordering licensed material and package receipt and opening.				☑
	AND				
	• For unsealed licensed material, submit a description of procedure(s) for ensuring material accountability.				❒

Item No.	Title and Criteria	Yes	No	N/A	Description Attached
10	**RADIATION SAFETY PROGRAM** ***(Cont'd.)***				
	Occupational Dosimetry				
	• "We will have a prospective evaluation and determine that unmonitored individuals are not likely to receive, in one year, a radiation dose in excess of 10% of the allowable limits in 10 CFR Part 20, or we will monitor individuals in accordance with the criteria in the section entitled 'Occupational Dose' in NUREG-1556, Vol. 18, 'Consolidated Guidance About Materials Licenses: Program-Specific Guidance About Service Provider Licenses,' dated November 2000."	☑	❒		
	OR				
	• A description of an alternate method for demonstrating compliance with the referenced regulations.				❒
	AND/OR				
	• Provide a bioassay program when using unsealed radioactive materials. If an applicant elects to provide a bioassay program that is less conservative than recommended in Regulatory Guide 8.20, its rationale should be stated.				❒
	AND				
	• Bioassay programs must include what the applicant considers and acceptable interval or schedule for conducting bioassays, identify action levels or guidelines, and describe specific actions to be taken when action levels are exceeded. Because of the complex nature of bioassay and corresponding data analysis, it is acceptable for applicants to make reference to the procedures in NRC guidance documents.				❒

Item No.	Title and Criteria	Yes	No	N/A	Description Attached
10	**RADIATION SAFETY PROGRAM** ***(Cont'd.)***				
	Occupational Dosimetry ***(Cont'd.)***				
	OR				
	• Contract with an outside group for bioassay services. Provide a commitment that each vendor is licensed or otherwise authorized by NRC or Agreement State to provide required bioassay services.				☑
	Public Dose	Need Not Be Submitted With Application			
	The applicant is not required to, and should not, submit a response to the public dose section during the licensing phase. This matter will be addressed during an inspection.				
	Operating and Emergency Procedures				
	• Procedure for obtaining an agreement with customers outlining the responsibilities of both the customer and service provider, when performing service operations at a customer's facility	☑	☐	☐	☑
	• Instructions for handling and using licensed materials.	☑	☐	☐	☑
	• Instructions for maintaining security during storage and transportation.	☑	☐	☐	☑
	• Instructions to keep licensed material under control and immediate surveillance during use.	☑	☐	☐	☑
	• Steps to take to keep radiation exposures ALARA.	☑	☐	☐	☑
	• Steps to maintain accountability during use.	☑	☐	☐	☑
	• Steps to control access to work sites.	☑	☐	☐	☑
	• Steps to take and whom to contact when an emergency occurs.	☑	☐	☐	☑
	• Instructions for using remote handling tools when handling sealed sources, except low-activity calibration sources.	☑	☐	☐	☑
	• Methods and occasions for conducting radiation surveys, including surveys for detecting contamination.	☑	☐	☐	☑

Item No.	Title and Criteria	Yes	No	N/A	Description Attached
10	**RADIATION SAFETY PROGRAM** ***(Cont'd.)***				
	Operating and Emergency Procedures ***(Cont'd.)***				
	• Procedures to minimize personnel exposure during routine use and in the event of an incident, including exposures from inhalation and ingestion of licensed unsealed materials.	☑	☐	☐	☐
	• Methods and occasions for locking and securing stored licensed materials.	☑	☐	☐	☐
	• Procedures for the implementation and adherence to good health physics practices while performing service operations:				
	– Minimization of distance to areas, to the extent practicable, where licensed materials are used and stored	☑	☐	☐	☐
	– Maximization of survey frequency, within reason, to enhance detection of contamination	☐	☐	☑	☐
	– Segregation of radioactive material in waste storage areas	☐	☐	☑	☐
	– Segregation of sealed sources and tracer materials to prevent cross-contamination	☐	☐	☑	☐
	– Separation of radioactive material from explosives	☐	☐	☑	☐
	– Separation of potentially contaminated areas from clean areas by barriers or other controls.	☐	☐	☑	☐
	• Personnel monitoring, including bioassays, and the use of personnel monitoring equipment.	☐	☐	☑	☐
	• Transportation of licensed materials to temporary job sites, packaging of licensed materials for transport in vehicles, placarding of vehicles when needed, and physically securing licensed materials in transport vehicles during transportation to prevent accidental loss, tampering, or unauthorized removal.	☐	☐	☑	☐
	• Procedures for picking up, receiving, and opening packages containing licensed materials, in accordance with 10 CFR 20.1906.	☐	☐	☑	☐
	• Instructions for maintaining records in accordance with the regulations and the license conditions.	☑	☐	☐	☑

Item No.	Title and Criteria	Yes	No	N/A	Description Attached
10	**RADIATION SAFETY PROGRAM** ***(Cont'd.)***				
	Operating and Emergency Procedures ***(Cont'd.)***				
	• Procedures for identifying and reporting to NRC defects and noncompliance as required by 10 CFR 21.21(a) of this chapter.	☑	☐	☐	☐
	• Procedures and actions to be taken if a sealed source is ruptured, including actions to prevent the spread of contamination and minimize inhalation and ingestion of licensed materials and actions to obtain suitable radiation survey instruments.	☑	☐	☐	☐
	• Instructions for the proper storage and disposal of radioactive waste.	☐	☐	☑	☐
	• Procedures to be followed in the event of uncontrolled release of radioactive unsealed licensed material to the environment, including notification of the RSO, NRC, and other Federal and state agencies.	☑	☐	☐	☐
	• Procedures for identifying and reporting to NRC defects and noncompliance. See Table 8.4, which describes the typical incident notifications required by NRC regulations.	☑	☐	☐	☐

Item No.	Title and Criteria	Yes	No	N/A	Description Attached
10	**RADIATION SAFETY PROGRAM** ***(Cont'd.)***				
	Surveys				
	• "We will survey our facility and maintain contamination levels in accordance with the survey frequencies and contamination levels published in NUREG-1556, Vol. 18, 'Consolidated Guidance About Materials Licenses: Program-Specific Guidance About Service Provider Licenses,' dated November 2000."	☑	☐		
	OR				
	• Submit description of alternative method for demonstrating how to evaluate a radiological hazard.				☐
	Leak Tests				
	• "Leak tests, when required by the license, will be performed at intervals approved by NRC or an Agreement State and specified in the Sealed Source and Device Registration Sheet. Leak tests will be performed by an organization authorized by NRC or an Agreement State to provide leak testing services to other licensees or using a leak test kit supplied by an organization authorized by NRC or an Agreement State to provide leak test kits to other licensees and according to the kit supplier's instructions."	☑	☐	☐	
	OR				
	• "Leak testing will follow the model procedures in Appendix O of NUREG-1556, Vol. 18, 'Consolidated Guidance About Materials Licenses: Program-Specific Guidance About Service Provider Licenses,' dated November 2000."	☐	☐		

Item No.	Title and Criteria	Yes	No	N/A	Description Attached
10	**RADIATION SAFETY PROGRAM** ***(Cont'd.)***				
	Leak Tests ***(Cont'd.)***				
	OR				
	• "Leak testing procedures and analysis will be done by the applicant." Provide the information in supporting a request to perform leak testing. Appendix O of NUREG-1556, Vol. 18, "Consolidated Guidance About Materials Licenses: Program-Specific Guidance About Service Provider Licenses," dated November 2000, may serve as guidance.	❒	❒	❒	❒
	OR				
	• "We will provide commercial leak test kits as described in the model leak test kit description in Section 8.9.8 of NUREG-1556, Vol. 18, 'Consolidated Guidance About Materials Licenses: Program-Specific Guidance About Service Provider Licenses,' dated November 2000."	❒	❒	❒	
	AND				
	• "We will provide leak test kits as described in the model leak test kit description in Section 8.9.8 of NUREG-1556, Vol. 18." • Provided is a sample of the leak test kits that will be distributed commercially for each type of sealed source/device combination we plan to provide.	☑	❒	❒	❒

Item No.	Title and Criteria	Yes	No	N/A	Description Attached
10	**RADIATION SAFETY PROGRAM** ***(Cont'd.)***				
	Maintenance				
	• "We will implement and maintain procedures for conducting routine maintenance of our device according to each manufacturer's (or distributor's) written recommendations and instructions."	☑	☐		☑
	OR				
	• Alternative procedures are provided for NRC's review. • "We will have the device manufacturer (or distributor) or other person authorized by NRC or an Agreement State to perform non-routine maintenance on our devices."	☐	☐		☐
	OR				
	• Information requested in Appendix P of NUREG-1556, Vol. 18, "Consolidated Guidance About Materials Licenses: Program-Specific Guidance About Service Provider Licenses," dated November 2000, is provided to support requests to conduct non-routine maintenance procedures.				☑
	Minimization of Contamination	No Response is Necessary for this Section			
	• NRC will consider that the criteria for minimization of contamination has been met if the applicant's responses satisfy the criteria in the following sections: "Radioactive Material – Unsealed and/or Sealed Sources," "Facilities and Equipment," "Radiation Safety Program – Safe Use of Radioisotopes and Emergency Procedures," "Radiation Safety Program – Surveys," and "Radiation Safety Program – Waste Management."				

Item No.	Title and Criteria	Yes	No	N/A	Description Attached
10	**RADIATION SAFETY PROGRAM** ***(Cont'd.)***				
	Transportation No response is needed from applicants during the licensing phase.	No Response is Necessary for this Section			
	Waste Management				
	• "We will use the model waste procedures published in Appendix N of NUREG-1556, Vol. 18, 'Consolidated Guidance About Materials Licenses: Program-Specific Guidance About Service Provider Licenses,' dated November 2000."	❒	❒	❒	
	• If the applicant wishes to use only selected model procedures, provide a statement that: "We will use the (specify either: (1) Decay-In-Storage; or (2) Disposal of Liquids Into Sanitary Sewerage) model waste procedures that are published in Appendix N of NUREG-1556, Vol. 18, 'Consolidated Guidance About Materials Licenses: Program-Specific Guidance About Service Provider Licenses,' dated November 2000."	❒	❒	❒	
	OR				
	• Provided are procedures for waste collection, storage, and disposal by any of the authorized methods described in this section.				❒
	OR				
	• If access to a radioactive waste burial site is unavailable, the applicant should request authorization for extended interim storage of waste. Applicant should refer to NRC IN 90-09, "Extended Interim Storage of Low-Level Radioactive Waste by Fuel Cycle and Materials Licensees," dated February 1990, for guidance if extended storage is required.	❒	❒	❒	❒

Radiation Operations and Emergency Manual

Procedure Number: 200

Revision: 5

Effective Date: 05-01-2005

Approved By: _____ 4-07-2005
James R. Beaty III — Date
Corporate Radiation Safety Officer

ATOMIC STRUCTURE AND RADIOACTIVITY

1.0 MATTER

All material is composed of elements or a combination of elements. There are over 100 elements known; of these some of the heavier ones are man made and do not occur in nature. The smallest unit of any element is an atom of that element. Atoms combine to form molecules. Molecules can be made up of atoms of the same element or as in compounds, of atoms of two or more elements.

1.1 FUNDAMENTAL PARTICLES

Atoms are extremely small but they themselves are built from yet smaller particles, their symbols and basic properties are as follows:

Particle	Symbol	Relative Mass	Electric Charge
proton	p	1 *	+
neutron	n	1	0
electron	e	1/1840	-

*weight of a proton = 1.67243×10^{-24} gm.

1.2 STRUCTURE

The negative charge of an atom is equal to the total positive charge. Thus the net charge on the atom is zero. Atoms consist of a central condensed mass called the nucleus made up of neutrons and protons around which circle a number of electrons, the path of which are called orbits. The simplest atom, that of hydrogen, consists of a single-proton in the nucleus with one electron circling round it. The second simplest atom, helium, has two neutrons and two protons in the nucleus and two electrons in the orbit. The number of protons and neutrons increase with weight of the elements but invariably for each proton in the nucleus the atom has one orbital electron which means that the total.

1.3 ELECTRON ORBITS

The electrons in an atom can be visualized as circling the central nucleus in orbits

at different levels or shells. (The atom is mostly empty space. Small as the hydrogen atom is, its diameter is 10,000 times greater than the diameter of its nucleus).

PARTIAL LIST OF THE ELEMENTS

Z	NAME OF ELEMENT	SYMBOL	Z	NAME OF ELEMENT	SYMBOL
1	Hydrogen	H	47	Silver	Ag
2	Helium	He	48	Cadmium	Cd
3	L lithium	Li	49	Indium	In
4	Beryllium	Be	50	Tin	Sn
5	Boron	B	51	Antimony	Sb
6	Carbon	C	52	Tellurium	Te
7	Nitrogen	N	53	Iodine	I
8	Oxygen	0	54	Xenon	Xe
9	Fluorine	F	55	Cesium	Cs
10	Neon	Ne	56	Barium	Ba
11	Sodium	Na	57	Lanthanum	La
12	Magnesium	Mg	58	Cerium	Ce
13	Aluminum	A1	59	Praseodynium	Pr
14	Silicon	Si	60	Neodymium	Md
15	Phosphorus	P	61	Promethium	Pm
16	Sulphur	S	62	Samarium	Sm
17	Chlorine	C1	63	Europium	Eu
18	Argon	A	64	Gadolinium	Gd
19	Potassium	K	65	Terbium	Tb
20	Calcium	Ca	66	Dysprosium	Dy
21	Scandium	Sc	67	Holmium	Ho
22	Titanium	Ti	68	Erbium	Er
23	Vanadium	V	69	Thulium	Tm
24	Chromium	Cr	70	Ytterbium	Yb
25	Manganese	Mn	71	Lutecium	Lu
26	Iron	Fe	72	Hafnium	Hf
27	Cobalt	Co	73	Tantalum	Ta
28	Nickel	Ni	74	Tungsten	W
29	Copper	Cu	75	Rhenium	Re

30	Zinc	Zn	76	Osmium	Os
31	Gallium	Ga	77	Iridium	Ir
32	Germanium	Ge	78	Platinum	pt
33	Arsenic	As	79	Gold	Au
34	Selenium	Se	80	Mercury	Hs
35	Bromine	Br	81	Thallium	T1
36	Krypton	Kr	82	Lead	Pb
37	Rubidium	Rb	83	Bismuth	Bi
38	Strontium	Sr	84	Polonium	Po
39	Yttrium	Y	85	Astatine	At
40	Zirconium	Zr	86	Radon	Rn
41	Niobium	Nb	87	Francium	Fr
42	Molybdenum	Mo	88	Radium	Ra
43	Technetium	Te	89	Actinium	Ac
44	Ruthenium	Ru	90	Thorium	Th
45	Rhodium	Rh	91	Protactinium	Pa
46	Palladium	Pd	92	Uranium	U

The innermost shell is called the "K" shell, the next "L", "M" and so on. The number of electrons that can be accommodated in each shell is limited. For example, the K shell can have 2 electrons while L and M can house 8 and 18 respectively. Transfer of electrons from an inner shell to an outer one requires energy while the reverse process results in released energy in the form of electro-magnetic radiations.

1.4 ATOMIC NUMBER

Since the number of orbital electrons in an atom is always equal to the number of protons in its nucleus, the number of protons determines the overall structure and is characteristic of the element. This important quantity is called the Atomic Number, and is usually represented by the letter "Z".

For hydrogen "Z" is 1, for helium it is 2, while for uranium, which has 92 protons, it is 92.

1.5 MASS NUMBER

As will be seen from the relative weights of the fundamental particles, nearly all the weight or mass of an atom is due to the neutrons and protons. The contribution by the

electrons is negligible. The sum of the numbers of protons and neutrons is called the Mass Number and is designated by the letter "A".

If the number of neutrons is denoted by the letter "N", then N = A - Z Since A = N + Z

Uranium has a mass number of 238 and its Atomic Number is 92, thus the number of neutrons is 238 - 92 = 146.

1.6 ISOTOPES

The number of neutrons per proton in a nucleus i.e. the ratio N/Z is equal to one in lighter elements (except hydrogen). This ratio increases with higher values of Z. (Fig. 8}. Nuclear Forces between neutrons and protons hold them together. A nucleus with a given number of protons requires a certain number of neutrons so that the nuclear forces are enough to counteract the repulsive forces between protons. Any great deviation from the optimum N/Z ratio is not tolerated but the number of neutrons can however vary somewhat. Thus it is possible to have atoms with the same Z but different A and N. Such atoms of the same element, which have different atomic masses or mass numbers, are called Isotopes.

As has been mentioned earlier the common form of hydrogen has only one proton in the nucleus. However other forms of hydrogen exist. The nucleus of an atom of a heavier form called deuterium has a neutron along with the proton. Such atoms have atomic number 1 but mass number 2. Hydrogen and deuterium are isotopes of the same element. Yet another form with 2 neutrons in the nucleus is known.
Many elements have more than one isotope occurring in nature. Unlike hydrogen they are not given special names, but are identified by their mass numbers, for example: Uranium 235 and Uranium - 238. The latter contains 3 more neutrons per atom than the former. More accurate symbols for these isotopes would be 92^{U235} and 92^{U238} respectively., Such symbols give information about Z, A and consequently about N. Except for the isotopes of the very light elements such as hydrogen, the elaborate.

