July 21, 2000

Mr. J. N. Adkins
Vice President - Production
United States Enrichment Corporation
Two Democracy Center
6903 Rockledge Drive
Bethesda, MD 20817

SUBJECT: NRC INSPECTION REPORT 70-7001/2000005(DNMS)

Dear Mr. Adkins:

On June 29, 2000, the NRC completed a routine resident inspection and special licensing review at your Paducah Gaseous Diffusion Plant. The enclosed report presents the results of this inspection. During the period covered by the inspection report, the conduct of safety-related activities at the Paducah Gaseous Diffusion Plant was generally adequate.

Based upon the information developed during the inspection and onsite review, the NRC identified two cited violations. The violation involving inadequate corrective actions for a self-identified condition adverse to quality is of concern because the plant staff did not take timely action to resolve a situation in which the approved management controls (written procedures) for activities affecting quality were not implemented. The violation involving the C-712 Acid Pit is of concern because the documented safety basis associated with the C-712 Acid Neutralization Pit could not demonstrate compliance with the double contingency principle at the enrichment limit of 5.5 weight percent uranium-235 (^{235}U). The NRC staff review of the actual C-710 laboratory and Acid Pit operations, however, provided assurance that operations as conducted did not pose an immediate safety concern given that the C-710 laboratory criticality safety mass limits, and the actual masses flowing into the pit, were much less than the safe mass limit established for the pit.

You are required to respond to this letter and should follow the instructions specified in the enclosed Notice when preparing your response. The NRC will use your response, in part, to determine whether further enforcement action is necessary to ensure compliance with regulatory requirements.

In accordance with 10 CFR 2.790 of the NRC's "Rules of Practice," a copy of this letter and its enclosure will be available **electronically** for public inspection in the NRC Public Document Room **or** from the *Publicly Available Records (PARS) component of NRC's document system (ADAMS). ADAMS is accessible from* the NRC Web site at http://www.nrc.gov/NRC/ADAMS/index.html (the Public Electronic Reading Room).

We will gladly discuss any questions you have concerning this inspection.

Sincerely,

/RA/

Patrick L. Hiland, Chief
Fuel Cycle Branch

Docket No. 70-7001
Certificate No. GDP-1

Enclosures: 1. Notice of Violation
2. Inspection Report 70-7001/2000005(DNMS)

cc w/encls: H. Pulley, Paducah General Manager
L. L. Jackson, Paducah Regulatory Affairs Manager
J. M. Brown, Portsmouth General Manager
S. A. Toelle, Manager, Nuclear Regulatory Assurance and Policy, USEC
Paducah Resident Inspector Office
Portsmouth Resident Inspector Office
R. M. DeVault, Regulatory Oversight Manager, DOE
W. D. Seaborg, Paducah Site Manager, DOE
J. Volpe, State Liaison Officer

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NAME	Jacobson:js		Hiland		Galloway			
DATE	07/21/00		07/21/00		7/21/00/email			

OFFICIAL RECORD COPY

We will gladly discuss any questions you have concerning this inspection.

Sincerely,

Patrick L. Hiland, Chief
Fuel Cycle Branch

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J. Volpe, State Liaison Officer

NOTICE OF VIOLATION

United States Enrichment Corporation
Paducah Gaseous Diffusion Plant

Docket No. 70-7001
Certificate No. GDP-1

During an onsite NRC licensing review conducted April 11, 2000, through April 14, 2000, and NRC routine inspection conducted from May 4 through June 29, 2000, violations of NRC requirements were identified. In accordance with the "General Statement of Policy and Procedure for NRC Enforcement Actions," Revision 1, the violations are listed below:

1. Title 10 of the Code of Federal Regulations, Part 76.93, “Quality Assurance,” requires, in part, that the Corporation establish, maintain, and execute a Quality Assurance Program.

   Section 2.16 of the Quality Assurance Program, “Corrective Action,” requires, in part, that conditions adverse to quality are promptly identified and corrected as soon as practical.

   Contrary to the above, on May 16, 2000, the Corporation failed to promptly correct as soon as practical a condition adverse to quality. Specifically, the Corporation failed to develop written procedures for dedication of seals manufactured or repaired in the maintenance seal shop, a condition adverse to quality, after the non-conformance was identified by the quality assurance staff.

