NRC INSPECTION MANUAL

INSPECTION PROCEDURE 85209

MEASUREMENT CONTROL AND STATISTICS

PROGRAM APPLICABILITY: MC 2681

85209-01 INSPECTION OBJECTIVE

Assure that an adequate program has been established, maintained and is being followed for the continuing determination and control of errors associated with measurement processes.

85209-02 INSPECTION REQUIREMENTS

The program for measurement control and statistics must comply with all applicable NRC regulations and license conditions. The licensee's FNMC Plan should provide general commitments concerning the program. By inspection determine whether:

02.01   Written procedures are established, maintained and followed which describe the methods used for statistical control of measurement performance; for determining measurement and sampling errors; for preparing, reviewing, approving and disseminating any program modifications or changes; and for recording, analyzing and reporting program data and information. [70.51(c); 70.57(b)(4), (5)(iii), (5)(iv), (11)]

02.02   Current data is generated on the performance of measurement systems which provides values for bias corrections and their uncertainties, random error variances, limits for systematic error, and any other parameters needed to establish the uncertainty of measurements pertaining to materials control and accounting. Program data and information is evaluated with appropriate statistical methods and bias corrections are made using an appropriate statistical procedure. [70.57(b)(8)(ii), (10)]

02.03   Error data reported by contractor laboratories provides sufficient data to allow the licensee to calculate bias corrections and measurement limits of error. The contractor's conformance with necessary requirements is supported by control data and statistical studies provided to the licensee by the contractor laboratory. [70.57(b)(3)]

02.04   Any pooling of prior period measurement error data with that from the current period is supported by records which show that measurements were in statistical control and statistical tests at the 0.05 level of significance which indicate that the data sets from the different periods are not significantly different. The limit of error for the plant material balance (LEMUF/LEID) is

calculated with qualified program data using appropriate statistical techniques. [70.57(b)(9),(10)]

02.05   Control charts designed to monitor the quality of each type of program measurement are established which utilize control limits equivalent to the 0.05 and 0.001 levels of significance. Control data exceeding the 0.05 limit is investigated and timely corrective action is taken. Measurement systems whose control data exceed the 0.001 limit are not used for MC&A purposes until brought into control at the 0.05 control level. [(70.57(b)(11)]

02.06   Shipper-receiver difference action limits set at the 95 percent confidence level are determined using appropriate statistical methods. [70.57(b)(10), 70.58(g)(3)]

85209-03 INSPECTION GUIDANCE

03.01   Regulations.   70.51(c); 70.57(b)(3), (4), (5)(iv), (8)(ii), (9), (10), (11); 70.58(g)(3).

03.02   Regulatory Guides and Reports

  a. Regulatory Guides
      5.3 - Statistical Terminology and Notation (2/73)
      5.18 - Limit of Error Concepts (1/74)
      5.22 - Assessment of Normality Assumption (4/74)
      5.28 - Evaluation of Shipper-Receiver Differences (6/74)
      5.33 - Statistical Evaluation of MUF (6/74)
      5.36 - Dealing with Outlying Observations (6/74)
      5.53 - Error Estimation Methods for NDA (2/84)

  b. NUREG/CR Reports
      0033 - Rounding Measurement Results (3/78)
      0683 - Statistical Methods (1979)
      0829 - Measurement Control Program (6/80)
      0830 - Monitoring Random Errors (6/80)
      1284 - Determining and Controlling Bias (6/80)
      3584 - Sources of Measurement Error (1/84)

  c. Other
      TID - 26298 - Statistical Methods (Jaech - 1973)
      NUSAC Report No. 752 - Uncertainty of LEID (4/83)
      NUSAC Report No. 790 - Analysis of S/R Differences (9/84)
      NUSAC Report No. 591 - Derivation of AMASS (9/84)
      NUSAC Report No. 756 - AMASS System Manual (7/83)
      NUSAC Report No. 755 - AMASS User/Analyst Manual (7/83)
      NUSAC Report No. 847 - AAMASS Applications Manual (9/84)
      NUSAC Report No. 859 - Applications of AAMASS (8/84)
      NUSAC Report No. 877 - Bias Correction (7/84)
      NUSAC Report No. 915 - Validation of AAMASS (8/84)