1.7 NUCLIDES

All the different types of atoms are referred to collectively as nuclides. A nuclide is a species (kind) of atom characterized by the make up of the nucleus i.e. by the number of neutrons and protons it contains. Most of the 92 naturally occurring elements have two or more isotopes. Hence, there are over 300 naturally occurring nuclides.

RADIOACTIVE TRANSFORMATIONS

1.0 Alpha Particles

When the neutron/proton ratio for all naturally occurring nuclides are plotted (Figure 8), a smooth band is obtained terminating with the nuclides of the heaviest element occurring in nature, namely uranium. Of these, however, nuclides having more than 92 protons are unstable, this can be ascribed to the fact that due to their large size the nuclear forces holding them together are not quite strong enough to overcome the mutual repulsion of the large number of positively charged protons.

Consequently such heavy nuclides have a tendency to eject a few protons or neutrons. Actually a nuclide of helium consisting of two neutrons and two protons is cast out. Such a package is projected with extremely high velocity and is called an alpha particle. The resulting nuclide is an atom of an element with atomic number and mass number reduced by two and four respectively. Thus Radium with Atomic Number 88 and mass number 226 is transformed to Radon with Z = 86 and A = 222 or $88^{Ra226} - 86^{Rn222} + 2^{He4} + Q$ t (7).

The above is a nuclear reaction equation showing a radioactive transformation whereby one element is transformed into another. In this case, Ra is the parent and Rn is the decay product or daughter.

Usually, for the heavier elements one such adjustment is not sufficient to establish stability but the process goes on giving rise to a series of radioactive nuclides of decreasing Z, N and A till a much lighter stable element is reached. There are four naturally occurring radioactive series in nature. Three of these terminate with different non-radioactive isotopes of lead and one with that of bismuth. Apart from the heavy elements, there are other naturally occurring isotopes, which are radioactive.

2.0 Neutron

Apart from spontaneous disintegration many of the heavier atoms can be induced to split into fragments. Such splitting of a large atom usually into two fragments is called fission. The most common method of bringing this about is to strike the heavy nuclide with a neutron.

Fission of uranium or other heavy nuclides results in production of neutrons. The importance of this will be seen later.

Apart from fission there are other methods of producing neutrons. Basically the only way to produce neutrons is to knock them out from nuclei. This can be done by either energizing a nuclide by gamma radiations or by bombarding it with suitable projectiles. An example of the first reaction is: $4^{Be9} + 'Y - 4^{BE8} + o^{nl} + Q\ f\ (8)$

Such reactions are called photonuclear reactions.

When a. particles react with certain substances such as Beryllium, neutrons are produced by the following reaction:

$4^{Be9} + 2^{He4}$ (a particle) $- 6^{C12} \quad + \quad o^{nl} + Q\ t\ (9)$

Such a neutron sources are prepared by intimately mixing radium and beryllium. The radium provides the alpha particles. There are other methods of knocking out neutrons from various nuclei.

3.0 Beta Particles

The ratio N/Z is an important factor in nuclear stability. If by artificial means a nuclide can be produced with an excess of either neutrons or protons, such a nuclide would tend to adjust itself so as to acquire a N/Z value corresponding to stability. To understand the process of doing this, it is necessary to look into behavior of neutrons. As has been noted previously the neutron is comparable in mass to a proton. Actually it is slightly heavier. Furthe4 a free neutron will spontaneously change into a proton and an electron.

$O^{nl} - 1^{Pl} + e^{-} + Q\ (10)$

Such radioactive decay of neutrons does not normally occur when it is bound in a nuclide. However, if a nuclide has too many neutrons it adjusts itself spontaneously by converting a neutron to a proton and ejecting an electron. Such ejected electrons, which travel at very great velocities, are called beta particles. Adjustments by this process can continue till the element nuclide has a N/Z ratio corresponding to stability. For each beta emission the nuclide loses a neutron but gains a proton, thus there is an increase in the Atomic Number by 1 unit but no change in mass number:

82^{Pb214} --- $83^{Bi214} + e^{-} + Q\ f\ (11)$

4.0 Capture

From the above it can be expected that if an artificially produced nuclide has an excess of protons, it will tend to convert a proton into a neutron. One method of achieving this is to capture one of the electrons circling in the orbits. Such a process is termed as K capture since an electron on the K orbit is involved. This form of radioactivity does not result in the emission of any particle but there is a release of energy in the form of electromagnetic waves. Such a transformation results in the daughter having an atomic number less than the parent by 1 unit.

5.0 Energy Release Gamma Radiation

In all nuclear reaction equations, it is seen that there is a term Q required to balance the two sides. This represents the energy released in the reaction. This manifests itself (as the kinetic energy carried away by the high-speed particles and recoil of the daughter atoms.

Many radioactive transformations leave the daughter in an "excited state". Such nuclei reach the ground state by emission of electromagnetic radiation called a gamma ray. Thus it is seen that gamma ray emission is a secondary effect of a nuclear transformation. More than one gamma radiation can be given off for each transformation.
The nature and properties of various radiations discussed so far will be dealt with in a subsequent chapter.

6.0 PRODUCTION OF RADIOISOTOPES

The production of radioactive nuclei can be achieved either by (1) splitting up large atoms or (2) by altering the N/Z ratio of a stable nuclide.

(1) The first reaction, namely fission, has already been mentioned:

When a heavy atom like uranium splits into 2 fragments, each fragment has a N/Z ratio closely corresponding to uranium. Thus they have far more neutrons than the stable nuclide of corresponding atomic number. To correct this situation the nuclide may initially lose neutrons but subsequently invariably undergoes successive radioactive decay by emission. The uranium atom in undergoing fission splits up in a variety of ways producing a large number of such neutron rich fragments. The nuclear reactor where fission of uranium under controlled conditions takes place is therefore a very good source for obtaining radioactive isotopes.

(2) The N/Z ratio of a nuclide can be altered by bombarding it with projectiles such as the a -particle, protons, and neutrons, etc. However, since the nucleus is positively charged, particles such as the proton or a particle which are themselves positively charged will be strongly repulsed. Such reactions can therefore be carried out only when the proton of the other charged particle is energized to a very great velocity.

If, however the neutron is used as a projectile, it will not be repulsed by the nucleus since it has no charge. If a material is placed in the path of a beam of neutrons, it can be expected that some of the nuclei will be hit by the neutrons. Such hits can result in capture by the target nucleus. Capture of neutrons is favored when the neutrons are traveling at a slow rate. Slow moving neutrons are called thermal neutrons. Apart from the speed of neutrons, the capturing power of nuclei are quite different for different material. Material which capture neutrons easily are said to have high capture cross sections.

Materials, which have captured neutrons, have an N/Z ratio greater than required for stability. Obviously therefore they are likely to be radioactive and decay by emission of B particles. This method of rendering a material radioactive is the most commonly used for producing isotopes used in industry. Neutron capture -reaction can be written as follows:

$$_{27}Co^{59} + on^{1} \ ? \ _{27}Co^{60} + Q \ ? \ (12)$$

Activation by neutron capture is carried out in nuclear reactors. Nuclear fission of materials such as uranium in nuclear reactors results in the production of a large number of free neutrons. If any material is placed in a reactor, it will capture some of these neutrons. The rate of capture can be greatly increased by allowing the neutrons to slow down by passing through materials called moderators.

7.0 THE RADIOACTIVE DECAY PROCESS

Since radioactive nuclei tend to decay to stable states, it is obvious that the amount of radioactivity will constantly decrease. It has been established experimentally that the rate of decrease is characteristic of the radioactive nuclei and cannot be changed by chemical or physical means. The time required for half the number of any given number of radioactive nuclei to decay is called the half life of the particular radioisotope. Let us suppose there are one thousand atoms of a certain radioactive substance which has a half life of ten minutes. After ten minutes, there will be only 500 radioactive atoms left. In the next ten minutes half of these 500 would decay leaving 250. This process would continue so that after four half lives lj16th of the original radioactive atoms would remain.

Analytically the number "N" of atoms disintegrating in a given time interval "t" is proportional to the number N_o of radioactive atoms present.

Where A is the constant of proportionality called the decay constant. This equation can be integrated to yield:
$N = N_O$ e- At

Where N_0 is the total number of atoms present at time, t = o.

Since this is an exponential equation, the ratio N/N_o can be plotted against time on a semi-log graph paper to yield a straight line. The above equation is true for all radioactive decay processes.

The half-life of radioactive isotopes can vary from 10^{-6} sec. or lower to billions of years as is seen in the following table:

Radionuclide	Half-life	Mass Req. for 1 Curie
Nitrogen-16 (N16)	7.3 Seconds	1×10^{-11} grams
Strontium-90 (Sr90)	19.9 years	7×10^{-3} grams
Radium-226 (Ra226)	1622 years	1 gram
Uranium-238 (U238)	4.49×10^{9} years	3.3 tons

8.0 UNIT OF RADIOACTIVITY

Since radioactive isotopes decay with their own characteristic half-lives, a given amount of material, which decays fast, will be more radioactive than a similar quantity of material, which is decaying slowly. Obviously therefore, the quantity in weight or volume is not a measure of its radioactivity. The unit of radioactivity was initially established as that amount of activity corresponding to one gram of radium or more precisely that quantity of radioactive nuclide, which is disintegrating at the rate of 3.7×10^{10} atoms per second. Smaller units used are the (millicurie and the microcurie) which are 3.7×10^{7} d.p.s. and 3.7×10^{4} d.p.s. respectively.

Krypton

Krypton is the substance most often used as a radiation source in Gauging System sensors. The following information describes what krypton is and where we get it. Later sections will describe the krypton source capsule, what happens to krypton as it decays, radiation safety precautions, and other related subjects.

Krypton is element #36 on the Periodic Chart. It makes up about one part per million of the earth's atmosphere. Krypton, along with neon, argon, and xenon, was discovered around the turn of the century as part of the gas, which remained after nitrogen and oxygen were boiled off from liquefied air. The word "krypton" comes from the Greek word "crypt" or "cryptic" and means "hidden." Krypton is considered to be an inert (or noble) gas since it does not react readily with other substances.

All krypton has 36 electrons and 36 protons per atom, so the krypton in the atmosphere and the krypton in radioactive source capsules are chemically identical. However, most of the atmospheric krypton is non-radioactive (stable) and differs from the radioactive krypton used in Gauging system sensors in that it has more or less neutrons in its nuclei.

Both radioactive and stable krypton is produced as fission products in nuclear reactors. This krypton can be recovered from the used fuel rods of fission reactors. Such fuel reprocessing is the source of commercially available Kr-85.

Before the recovered krypton gas is used, it is desirable to separate as much as possible of the stable krypton from the radioactive Kr-85. This is because the stable krypton does not contribute to the emitted radiation, but actually absorbs some of the Kr-85 radiation. Since stable and radioactive krypton have the same number of electrons per atom and are thus chemically identical, it is not possible to separate them using chemical techniques.

One method that is presently used in separation of various types of krypton is called *U* gaseous diffusion." It is one of the processes used to separate uranium-235 for use as a fuel in fission reactors from non-fissionable types of uranium. The result of the gas diffusion process is not pure Kr-85, but a mixture of radioactive and stable krypton.

The fraction of the total krypton mass, which is due to Kr-85, is called "the enrichment." Krypton gas that is pure Kr-85 has an enrichment of 1.

Krypton Sources Used by OEM Gauging Systems

The krypton sources are small metal cylinders with a circular flange used to mount them in basic weight assemblies. They are a few centimeters in height and contain a very small volume of pressurized Kr-85 enriched krypton gas. The window consists of a thin metal foil, which permits considerably more of the radiation emitted by the gas to be transmitted than do the capsule walls. The top of the capsule is etched to identify the contents. The capsule does not glow!

The capsule window is located immediately above the shutter in basis weight assemblies. The source capsule must never be accessed except by persons specifically licensed to disassemble basis weight assemblies. GE Automation Services is not authorized to perform this operation.

Radioactive sources exist in two basic forms. Most of the radioactive material sold by source manufacturers is in an unsealed form. Examples are the radioactively labeled gases and solutions used in medicine and research. Other radioactive sources, such as those used by gauging companies, are in a sealed form. In sealed sources, the radioactive material is completely sealed within a container.

In the case of sealed sources, the radionuclide vendor must obtain permission from the Nuclear Regulatory Commission (NRC) or from the state agency to which the NRC has delegated authority before it can manufacture and sell a particular capsule design.

To produce the krypton sources, the radionuclide vendor fills the sources with krypton gas by attaching the empty capsules to a pressurized gas line. The capsules are sealed after the desired quantity of gas has been frozen inside. Krypton has a freezing point of -156.6°C, but it is a gas at temperatures above -152.3°C.

Each time a Kr-85 nucleus undergoes decay, it emits a beta particle. (A beta particle is just an energetic electron.) This beta particle will have a kinetic energy of anywhere from 0 to 672,000 electron volts (eV). The average beta energy will be 249,000 eV. In about one out of every 244 nuclear decays, Kr-85 emits a photon. Photons are massless and chargeless. They are basically an invisible and high-energy form of light. The photon emitted by Kr-85 has energy of 514,000 electron volts.

Ignoring the effects of capsule and self-absorption, the dose rate from the most active Kr-85 source used by Gauging systems is approximately 1300 Rem per minute at a distance of 2 m. For comparison, a typical chest X-ray would result in a skin dose of about 0.045 Rem.

Kr-85 is primarily a hazard to the skin. This is because none of the emitted beta particles can penetrate deeper than 1/4 mm (1/10 in.) below the surface of the skin. The photons emitted by Kr-85 are much more penetrating - 50 percent of them can penetrate to a depth of 7 mm (2.8 in.) or more below the skin surface. However, because photons are emitted in much smaller numbers than beta particles, their contribution to the radiation dose is relatively small.

Exposure to an unshielded Kr-85 source of the type used by gauging systems can produce serious damage to the skin exposed to the beam. At short distances, the source output is sufficient to cause the equivalent of a third-degree bum to the exposed skin in a matter of minutes. A third degree bum may require skin grafts because healing will not take place. Burns of lesser severity, equivalent to second- or first-degree thermal burns, can occur from shorter exposure time.
In addition, we assume that any increase in skin dose increases the risk of skin cancer. Large radiation doses to the skin increase this risk much more than smaller doses. Therefore, it is very important to exercise proper precautions to avoid the possibility of direct exposure to a Kr-85 source.

The radiation levels adjacent to sheet gauges containing Kr-85 sources are low when the heads are in their normal configuration. The actual radiation beam emitted by the Kr-85 source is quite small in size since the source aperture is no more than 1.8mm (0.7 inch) in diameter. Radiation present outside the measurement gap is primarily due to beta particles, which scatter out of the primary beam. These scattered particles are very low energy and contribute only to a non-penetrating or skin dose rate.

There are also a very small number of more energetic photons present. Because these photons are relatively penetrating, a small amount of radiation above background can be measured near the sensor even when the source shutter is closed.

With the exception of a small percentage of systems built for customers with specific radioactive materials licenses, all sensors shipped must satisfy the following shutter-open dose rate limits at a distance of 30 cm (12 inches) from the edges of the heads or sheet guide extenders.

Non-penetrating or skin dose rate - 0.03 rem/hr
Penetrating dose rate –
Capable of penetrating to the depth of the lens of the eye or deeper - 0.005 rem/hr

In reality, the shutter-open penetrating dose rate 30 cm from Gauging systems Kr-85 sensor heads is rarely more than 10 percent of the limit. The non-penetrating dose rate approaches the 0.03 rem/hr limit for some sensors.

It means that the dose rate outside the measurement gap of Kr-85 sensors is quite low. For example, in order to exceed the U.S. limits for occupational exposure to the skin, a person would have to spend more than 1600 hours in one year at 30 cm or less from a Kr-85 sensor. The source shutter would have to be open and contain no product in the measurement gap. The probability of this occurring is negligible.

In essence, this means that a person can work around a Kr-85 sensor without being concerned about receiving a large radiation exposure. At the same time, we assume that all radiation exposure carries some risk. The reasonable approach is to avoid all unnecessary exposure and to spend no more time than necessary near sensors when the source shutter is open.

Consequences of a Kr-85 Capsule Rupture

Although it is an infrequent event, Kr-85 source capsules occasionally rupture. This information note discusses Kr-85 capsule leaks, how they can be detected, and what to do.

As described earlier, krypton source capsules contain a very small amount of pressurized gas. The source window is a thin metal foil, which permits more of the radiation to be transmitted than do the thicker capsule walls. A leak can develop in the foil window, itself, or in the weld between the foil and the capsule wall. When that happens, the capsule may slowly leak its contents over a period of weeks or months. Alternatively, the source may vent most of the krypton it contains within a very short period of time.

A slow leak may not be immediately obvious since Kr-85 sources normally decrease in output by about 0.5 percent per month due to radioactive decay. More rapid leaks may cause large drops in reference counts, sensor readings and increased sensor instability. Unfortunately, these same symptoms can exist for other conditions, such as debris buildup in the basis weight assembly, an ion chamber failure, or a source shutter problem.

If possible, maximize the ventilation in the area containing the Kr-85 source. Contact the Radiation Safety Office promptly. You will be asked a series of questions to help determine whether the source is actually leaking. If it is, you will be given instructions and assistance in replacing the basis weight assembly.

In the mill environment, there is no reasonable way that a Kr-85 capsule leak could pose a hazard to you or others because.