   This is a Severity Level IV violation (Supplement VI). **(VIO 70-7001/2000005-01)**.

2. Technical Safety Requirement (TSR) 3.11.1 requires, in part, that the nuclear criticality safety program shall be established, implemented, and maintained as described in the Safety Analysis Report (SAR) and shall address process evaluations and approvals.

   Safety Analysis Report Section 5.2.2.3, “Process Evaluation and Approval,” requires, in part, that a nuclear criticality safety evaluation (NCSE) be prepared to: (1) document the analyses as specified in the NCSE procedure; (2) document potential upset conditions presenting nuclear criticality safety concerns; and (3) identify the assumptions and equipment needed to ensure criticality safety.

   Procedure CP4-EG-NS1101, Rev. 0, “Evaluation of Requests for Criticality Safety Approval,” dated October 31, 1996, requires that: (1) normal case conditions based on available information be defined; (2) information is accurate; and (3) information documented in the NCSE is sufficient to enable independent analysis.

   Contrary to the above, as of April 14, 2000, the certificatee failed to follow procedure CP4-EG-NS1101, Rev. 0, in the development of NCSE 1493-25. Specifically, the certificatee did not:

   A. Define the normal conditions for the C-712 Acid Neutralization Pit based on information available in NCSE 1493-25;

   B. Accurately describe the operation of the C-712 Acid Neutralization Pit in NCSE 1493-25;

C. Ensure that NCSE 1493-25 for the C-712 Acid Neutralization Pit was sufficiently documented to enable independent analysis;

This is a Severity Level IV violation (Supplement VI) **(VIO 070-07001/2000005-04)**.

Pursuant to the provisions of 10 CFR 76.70, United States Enrichment Corporation is hereby required to submit a written statement or explanation in reply to the violation to the U.S. Nuclear Regulatory Commission, ATTN: Document Control Desk, Washington, D.C. 20555, with a copy to the Regional Administrator, Region III, and a copy to the NRC Resident Inspector at Paducah, within 30 days of the date of the letter transmitting this Notice of Violation (Notice). Your reply to the violation should be clearly marked as a "Reply to a Notice of Violation" and should include for the violation: (1) the reason for the violation, or, if contested, the basis for disputing the violation, (2) the corrective steps that have been taken and the results achieved, (3) the corrective steps that will be taken to avoid further violations, and (4) the date when full compliance will be achieved. Your response may reference or include previously docketed correspondence, if the correspondence adequately addresses the required response. If an adequate reply is not received within the time specified in this Notice, an Order or a Demand for Information may be issued as to why the Certificate should not be modified, suspended, or revoked, or why such other action, as may be proper, should not be taken. Where good cause is shown, consideration will be given to extending the response time.

The NRC has concluded that information regarding the reasons for Violation 70-7001/2000005-01, the corrective actions taken and planned to correct the violation and prevent recurrence, and the date when full compliance will be achieved is already adequately addressed in this inspection report. Therefore, a specific response to Violation 70-7001/2000005-01 is not required. However, you are required to submit a written statement or explanation, pursuant to 10 CFR 76.70, if the description therein does not accurately reflect your corrective actions or your position. In that case, or if you choose to respond, clearly mark your response as a “Reply to a Notice of Violation,” and send it to the address identified above within 30 days of the date of this letter transmitting this Notice.

If you contest this enforcement action, you should also provide a copy of your response to the Director, Office of Enforcement, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555-0001.

Because your response will be placed in the NRC Public Document Room (PDR), to the extent possible, it should not include any personal privacy, proprietary, or safeguards information so that it can be placed in the PDR without redaction. If personal privacy or proprietary information is necessary to provide an acceptable response, then please provide a bracketed copy of your response that identifies the information that should be protected and a redacted copy of your response that deletes such information. If you request withholding of such material, you must specifically identify the portions of your response that you seek to have withheld and provide in detail the bases for your claim of withholding (for example, explain why the disclosure of information will create an unwarranted invasion of personal privacy or provide the information

required by 10 CFR 2.790(b) to support a request for withholding confidential commercial or financial information). If safeguards information is necessary to provide an acceptable response, please provide the level of protection described in 10 CFR 73.21.

