



UNITED STATES
NUCLEAR REGULATORY COMMISSION

REGION II
101 MARIETTA STREET, N.W.
ATLANTA, GEORGIA 30303

OCT 31 1983

Report No. 70-1113/83-28

Docket No. 70-1113

License No. SNM-1097

Safeguards Group No. III

Licensee: General Electric Company
P. O. Box 780
Wilmington, NC 28402

Date of Inspection: September 20-23, 1983

Type of Inspection: Unannounced Material Control and Accountability

Inspector: B. D. Richards
for B. D. Richards, Statistician

10/25/83
Date Signed

Approved by: E. J. McAlpine
E. J. McAlpine, Section Chief, Material Control
and Accountability Section, Safeguards Branch
Division of Emergency Preparedness and Materials
Safety Programs

10/28/83
Date Signed

Inspection Summary

Areas Inspected: Measurements and Statistical Controls.

The inspection involved 25 inspector-hours by one NRC inspector and was begun during the regular hours.

Results: The licensee was found to be in compliance with NRC requirements in the one area examined during the inspection except for the following items:

1. Failure to adequately reevaluate control chart limits at least once each material balance period and failure to establish a written procedure to describe the methods used for evaluating control chart limits.
2. The licensee's procedure which described control chart limit calculations was inadequate in that it included inappropriate statistical techniques.

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REPORT DETAILS

Report No. 70-1113/83-28

1. Key Persons Contacted

- *B. F. Bentley, Acting Manager, Fuel Manufacturing
- *T. D. Brechtlein, Manager, Fuel Chemical Quality Control
- R. L. Bruce, Analyst, Licensing and Nuclear Materials Management
- *R. H. Foleck, Acting Manager, Licensing and Nuclear Materials Management
- W. B. Haverty, Analyst, Licensing and Nuclear Materials Management
- *W. J. Kemp, Acting Manager, Fuel Fabrication
- *E. A. Lees, Manager, Quality Assurance
- *R. I. Parnell, Measurement Control Engineer
- *L. A. Sheely, Manager, Fuel Quality
- *W. B. Smalley, Acting Manager, Regulatory Compliance
- *J. P. Stewart, Senior Engineer, Nuclear Safety Evaluation
- *J. W. Summey, Acting Manager, Planning and Projects
- *T. P. Winslow, Manager, Chemet Laboratory

The inspector also interviewed several other licensee employees.

*Denotes those present at the exit interview

2. MC 85206B - Measurements and Statistical Controls

a. Control Chart Program

The licensee's statistical program for establishing and maintaining the control charts used to monitor the quality of special nuclear material accountability measurements was inspected. The inspection consisted of a review of the licensee's applicable written procedures, the licensee's methods for detecting out-of-control situations (associated with standard measurements), the data base used to establish the control chart limits, and the statistical methods employed in the evaluation of the data base. The data base and statistical methods used to determine the control chart limits which were in effect during the current inventory period were examined. The program data for the following measurement systems were inspected: standard control charts for uranium concentration measurements of uranium dioxide powder and clean scrap, enrichment measurements of uranium dioxide powder, and bulk measurements of uranium hexafluoride.

The licensee maintained control charts for the measurement of standards to monitor the performance of applicable measurement systems. Control charts have been established for individual measurements of standards. The licensee appeared to have an adequate system in place for detecting out-of-control situations for standard measurements for those measurement systems reviewed during the inspection.