1. Krypton gas dilutes and disperses very rapidly.
2. Krypton is an inert gas, which does not contaminate objects or accumulate in body tissue.
3. Except when in a fairly concentrated form, the quantity of Krypton 85 is not sufficient to result in hazardous radiation levels.
4. Krypton 85 leaks are infrequent events. They are a subject of concern, but should not be a cause of alarm.

Source Leak or Damage Emergency Procedure

1. **Get all personnel away from area.**
2. **Assume Gauge/Source is damaged**
3. **Notify RSO**
4. **Use Survey Meter to perform checks**
5. **If readings reach 2 mr/hr, STOP!**
6. **Call RSO**

BASIC RADIATION PROTECTION - INDUSTRIAL TECHNIQUES

ROUTINE AND EMERGENCY PROCEDURES

1.0 Spill and Leaks

There is a distinction normally made between spills and leaks.

Spills are said to occur when unsealed sources as, for instance, radioactive liquids being used as tracers in the oil industry, escape from the containers in which they are being transported or handled. Leaks are said to occur when radioactive material escapes from a sealed source of some kind. The end result is the same in that radioactive contamination is present where it is not wanted and that steps must be taken to remove it.

It is not possible to neutralize radioactivity in the same way as; for instance, an acid spill can be neutralized with a caustic solution. If it has a very short half-life, a spill of radioactive material can sometimes be roped off and left to decay. The advantage of this method is that it avoids involvement in physical decontamination operations. After seven half-lives, the level of activity will have decayed to less than one percent of its original strength, and after ten half-lives, the level will be down to 0.1 percent.

If the half-life of the material is too long to allow it to be left to decay naturally, and if the level of contamination is sufficient to constitute a possible health hazard to personnel, the only solution to the problem is to take steps to remove the contamination to where it can be safely disposed of. Methods of decontamination may be either destructive or non-destructive depending upon the level and nature of the contamination, the surface involved and the use to which it is to be put. However, it is not the purpose of this lecture to deal with the various methods of decontamination in detail.

If a spill or leak is found to have occurred, the area surrounding it should immediately be segregated by being roped off, by closing and taping up all the windows and doors of the room concerned, or in any other suitable manner. All ventilation should be shut off. All personnel who have been in the vicinity of the spill should be held at the barrier surrounding the segregated area until it is possible to monitor them for possible contamination. Any clothes or shoes, which are contaminated, should be removed and left within the segregated area. Under no circumstances should anyone, other than qualified health physics personnel, enter the area to give assistance.
The case of a leaking Kr85 Krypton source is an exception. Since Krypton is a noble gas and is non-reactive in the biological system, the best method is to clear the area of the

leaking gas by excess ventilation. Krypton is the only radioisotope used by gauging systems that falls into this category.
Attempts to remove skin contamination should be limited to washing the affected area three (3) times with soap and warm water. Under no circumstances should the skin be scrubbed so severely that it is reddened or broken. If this is not successful in removing the contamination, immediately contact the RSO at the site or contact the GEAS CRSO. DO not panic and rush to the nearest doctor or hospital, as most have neither the knowledge nor facilities to handle such emergencies. The exception to this is, of course, in the case of concurrent severe physical injuries.

It is most important that plans be thought out in advance to cover all possible accidents involving a spread of radioactive contamination. In general, if one is involved in a contamination accident of any magnitude, it is wise to seek outside assistance from qualified personnel. When attempts are made to clean up contamination using only unskilled personnel, the usual result is an additional spread of contamination.

If a sealed source other than Krypton is inadvertently ruptured or severely damaged, do not attempt to remove or repair it. The best course of action is to cover the entire source and any visible leakage with several wet paper or cloth towels and then leave it alone until qualified assistance can arrive.

2.0 Current Requirements for Leak testing

With some minor exceptions, the following conditions for the leak testing of sealed sources are being attached to licenses for radioisotopes, which are being issued at the present time.

1. Sealed sources containing radioactive material in solid or liquid form, other than tritium, with a half-life greater than 30 days, shall be tested for leakage and/or contamination at intervals not to exceed 6 months. In the absence of a certificate from a supplier certifying that a test has been made within 6 months of the date of the transfer, the sealed source shall not be put into use until tested.

2. The tests used should be capable of detecting the presence of 0.005 Ci, 0.5 mR/hr, of radioactive material on the exterior of the source holder or container.

3. The leak tests shall be made either on the source itself, or on the surfaces of the device in which the source is permanently mounted or stored on which one might expect contamination to accumulate. Records of leak test results shall be

maintained in permanent form and should be available for inspection by federal and state or provincial health authorities when required.

4. If the tests reveal the presence of 0.005 Ci, 0.5 mR/hr, or more of removable contamination, the responsible user shall withdraw the source from use immediately, and shall ensure that it is decontaminated and repaired, or disposed of in accordance with the conditions of the license. A report shall be filed within 5 days of the test with the agreement state involved or in the case of non-agreement states, the NRC, describing the equipment involved, the test results, and the corrective action taken.

3.0 Gaseous Leakage

Some gauges used in industry utilize radioactive sources in their gaseous form such as Kr-85. This isotope, or H-3, another gaseous isotope, is often used in luminous markers, etc. In addition, gaseous Rn-222 is formed as a daughter product of the decay of Ra-226. A very brief consideration will show that the majority of the methods of leak testing listed above are not suitable for detecting the leakage of a gas. The methods commonly used to detect gaseous leakage are as follows:

In the case of Kr-85 in a gauge, after the instrument has been initially installed and calibrated, any significant drift from the zero position on the recording instrument should be investigated. If the source is leaking, this drift will probably be of a continuing nature. Such a drift may also be caused by electronic fault. It is recommended that this latter possibility be investigated first, since it is a more probable type of failure. If the source is leaking, the magnitude of the leak will determine the rate of drift, which will range from the obviously noticeable to the quite insignificant. In the case of a very small leak, the drift may go unnoticed until the instrument can no longer be zeroed. It is suggested that these facts be explained to the operators of the instruments.

If the symptoms mentioned above are noted, the service representative should be consulted. Since Kr-85 is an inert gas, a small leak is not considered overly dangerous, but if suspected should definitely be investigated. If such a gauge is thought to be leaking, it should immediately be taken out of service and placed in a well-ventilated area until it has been examined by a suitably qualified person. Care should be taken, by means of ventilation, not to expose the remover to airborne hazards.

4.0 Notification of Leakage

If a sealed source of any kind is found to be leaking, it is recommended that information on the discovery of the leakage, and on the probable cause of it, should be sent to both the NRC and State Health Authorities and to the manufacturer. This will help to provide information that will be useful in designing safer sources, and will also enable the health authorities to notify other users of the possible hazards involved in the use of such a source. The most practical method of notifying the authorities is to first contact the supplier's radiation safety officer and have him notify the appropriate authorities.

5.0 Storage and Disposal of Sources

When not in use, sealed sources should be stored in a locked fireproof container, so shielded that the field at the nearest accessible place on the exterior does not exceed 2.5 mR/hr. Access to the stored source should be restricted to the responsible user or his delegate. In addition, care should be taken that non-atomic energy workers are not exposed to radiation fields, which will cause exposures in excess of 300 mrem in any 13-week period, or 500 mrem in any calendar equivalent year. If a source is stored, it must be leak-tested at six-month intervals.

6.0 Postal Regulations

The United States Post Office permits transmission of radioactive materials through the mails generally in accordance with the Universal Postal Union recommendations. For the U.S.A. this applies only to exempt quantities not requiring a label.

IMPORTANT

Before sending smears through the mail, they should be monitored with a survey meter to verify that the radiation level is less than 0.5mR/hr. If the levels exceed this value the samples cannot be sent by mail. (U.S. Postal Service Publication 6, Dated April 1971). A radiation level of 0.5mR/hr is a result of at least 0.185 kilobecquerel (0.005 microcuries). This contamination level indicates a leaking source and a report must be made to the regulatory agencies within 5 days.

Methods of Leak-Testing

The method of leak testing listed below is commonly used to test sealed sources. The method selected in any particular instance depends upon which test is thought to give the most efficient and convenient results for that particular type of source.

1.0 Wipe Test

Exposed external surfaces of the object to be tested are wiped thoroughly with a piece of filter paper of high wet strength and absorption capacity, or Q-tips moistened with alcohol or water. The piece is allowed to dry and the contamination on the Q-tip is then measured.

When wiping the object, special attention should be paid to any cracks or joints since it is most probable that contamination will appear and be lodged in such places. As an alternative to filter paper, tissues such as Scotties or applicators such as "Q-tips", may be used. The choice of the particular type of material used to make the wipe will depend partly upon the surface being wiped. Filter paper should be maintained at less than 2" diameter for easy analysis.

2.0 SOURCE INSPECTION PROCEDURES
Materials Required for Source Inspection

1. TLD Badge
2. Rubber Gloves
3. Safety Glasses
4. Alcohol
5. Cotton Swabs
6. Geiger Counter with beta detector
7. Source Report Envelope
8. Plastic Bag, Zip-Lock
9. Plastic Sheet
10. Mirror

1. Determine if source is a sealed gas type or a solid type. Pm-147 or Sr-90.

2. If it is a sealed gas type, KR-85 or other gas, a shutter inspection is all that is required. (Shutter inspection means verifying that the shutter is functioning electrically and mechanically and all safety interlocks are functional and all required labels are present and readable.) Use attached form and follow the directions on the form.

Semi-Annual Radiation Safety Survey

Date: _____

GE Rep: _____ Emp. #: _____

Customer: _____ Customer RSO: _____

Address: _____ Title: _____

_____

Note: A person who is presently employed by GE Automation Services and who has been trained and authorized in accordance with GEAS Procedure 100-2 must conduct this procedure. This procedure must be completed at 6-month intervals and are not to exceed this interval except by special permission.

Use one form for each system. When completed, make 2 copies, send one copy to the analyzing facility with the wipes, and one copy to the CRSO. Put the original in your site file book.

Location:			
Device Model:			
Device Serial No.:			
Source Serial No.:			
Isotope:			
Quantity (mCi):			
Labels:			
Shutter Lights:			
Interlocks:			
Source wipe required:			
Meter Background counts			
Wipe test counts			

Survey Meter Serial #: _____ SN _____ Probe SN _____
Survey Meter last Calibration Date: _____

Leak Test Procedure

Comments:

3. If the source is a solid, follows steps "a" through "f".
   a) Turn source shutter to "OFF".
   b) Ensure source closed lights are on.
   c) Check calibration of Survey Meter.
   d) Don protective gear (safety glasses, gloves, film badge, and finger badges)
   d) Moisten CLEAN swabs in alcohol or water.
   e) Check background radiation well away from source.
   f) Verify source is closed using Survey Meter.
   g) Remove side covers.
   h) Swab the entire exterior source window and source housing.
   i) Check each swab for contamination. Make sure you are well away from the area of the source so that the counter reads the swabs only.
   j) If there is no apparent leakage, swabs read less than .005 mCi, .5 mr/hr, on the lowest scale, place the swabs into the Source Report Envelope and return them to the provider of the Source Wipe Kit for analysis. Include analysis return in envelope with your samples.
   k) Check your hands with the Survey Meter before removing your gloves for any contamination.

   If you have a reading in excess of 0.5mR/hr you probably have a leaking source. Notify the Mill RSO immediately and follow the instructions in Emergency Procedures, section C, page 33 of this manual.

ANALYSIS RETURN FORM

Include a copy of this form in your mailing envelope.

Send wipe test samples to: Perry Consulting
Attn: David Wiik
6450 Overlook Road
Mobile, Al. 36618

Mr. Wiik
Return analysis to:

Jim Beaty
Corporate Radiation Safety Officer
916 Butler
Mobile, AL. 36693

NON-ROUTINE MAINTENANCE PROCEDURE

****IMPORTANT****

Insure all Manufacturer's or Distributor's instructions and recommendations are followed for any non-routine maintenance. This would include installation of the sealed source/device, initial radiation survey, repair or maintenance involving or potentially affecting components, including electronics, related to the radiological safety (e.g. the source, source holder, drive mechanism, shutter, shutter control, or shielding), relocation, replacement and disposal of sealed sources, alignment, removal of a sealed source/device from service and any other activities during which personnel could receive radiation doses exceeding NRC limits.

PROCEDURES FOR THE SAFE HANDLING OF LOADED SOURCE HOLDERS

Receiving and Storing of Source Holders

All radioactive sealed sources shipped in source holders by gauging companies are packaged so that they may be shipped using either a White I label or a Yellow II label.

This means that the activity at the surface of the package will be no greater than 50 mrem/hr., and at a distance of 3 feet it will be no greater than 1.0 mrem/hr. Packages are normally delivered directly to the mill by the carrier. GEAS personnel do not receive or sign for any source shipment. The source must be received by the mill RSO and should be immediately surveyed for any leakage. After normal receiving procedures are completed, the box should be taken to the maintenance office for unpacking or to the designated storage room in the mill. Only if the source is to be immediately installed in the gauge should it be removed from the shipping container.

The following receiving procedures are provided for your information in that you may be asked to verify the shipping container for your customer.

1. (a) Monitor the external surfaces of a package for radioactive contamination that are labeled with a Radioactive White I, Yellow II, or Yellow III label as specified in U.S. Department of Transportation regulations in 49 CFR 172.403 and 172.436, 438, and 440.

   (b) Monitor the external surfaces of a package for radiation levels that are labeled with a Radioactive White I, Yellow II, or Yellow III label as specified in U.S. Department of Transportation regulations in 49 CFR 172.403 and 172.436, 438, and 440.

   (c) Monitor all packages known to contain radioactive material for radioactive contamination and radiation levels if there is evidence of degradation of package integrity, such as packages that are crushed, wet, or damaged.

2. The licensee or registrant shall perform the monitoring required by Item 1 above, as soon as practicable after receipt of the package but not later than 3 hours after the package is received at the licensee's facility if it is received during the licensee's normal working hours, or not later than 3 hours from the beginning of the next working day if it is received after working hours.

3. The licensee shall immediately notify the final delivery carrier and the state regulatory agency by telephone and telegram, mailgram, or facsimile when:

   (a) Removable radioactive surface contamination exceeds the applicable levels of U.S. Department of Transportation, 49 CFR 173.443; and

(b) External radiation levels around the package exceeds the limits specified in U. S. Department of Transportation, 49 CFR 173.441.

4. Each licensee shall:

(a) Establish, maintain, and retain written procedures for safely opening packages in which radioactive material is received; and

(b) Ensure that the procedures are followed and that consideration is given to special instructions for the type of package being opened.

5. No special form sources shall be transferred in vehicles owned or operated by the Technician or GE Automation Services to or from any work site.

If the source is to be stored, the storage location must be specified by the mill RSO. The source must be secured against unauthorized removal from the storage place and must not be stored in the same facilities with materials which might substantially increase the fire or explosion hazard of the storage space and its radioactive contents. Normally, a lockable unused space in the maintenance office meets all these requirements.

NOTE: Do not leave film badges closer than 6 feet from the source package when using this room.

Unpacking and Installing the Radioactive Gauge

If you have ordered a replacement source from an OEM manufacturer, part of the cost will be to have their Qualified Person unpack and replace the source holder. They should conform to the following procedures.

Before the package containing the radioactive source is opened, it must be inspected to ensure that the shielding material has not changed during transport. For this purpose, a special radiation survey meter capable of measuring beta dose rates must be used. The survey meter used by GEAS to make this measurement is a Victoreen 493 or an NDS-2RP or an NDS-2RPC Survey meter.
If the radiation from the package appears normal (with a Yellow II label this means less than 50 mr/hr at the surface of the box), the box containing the source should be opened and the inner container in which the source is sealed should be removed.

With the container sitting on the bench, open the container. With the lid removed from the container, check that there is no significant beta radiation, the presence of which would indicate that the shielding has moved during transport. If there is a large amount of beta radiation it means that the source is no longer properly capped and special precautionary measures must be taken. If all appears normal, the loaded source housing can be removed from the container.

To check for leakage from the source during shipping, the inner container should be checked for radioactivity, if the source is Krypton 85. (The Krypton will remain in the bottom of the can if it has leaked). If it is a Promethium 147 source, the inside of the aluminum cap should be wipe tested.

Do not leave the loaded source housing unattended. Take the source housing directly to the gauge and install. Replace and test all safety locks and interlocks. Replace all covers removed.

GAUGE RELOCATIONS AND REMOVALS

If you are requested by your customer to relocate or remove a scanning process gauge containing a radioactive source, follow the instructions below.

Get all of the information from your customer and the Mill Radiation Safety Officer and then contact the GEAS Corporate Radiation Safety Officer.

RELOCATION

1. Have a Source Safety Shield, and storage container available and temporary storage location designated by the Mill Radiation Safety Officer. If a safety shield and storage container are not available, they will have to ordered from the manufacturer.

2. Wear your personnel monitoring devices, whole body and extremity tab.

3. Verify source closed lights are lit and verify source closure with a survey meter.

4. If the source is a gas, perform a source safety check. If the source is a solid, follow the directions and perform a source leak test. Verify that the reading on your wipes are below 0.5mR/hr. If you reading is above this level, contact the Mill RSO immediately.

5. Before the scanning frame is moved, remove the source housing and install the safety shield. Put the protected source into the storage container and seal the container.

6. Use your survey meter and verify the radiation reading at the surface of the container and at 30 cm. These readings should be no higher than the requirements for a Yellow II shipping label.

7. Take the source, in the shipping container, immediately to the designated, protected storage area. This should be a location that is lockable or constantly supervised.