In accordance with 10 CFR 19.11, you may be required to post this Notice within two working days.

Dated this day of July 2000

U.S. NUCLEAR REGULATORY COMMISSION

REGION III

Docket No:	70-7001
Certificate No:	GDP-1
Report No:	70-7001/2000005(DNMS)
Licensee:	United States Enrichment Corporation
Facility:	Paducah Gaseous Diffusion Plant
Location:	5600 Hobbs Road P.O. Box 1410 Paducah, KY 42001
Dates:	May 4 through June 29, 2000 and Licensing Review of April 11-14, 2000
Inspectors:	K. G. O'Brien, Senior Resident Inspector J. M. Jacobson, Resident Inspector L. Berg, Licensing Reviewer C. Tripp, Licensing Reviewer
Approved By:	Patrick L. Hiland, Chief Fuel Cycle Branch Division of Nuclear Materials Safety

EXECUTIVE SUMMARY

United States Enrichment Corporation
Paducah Gaseous Diffusion Plant
NRC Inspection Report 70-7001/2000005(DNMS)

Plant Operations

- The plant staff took an orderly approach to reducing the cascade power level and shutting down approximately 130 cells for the summer. The power reduction occurred without any significant cascade perturbations and without any releases. (Section O1.1)

- The inspectors identified a weakness in the plant staff's use of written and approved operational procedures. Specifically, the plant staff used a maintenance work package that contained detailed instructions and limited functional testing as a substitute for a written and approved operational procedure for an off-normal operations effort prior to corrective maintenance involving failed freezer-sublimer valves. (Section O1.2)

Maintenance

- The inspectors determined that the plant staff identified a long-standing failure to control seal maintenance activities impacting safety consistent with the Quality Assurance Plan requirements. However, the plant staff's initial corrective actions to the non-conformance were not fully consistent with the potential operability impacts and did not include corrective actions necessary to ensure that future activities were conducted in accordance with the Quality Assurance Plan. The inspectors determined that corrective actions developed after the issue was raised by the inspectors were adequate to resolve the non-conformances. (Section M1.1)

Engineering

- The plant staff identified a non-cited violation involving the lack of an independent calibration verification for neutron slab instruments used onsite to quantify the enriched uranium mass in potentially fissile equipment. The plant staff stopped characterization activities until a single-failure-proof process for performing instrument calibrations was developed and formal validation of the software used to calculate mass was complete. (Section E1.1)

- The plant staff developed an engineering evaluation that provided guidance to the operations staff to respond to criticality accident alarm fault conditions. The inspectors noted that the response for most of the conditions was reasonable, but the guidance for two of three detectors for a cluster in fault status raised issues for additional followup with NRC Headquarters staff. (Section E1.2)

- The NRC staff identified a violation involving a failure to follow Procedure CP4-EG-NS1101, Revision 0, dated October 31, 1996, during the development of NCSE 1493-25. The staff concluded that the operation, as actually conducted, would require at least two unlikely and independent process upsets before criticality was possible, and thus met the intent of the double contingency principle. However, the documented safety basis established by the Acid Pit Nuclear Criticality Safety Approval/Evaluation (NCSA/E) assumed a much larger mass loading as part of normal conditions than encompassed by

the three Laboratory NCSA/Es. With this documented “normal condition” as defined in the evaluation, the staff could not adequately demonstrate that the Acid Pit would remain subcritical under normal and all credible abnormal conditions. The staff determined that an immediate safety concern did not exist, however, because the laboratory criticality safety mass limits, and the actual masses flowing into the Pit, were less than the safe mass limit established by the Acid Pit NCSA/E. Specifically, the staff concluded that there did not appear to be a credible concentrating mechanism that could invalidate the calculation’s assumptions that material remained in a slab configuration. On this basis, the staff concluded that no immediate safety concern existed at 5.5 weight percent ^{235}U, and that the operation of the Acid Pit, as actually conducted, could be shown to meet the double contingency principle. (Section E1.3)

Report Details

I. Operations

O1 Conduct of Operations

O1.1 Transition to Cascade Operations at Low Power

a. Inspection Scope (88100)