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b. Control Chart Limit Evaluations

The licensee is required by Section 4.5.1 of his Fundamental Nuclear Material Control Plan to reevaluate existing control chart limits once each material balance period. The purpose of this evaluation is to determine whether the existing control chart limits are still applicable. An examination of the control chart limits associated with the NBL97 standard which is used to monitor uranium concentration measurements of uranium dioxide powder disclosed that the limits were calculated in November 1981, from measurement data generated between April 1, 1981 and November 12, 1981. The licensee did not have a program in place to compare, by means of formal statistical tests, current measurement data to the measurement data associated with the existing control chart limits. The licensee generated a report every three months which summarized standard measurements from the current three months along with key statistical parameters associated with the standard measurements. The licensee compared the current three months of measurement data to the measurement data from the preceding three months. However, the licensee's program did not include a provision for comparing current measurement data to the measurement data upon which the existing control chart limits were based - a necessary step in determining the applicability of the existing control chart limits. If the licensee had performed such a test, he would have found that the variance associated with standard measurements changed significantly on two separate occasions. The variance of the February 7 - May 8, 1983 period in particular decreased by a factor of five relative to the variance of the April 1, 1981 - November 12, 1981 period. These variances are statistically significantly different at the .0001 level. It should be noted that the variance associated with standard measurements is a key parameter in determining control chart limits. These independent tests performed by the inspector indicated that measurement performance had significantly changed, based on the statistical variation of standard measurements from period to period, and that the control chart limits should have been updated. The variance of the measurements of standards associated with the February 1 - May 2, 1982 time period was also found to be significantly different (at the .05 level) from the variance of the measurements of standards associated with the data base from which the existing control chart limits were calculated. The licensee failed to reevaluate control chart limits associated with the gravimetric uranium measurement system during the August 10, 1982 through August 8, 1983 material balance period.

In addition, the licensee did not have a procedure that described the methods used for evaluating control chart limits. Aspects of the program such as frequency of evaluation, composition of the data base, and the statistical tests and criteria to be applied to the evaluation of the data base were not addressed in any procedure. The licensee's failure to establish a written procedure for this aspect of the measurement control program and the failure to reevaluate the control chart limits is a violation. (83-28-01)

c. Control Chart Limit Calculations

The statistical techniques used by the licensee in calculating control chart limits were examined and found to be appropriate except for two concerns. It was disclosed that the licensee was using an inappropriate method to obtain the "t"-statistic. The "t"-statistic is a key parameter used in the formula to calculate control chart limits. For some measurement systems, the licensee analyzed the same standard a number of times when a batch of process material was analyzed. The licensee chose to control a series of standard measurements at the .05 and .001 levels of significance. This resulted in the licensee controlling each individual standard measurement at levels other than .05 and .001, as is required by 10 CFR 70.57(b)(11). In order for a series of measurements to be in control, all the results in that series must be in control. A series of measurements is out-of-control if any one or more of the results are out-of-control.

The control chart limits associated with standard NBS 950B (which is used to monitor uranium concentration in clean scrap), for example, were calculated incorrectly because of the licensee's inappropriate statistical techniques. The licensee controlled a pair of standard measurements for this measurement system at the .05 and .001 levels of significance. However, the licensee compared each standard measurement result to the calculated control chart limits. The existing control chart limits went into effect July 13, 1983. The licensee established the control chart limits from the measurement data associated with 83 individual measurements of the standard (NBS 950B) performed between February 7, 1983 and May 8, 1983. The degrees of freedom associated with the "t"-statistic used in calculating the control chart limits thus became 82 ($n-1=83-1$). To choose the correct "t"-statistic for significance levels of .05 and .001, one should look up the row of values in a "t"-table corresponding to the applicable degrees of freedom, 82 in this case. Then the two values in that row corresponding to alpha levels of .05 and .001 should be selected. The inspector found these values (after interpolation) to be $t(82; .05) = 1.99$ and $t(82; .001) = 3.424$. The "t"-statistics that the licensee used in the formula to calculate the control chart limits for this system were 2.2781 and 3.6250. The corresponding significance levels associated with these "t"-statistics are .028 and .0007 (after interpolations are performed). Thus, in order for the licensee to control the pair of standard measurement results at the .05 and .001 significance levels, each individual standard measurement had to be controlled at the .028 and .0007 significance levels. The use of significance levels that were smaller than .05 and .001 resulted in values for the "t"-statistic that were too large, and therefore control chart limits that were too large. This type of anomaly resulted in inaccurate control chart limits for this measurement system, as evidenced by the following table:

	<u>Significance Levels</u>	<u>"t" - Statistic</u>	<u>Control Chart Limits</u>
GE	.028	2.2781	84.65, 84.89
method	.0007	3.6250	84.59, 84.95
10 CFR 70.57 (b)(11)	.05	1.990	84.67, 84.87
criteria method	.001	3.424	84.60, 84.94

The licensee's applicable procedure for calculating control chart limits, COI #002, entitled "Chemet Laboratories Control Charting", was found to be inadequate. It included a provision for controlling individual standard measurements at significance levels other than .05 and .001. The procedure was reviewed by the appropriate managers, but the review did not detect the provision for using an inappropriate "t"-statistic. Therefore, the licensee's review of the procedure (in accordance with 10 CFR 70.57(b)(5)) was not adequate. The most recent revision (6) of the procedure was issued May 6, 1983, after various licensee representatives reviewed it between April 15 and April 27, 1983. The inspector examined the process resulting in approval of this procedure. It appeared that sufficient technical or regulatory expertise was not obtained to properly evaluate the adequacy of this procedure. In this matter, it should be noted that the requirement for an adequate review differs from the requirement for establishing a procedure. The failure to perform an adequate review of an already established procedure is equally significant and its proper function is required by 10 CFR 70.57(b)(5). The licensee's use of a procedure which was inadequately reviewed, in that it contained inappropriate statistical techniques, is a violation (83-28-02).

It should be noted that the licensee has an exemption from 10 CFR 70.57(b)(11) (License Condition 4.3) for establishing control chart limits. The exemption was granted to allow the licensee to use least scale divisions in calculating control chart limits in lieu of exact .05 and .001 levels of significance for bulk measurements. At no time was the intent of the exemption to allow the licensee to control individual standard measurements at levels significantly different than .05 and .001.

The second issue concerns the licensee's method for calculating control chart limits associated with uranium hexafluoride weight measurements. The licensee representative who was responsible for these calculations was not on site during the inspection. Therefore, the licensee's statistical methods could not be fully evaluated in this area. This item is unresolved, pending further inspection in this area by the NRC. (83-28-03)

3. Unresolved Items

Unresolved items are matters about which more information is required to determine whether they are acceptable or may involve violations or deviations. One new unresolved item identified during this inspection is discussed in Paragraph 2.

4. Exit Interview

The inspection scope and findings were summarized on September 23, 1983, with those persons indicated in Paragraph 1 above.

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GENERAL ELECTRIC

WILMINGTON MANUFACTURING DEPARTMENT
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June 7, 1984

Mr. J. Philip Stohr, Director
Division of Emergency Preparedness &
Materials Safety Programs
U. S. Nuclear Regulatory Commission, RII
Post Office Box 2203
Atlanta, Georgia 30301

Dear Mr. Stohr:

References: (1) NRC License SNM-1097, Docket 70-1113
(2) NRC Inspection Report 70-1113/83-28, 10/31/83
(3) Letter, C. M. Vaughan to J. P. Stohr, 11/29/83
(4) Letter, J. P. Stohr to J. A. Long, 1/5/84
(5) Letter, C. M. Vaughan to J. P. Stohr, 2/3/84
(6) Letter, J. P. O'Reilly to J. A. Long, 5/11/84

Thank you very much for your letter reporting your review of General Electric's responses to the findings of the referenced inspection.

General Electric replies pertaining to the items of apparent noncompliance are given in the attachment to this letter. We welcome further discussion with your staff on these items or to our related replies for further clarification.

Pursuant to 10 CFR 2.790(d), General Electric Company requests that the attachment to this letter be withheld from public disclosure since this attachment identifies details of General Electric's control and accounting procedures for safeguarding licensed special nuclear material.

Very truly yours,

GENERAL ELECTRIC COMPANY

Charles M. Vaughan

Charles M. Vaughan, Manager
Licensing & Nuclear Materials Management
M/C J26

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Attachment

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