8. After the scanning frame is relocated, verify the measurement gap is correct.

9. Reinstall the source housing and replace all locks.
10. Perform a source safety check and verify all interlocks.

11. Using the supplied form and your survey meter, make a drawing of the new location and perform a radiation pattern survey.

12. Send one copy of the Radiation Pattern Survey to the GEAS CRSO, one copy to the Mill RSO and file the original in your site Radiation Safety notebook. The Mill RSO has the responsibility to inform the proper agencies of the move.

REMOVAL

1. Have a Source Safety Shield, and storage container available and temporary storage location designated by the Mill Radiation Safety Officer. If a safety shield and storage container are not available, they will have to ordered from the manufacturer.

2. Wear your personnel monitoring devices, whole body and extremity tab.

3. Verify source closed lights are lit, if power is still available and verify source closure with a survey meter.

4. If the source is a gas, perform a source safety check. If the source is a solid, follow the directions and perform a source leak test. Verify that the reading on your wipes are below 0.5mR/hr. If you reading is above this level, contact the Mill RSO immediately.

5. Before the scanning frame is moved, remove the source housing and install the safety shield. Enclose the source housing in the material provided and place the protected source

into the storage container and seal the container.

6. Use your survey meter and verify the radiation reading at the surface of the container and at 30 cm. These readings should be no higher than the requirements for a Yellow II shipping label. If the readings are higher than those for a Yellow II label, contact the MILL RSO immediately.

7. Take the source, in the shipping container, immediately to the designated, protected storage area. This should be a location that is lockable or constantly supervised.
8. The Mill RSO should have made prior arrangements to return the source to the manufacturer or to a licensed disposal facility.

RADIATION SURVEY	
CUSTOMER NAME	DATE:
FRAME LOCATION SOURCE TYPE	QUANTITY
Survey Performed by:	
USNRC SKETCH	

Radiation reading at: Scale: _____

Head surface_____

Gap_____

30 cm_____

Tending side view

Top view

EMERGENCY PROCEDURES

ACCURAY, MEASUREX AND SENTROL SYSTEMS

A. Introduction

AccuRay, Measurex, Lippke, LFE, and Sentrol process control systems contain radioactive source capsules that have been designed to minimize the probability of leakage of radioactive material in normal use, shipment, and under foreseeable abnormal conditions. These procedures are established in the event of a suspected overexposure from an open sensor, a ruptured source capsule, a damaged scanner head, fire involving or threatening radioactive material, or a natural disaster.

In the event of any suspected emergency involving radioactive material the Mill Radiation Safety Officer must be notified IMMEDIATELY.

B. Suspected Overexposure to GEAS Personnel

The Radiation Safety Officer shall be notified immediately if overexposure to personnel, or inhalation or ingestion of radioactive material is suspected. The personal radiation monitoring devices shall be processed immediately, and a medical examination arranged if necessary.

C. Suspected Source Rupture

The possibility of rupturing a source capsule while in field installation and use is very remote. The capsule is protected by the source housing and the source housing is protected by the head itself. The amount of damage necessary to destroy all of these protective casings and rupture the source capsule is higher than should ever be encountered. A more feasible case of source rupture would be slow leakage discovered at the time of wipe testing. In either case, if it is suspected that a source capsule has been ruptured, the following actions shall be taken:

1) **Evacuate the immediate area.**

2) **Identify all persons in the vicinity of the source, and record their presence.**
3) **The Mill Radiation Safety Officer or, before his arrival, supervisor, in charge, shall designate a suitable holding area away from the contaminated area. All persons in until checked and released the vicinity of the source should go to this**

area. No one shall leave the holding area until cleared by the Mill's Radiation Safety Officer.

4) **Notify the Radiation Safety Officer or the Corporate Radiation Safety Officer of GEAS immediately. The GEAS Radiation Safety Office will notify the appropriate Federal and State agencies and the manufacture.**

5) **If Krypton 85 is involved, turn on all fans and blowers in the area to increase. Ventilation and fresh air exchange. If possible, vent to the outdoors.**

6) **If the accident involves Strontium 90 or Premithem147 radioactive material, the following steps shall be taken:**

   a. **The source of contamination shall immediately be contained by placing it in a plastic bag or other sealable container.**

   b. **Close all windows and shut off all fans and air conditioners in the immediate area if possible.**

   c. **Define the area of contamination and contain its spread, but do not attempt to clean up the contamination.**

   d. **Access to the contaminated area, including the designated holding area, shall be prohibited until the Mill Radiation Safety Officer has assessed the accident, established the extent of contamination and prepared a decontamination plan.**

   e. **If injuries have occurred which are suspected to contain contamination or if skin contamination is suspected, immediate attention shall be given by washing thoroughly with soap and lukewarm water; do not use hot water. Retain the wash water for later disposal by the Radiation Safety Officer. Injured persons shall be checked for contamination and, if necessary, decontaminated under the direction of the Mill Radiation Safety Officer before removal. If ingestion or inhalation of radioactive material is suspected, the Mill RSO will arrange for the necessary medical attention.**

D. Head Separation/ Misalignment

There are several circumstances in which the heads can become separated from each other. The most severe condition is one in which one or more heads have been ripped off the tracks due to contact between the head and the product. In this case, tilt switch interlocks will interrupt the shutter signal and close the shutter.

The OFF SHEET button should be pressed (at the operator station if possible), and the green "shutter closed" lamps observed to be sure that the shutter has closed. The OFF SHEET button is designed to close the shutters even if the heads do not go off sheet. If the green "shutter closed" lamps indicate that the shutter is closed, and either head has not gone off sheet, the head can now be pushed off sheet, preferably by using a long pole to ensure no inadvertent radiation exposure. If for any reason the green "shutter closed" lamps do not indicate that the shatter is closed, no one shall be allowed within 10 feet of the heads under any circumstances.

E. Accidents Involving Fire

In the event of fire, fire fighting has precedence over contamination control. Fire is the primary hazard and should be fought accordingly. Scanning heads should be sent "OFF SHEET" at the earliest possible moment. All source housings are designed with fire safety assemblies, which will lock the shutters closed if fire approaches the heads. After the fire has been extinguished, do not return the system to service for any reason until it has been checked for damage or leakage.

F. Natural Disaster

In the event of a natural disaster such as earthquake or flood, scanning heads should be sent off-sheet at the earliest possible moment. The head will provide the required protection for the radiation source. After such a disaster, do not the gauging system to service for any reason until it has been checked for damage or leakage.

G. NRC Notification

In the event of any occurrence discussed above or any occurrence, which could expose the source capsule or endanger personnel, the NRC in non-agreement states or the agreement state must be notified. Also, notify the Mill RSO, and the GE Corporate RSO. Use the following table for incident notification time frames. Use NRC form 366 and 366A to file a complete report by date given in the table. The RSO will be responsible for notifying the proper authorities.
Note: Telephone notifications shall be made to the NRC Operations Center at (301)-816-5100 or (301)-951-0550.

Typical NRC Incident Notifications Required for Service Provider Licenses.

EVENT	Telephone Notification	Written Report	Regulatory Requirement
Theft or loss of material	Immediate	30 days	10 CFR 20.2201(a)(1)(i)
Whole body dose greater than 0.25 Sv (25 rems)	Immediate	30 days	10 CFR 20.2202(a)(1)(i)
Extremity dose greater than 2.5 Sv (250 rems}	Immediate	30 days	10 CFR 20.2202(a)(1)(iii)
Whole body dose greater than 0.05 Sv (5 rems) in 24 hours	24 hours	30 days	10 CFR 20.2202(b)(1)(i)
Extremity dose greater than 0.5 Sv (50 rems) in 24 hours	24 hours	30 days	10 CFR 20.2202(b)(1)(iii)
Whole body dose greater than 0.05 Sv (5 rems)	None	30 days	10 CFR 20.2203(a)(2)(i)
Dose to individual member of public greater than 1 mSv(100mrems)	None	30 days	10 CFR 20.2203(a)(2)(i)
Defect in equipment that could create a substantial safety hazard	2 days	30 days	10 CFR 21.21(d)(3)(i)
Filing Petition for bankruptcy under 11 U.S.C.	None	Immediately After filing petition	10 CFR 30.34(h)
Expiration of license	None	60 days	10 CFR 30.36(d)
Decision to permanently cease licensed activities at entire site	None	60 days	10 CFR 30.36(d)
No principle activities conducted for 24 months at entire site	None	60 days	10 CFR 30.36(d)
No principle activities conducted for 24 months in any separate building or outdoor area that is unsuitable for release for unrestricted use	None	60 days	10 CFR 30.36(d)
Events that prevents immediate protective actions necessary to avoid exposure to radioactive materials that could exceed regulatory limits	Immediate	30 days	10 CFR 30.50(a)
Equipment is disabled or fails to function as designed when required to prevent radiation exposure in excess of regulatory limits	24 hours	30 days	10 CFR 30.50(b)(2)
Unplanned fire or explosion that effects the integrity of any licensed device, container, or equipment with licensed material	24 hours	30 days	10 CFR 30.50(b)(4)

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NRC FORM 366 (7-2001) U.S. NUCLEAR REGULATORY COMMISSION

APPROVED BY OMB NO. 3150-0104 EXPIRES 7-31-2004

Estimated burden per response to comply with this mandatory information collection request: 50 hours. Reported lessons learned are incorporated into the licensing process and fed back to industry. Send comments regarding burden estimate to the Records Management Branch (T-6 E6), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by internet e-mail to bjs1@nrc.gov, and to the Desk Officer, Office of Information and Regulatory Affairs, NEOB-10202 (3150-0104), Office of Management and Budget, Washington, DC 20503. If a means used to impose information collection does not display a currently valid OMB control number, the NRC may not conduct or sponsor, and a

LICENSEE EVENT REPORT (LER)

(See reverse for required number of digits/characters for each block)

1. FACILITY NAME	2. DOCKET NUMBER	3. PAGE
	05000	1 OF

4. TITLE

5. EVENT DATE			6. LER NUMBER			7. REPORT DATE			8. OTHER FACILITIES INVOLVED	
MO	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REV NO	MO	DAY	YEAR	FACILITY NAME	DOCKET NUMBER 05000
				–	–				FACILITY NAME	DOCKET NUMBER 05000

9. OPERATING MODE		11. THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check all that apply)							
10. POWER LEVEL		20.2201(b)		20.2203(a)(3)(ii)		50.73(a)(2)(ii)(B)		50.73(a)(2)(ix)(A)	
		20.2201(d)		20.2203(a)(4)		50.73(a)(2)(iii)		50.73(a)(2)(x)	
		20.2203(a)(1)		50.36(c)(1)(i)(A)		50.73(a)(2)(iv)(A)		73.71(a)(4)	
		20.2203(a)(2)(i)		50.36(c)(1)(ii)(A)		50.73(a)(2)(v)(A)		73.71(a)(5)	
		20.2203(a)(2)(ii)		50.36(c)(2)		50.73(a)(2)(v)(B)		OTHER Specify in Abstract below or in NRC Form 366A	
		20.2203(a)(2)(iii)		50.46(a)(3)(ii)		50.73(a)(2)(v)(C)			
		20.2203(a)(2)(iv)		50.73(a)(2)(i)(A)		50.73(a)(2)(v)(D)			
		20.2203(a)(2)(v)		50.73(a)(2)(i)(B)		50.73(a)(2)(vii)			
		20.2203(a)(2)(vi)		50.73(a)(2)(i)(C)		50.73(a)(2)(viii)(A)			
		20.2203(a)(3)(i)		50.73(a)(2)(ii)(A)		50.73(a)(2)(viii)(B)			

12. LICENSEE CONTACT FOR THIS LER

NAME	TELEPHONE NUMBER (Include Area Code)

13. COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT

CAUSE	SYSTEM	COMPONENT	MANU-FACTURER	REPORTABLE TO EPIX	CAUSE	SYSTEM	COMPONENT	MANU-FACTURER	REPORTABLE TO EPIX

14. SUPPLEMENTAL REPORT EXPECTED				15. EXPECTED SUBMISSION DATE	MONTH	DAY	YEAR
	YES (If yes, complete EXPECTED SUBMISSION DATE)		NO				

16. ABSTRACT (Limit to 1400 spaces, i.e., approximately 15 single-spaced typewritten lines)

NRC FORM 366 (7-2001)

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NRC FORM 366A
(1-2001)

U.S. NUCLEAR REGULATORY COMMISSION

LICENSEE EVENT REPORT (LER)

FACILITY NAME (1)	DOCKET (2)	LER NUMBER (6)			PAGE (3)
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
	05000	--	--		OF

NARRATIVE *(If more space is required, use additional copies of NRC Form 366A)* **(17)**

NRC FORM 366A (1-2001)

SAFETY AND EMERGENCY INSTRUCTIONS FOR X-RAY SENSORS MANUFACTURED BY MEASUREX OR ABB CORPORATION

The Measurex and ABB system has been designed with built-in safety interlocks to handle anticipated hazards. However, there are a few additional common sense rules of safety that must be followed:

a. All persons authorized to perform their duties with or in the vicinity of the system must read the safety procedures.

b. Only authorized personnel shall Operate or repair this system.

c. No tests on this system shall be performed by unauthorized persons.

d. The shutter mechanism, interlocks and indicator lamps must be verified for proper operation every 6 months. A site survey must be performed whenever changes are made to the gauge operating parameters that might affect the radiation field around the gauge at least annually

e. Before approaching the sensor head, determine the status of the source shutter and high voltage supply by observing the shutter status lights and the amber x-ray on lamp. If there is any doubt, use your survey meter.

f. Avoid any direct exposure --- DO NOT insert hands, fingers or other parts of the body in front of the beam exit window.

g. If the heads become damaged or misaligned, turn the gauge power off by pressing the "X RAYS OFF" button before you approach the heads.

h. Loitering around the heads should not be permitted even though the radiation field is minimal.

i. In the event of fire, ensure that the shutter is closed and the heads off-sheet, then turn the equipment off and put out the fire.

j. Verify proper postings, Notice to Employees, perform annual survey, and verify interlocks

k. Insure annual registrations are completed

Customer Information and Responsibilities

1. Customer Responsibilities

Although regulations governing radioactive materials vary in detail somewhat from state to state, persons who possess a device pursuant to a general license must comply with the following general requirements. Remember, the customer owns the sensor.

a. Take all precautions necessary to provide reasonably adequate protection to people and property.

b. Register receipt of the device with the local radiation control authority.

c. DO not transfer, abandon, or dispose of the device except to a specific license holder.

d. Make sure that all the labels affixed to the device are maintained and comply with all instructions contained on such labels.

e. Have the device tested for leakage of radioactive material and proper operation of the on-off indicator mechanism at installation and every six months thereafter. Devices containing only Krypton in gaseous form need not be tested for leakage. The tests and all other services involving the radioactive material are to be performed by a person holding an appropriate specific license.

f. Maintain records of all tests performed on the device.

g. Maintain records on each receipt, transfer and disposal of a device.

h. Give the regulatory agency access at all reasonable times to all sources of radiation, their place of storage or use, and all records maintained thereon.

i. If the device fails or becomes damaged, suspend operation of the device until it has been repaired or replaced by a person holding an appropriate specific license.

j. Within 30 days after the occurrence of a failure or damage to the material or the detection of any trace of removable radioactive material, furnish a complete description of the device and the events to the regulating agency.

k. Report the theft or loss of any radioactive device to the regulatory authority immediately.

l. Immediately notify the regulatory authority of any incidents involving radioactive devices in his possession which may have caused or threaten to cause a hazard.

As part of a normal service contract, GEAS will perform the following services in order to help the customer fulfill his responsibilities as a general licensee:

a) Assume the responsibility for maintaining the labels and compliance with the instructions thereon.

b) Assume the responsibility for performing all test and repairs and preparing all reports. GEAS will supply the customer with copies of all tests performed so that he may keep accurate and current records.

In general, the responsibilities remaining to the customer are as follows:

a) See that the device is registered with his state regulatory authority within the time specified by local regulations.

b) Do not transfer or dispose of the device except to properly licensed and approved firms (Measurex, Sentrol or Accuray).

c) Maintain records of all tests performed, each receipt, transfer, and disposal of a device.

d) Give the regulatory agency access to all sources of radiation and all records concerning them.

e) In the case of damage, immediately suspend operation of the device until it has been repaired or replaced.

f) Report any damage, theft, or loss pertaining to radioactive materials to the regulatory authority within 30 days of the incident.

RADIATION SAFETY AND EMERGENCY PROCEDURES TO BE POSTED IN THE MILL

It is very important that a brief summary of the radiation and safety and emergency instructions discussed in this manual, as they apply to the individual systems, be posted in a prominent place in the mill, near the system. For GEAS the NRC or State Notices will be posted prominently in each office.