The inspectors observed and followed the transition activities associated with the plant reduction in power for the summer months.

b. Observations and Findings

The plant staff initiated a power reduction for the cascade in May and June which ultimately resulted in the cascade operating at 175 megawatts (MW). This power level was the lowest level at which the plant had ever operated. The number of operating cells in the large process buildings was reduced from approximately 160 to 32 (eight cells per building). In addition, the amount of material fed into the cascade was reduced and the feed itself was below normal enrichment (0.71 weight percent). As a result, the product withdrawn in Building C-310 (Product Withdrawal) was also below normal enrichment. The plant staff planned to continue to operate the cascade at this power level until some time in mid-August or early September 2000, depending on the temperatures and cost of power at the end of the summer.

The inspectors noted that the power reduction was accomplished safely and in a controlled manner. The plant staff developed a weekly schedule of cells to take off-line and evacuate. The cells were then sampled to ensure the uranium hexafluoride pressure remaining was essentially zero, and then the cells were pressurized with dry air. The evacuation process was facilitated by the plant staff's focus on improving the material condition of the seal exhaust and wet air pumps over the previous year. Once the power reduction was complete, the plant staff initiated a process for performing maintenance on the shutdown cells in order to place them on ready standby for the end-of-summer power escalation.

c. Conclusion

The plant staff took an orderly approach to reducing the cascade power level and shutting down approximately 130 cells for the summer. The power reduction occurred without any significant cascade perturbations and without any releases.

O1.2 Freezer/Sublimer Operations

a. Inspection Scope (88100)

The inspectors reviewed the operations staff's removal of solidified uranium hexaflouride from a freezer/sublimer (F/S) following a failure of a valve to reposition on command.

b. Observations and Findings

During the inspection period, the Plant Shift Superintendent (PSS) made a 24-hour event report to the NRC Duty Officer following two failures of F/S valves. The reports indicated that the valves failed during efforts to sublime uranium hexafluoride from the freezer-sublimers in preparation for summer cascade operations at decreased power levels. Subsequent to the valve failures, the operations staff placed the freezer-sublimers in the "out-of-service" mode, a condition that did not require the valves to be operable to open. The "out-of-service" mode also required that the freezer-sublimer freon must be removed from the system. Without freon in the system, the freezer-sublimers could not freeze additional quantities of UF_6.

The inspectors performed a walk-down of the failed F/S valves and noted that, subsequent to the failures, the operations staff had modified the valve control systems. The modifications involved providing an alternate source of air to the air-operated valves in order to open the valves and allow the UF_6 remaining in the freezer-subliimers to be removed. The alternate air supply was necessary due to configuration limitations programmed into the F/S control system.

The inspectors discussed the F/S valve failures and system modifications with the operations staff. The operations staff indicated that the valve modifications were necessary to allow the system to be aligned in the manner necessary to remove the UF_6. The inspectors were also informed that the modifications had been previously used to resolve similar past valve and system failures.

The inspectors reviewed the maintenance work package used to implement the air supply modifications for the valve control systems. The package scope described the work as a "troubleshoot and repair" effort and included the detailed instructions necessary to guide the maintenance craftsmen in their efforts to disconnect the normal air supplies to the valves and to provide a manually regulated alternate air supply. The package further included instructions necessary to return the system to its pre-modification status and a final status functional test of the valves. While the maintenance package appeared to include adequate work instructions necessary to ensure that the work would be properly completed, the inspectors noted that the work activities appeared to be an off-normal operations evolution and not a maintenance effort. In addition, the final functional test included in the maintenance package, though adequate to ensure that the valves would be functional, did not ensure that the valves could perform the required safety function when required.

The inspectors discussed the observations with the involved operations and maintenance managers. The managers concurred with the inspectors observations and informed the inspectors that the operation appeared to require additional formalization and management control consistent with the procedure system. The operations management further indicated to the inspectors that an additional safety testing of the valves had been planned separate from the trouble-shooting maintenance package. The second set of tests was planned as a part of the valve repair efforts.