03.03   Criteria. The emphasis of bias correction should be to obtain an unbiased value for the total plant MUF/ID quantity. Each bias correction that is greater than its uncertainty at the 95 percent confidence level should be considered to be statistically significant and all affected items and associated records should be

corrected. For LEU enriched to less than 6 percent, only statistically significant bias corrections need to be included in the report of plant MUF/ID. For all other SNM, both statistically significant and insignificant bias corrections must be included in the reported plant MUF/ID value. In addition, bias correction information from prior periods must be maintained and accurately tracked so that it can be correctly applied to SNM listed under each term in the plant MUF/ID expression (i.e., beginning inventory, ending inventory, additions to inventory, removals, and prior period adjustments). The number of significant figures in each bias correction should be consistent with the number of significant figures in the originally assigned value. With respect to the above, bias correction need not be considered if:

a. A measurement system utilizes a point calibration/standardization technique in a manner such that the quantities assigned to unknowns are determined directly from standards data and the range of uncertainty for unknowns intersects the region within plus or minus ten percent of the standard's assigned value.

b. The bias of a measurement system is less than:

1. the uncertainty in the standard reference material involved in the system's standards,

2. the uncertainty in the system's working standard's assigned value determined from calculation, or

3. the uncertainty in the system's working standard's assigned value from measurement provided the uncertainty is less than 0.05%.

c. The total plant MUF/ID bias correction is less than 50 grams of HEU, U-233, or Pu; or 300 grams of LEU (6-20% enriched).

The amount of effort expended to determine the magnitude of random and systematic errors should be related to the role that such errors play in the calculation of LEMUF/LEID. As a general rule, a minimum of 15 replicates should be analyzed during each material balance period for each material type. In addition, a minimum of 16 standards should be measured per material balance period for each measurement system on the basis of a minimum of two standards per week that a system is in operation. However, fewer than the above minimums may be acceptable if justified by an effort/benefit analysis. No replicates are required for bulk volume measurements; reproducibility results obtained during calibration are sufficient. Random error variances for scales, balances, and NDA can be determined from individual or replicate measurements of standards or process materials. Systematic errors whose contribution to LEMUF/LEID is less than 5 grams HEU, U-233 or Pu, 30 grams of U-235 in LEU enriched to greater than 6 percent, or 100 grams of U-235 in LEU enriched to less than or equal to 6 percent can be excluded from the calculation of LEMUF/LEID, provided that their total contribution is less than 50 grams HEU, U-233 or Pu, 300 grams of U-235 in LEU enriched to greater than 6 percent, or 1000 grams of U-235 in LEU enriched to less than or equal to 6 percent.

Contractor measurement control and statistics programs should be checked for conformance with applicable NRC requirements by analyzing the results of the licensee's annual reviews and audits of its contractor laboratory. An occasional visit by inspectors to contractor labs (perhaps every two to three years) might also be employed as an overcheck of the effectiveness and compliance of these labs.

The measurement control program must monitor and control the measurement of all standards and replicates analyzed for MC&A purposes unless specifically exempted by license condition. Control charts or their equivalent should be used in conjunction with more comprehensive analyses of control data during and at the end of each material balance period. Such analyses should include but not be limited to trend analysis, analysis of out-of-control data, analysis of the appropriateness of control limits, and tests for randomness and normality. The results of these analyses should be reported to all individuals who have direct or indirect responsibility for performing the associated measurements.

The establishment and modification of control limits must be approved by the measurement control coordinator (MCC) or the designated alternate. Control limits must not be recalculated simply to resolve an out-of-control situation. Whenever a measurement system is operating between the 0.05 and 0.001 control limits, more data should be collected and analyzed.

In addition, the MCC or the designated alternate should be promptly notified of this condition. Such notification should occur within 48 hours if one data point falls in this range and within 24 hours if two consecutive points fall in this range (excluding Saturdays, Sundays, and holidays if the plant is not operating). Investigations of exceeded control limits should concentrate on determining the assignable cause of such situations. These investigations and the associated corrective actions should be completed and documented within 7 calendar days. The MCC must have the authority to suspend measurement activities for MC&A purposes when a system's data exceeds the 0.001 control limit.

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