Radiation Badges

GE Automation Services adheres to keeping all exposures
As Low As Reasonably Achievable. (ALARA)

1. ***Wear badges on torso and on hand likely to be exposed to radiation***
2. ***Turn your badge in on time***
3. ***Do NOT share your badge or wear it outside of work***
4. ***If you suspect exposure, turn your badge in immediately and call the RSO.***
5. ***If your badge is lost or damaged notify the RSO immediately***

1. Introduction

Federal regulations require that all persons working on or near a radiation source from which they could and might receive 25% of the radiation dose described in the NRC radiation dose limits for occupational workers shall be monitored for radiation exposure. It is the policy of GEAS to monitor the radiation dose with personal monitoring devices, and to maintain the radiation dose to all employees as far below the radiation guidelines as possible, ALARA

2. How Radiation Badges Work

There are currently two main types of badges in use for radiation monitoring. A FILM BADGE contains photographic film, which will darken when exposed to radiation. The level of exposure is shown by the degree of darkening of the film. In addition, if various areas of the film are masked behind materials of differing thickness and density, the exposed film will show the type of radiation. A THERMOLUMINESCENT DOSIMETER (TLD) badge contains a small amount of lithium fluoride, which stores energy from the radiation to which it is exposed. When the badge is to be read, the lithium fluoride is heated to a high temperature. At a specific temperature, the stored energy is released as blue light, which can be measured very precisely with a photomultiplier tube. GEAS employees currently use the thermoluminescent (TLD) type.

3. Conditions In Which Usage of Badges Is Mandatory

A whole body badge is to be worn by any individual who may be working in close proximity (three feet or less) to a device containing a radioactive source or a device, which produces X-Rays. This badge is required whether or not the individual is actually working on the radiation-producing device. **The badge must be worn at all times when the individual is on the job.** The badge should be worn at the same location on the body and preferably at the collar, pocket, or waist with the clip facing the body.

4. Badge Distribution

Badges will be routinely assigned to all Qualified Persons who require badges. Customers who are visiting a GEAS maintained facility do not need to have a badge unless they will be working in close proximity to nuclear or X-Ray sources. Badges are not required during brief customer demonstrations. (As a matter of practice, radiation exposures to visiting customers should be minimized. This can be accomplished by spending the least time necessary in close proximity to nuclear or X-Ray sources.) The Corporate Radiation Safety Officer has the final authority for determining whether or not an individual should be given a badge.
Radiation Detection Company provides Quarterly new radiation badges. Badges will be mailed to all field personnel who require them. Old badges must be returned within 10 days after the new badge period starts. DO NOT save up several badges and mail them together. Remember that radiation badges are the sole indicator of radiation overexposure. The Radiation Safety Office must know of any such overexposures as soon as possible so that corrective action may be taken.

5. Use and Care of Badges

a. WEAR YOUR BADGE. Radiation exposure monitoring is for your protection. Body badges should be worn at all times you are on the job, either in house or in the field.

b. Do not allow a badge to get wet. Do not put any badge into the washer or dryer as this could invalidate the reading.

c. Do not expose badges to medical X-Rays.

d. As a precaution against erroneous readings on your badge, please carry the badge in your pocket while passing through the airline passenger inspection station. Do not subject the dosimeter to the X-Ray equipment for baggage. Your Baggage receives a much higher radiation dose than you do since it passes through a DIRECT X-Ray beam.

e. Do not allow anyone else to use your badge. Do not use a badge assigned to anyone else.

f. Use of Information From Badges

All badges are analyzed by an outside vendor, who provides the Radiation Safety Officer with the results. All radiation dose reports must be reviewed either by the Corporate Radiation Safety Officer. Although federal regulations specify the occupational radiation dose limits, it is a GEAS policy to notify employees of a quarterly badge report, which indicates a dose to the badge of 20% or more of the allowable guideline. Such cases are reviewed by the Radiation Safety Officer to determine if the exposure report is valid and, if so, recommendations are made to minimize personnel exposure.

All radiation exposure reports are entered as a permanent part of the employee's radiation exposure history and are available to inspection. Information on exposures received during your employment by GEAS will be made available to any subsequent employer. Badged employees are provided a written report of radiation exposures on an annual basis. They are welcome to view their exposure record at any time.

7. Compliance

COMPLIANCE WITH THESE POLICIES IS MANDATORY. These policies are a translation of regulatory requirements in the states in which GEAS is licensed. Continuance of the GEAS license requires strict adherence to these regulations. Cooperation by each individual employee is vital. All supervisors are required to assure that their subordinates wear badges as required in this guide, and that quarterly badge exchanges are performed on time. The Radiation Safety Officer is responsible for assuring compliance by GEAS with all rules and regulations pertaining to radiation safety. The Corporate Radiation Safety Officer, the Manager of Specialty Services and area supervisors will, therefore, take appropriate action to assure compliance.

Radiation Measurement Devices - Survey Meters

Use and Care of Survey Meters

1. ***Check calibration date. (Must be within one year)***
2. ***Check batteries.***
3. ***Check condition of probe and cable.***
4. ***Check background.***
5. ***Note information. (Model and Serial numbers of the meter and probe)***
6. ***Keep clean.***
7. ***Store at room temperature. (Probe can be very sensitive)***
8. ***Avoid excessive moisture.***

1. Instruments Used to Measure Radiation

GEAS uses the Geiger-Muller (G-M) Counter (Victoreen Model 473 or an NDS-2RP /2RPC) or equivalent. The G-M tube is designed to create an avalancheionizing effect when exposed to any type of radiation, resulting in a number of current pulses. The number of pulses is proportional to amount of radiation present.

The pulses are measured against a time reference, which gives a meter reading in R/hour. It should be noted that the amplitude of the current pulse is unrelated to the energy or type of the radiation detected. The G-M tube does not, therefore, give accurate readings of exposure rates. This type of device is, however, very sensitive to the presence of radiation. The G-M counter responds quickly and is easy to use, even though it is somewhat less

accurate than the ion chamber type. The G-M counter is the type of meter normally issued for field use.

There are two styles of probes used with the G-M meter. The most common model, 491-30, can be identified by the grid pattern sleeve over a thin walled metal tube. The sensitive area is the sidewall, not the end of the tube extended. When the probe is passed through an emitting field, it will response to both beta and gamma radiation. When the tube is retracted into the solid metal housing, it responds only to gamma radiation. The second style of probe is the model 489-35. It has a very thin, very fragile mica window at the end of the tube. This probe is sensitive to beta, gamma, and alpha radiation.

2. Care of Radiation Survey Meters

a) Handle the meter with care, as you would any delicate test instrument. When not in use, store in a clean dry place. Always replace the protective metal or plastic cover on the probe after use. Avoid mechanical shocks to the meter, especially to the probe.

b) Be sure that the meter is turned off when not in use. There is a battery test position on the rotary on-off switch. Always check the batteries before using the meter. Since meters are infrequently used in the field, remove the batteries from the meter when not in use. This will prevent damage from battery corrosion.

3. Use of Radiation Survey Meters

Use of either type of radiation meter is a straightforward procedure, but two important points need to be made. First, keep in mind that for a useful reading the numbers of the dial must be properly interpreted. Like a voltmeter, radiation meters have a scaling adjustment. BE SURE YOU KNOW WHICH SCALE YOU ARE READING. Second, there is a response (time constant) selector to lengthen the reading time. When reading very low radiation levels, the random nature of gas ionization events in the chamber makes the meter jump around. In this case, lengthen the response time (increase the time constant) to damp the meter and it will be easier to read. Be sure to wait until the meter gives a steady reading before recording any values.

4. Radiation Survey Meter Applications

Leak Testing - In the event of a leak developing in a source capsule, radioactive material may escape. For gaseous sources such as Krypton 85, this situation, though serious, is not critical, since the gas will diffuse rapidly. Solid source leaks, however, are very dangerous, since any leaked material will not diffuse, and can be inhaled, ingested, or absorbed into the body. For this reason, the United States Code of Federal Regulations requires that all solid source capsules be leak tested at installation and every six months thereafter. A G-M survey meter is used to perform the part of these tests.

GEAS Customer Site Files

One of the most important tasks a field service technician can perform is the correct administration of the site Radiation Safety Notebook and performing all required surveys and wipe tests on schedule.

Each customer site will be provided with a notebook in which to file all required Radiation Safety documentation.

Notebook contents:

1. State and Federal NRC license.
2. Technician's authorization.
3. Site Equipment list and source information.
4. Survey meter calibration reports.
5. Source Safety Surveys, one tab for each system.
6. Source wipe test results, one tab for each system.
7. GEAS Series 100, Corporate Radiation Procedures.
8. GEAS 200, Radiation Operating and Emergency Procedures

It is the responsibility of the Site Leader or Site Technician to ensure that this notebook is kept up to date and all information is current. The notebook must be ready to present to

the Customer RSO, GEAS Corporate RSO, or any authorized authority requesting to review the contents. Failure to keep this record up to date will result in a severe reprimand or possible termination.

ADMINISTRATIVE ORGANIZATION AND RESPONSIBILITY

Procedure Number: 100-1

Revision: 4

Effective Date: 4-07-2005

Approved By: 4-07-2005

James. R. Beaty III — Date

Corporate Radiation Safety Officer

Approved By: 04-07-2005

Steve Richards — Date

President GE Automation Services

ADMINISTRATIVE ORGANIZATION AND RESPONSIBILITY

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ADMINISTRATIVE ORGANIZATION AND RESPONSIBILITY

1. PURPOSE

1.1. The purpose of this procedure is to outline individual responsibilities for the administration and implementation of GE Automation Service's Radiation Safety Program.

2. PRESIDENT OF GE AUTOMATION SERVICES

2.1. The President of GE Automation Services, shall ensure that all segments of the Radiation Safety Program are properly enacted, and shall provide the necessary support to facilitate the implementation of the Radiation Safety Program.

3. VICE PRESIDENT, SERVICES

3.1. The Vice President, Services is responsible for the overall management of the Specialty Services group and along with the Manager of Specialty Services and ensures all participants in the GEAS Radiation Safety Program comply with all GEAS, State and NRC applicable regulations.

4. CORPORATE RADIATION SAFETY OFFICE (CRSO)

4.1. The Corporate Radiation Safety Officer shall be responsible for the overall administration of the Radiation Safety Program.

4.2. The Corporate RSO shall possess sufficient authority to enforce all aspects of the Radiation Safety Program.

4.3. Specific responsibilities of the CRSO include, but are not limited to:

4.3.1. Act as the liaison between GE Automation Services and regulatory agencies on matters pertaining to radiation safety, loss, theft or damage of radioactive material.

4.3.2. Ensure that all terms and conditions of the license and these regulations are complied with.

4.3.3. Ensure that all sealed sources are leak tested timely and as prescribed by the manufacturer or by the license.

4.3.4. Ensure that radioactive materials are used only by individuals who are authorized by the license and that all individuals wear required personnel monitoring equipment.

4.3.5. Maintain all records required by the license and applicable State and Federal regulations. These records shall include personnel monitoring records, leak test records, inventory records, and training records for users.

4.3.6. Ensure that radioactive materials are properly secured against unauthorized access or removal.

4.3.7. Establish and review Operating, Emergency, and ALARA procedures to ensure conformance to applicable Federal and State regulations.

4.3.8. Ensure that all users read and understand the licensee's emergency, operating and radiation safety procedures.

4.3.9. Establish and administer the radiation safety training and testing program and ensure that only trained and qualified individuals are assigned to gauging activities.

4.3.10. Conduct administrative and field audits to ensure compliance with GE Automation Services Gauging System Operating and Emergency Procedures, Agency regulations, and license conditions.

4.3.11. Investigate emergency situations, and personnel radiation exposure in excess of ALARA limits.

4.3.12. Notify applicable Federal or State regulatory agencies of reportable incidents as outlined in GEAS 200.

5. MANAGER OF SPECIALTY SERVICES

6.1. The Manager of Specialty Services shall be responsible for notifying the Corporate RSO of transfer, discharge or addition of personnel and acquiring the used personal dosimetry of discharged personnel.

6.2. The Manager of Specialty Services shall be responsible for ensuring that individuals assigned to gauging system customer sites meet the training, testing and experience requirements of GEAS and the state where the service operations will be performed.

6.3. The Manager of Specialty Services shall be responsible for notifying the Corporate Radiation Safety Officer of any addition or deletion of contract sites which could effect GEAS licensing requirements and will ensure that the Site Radiation Safety Manual is removed from the deleted site and returned to the Corporate Radiation Safety Office.

6. QUALIFIED PERSONS

7.1. Qualified Persons shall assume responsibility for, not ownership, of all sources of radiation, x-ray gauges, and related handling and test equipment in his custody.

7.2. Qualified Persons shall ensure that all gauging system operations to which he is assigned are performed in accordance with GEAS 200 Radiation Safety Operating and Emergency Procedures, applicable regulatory requirements, and license conditions

7.3. Qualified Persons shall perform only those operations to which he is specifically authorized and only on specifically authorized equipment.

7.4. Qualified Persons may clean and replace source windows, repair source housings, perform source safety inspections, and perform source leak tests.

7.5. Qualified Persons shall not expose or handle a sealed source.

7.6. Qualified Person shall keep the site files up to date and ready to present to any authorized agency or their customer.

7.7. Qualified Persons shall not ship or receive any source material except source wipe tests without specific permission from the CRSO.

7.8. Qualification of a Qualified Person shall only be performed under the direct supervision of the Corporate Radiation Safety Officer (CRSO).

7.9. Provide personal supervision to Gauging System Trainees as required.

7.10. Qualified Persons shall ensure that personal dosimeter devices are worn at any time a radiologic device is serviced. They shall ensure that dosimeter devices are returned in a timely manner after replacement is received.

7. GAUGING SYSTEM TRAINEES

8.1. Gauging system Trainees shall be responsible for adhering to the requirements of GEAS 200, applicable Federal or State regulations, and license conditions.

8.2. Gauging System Trainees shall not perform any maintenance, source wipes or source inspections on any model of gauging system until qualified by the CRSO.

TRAINING, TESTING AND QUALIFICATION OF GAUGING SYSTEM PERSONNEL

Procedure Number: 100-2

Revision: 5

Effective Date: 04-04-2005

Approved By:

James R. Beaty III
Corporate Radiation Safety Officer

04-04-2005
Date

Approved By:

Steve Richards
President, GE Automation Services

04-04-2005
Date

TRAINING, TESTING AND QUALIFICATION OF GAUGING SYSTEM PERSONNEL

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TRAINING, TESTING AND QUALIFICATION OF GAUGING SYSTEM PERSONNEL

1. PURPOSE

1.1. The purpose of this procedure is to establish training, testing and qualification requirements for individuals assigned to gauging system repair activities and the administration of the radiation safety program.

2. DEFINITIONS

2.1. **Qualified Person** - Any individual who has successfully completed the training and testing requirements of section 10.1.4 or can produce a qualification document from and OEM manufacturer or someone with a license to perform this service and who performs maintenance on gauging systems.

2.2. **Gauging System Trainee** - any individual, who has not completed the training and testing requirements of section 10.1.4 and who, cannot produce a training certificate from an OEM manufacturer or licensed persons or cannot produce documentation of previous certification.

3. ADMINISTRATION OF FORMAL RADIATION SAFETY TRAINING

3.1. Radiation safety training shall be provided to prospective applicants in a formal classroom presentation. Several states require notification of training to be held prior to the actual training taking place. If not notified, they will not honor the training. Check pertinent State regulations when planning dates to hold training.

3.2. Prospective Gauging System Technicians with no previous experience shall receive, at a minimum, 40 hours of training in the subjects outlined in Attachment 1. This training will be administered by an organization licensed to provide this training and approved by the Corporate RSO.

3.2.1 In the State of Texas, prospective Gauging System Technicians with no previous experience shall receive, at a minimum, 40 hours of training in the subjects outlined in Attachment 1. A Classroom Instructor shall administer the training.

TRAINING, TESTING AND QUALIFICATION OF GAUGING SYSTEM PERSONNEL

3.3. Previously OEM certified, newly hired gauging system technicians shall receive GE Automation Services specific training including review of GEAS 200 outlined in Attachment 2. Operating and Emergency Procedures, and GEAS 100, Radiation Safety Administrative Manual, and 5 to 6 hours devoted to instruction in the proper use of equipment. The training shall be administered by the Corporate RSO, or a designated qualified trainer with a service license who meets the requirements of section 10.1.4, approved by the Corporate RSO.

3.4. Visual aids shall be utilized to provide recognition of gauging system source assemblies. Visual aids shall include, but are not limited to, film badge, survey meter, labeling, leak test procedures and OEM safety systems.

4. WRITTEN EXAMINATIONS

4.1. A written test will administered to assure competence

5. FAILED EXAMINATIONS

5.1. Individuals who fail to successfully complete a written examination shall be given remedial instruction focused on those deficiencies exhibited by test results and retested

6. ADMINISTRATION OF TRAINING

6.1. Refresher Radiation Safety Training shall be provided to all gauging personnel periodically. Training may be provided in segments to continually educate gauging system personnel. This may be in person or Computer Based Training

6.2. Training topics shall be selected by the Corporate RSO based on subjects central to radiation safety principles, ALARA principles, regulations, Operating and Emergency Procedures, etc.

6.3. Training shall be administered by the Corporate RSO, or a designated Qualified Person, authorized by the Corporate RSO, who meets the requirements of section 10.1.4. Training shall be documented on the Training Record (Attachment 3), and Quarterly Audit and Training Summary, (Attachment 4) of GEAS 100-2.

6.4. Examinations covering periodic training topics shall be administered at the discretion of the Corporate RSO

6.5. Refresher training will address such issues as new equipment, revised operating and emergency procedures, and any safety related issues. This training will be conducted periodically.

7. ADMINISTRATION OF PRACTICAL EXAMINATION

7.1. Applicants qualifying to the status of a Qualified Person shall be administered a practical examination at the completion of formal training. The applicant shall demonstrate competence to sealed sources, related handling equipment, and survey instruments.