As of the end of the inspection period, the F/S remained out of service and the operations staff were modifying a current approved procedure to include appropriate steps for controlling the removal of UF_6 from freezer/sublimers under all normally encountered operational situations.

c. Conclusions

The inspectors identified a weakness in the plant staff's use of written and approved operational procedures. Specifically, the plant staff used a maintenance work package that contained detailed instructions and limited functional testing as a substitute for a written and approved operational procedure for an off-normal operations effort prior to corrective maintenance involving failed freezer-sublimer valves.

O8 Miscellaneous Operations Issues

08.01 Certificatee Event Reports

The certificatee made the following operations-related event reports during the inspection period. The inspectors reviewed any immediate safety concerns indicated at the time of the initial verbal notification. In the case of retracted notifications, the inspectors reviewed the basis for the certificatee's retraction of the notification at the time of the retraction. The inspectors will evaluate the associated written report for each of the events following submittal.

Number	Status	Title
36934	Open	Inoperable Building C-337 CAAS "X" Cluster.
36985	Open	Freezer/Sublimer A-Valve (Safety System Component) failed to open.
37080	Open	Building C-333 Sprinkler System A-9 found with 16 corroded sprinkler heads.

08.02 Bulletin 91-01 Reports

The certificatee made the following reports pursuant to Bulletin 91-01 during the inspection period. The inspectors reviewed any immediate nuclear criticality safety (NCS) concerns associated with the report at the time of the initial verbal notification. Any significant issues emerging from these reviews are discussed in separate sections of the report.

Number	Date	Title
36952	5/1/00	Building C-360 drain configuration was found to deviate from the assumptions of Nuclear Criticality Safety Evaluation 3972-11.
36965	5/3/00	Annual visual inspection of 12A cylinder was not performed in accordance with nuclear criticality safety approval.

36993	5/11/00	Loss of double contingency due to non-conservative fissile mass calculations due to instrument calibration error.
37083	6/14/00	Length of Building C-400 Cylinder Wash Station hose exceeded limit.

II. Maintenance

M1 Conduct of Maintenance

M1.1 Seal Maintenance Activities

a. Inspection Scope (88103)

The inspectors reviewed corrective actions developed by the plant staff for issues identified as a part of an internal audit of seal maintenance activities, a safety-related function.

b. Observations and Findings

During the inspection period, the inspectors noted that the plant quality assurance staff had conducted an audit of the seal maintenance shop activities. One of the quality assurance staff's audit findings indicated that seal maintenance activities were conducted using informal notes and unofficial drawings. The finding was documented in both the audit report and the plant non-conformance reporting system. The inspectors reviewed an initial assessment of the finding, provided by the Shift Engineer and the Plant Shift Supervisor, and noted that the plant staff did not believe that the finding impacted seal operability. In addition, the plant staff indicated on the non-conformance report that the seal maintenance activities, though categorized with an Augmented Quality rating, were not required to be conducted in accordance with written and approved procedures and drawings.

The inspectors discussed the findings and the non-conformance report initial assessment with the quality assurance, maintenance, and regulatory staff. The quality assurance staff indicated that corrective actions were being taken to address the finding, to include the development of plant procedures, appropriate staff training, and necessary engineering drawings. The maintenance staff indicated that a plan of action had been developed for the committed corrective actions; however, only minor progress had been made on these activities since the initial finding. The regulatory affairs staff noted that the initial assessment on the non-conformance report did not appear to be consistent with the quality assurance or procedures programs. In addition, the regulatory affairs staff determined that the findings appeared to have the potential to impact the seal's ability to perform their intended safety function. As such, the regulatory affairs staff initiated an immediate engineering evaluation of the as-found condition and requested the plant shift superintendent to maintain the cascade operating pressure sub-atmospheric to limit any potential safety impacts.

Subsequent to the inspectors' review of the issue with the plant staff, the engineering group determined that the installation of seals, following maintenance activities conducted using informal notes and unapproved drawings, did not present an immediate safety issue,

due in part, to the current cascade operating conditions (below atmospheric pressure). However, prior to any further seal installations, the seal maintenance activities required proceduralization, including the identification of appropriate item dedication testing to ensure that the seals could perform the Safety Analysis Report-assumed safety function. The inspectors reviewed the engineering evaluation efforts and the seal maintenance activities corrective actions. Both the engineering efforts and the maintenance corrective actions appeared to be appropriate to resolve the initial quality assurance staff's non-conformance finding.

The inspectors also noted that the quality assurance, engineering, and operations staff conducted a lessons-learned review of the issues identified by the inspectors. The reviews identified a need for increased questioning of initial assessments of issues by the PSS and the Shift Engineer to ensure a high-quality and rigorous product. In addition, the lessons-learned noted that specific issues of ineffective assessment and corrective actions for the quality assurance findings could have been identified by several layers of plant staff and management that came into contact with the non-conformance report. The results of the lessons-learned reviews were provided to operations, engineering, and quality assurance staff. The general manager also conducted a brief of the issues for the attendees at the plant's daily meeting as this group also reviews the non-conformance reports during their meetings.

The Quality Assurance Plan required, in part, for the plant staff to identify and correct non-conforming conditions affecting quality consistent with their importance to safety. The plant staff's failure to fully identify the requirement for seal maintenance activities, including testing of the seals, to be conducted using formal procedures appropriate to the circumstances and to initiate comprehensive corrective actions is **a Violation of the Quality Assurance Plan (VIO 70-7001/2000005-01)**. Subsequent to the inspectors identification of the plant staff's inadequate corrective action for the initial quality assurance finding, the inspectors determined that the plant staff appropriately assessed the non-conformance's impact on cascade operability, took immediate corrective measures, including maintaining cascade pressures below atmospheric pressure, consistent with the non-conformance's safety significance. In addition, the plant staff developed formal, approved procedures for the maintenance activities, and initiated lessons learned for the plant staff's failure to properly resolve the initial non-conformance.

c. Conclusion

The inspectors determined that the plant staff identified a long-standing failure to control seal maintenance activities impacting safety consistent with the Quality Assurance Plan requirements. However, the plant staff's initial corrective actions to the non-conformance were not fully consistent the potential operability impacts and did not include corrective actions necessary to ensure that future activities were conducted in accordance with the Quality Assurance Plan. The inspectors determined that corrective actions developed after the issue was raised by the inspectors were adequate to resolve the non-conformances.

III. Engineering

E1 Conduct of Engineering

E1.1 Non-Destructive Assay Equipment Calibration

a. Inspection Scope (88100)

The inspectors reviewed the circumstances surrounding a report of loss of double contingency for non-destructive assay (NDA) measurements associated with the measurement of uranium masses in equipment in the Department of Energy Material Storage Areas (DMSAs). The condition was reported to the NRC on May 11 (Event Report 36993).

b. Observations and Findings

While reviewing the calibration file for one of the neutron slab detectors used for NDA measurements, the plant staff discovered that the current calibration for the instrument was in error due to a typographical error for the calibration source certification date in the calibration spreadsheet. The erroneous date was off by one year and resulted in non-conservative calculations of the calibration correction factors used for the instrument. As a result, uranium mass measurements calculated from neutron flux readings taken with the instrument were in error by up to 30 percent in the non-conservative direction. The mass determinations had been used to characterize the amount of enriched uranium in legacy equipment stored in certain DMSAs to support a decision on the appropriate nuclear criticality safety (NCS) controls to apply to the equipment (planned expeditious handling or uncomplicated handling). The controls determined the spacing requirements for the equipment. Two independent determinations of the enriched uranium mass were required as part of the establishment of double contingency for the equipment. Upon discovery of the error, the plant staff immediately halted any handling of equipment characterized by NDA techniques and placed NDA measurements on hold.

In reviewing the issue, the plant staff identified that the nuclear criticality safety evaluation (NCSE) for the process of characterizing equipment relied upon an independent one-point calibration of NDA instrumentation by using a check source in between instrument uses. However, the NDA staff identified that the use of the check source was not an independent one-point calibration, but rather a verification that the initial calibration for the instrument had not changed since the instrument was last calibrated. As a result, the assumption relied upon to establish double contingency for the NDA operation was not valid.