7.2. The Qualified Person's practical examination may include the actual performance of duties normally required during daily service activities. The instructor shall judge the individual's ability, based on the checklist and the Radiation Safety Training/Certification Record (Attachment 4), to follow procedure, perform required radiation surveys, perform daily maintenance inspections, package sources of radiation for transportation, etc.

7.3. The Gauging System Trainee or Qualified Person's, practical examination shall consist of ascertaining the individual's ability to work safely around sources of radiation. The instructor shall judge the individual's ability based on the checklist and the Safety Training/Certification Record (Attachment 4).

7.4. Gauging System Trainees and Qualified Persons shall be under the personal supervision of the instructor during performance of the practical examination.

8. AUTHORIZATION AND CERTIFICATION

8.1. Upon successful completion of the examination, the instructor shall document the training and testing on the individual's Radiation Safety Training/Certification Record (Attachment 4). The Corporate RSO shall authorize the individual to perform the duties to which he has been trained and certify on the Radiation Safety Training Certificate (Attachment 5). No individual shall be issued personal monitoring equipment until previous exposures have been verified

9. TRAINING, QUALIFICATION, EXPERIENCE AND DOCUMENTATION REQUIREMENTS

9.1. Individuals shall meet the following minimum requirements to perform the specific duties of each position.

TRAINING, TESTING AND QUALIFICATION OF GAUGING SYSTEM PERSONNEL

9.1.1 Corporate Radiation Safety Officer

9.1.1.1 Possess a high school diploma or a certificate of high school equivalency based on a G.E.D. test.

9.1.1.2 Successfully complete the training, qualification, and experience requirements outlined in section 10.1.4.

9.1.1.3 Possess two years of documented hands on experience related to radiation protection, including knowledge of industrial gauging system operations.

9.1.1.4 Be designated on the radioactive materials license, if required by the applicable regulatory agency.

9.1.1.5 Receive 40 hours formal RSO administration and radiation safety training from an institution certified to give such training.

9.1.1.6 Be approved by the EHS Safety Officer and appointed by the Manager of Business Operations of GE Automation Services.

9.1.2 Gauging System Trainee

9.1.2.1 Possess sufficient education to comprehend the physics and mathematical principles of radiation safety.

9.1.2.2 Possess sufficient mechanical abilities to perform those specialized operations for which the individual is trained and certified.

9.1.2.3 Successfully complete the training requirements outlined in Attachment 1, and the testing requirements outlined in section 4, as appropriate.

9.1.2.4 Demonstrate competency as outlined in section 8, as appropriate.

9.1.3 Qualified Person

9.1.3.1 Possess sufficient mechanical abilities to perform those specialized operations for which the individual is trained and certified.

9.1.3.2 Successfully complete an OEM manufacturer or other person licensed to teach course certification examination and possess proof of successful completion.

9.1.3.3 Complete at least three months (520 hours) on the job training as a Gauging System Technician with an OEM manufacturer.

9.1.3.4 OR: Successfully complete the training requirements outlined in section 10.1.4 and, if required, Attachment 6, and the testing requirements outlined in section 4, as appropriate

9.1.3.5 AND: Demonstrate competence as outlined in section 8, as appropriate.

9.1.3.6 Be specifically authorized to perform specialized operations by the Corporate RSO.

10. DOCUMENT REVIEW

10.1. Each individual trained shall receive copies of the following instructions. (As appropriate):

10.1.1 Pertinent NRC/Agreement State License.

10.1.2 GEAS 200

10.1.3 GEAS 100 Series

10.1.4 NRC 10 CFR Parts 19 and 20

10.1.5 NRC 10 CFR Parts 30.7; 30.9 and 30.10

10.2. Only the pertinent sections of the above documents shall be distributed to each individual trained.

10.3. Document materials received on Attachment 7.

11. TERMINATION OF EMPLOYMENT

11.1. Qualifications shall terminate whenever employment terminates. If rehired within a (6) month period, re-qualification is not required. Retraining shall be required on any new procedures or equipment changes during the time the individual was not employed.

TRAINING, TESTING AND QUALIFICATION OF GAUGING SYSTEM PERSONNEL

Attachment 1

Subjects of Instruction for Qualified Persons and Gauging System Trainees

Reference material for the instruction of training topics:

GEAS 100 Series. Radiation Safety Administration Manual

GEAS 200, Radiation Operating and Emergency Procedures

10 CFR Parts 19 & 20

10 CFR Part 30.7, 30.9, and 30.10

Pertinent NRC/Agreement State License

California Title 17 as applicable

Training Outline

1. Fundamentals of Radiation Safety
    a. Characteristics of radiation
    b. Units of radiation dose and exposure (REM) and quantity of radioactivity curie)
    c. Significance of radiation dose
        i. Radiation protection standards
        ii. Biological effects of radiation dose
        iii. Case histories of radiation accidents
    d. Levels of radiation from sources of radiation
    e. ALARA program
    f. Methods of controlling radiation dose
        i. Working time
        ii. Working distances

TRAINING, TESTING AND QUALIFICATION OF GAUGING SYSTEM PERSONNEL

iii. Shielding

g. Radiation Detection instrumentation to be used

i. Use of radiation survey instruments

1. Operation
2. Limitations

ii. Survey Techniques

iii. Use of personnel monitoring equipment

1. Film badges

h. Pertinent Federal and State Regulatory Requirements and License Conditions

i. GEAS Gauging System Operating and Emergency Procedures and GEAS 100 series Radiation Safety Administration Policies.

j. Technical designs of source holder assemblies.

All individuals receiving the above listed classroom instruction shall be provided with copies of GEAS 100, GEAS 200, 10 CFR Parts 19 and 20, 10CFR Part 30.7, 30.9 and 30.10, and pertinent NRC/Agreement State License. Only the pertinent parts of Federal and State rules and regulations apply.

TRAINING, TESTING AND QUALIFICATION OF GAUGING SYSTEM PERSONNEL

Attachment 2

Reference material for the instruction of training topics:

GEAS 100 Series. Radiation Safety Administration Manual

GEAS 200, Radiation Operating and Emergency Procedures

10 CFR Parts 19 & 20

10 CFR Part 30.7, 30.9, and 30.10

Pertinent NRC/Agreement State License

Training Outline

1. Operating and Emergency Procedures
   a. Rules for handling sources of radiation.
   b. Procedural steps and survey requirements
   c. Sources of radiation
   d. Proper use of survey meters
   e. Personnel monitoring devices
   f. Emergency Procedures
   g. Operation of equipment
   h. Administration

2. Radiation Accidents
   i. Case histories of accidents

TRAINING, TESTING AND QUALIFICATION OF GAUGING SYSTEM PERSONNEL

j. Why do accidents occur

k. ALARA program

3. Gauging Equipment

l. Operation of exposure devices

m. Use of survey meters

n. Source assemblies

o. Transport containers

4. Safety Inspections

p. Source inspections

q. Source wipes

r. Administration

5. Pertinent Federal and State Regulatory requirements and license conditions.

All individuals receiving the above listed classroom instruction shall be provided with copies of GEAS 100, GEAS 200, 10 CFR Parts 19 and 20, 10CFR Part 30.7, 30.9 and 30.10, and pertinent NRC/Agreement State License. Only the pertinent parts of Federal and State rules and regulations apply.

TRAINING, TESTING AND QUALIFICATION OF GAUGING SYSTEM PERSONNEL

Attachment 3

GE Automation Services

Radiation Safety Training Record

Name:_____ Social Security #:_____

Training Date	Periodic/Refresher Training Topics	Instructor Name	Training Hours	Employee Signature

TRAINING, TESTING AND QUALIFICATION OF GAUGING SYSTEM PERSONNEL

Attachment 4

GE Automation Services
Radiation Safety Training/Certification Record

Training						
Training Date	Course Description	Instructor	Training Hours	Exam Grade	Inst. Initials	Level of Certification

Practical Demonstration

1. Use of personnel monitoring devices.
2. Proper use of survey meters.
3. Knowledge of emergency procedures
4. Proper completion of radiation surveys.
5. Proper packaging of radioactive material
6. Proper Daily inspection of radiation safety features.
7. Knowledge/performance of required Surveys.
8. Proper maintenance safety procedures.

The above individual has demonstrated competence to use, under personal supervision, the radiation exposure devices, sealed sources, radiation survey instruments, proper maintenance procedures, which must be employed in industrial gauging operations.

Instructor:_____ Date:_____

Authorization

Date	Certification Level	Signature of Corporate RSO

TRAINING, TESTING AND QUALIFICATION OF GAUGING SYSTEM PERSONNEL

Attachment 5

GE Automation Services
8301 Scenic Highway
Pensacola, Florida 32514

30 December 2002

This document certifies that **Employees Name, Employee Number XXXXX**, has completed the required qualifications and is authorized by GE Automation Services, License Number 09-28781-02, Nuclear Regulatory Commission or its Agreement State equivalent and /or by applicable X-Ray service registration to perform routine and repair service to the holder and windows and periodic testing of the radiation safety features (including collection of leak test samples, where applicable) involving industrial thickness gauges of the manufacturers listed below:

Fill in equipment Approved for:

Measurex any model
Accuray any model
Valmet any model
LFE any model
Sentrol any model

The following restrictions apply:

This authorization does not permit the removal of the radioactive source from its holder.

This certificate is valid only while **Employee's Name** is employed by GE Automation Services and remains on the list of authorized employees maintained by the GE Automation Services Radiation Safety Officer.

Note: File this certificate and have it available for review by regulatory authorities.

Signed:

James R Beaty III
Corporate Radiation Safety Officer
GE Automation Services

TRAINING, TESTING AND QUALIFICATION OF GAUGING SYSTEM PERSONNEL

Attachment 6

GE Automation Services

Radiation Safety Document Review

Name:_____ Social Security #:_____

I certify that I have received copies of the following documents, and I have been instructed as to their purpose and meaning. I understand my responsibilities to the Regulatory Authorities and GE Automation Services. ALARA requirements have been fully explained.

GEAS 100 Series. Radiation Safety Administration Manual

GEAS 200. Radiation Operating and Emergency Procedures

Pertinent Parts of 10 CFR Parts 19 & 20

Pertinent Parts of 10 CFR Part 30.7, 30.9, and 30.10

Pertinent NRC/ Agreement State License

Signature:_____ Date:_____

CRSO:_____ Date:_____

RADIATION SAFETY INTERNAL INSPECTION PROCEDURE

Procedure Number:	GEAS 100-3
Revision:	4
Effective Date:	04-04-2005

Approved By:

James R. Beaty III — 04-04-2005 Date

Corporate Radiation Safety Officer

Approved By:

Steve Richards — 04-04-2005 Date

President, GE Automation Services

RADIATION SAFETY INTERNAL INSPECTION PROCEDURE

1.0 PURPOSE

1.1 The purpose of this procedure is to provide an internal inspection program of gauging system records and field operations to verify compliance with GE Automation Services, Gauging System Operating and Emergency Procedures, applicable Agency regulations, and license conditions.

2.0 DEFINITIONS

2.1 Qualified Person - An individual who has met the training and experience requirements to be authorized to perform specific operations as defined in section 10 of GEAS 100-2.

2.2 Gauging System Trainee - An individual who has not met the training and experience requirements to be authorized to perform specific operations as defined in section 10 of GEAS 100-2.

2.3 Specific Operation - For the purpose of this procedure, the term "specific operations" relates to the limited, specialized tasks for which a Qualified Person has been trained and authorized.

2.4 Special Location – A location within a specific state for location of duplicate Corporate records as required by that state, currently Georgia and South Carolina.

3.0 FREQUENCY OF INSPECTION

3.1 Audits of the site records shall be performed annually. The person performing the audit shall be the Corporate RSO or his qualified designate.

3.2 If an individual has not participated in any type of Gauging system operations for a one year interval, that individual's performance shall be observed and recorded within 30 days of returning to work.

RADIATION SAFETY INTERNAL INSPECTION PROCEDURE

3.3 If an individual has not participated in any type of gauging system operations for a 2-year interval, that individual's performance shall be observed by demonstrating a practical exam prior to participating in further gauging system operations.

4.0 AUDITORS

4.1 Audits shall be performed by the Corporate RSO, the Senior Technical Leader, designated senior gauging system technician, or person with a services license to perform such services authorized by the Corporate RSO who meets the requirements of GEAS 100-2, Section 10.1.4

5.0 CONDUCT OF AUDIT

5.1 Auditors shall verify the following:

- Proper use of personnel monitoring devices
- Restricted Area and High Radiation Area boundaries properly posted.
- Operable and calibrated survey meter utilized
- Radiation surveys performed after each repair / relocation
- Restricted Area boundary properly surveyed
- Assistant/Trainee under personal supervision
- Proper documentation of surveys and utilization available
- Storage area(s) properly placarded, surveyed and secured
- Required documents on site, Revision levels correct
- Proper packing and marking of packages for transportation
- Daily maintenance inspection performed
- Possession of GEAS authorization letter.
- Gauging system technician's knowledge of safety rules (ascertained by oral questions).

5.2 During an inspection by an auditor, the auditor may cease work if operations are not performed in accordance with GEAS 200, applicable Federal or State rules and regulations, applicable radioactive material license conditions, or if the auditor determines that other unsafe conditions exist.

RADIATION SAFETY INTERNAL INSPECTION PROCEDURE

5.3 Non-conforming conditions shall be immediately corrected prior to the continuance of gauging system activities.

6.0 DOCUMENTATION

6.1 Results of the inspection and any corrective action shall be documented on the Gauging System Field Operations Inspection Report (Attachment 1).

6.2 Results of Special location record audits shall be documented on attachment (2).

6.3 Results of Special location self-assessment audits shall be recorded on attachment (2).

RADIATION SAFETY INTERNAL INSPECTION PROCEDURE

Gauging System Field Operations Inspection Report

Inspector: _____ Date: _____

Site: _____ Job No. _____

Are Technicians wearing dosimeter?	
Is dosimeter located properly?	
Is dosimeter of proper date period?	
Survey meter operable?	
Survey meter calibration current?	
Site records available?	
Technicians certificate in notebook?	
GE regulations available, correct revisions?	
State regulations available?	
NRC and state license available?	
Are Source Safety Surveys available?	
Are Safety Surveys current?	
Are any trainees under proper supervision?	
Are any source storage containers properly marked?	
Are all source lights working properly?	
Are all shutters working properly?	
Are all labels in place and legible?	
Verify technician's knowledge of safety rules.	
Reminded to service only sources on GE AS Material License	

Problems/corrections: _____

_____

_____

The site inspection has been performed and all items are acceptable except as noted.
Signed: _____ Date: _____

Attachment 1

RADIATION SAFETY INTERNAL INSPECTION PROCEDURE

Special Location Record Audit Report

Inspector: _____ Date: _____

Location: _____ State: _____

Are Personnel files complete?	
1. Qualifications?	
2. Training records up to date?	
3. Film Badge results?	
4. Technicians authorization?	
Site records available?	
1. Surveys and wipe tests ok?	
2. Survey meter calibrations up to date?	
3. Site resources list up to date?	
4. Customer correspondence up to date?	
Are copies of all corp. regulations available?	
Are copies of al State regulations available?	
Are copies of any state notifications available?	
Are records neat and well kept?	

Problems/corrections: _____

_____

_____

The site inspection has been performed and all items are acceptable except as noted.

Signed: _____ Date: _____

Attachment 2

RADIATION SAFETY RECORD KEEPING

Procedure Number: 100-4

Revision: 3

Effective Date: 04-04-2005

Approved By:

James R. Beaty III
Corporate Radiation Safety Officer

04-04-2005
Date

Approved By:

Steve Richards
President, GE Automation Services

04-04-2005
Date

RADIATION SAFETY RECORD KEEPING

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RADIATION SAFETY RECORD KEEPING

1. PURPOSE

1.1. The purpose of this procedure is to provide guidelines for the distribution and maintenance of documents generated in relation to the radiation safety program.

2. RETENTION OF RECORDS

2.1. All records generated in relation to the GEAS Radiation Safety Program shall be retained until disposal is authorized by the Corporate Radiation Safety Officer.

2.2. Prior to granting authorization for disposal of records, the Corporate RSO shall verify the requirements of the appropriate Federal or State regulations to ensure compatibility.

3. REQUIRED RECORDS

3.1 **Corporate Records** - Corporate Records for GE Automation Services will be kept by the Corporate Radiation Safety Officer.

3.1.1 Personnel Records – The following records will be maintained for each employee working with gauging systems.

3.1.1.1 Qualifications

3.1.1.2 Safety Training

3.1.1.3 Film badge results

3.1.2 Site Records – The following records will be maintained for each customer site with which GE Automation Services performs radiation activities.

3.1.2.1 Correspondence

3.1.2.2 Radiation Surveys and Source Wipe Test results

3.1.2.3 State License

3.1.2.4 Survey Meter Calibrations

3.1.2.5 Site customer equipment list

3.1.3 Corporation Records

3.1.3.1 Operating Procedures

3.1.3.2 Corporate training outlines

3.1.3.3 Safety Training

3.1.4 State Records

3.1.4.1 Correspondence

3.1.4.2 State License

3.1.4.3 Copy of State Regulations

3.2 **Special Location Records** – Special Location Records for GE Automation Services will be maintained by the assigned individual.

3.2.1 Personnel Records – The following records will be maintained for each employee working with gauging systems.

3.2.1.1 Qualifications

3.2.1.2 Safety Training

3.2.1.3 Film badge results

3.2.2 Site Records – The following records will be maintained for each customer site with which GE Automation Services performs radiation activities.

3.2.2.1 Correspondence

3.2.2.2 Radiation Surveys and Source Wipe Test results

3.2.2.3 State License

3.2.2.4 Survey Meter Calibrations

3.2.2.5 Site customer equipment list

3.2.2.6 Site Annual Audit Reports

3.2.3 Corporation Records

3.2.3.1 Operating Procedures

3.2.3.2 Corporate training outlines

3.2.3.3 Safety Training

3.2.4 State Records

3.2.4.1 Correspondence

3.2.4.2 State License

3.2.4.3 Copy of State Regulations

3.3 **Site Records** – These records will be maintained on the customer's site by the site Technicians in the notebook provided.

3.3.1 Notice to Workers, State and Federal

3.3.2 Copy of State License

3.3.3 Technician's authorization

3.3.4 Copy of GEAS 100 Series

3.3.5 Copy of GEAS 200, Radiation Operations and Safety Manual

3.3.6 NRC and State Regulations on CD

3.3.7 Radiation Safety surveys

3.3.8 Source Wipe Test results for each system

3.3.9 Survey Meter Calibrations

3.3.10 Film Badge Reports

3.3.11 Source Service Log

4. RADIATION SAFETY TRAINING

4.1. A record containing the following documents shall be maintained by the Corporate RSO for all Gauging system personnel in the Gauging Services Group.

4.1.1 Radiation Safety Training/Certification Record

4.1.1.1 This document indicates the job classification of the individual and shall be generated by the instructor upon successful completion of training in accordance with GEAS 100-2. This record shall be maintained by the Corporate Radiation Safety Officer.

4.1.2 Radiation Safety Training Certificate

4.1.2.1 The certificate shall be generated to certify successful completion of each segment of training in accordance with GEAS 100-2. The original certificate shall be given to the student and a copy maintained by the Corporate Radiation Safety Officer.

4.1.3 Written Examination

4.1.3.1 The written examination(s) verifies comprehension of the classroom instruction. All completed examinations shall be maintained by the Radiation Safety Officer.

4.1.4 Radiation Safety Training Record

4.1.4.1 This document indicates the periodic and refresher training received by an individual in accordance with GEAS 100-2. Training shall be documented and maintained by the Corporate RSO on an on-going basis. At the end of each calendar year, RSO shall submit an Annual Audit/Training Summary to the appropriate Manager within GE Automation Services reflecting the training administered to each individual assigned within that year.

4.1.5 Gauging System Field Operation Inspection Report

4.1.5.1 This report documents pertinent radiation safety activities and regulation compliance for each calendar year.

5. TLD BADGE RECORDS

5.1. Records documenting exposure shall be maintained for each individual assigned to gauging system activities.

5.1.1. Occupational External Radiation Exposure History

5.1.1.1. An individual's previously accumulated occupational exposure history shall be documented by the Corporate RSO. The reports will be verified by the CRSO and filed in the individual's personnel file. The exposure shall be verified and documented **prior** to allowing an individual to engage in gauging system activities. Previous occupational exposure must be obtained from the individual's most recent employer using attachment 3 or acquire a written, signed statement from the individual.

5.1.1.2. Reasonable efforts shall be made by the Corporate RSO to obtain reports of previous exposure. If unable to obtain a complete record of an individual's current and previous accumulated occupational dose, GEAS shall, for the current year, reduce the allowable dose limit for the individual by 1.25 Rem for each quarter for which records are unavailable.

5.1.2 TLD Badge Exposure Report

This report indicates the exposure received to an individual's assigned NVLAP badge. The Corporate RSO shall review this report Quarterly, and discuss any unusual exposures with the individual.

5.1.3 ALARA Investigation Report

5.1.3.1 The Corporate RSO shall document the results of ALARA investigations performed on this form. All ALARA investigations shall be performed in accordance with GEAS 100-6. The ALARA investigation report shall be maintained at the corporate Radiation Safety Office.

6. CALIBRATION RECORDS

6.1. The Corporate RSO and the sites shall maintain calibration records on all company owned survey instruments.

6.2. Survey Meter Calibration Record

6.2.1. This document provided by the calibrating vendor (or equivalent) certifies proper calibration of survey instruments and shall be generated by an approved vendor calibrating the instrument.

7. MISCELLANEOUS RECORDS

7.1 Previous Occupational Radiation Exposure Request.

7.1.1 This is a form letter (Attachment 3) used to request occupational radiation exposure history information from an employee's (or prospective employee's) previous employer(s).

7.2 Occupational Radiation Exposure Report

7.2.1 This report is utilized to provide a former employee with documentation of their accumulated radiation exposure while employed with GE Automation Services. This report (Termination Report) is provided by Radiation Detection Company upon request, but can be generated by the CRSO, with a copy to the corporate office files.

7.3 Annual Occupational Radiation Exposure Report

7.4.1 This report (Attachment 4) is furnished by Radiation Detection Company annually containing the worker's occupational exposure for the previous year. A copy will be given to each worker by the CRSO explaining exposure requirements. A copy shall be transmitted by the CRSO to the South Carolina and Georgia state records location to any agreement state that requests a copy.

RADIATION SAFETY RECORD KEEPING

RADIATION SAFETY RECORD-KEEPING SUBMISSION SCHEDULE

DOCUMENT	GENERATED BY	MAINTAIN	SUBMIT	SUBMISSION TIME
Radiation Safety Training Certificate	CRSO	Corp.	CRSO	Upon Completion
Written Examinations	CRSO	Corp.	CRSO	Upon Completion
Previous Occupational Exposure Request	CRSO	Corp	CRSO	Upon Completion
Radiation Safety Training / Certification Record	Instructor CRSO	Corp	CRSO	Immed. Upon Completion of Training
Training Record	CRSO	Corp	CRSO	Upon Request
Annual Audit & Training Summary	CRSO	Corp.	CRSO	End of Calendar Year
Radiation Survey/Wipe Test Record	Site Tech./Qualified Person	Site/Corp.	CRSO	Upon Request
ALARA Investigation Report	CRSO	Corp.	CRSO	Immed. Upon Completion of Investigation
Periodic Inspection and Maintenance Record	CRSO	Corp	CRSO	Upon Request
Survey Meter Calibration Record	Approved Vendor	Site/CRSO	CRSO	Upon Request
Records of Individual Monitoring Results	Certified Lab	Corp	---------- --	----------

Attachment 1

RADIATION SAFETY RECORD KEEPING

GE Automation Services

Radiation Safety Training Record

Name:_____ Social Security #:_____

Training Date	Periodic/Refresher Training Topics	Instructor Name	Training Hours	Employee Signature

Attachment 2

RADIATION SAFETY RECORD KEEPING

GE Automation Services
Radiation Safety Training/Certification Record

Training						
Training Date	Course Description	Instructor	Training Hours	Exam Grade	Inst. Initials	Level of Certification

Practical Demonstration

1. Use of personnel monitoring devices.
2. Proper use of survey meters.
3. Knowledge of emergency procedures
4. Proper completion of radiation surveys.
5. Proper packaging of radioactive material
6. Proper Daily inspection of radiation safety features.
7. Knowledge/performance of required Surveys.
8. Proper maintenance safety procedures.

The above individual has demonstrated competence to use, under personal supervision, the radiation exposure devices, sealed sources, radiation survey instruments, proper maintenance procedures, which must be employed in industrial gauging operations.

Instructor:_____ Date:_____

Authorization

Date	Certification Level	Signature of Corporate RSO

Date: _____

Attachment 3

RADIATION SAFETY RECORD KEEPING

To: Radiation Safety Officer

I am requesting a copy of my previous occupational radiation exposure history. Please complete the information below and return to the indicated address.

Name of Employee: _____

Employee SSN: _____

Employee Signature: _____

Return to: Radiation Safety Officer
GE Automation Services
916 Butler Dr
Mobile, AL. 36693

Current dose (Millirem)			
Deep			
X+G	Neutron	Eye	Shallow

Cumulative External dose (Millirem)								
Calendar Quarter			Calendar Year			Lifetime		
Deep	Eye	Shallow	Deep	Eye	Shallow	Deep	Eye	Shallow

Cumulative dose (Millirem)			
Calendar Year			
CEDE	CDE	TEDE	TODE

I certify that the information given above is true and accurate to the best of my knowledge.

Signed: _____ Corporate RSO

Company Name: _____

Attachment 4

Occupational Exposure Record

For A Monitoring Record

Approved By OMB No. 3150-006

Expires

Estimated burden per response to comply with this information Collection request: minutes. Forward comments regarding burden estimate to the information and records management branch (MNBB 7714), US. Regulatory Commission, Washington, DC 20555, and to the paperwork Reduction Project (3 150-0006), Office Of Management

1. Name (Last, First, Middle Initial)	2. Identification Number	3. ID Type	4. Sex	5. Date of Birth
		SSN	Male Female	00/00/2003

6. Monitoring Period	7. Licensee Name	8. License Number(s)	9A.		9B.	
0/00/2002-0/00/2003	GE AUTOMATION SERVICES		X	Record	X	Routine
				Estimate		PSE

Intakes				Doses (in rem)		
10A. Radionuclide	10B. Class	10C. Mode	10D. Intakes in uCi			
				Deep Dose Equivalent	(DDE)	11. ND
				Eye Dose Equivalent To The Lens Of The Eye	(LDE)	12. NR
				Shallow Dose Equivalent, Whole Body	(SDE,WB)	13. 0.01
				Shallow Dose Equivalent, Max Extremity	(SDE,ME)	14. ND
				Committed Effective Dose Equivalent	(CEDE)	15. NR
				Committed Dose Equivalent, Maximally Exposed Organ	(CDE)	16. NR
				Total Effective Dose Equivalent (Blocks 11 + 15)	(TEDE)	17. ND
				Total Organ Dose Equivalent (Blocks 11 + 16)	(TODE)	18. ND
				19. Comments		

20. Signature -- Licensee		21. Date Prepared
		0/00/2003

RADIATION STANDARDS, NOTICES, AND WORKER'S RIGHTS

Procedure Number: 100-5

Revision: 2

Effective Date: 04-04-2005

Approved By:

James R. Beaty III
Corporate Radiation Safety Officer

04-04-2005
Date

Approved By:

Steve Richards
President, GE Automation Services

04-04-2005
Date

RADIATION STANDARDS, NOTICES, AND WORKER'S RIGHTS

1.0 PURPOSE

1.1 The purpose of this procedure is to provide guidelines regarding radiation protection standards, equipment purchasing standards, posting of notices, notification and reports to individuals, and worker's rights relative to GE Automation Services, Radiation Safety Program.

2.0 PURCHASING OF EQUIPMENT

2.1 Purchases of radiation devices and safety related equipment shall conform to the requirements of GEAS 200, "Purchasing of Equipment and Materials" and Code of Federal Regulations, Title 10, Part 34.20 and equivalent State Regulations.

2.2 Purchased equipment found to have defects, which would affect safety, shall be reported in accordance with GEAS, "Reporting of Defects and Noncompliance".

2.3 Equipment calibration shall be performed in accordance with GEAS 200, "Radiographic Operating and Emergency Procedures", and applicable Federal or State Agency regulations.

3.0 POSTING OF NOTICES

3.1 Current copies of the following documents shall be posted at all GEAS facilities:

3.1.1 Regulations for Protection Against Radiation for the applicable State.

3.1.2 Radioactive Material License conditions or documents incorporated by reference, and any amendments.

3.1.3 Operating and Emergency Procedures (GEAS 200)

3.1.4 Notice to Employees for applicable State

3.1.5 Any notice of violation, and any response from the licensee

3.2 If posting of items 3.1.1, 3.1.2, or 3.1.3 is not practical, a notice may be posted which describes the document and specifies where it may be examined. However, in the State of Florida, the Emergency Procedures shall be posted in their entirety.

3.3 Documents pertaining to item 3.1.5 shall be posted within 2 working days of receipt or submission to the Department or Agency, and shall remain posted for 5 days or until violation is corrected, whichever is later.

3.4 Documents, notices, or forms posted in accordance with this section shall appear in a sufficient number of places to permit gauging personnel to observe them on the way to or from radiological operations. These documents shall be posted in a conspicuous manner and shall be replaced if defaced or altered.

4.0 OCCUPATIONAL DOSE LIMITS FOR ADULTS

4.1 Occupational radiation exposure dose to individual adults shall be controlled to the following annual limits.

	REMS PER CALENDAR YEAR	
1.	Total effective dose equivalent equal to	5.00 Rem
2.	Eye dose equivalent to:	15.00 Rem
3.	Shallow dose equivalent to the skin or to any extremity of:	50.00 Rem

4.2 The dose that an individual can be allowed to receive in the current calendar year shall be reduced by the amount of occupational dose received while employed by any other company in the same year.

4.3 An adult worker may be authorized to receive doses in addition to and accounted for separately from the above dose limits in accordance with the applicable regulatory requirements for a planned exposure. All regulatory requirements for a planned special exposure must be adhered to and authorization from the Corporate RSO must be obtained prior to the planned special exposure.

5.0 EXPOSURE OF MINORS

5.1 No individual who is under 18 years of age shall be allowed to participate in the GE Automation Services, Radiation Safety Program.

RADIATION STANDARDS, NOTICES, AND WORKER'S RIGHTS

6.0 NOTIFICATION AND REPORTS TO INDIVIDUALS

6.1 Radiation Exposure data shall be reported to the individual as specified below:

- As an annual summary of exposure received during the previous calendar year,
- Upon termination of employment,
- When notifying of exposure in excess of the limits specified in 4.0, and
- At the written request of a former employee.

6.2 Each notification and report shall be in writing. Reports shall include appropriate identifying data such as the name of the company, the radioactive materials license number under which the exposure was received, the name of the individual, the individual's social security number, the exposure information, and shall contain the following statement:

> "This report is furnished to you under the provisions of the (insert applicable Federal or State Agency and reference number). You should preserve this report for further reference."

The notification may be furnished utilizing the appropriate regulatory agency form, or a form containing the same information as the agency form.

7.0 WORKER'S RIGHTS

7.1 All individuals involved in gauging system activities are entitled to sufficient training and information to safely accomplish their assigned tasks. Gauging System personnel frequenting any area where sources of radiation are used or stored are entitled to the following:

- Information pertaining to the storage, transfer, or use of radioactive material or radiation in these areas,
- Instruction in the health protection problems associated with exposure to radioactive materials or radiation, and in the purposes and functions of protective devices employed,

RADIATION STANDARDS, NOTICES, AND WORKER'S RIGHTS

- Instruction in, and instruction to observe, to the extent within the Company's control, the applicable provisions of Federal and State regulations and licenses for the protection of personnel from exposure to radioactive materials or radiation,

- Instruction in the appropriate response to warnings made in the event of any unusual occurrence or malfunction that may involve exposure to radioactive material or radiation, and the proper methods to report such occurrences or malfunctions,

- Consultation with regulatory authorities, in the event of an inspection, concerning matters of occupational radiation protection, and

- Gauging system personnel who believe that a violation of Federal or State radiation protection regulations exists or has occurred, may request an inspection by the applicable regulatory authority. Such requests must be in writing, and shall be in accordance with the procedure outlined in the applicable Federal or State regulations.

ALARA PROGRAM

Procedure Number: 100-6

Revision: 3

Effective Date: 04-04-2005

Approved By:

James R. Beaty III
Corporate Radiation Safety Officer

04-04-2005
Date

Approved By:

Steve Richards
President, GE Automation Services

05-01-2005
Date

ALARA PROGRAM

GE Automation Services, Program for Maintaining Occupational Radiation Exposures As Low As Reasonably Achievable (ALARA).

1. MANAGEMENT COMMITMENT

We, the management of GE Automaton Services, are committed to the program described below for keeping radiation exposures (individual and collective) as low as reasonably achievable.

A. It will be a management priority that all radiographic personnel be made aware of our commitment to the ALARA philosophy and that they be instructed in the procedures and precautions to be used to keep their radiation exposure as low as possible. Management has established three Investigational Exposure Levels (IELs) below regulatory limits that, if reached, will initiate an investigation by the radiation safety officer (RSO) of the cause of the exposure and to determine what actions can be taken to reduce the probability of recurrence. The IELs are: (1) 350 millirems per quarter and (2) 1400 millirems per year.

B. Management has delegated authority to the Corporate RSO (CRSO) to enforce the ALARA program. Management will support the CRSO in all instances where this authority must be asserted.

C. Management will make all reasonable modifications to procedures, equipment and facilities to reduce exposures. We will be able to demonstrate that improvements have been sought, that modifications have been considered, and that they have been implemented where reasonable. We will be prepared to describe the reasons for not implementing modifications that have been recommended.

2. RADIATION SAFETY OFFICER RESPONSIBILITIES

A. The CRSO will emphasize the ALARA philosophy in all training of personnel, and will encourage personnel to review current procedures and propose changes to reduce exposure levels.

B. The Corporate RSO will conduct weekly reviews of pocket dosimeter reports, if used, and quarterly reviews of TLD badge reports for all gauging system personnel to determine if unnecessary exposures are being received.

ALARA PROGRAM

C. Investigational Exposure Levels (IEL)

Quarterly IEL	Annually
350 millirems	1400 millirems

The CRSO will investigate in a timely manner the causes of all personnel doses equaling or exceeding the IELs listed above. If warranted, the CRSO will take corrective actions to ensure that all unnecessary exposures are halted and recurrence is prevented. A report of each investigation and the actions taken, if any, will be recorded (Attachment 1) and forwarded to the Corporate RSO. The individual who receives the ALARA violation will be removed from the Radiation Safety Program until the event has been investigated by the Corporate RSO, to include a telephone conference call examining all circumstances surrounding the violation. Results of investigations will be maintained by the CRSO.

D. At least annually, the Corporate RSO will conduct a formal ALARA audit of the company's radiation safety program. The audit will include reviews of the company's personnel exposure records, internal audits, and any incidents. The goal of the audit will be to assess trends in occupational exposure as an index of the ALARA program's success and to determine if modification of the company's radiation safety program is needed. A summary of the results of each ALARA audit, including a description of actions proposed and taken, will be documented by the Corporate RSO. A report on each audit will be maintained on file for inspection purposes for 3 years from the date of the audit.

The undersigned certifies that the ALARA program set forth above has been implemented.

James R. Beaty III
Corporate Radiation Safety Officer

PRENATAL RADIATION EXPOSURE

Procedure Number: 100-7

Revision: 2

Effective Date: 04-04-2005

Approved By:

James. R. Beaty III
Corporate Radiation Safety Officer

04-04-2005
Date

Approved By:

Steve Richards
President, GE Automation Services

04-04-2005
Date

PRENATAL RADIATION EXPOSURE

1.0 PURPOSE

1.1 The purpose of this procedure is to provide guidance concerning prenatal radiation exposure.

2.0 DEFINITIONS

2.1 EMBRYO/FETUS: The developing human organism from conception until the time of birth.

2.2 DECLARED PREGNANT WOMAN: A woman who has voluntarily informed her employer, in writing, of her pregnancy and the estimated date of conception.

2.3 OCCUPATIONAL EXPOSURE: Exposure received in the course of employment in which the individuals duties involve exposure to radiation, excluding exposure received for medical purposes.

2.4 DOSE: The quantity of radiation absorbed by the body or by a portion of the body.

3.0 DECLARATION OF PREGNANCY

3.1 It is the woman's choice whether she will or will not declare pregnancy to the company. If the choice is to declare pregnancy a lower radiation dose limit will apply, possibly affecting the job assignments. If the choice is not to declare pregnancy, the same radiation dose limits of non-pregnant workers apply, even if the woman is visibly pregnant. The declaration of pregnancy or if pregnancy is terminated must be furnished to the company, in writing. Attachment 1 is provided for convenience in declaring pregnant woman status.

3.2 Work assignment could possibly be affected for a declared pregnant woman, according to the amount of occupational exposure already received. Normally the declared pregnant woman can continue to perform her job with no change and still meet the required exposure limits.

3.3 Documented medical proof is not required to declare pregnancy. However, intentionally declaring yourself to be a pregnant woman when you know you are not, may result

in appropriate disciplinary action, up to and including termination.

4.0 OCCUPATIONAL DOSE LIMITS

4.1 The external occupational dose to a declared pregnant woman must be monitored with individual monitoring devices, if it is likely that the embryo/fetus will receive, from sources external to the body, a dose in excess of 50 Millirem.

4.2 The dose to an embryo/fetus for the term of the pregnancy, due to occupational exposure, shall not exceed 500 Millirem. Efforts must be made to avoid substantial variations above a uniform monthly dose rate so that all of the dose received does not occur during a particular time of pregnancy. If the dose to the embryo/fetus is found to have exceeded 500 Millirem, by the time the woman declares the pregnancy, any additional dose to the embryo/fetus shall not exceed 50 Millirem during the remainder of the pregnancy.

4.3 The lower dose limit will remain in effect until the declared pregnant woman 1) is known to have given birth, 2) informed the company, in writing, that she is no longer pregnant, or 3) informs the company, in writing, that she no longer wants to be considered a declared pregnant woman.

5.0 TRAINING

5.1 Instruction concerning prenatal radiation exposure and it's risks to the embryo/fetus should be provided to female workers before they are allowed to work in a restricted area. Each supervisor of a female worker who will work in a restricted area should receive the same instruction. The instruction will be presented both orally and in written form and the workers will be given opportunity to ask questions. Attachments 2 and 3 will be explained to all female workers to provide written confirmation of understanding.

6.0 RECORDS

6.1 Records shall be maintained to record the dose to an embryo/fetus with the records of dose to the declared pregnant woman. The declaration of pregnancy shall also be kept in the individuals personnel file. Records should be protected from public disclosure because of their personal nature. The records shall be retained until the disposal is authorized by the Corporate Radiation Safety Officer.

PRENATAL RADIATION EXPOSURE

DECLARATION OF PREGNANCY

TO: _____
(Name of Your Supervisor)

I am declaring that I am pregnant. I believe I became pregnant in _____ of 20____. (Only the month and year need to be provided)

I understand that my occupational radiation dose during my entire pregnancy will not be allowed to exceed 0.5 rem (5 millisieverts)(unless that dose has already been exceeded between the time of conception and submitting this letter). I also understand that meeting the lower dose limit may require a change in job or job responsibilities during my pregnancy.

If I find out that I am not pregnant, or if my pregnancy is terminated, I will promptly inform you in writing that my pregnancy has ended.

_____
(Your Signature)

_____
(Your Name Printed)

_____
(Date)

PRENATAL RADIATION EXPOSURE

Instructions for Women Working with Radiation

I have received verbal instructions concerning the potential risks involved for pregnant women exposed to radiation, including a copy of U.S. Nuclear Regulatory Commission (NRC) Regulatory Guide 8.13, "Instruction Concerning Prenatal Radiation Exposure" (Rev. 3, 6/99).

The radiation safety officer (RSO) has encouraged me to ask for additional information if needed, and I am aware that the RSO is available to answer any questions I may have regarding the issue of radiation exposure to an embryo/fetus.

_____
Signature

_____
Printed Name

_____
Date

_____ _____
RSO Signature Date

PRENATAL RADIATION EXPOSURE

Instructions for Declared Pregnant Women

I have received verbal instructions on personnel monitoring (PM) requirements for declared pregnant women conducting activities involving sources of radiation, in accordance with the requirements of my employer's radiation safety program, the terms and conditions of my employer's radioactive materials license.

I have been instructed to wear my assigned PM badge at waist level to estimate the embryo/fetus dose. I am aware that the fetal dose is not allowed to exceed 500 millirem during the entire pregnancy as a result of occupational radiation exposures (unless that dose has already been exceeded between the time of conception and submitting my declaration of pregnancy), and that meeting the lower dose limit may require a change in job or job responsibilities during my pregnancy. I must make every effort to maintain the fetal dose as low as reasonably achievable (ALARA), and I am also aware that the Nuclear Regulatory Commission and equivalent state regulations recommends that an embryo/fetus not receive more than 50 millirem in any one month. I understand that records of fetal dose are maintained with my dose records.
The radiation safety officer has encouraged me to ask for additional information if needed, and to review information on the potential risks involved for pregnant women exposed to radiation, particularly U.S. Nuclear Regulatory Commission (NRC) Regulatory Guide 8.13.

_____
Signature

_____
Printed Name

_____
Date

_____ _____
RSO Signature Date

RECIPROCITY REQUIREMENTS

Procedure Number: 100-8

Revision Number: 5

Effective Date: 04-04-2005

Approved By:

James. R. Beaty III
Corporate Radiation Safety Officer

04-04-2005
Date

Approved By:

Steve Richards
President, GE Automation Services

04-04-2005
Date

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RECIPROCITY REQUIREMENTS

1.O PURPOSE:

1.1 The purpose of this procedure is to provide clarification of Reciprocity Requirements, as they pertain to Agreement States, and Nuclear Regulatory Commission (NRC) Federal Facility Regulations.

2.O SCOPE:

2.1 These rules apply to all GEAS personnel who use or handle sources of radiation for Industrial Radiography. All radiographic personnel are responsible for adhering to the guidelines set forth in this procedure, and the rules and regulations of the applicable regulatory authorities when using or handling sources of radiation.

3.O DEFINITIONS:

3.1 Reciprocity: A mutual agreement between Agreement States and NRC allowing licensee's to conduct Gauging System Maintenance Operations with-in that particular state without obtaining a specific license.

3.2 Notification: Written and or verbal communication prior to the actual act.

3.3 Fees: Monitory value required by each state prior to approving reciprocity.

4.0 REQUIREMENTS:

4.1 There are (2) two methods in which to conduct gauging system operations in a state, where GEAS does not hold a specific license.

4.1.1 Method # 1-File for reciprocity and pay the required fees.

4.1.2 Method # 2- Transfer all equipment and records, (see 5.5.2) to an Office located within that particular state which has a specific license in that state.

5.0 PROCEDURES:

5.1 Compliance

5.1.1 The out of state licensee must comply with:

(1) Their specific license.

(2) Inconsistent regulations of their specific license as compared to state regulations where Gauging Systems maintenance operations will be performed.

(3) State regulations where Gauging system maintenance operations will be conducted.

5.1.2 Refer to attachment # 1 for special reciprocity condition requirements by their license and additional requirements in the state where gauging system operations will be performed. Attachment # 2 lists all current reciprocity licenses by State.

5.2 Fees

5.1.3 Reciprocity must be applied for, and any specific fees paid, prior to engaging in gauging system operations in that state. All fees will be submitted and paid through the corporate location.

5.3 Notification

5.1.4 The out of state licensee must notify the Department of Radiation Control in writing at least (3) three days prior to engaging in radiographic operations. If an emergency job occurs where three days notification is not possible, the state may allow a telephone call and a fax notification. (See attachment # 4).

5.4 Gauging System Operations:

5.4.1 Gauging System Operations may be conducted for a specific number of days in the state, subject to applicable state regulations. If the number of days will be exceeded then the specific Operations Manager notify the CRSO who must apply for and obtain a specific state license to conduct further operations. (See attachment # 3)

5.5 Application

5.5.1 If reciprocity is not applied for, activities may be conducted through an existing specific license provided the record requirements of 5.5.2 are met. (See figure # 1 for examples)

5.5.2 All records of activities must be on file at the existing office within the state. Records include:
Source records (Receipt/Transfer/Disposal, Utilization Logs)
Leak tests
Equipment maintenance
Personnel qualifications, and personnel Dosimetry.
Calibrations.
Radiation Survey/Shipping Records, (RSSR's)

5.5.3 If reciprocity is applied for, the Services Manager will submit a request to the Corporate RSO, who in turn will process the request and ensure the Services Manager is apprised of updated regulations.

RECIPROCITY REQUIREMENTS

LICENSE	#	EXPIRES	ANNUAL FEE
S. CAROLINA	766	07/31/2008	175.00- JUN
NRC	09-28781-02	10/31/2004	6,100.00- OCT
GEORGIA	1489-1	05/31/2008	500.00 - APR
FLORIDA	3490-1	08/31/2008	430.50- JAN
OREGON	ORE-9101301	05/31/2014	695.00 - APR
INDIANA	Non-Agreement	With NRC	None
VIRGINA	Non-Agreement	With NRC	None

Attachment # 1

RECIPROCITY REQUIREMENTS

MAXIMUM NUMBER OF DAYS RECIPROCITY CAN BE REQUESTED PER YEAR

Florida	365 days
Kentucky	180 days
N. Carolina	180 days
S. Carolina	180 days
Georgia	180 days
Arkansas	180 days
Alabama	30 days
Mississippi	180 days
Louisiana	365 days
Maryland	180 days
Tennessee	180 days
California	180 days
Texas	180 days
Arizona	180 days
Oregon	180 days

The number of days above cannot be exceeded under Reciprocity Requirements. If the need is to exceed the above limits, then a specific license must be applied for. In general reciprocity cannot be used for greater than 30 days consecutively. Radioactive materials cannot be stored in the state, because the work site is not considered a permanent storage facility. Reciprocity notification must be in writing at least 3 days prior to engaging in gauging system activities.

Attachment # 2

EMPLOYEE RESPONSIBILITIES FOR RADIATION SAFETY

Procedure Number: 100-9

Revision: 5

Effective Date: 04-04-2005

Approved By:

James R. Beaty III — 04-04-2005
Corporate Radiation Safety Officer — Date

Approved By:

Steve Richards — 04-04-2005
President, GE Automation Services — Date

EMPLOYEE RESPONSIBILITIES FOR RADIATION SAFETY

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EMPLOYEE RESPONSIBILITIES FOR RADIATION SAFETY

1. PURPOSE

1.1. The purpose of this procedure is to establish a strong Corporate employee radiation safety program to:

1.1.1. Prevent customer or employee injury.

1.1.2. Protect the Corporation's license to provide customer service.

1.1.3. Comply with all applicable requirements under federal and state requirements.

2. DEFINITIONS

2.1. Radiation Indicators – These are warning lights that indicate the source shutter status, e.g., a red warning lamp indicates the source shutter is open and radiation is present in the measurement gap.

2.2. Radiation Safety Interlocks – Hardware or software features that function to prevent a radiation hazard, usually causing the source shutter to close under certain conditions.

2.3. Source Shutter – Part of the source holder that can be positioned to mechanically block the radiation beam and prevent significant quantities of radiation from being present outside of the source holder.

3. POLICY

3.1. The items listed below shall be grounds for written reprimand or termination of employment.

3.1.1. Deliberate disabling of a radiation indicator, a radiation interlock, or the source shutter mechanism with the following exception: An employee may disable a safety device for the purpose of temporary testing, however, all safety devices must be returned to the operational state before the employee leaves the immediate vicinity of the radiation source.

3.1.2. Failure to promptly take the necessary steps for the repair or replacement of non-functional radiation, radiation safety interlocks, or the source shutter mechanism.

3.1.3. Failure to notify the CRSO if repair or replacement cannot be promptly completed due to circumstances beyond the employee's control; e.g. necessary parts ordered but unavailable, or customer refuses to permit system downtime necessary to perform repair or replacement, and etc.

3.1.4. Failure to notify the CRSO immediately in the event a source shutter fails to close when commanded to do so.

3.1.5. Violation of the policies concerning the disassembly of source bodies containing radioactive sources in GEAS 200.

3.1.6. Violation of the policies concerning the use of personal Dosimetry.

3.1.7. Failure to perform the required radiation safety tests at the intervals specified by the Radiation Safety Officer or failure to submit records by the due date.

3.1.8. Falsification of radiation or radiation safety records.

3.1.9. Failure to maintain site records according to Corporate policy.

3.1.10. Failure to notify the CRSO if testing or records deadlines cannot be met due to circumstances beyond the employee's control.

3.1.11. Failure to maintain Site survey meter in proper calibrated condition

3.1.12. Violating and corporate, federal, or state instruction related to radiation safety.

3.1.13. Instructing a subordinate to do any of the items listed in 3.1.1 to 3.1.12.

3.1.14. Performing service on equipment GE Automation Services is not authorized to service.

4. PROCEDURES FOR NON-COMPLIANCE OF POLICY.

4.1.1 First Non-Compliance – Policy and correct procedures will be discussed with the employee and/or the Site Leader by the Corporate Radiation Safety Officer. A report of items discussed will be placed in the employee's and/or the Site Leader's Corporate Radiation Safety file.

4.1.2 Second Non-Compliance – A written reprimand will be given to the employee and/or the Site Leader by the Corporate Radiation Safety Officer. A copy will be sent to the employee's immediate supervisor and the Leader of Specialty Services by the Corporate Radiation Safety Officer. A copy of the reprimand will be placed in the employee's personnel file and in the employee's Corporate Radiation Safety file. This policy, GEAS 100-9, will be discussed with the employee and/or the Site Leader by the Leader of Specialty Services.

4.1.3 Third Non-Compliance – A written reprimand will be given to the employee and/or the Site Leader by the Leader of Specialty Services. A copy of the reprimand will be placed in the employee's personnel file and in the employee's Corporate Radiation Safety file. A conference call will be held with the employee, their immediate supervisor, the Leader of Specialty Services and the Corporate Radiation Safety Officer to discuss the current and previous item/items of non-compliance. The employee will be relieved from his duties for a period of two working days (16 hours) without pay. Vacation, Sick days, and optional holidays cannot be substituted for these days. At the request of the Leader of Specialty Services or the Corporate Radiation Safety Officer, the employee's Radiation Safety Certification may be terminated and the employee must be retrained in GE Automation Services Policies and Operating Procedures.

4.1.4 Fourth Non-Compliance – The employee will be immediately terminated.

5. PROCEDURES FOR NOTIFYING EMPLOYEES OF THIS POLICY

5.1. The Radiation Safety Officer shall be responsible for proper instruction of this policy and distributing the Employee's Responsibility Certificate (Attachment #1) to all Qualified Persons, Gauging system Trainees, and New Hires before a radiation badge is issued.

5.2. The Corporate Radiation Safety Officer shall be responsible for filing the Employee's Responsibility Certificate in the employee's corporate training file.

Attachment 1

General Electric Automation Services

Radiation Safety Responsibility Certificate

I certify that I have read and understand the requirements of GE Automation Service's instruction GEAS 100-9, "Employee Responsibilities for Radiation Safety" and NRC 10 CFR Part 19 and equivalent state regulations. I understand that failure to comply with the specified radiation safety requirements are grounds for a written reprimand or for termination of employment as set forth in section 4. A question and answer session was held to explain any misunderstood information and I had the opportunity to have my questions answered.

Date: _____

Print Name: _____

Signature: _____

Employee Number: _____