In response to the issue, the plant staff revised the governing NCSE and associated nuclear criticality safety approval (NCSA) GEN-01 to require that the NDA instrument calibration process, relied upon to support NCS measurements, be single-failure-proof or an instrument calibration check be used that is independent of the original calibration. As such, no single error in the calibration process could lead to a situation in which the error would not be identified and corrected during the process. The inspectors reviewed the change and the implementing procedures and noted that a number of independent verifications of the NDA calibration process had been added. In addition, the plant staff completed a formal validation of the software used to perform the correction factor calculations to ensure the uranium mass results obtained using the NDA instrumentation

were greater than or equal to the actual uranium mass (i.e., conservative). The plant staff also verified that the NCS characterization of the legacy equipment determined to require uncomplicated handling (i.e., containing less that an always safe mass of enriched uranium) did not change as a result of the error.

Technical Safety Requirement 3.11.2 requires, in part, that all operations involving uranium enriched to 1.0 weight percent or higher in ^{235}U and 15 grams or more of ^{235}U to be based upon a documented NCSE and performed in accordance with a documented NCSA. As a result of the plant staff's identification and timely corrective actions, the failure to perform an independent calibration check of the NDA neutron slab detectors in accordance with NCSA GEN-01 is a non-repetitive, certificatee-identified and corrected violation and is being treated as a **Non-Cited Violation (NCV 70-7001/2000005-02)**, consistent with Section VII.B.1 of the NRC Enforcement Policy.

c. Conclusion

The plant staff identified a non-cited violation involving the lack of an independent calibration verification for neutron slab instruments used on site to quantify the enriched uranium mass in potentially fissile equipment. The plant staff stopped characterization activities until a single-failure-proof process for performing instrument calibrations was developed and formal validation of the software used to calculate mass was complete.

E1.2 Criticality Accident Alarm System Engineering Evaluation

a. Inspection Scope (88100)

The inspectors reviewed Engineering Evaluation No.EN-C-822-97-205, Revision 2, "Recommended Response to C-300 CAAS [Criticality Accident Alarm System] Trouble Alarm," dated May 23, 2000, which provided guidance to the plant staff on CAAS conditions which were nonconforming versus when the CAAS was to be considered inoperable.

b. Observations and Findings

The inspectors noted that the evaluation addressed a number of trouble conditions for the CAAS systems onsite, including loss of power, cluster fault alarms, low temperature alarms, etc. The inspectors found the operability and reportability guidance for most of the conditions reasonable. However, the inspectors questioned the rationale for the condition in which two of three detectors for a CAAS cluster were in fault. The engineering evaluation concluded that in this condition, the CAAS cluster should be considered operable, but nonconforming. The inspectors were concerned that although the cluster could still detect a criticality with only one functional detector, the chance of a false alarm increased since the cluster automatically went into alarm with the one detector in alarm. In addition, the inspectors noted that 10 CFR 76.89(b) required that coverage of all monitored areas be provided by two detectors. In the event that a single CAAS cluster provided the CAAS coverage for an area of the plant, the area would not be covered by two detectors in this scenario.

The plant staff responded to the inspectors' questions by noting that the latest guidance Generic Letter 91-18 appeared to indicate that this situation met the criteria for "operable, but nonconforming." In particular, the plant staff indicated that, although the system would

not meet the requirements in the licensing basis, the CAAS cluster would still be able to detect and alarm upon a high radiation signal which was its intended safety function. The plant staff indicated that under these conditions, Generic Letter 91-18 indicated that the system would remain operable, and that the plant staff would have to repair the system in a timely fashion commensurate with the safety significance. As a result, the plant staff developed procedural guidance for operations which stated: "If a CAAS cluster or system is in an operable but nonconforming condition, repairs shall be initiated without delay in an orderly manner to restore the cluster or system to a conforming condition."

The inspectors reviewed the Statements of Consideration for 10 CFR 76 and 10 CFR 70 for discussions of the rationale behind requiring two detectors for each monitored area (American National Standard 8.3, "Criticality Accident Alarm System," only required one detector, but indicated consideration shall be given for the avoidance of false alarms which could be accomplished by the concurrent response of two detectors). However, the inspectors were unable to identify any detailed discussion of the rationale behind the regulation. The inspectors were not aware of any incident in the previous three years in which the condition of two of three detector in fault had occurred for any of the CAAS clusters onsite. The inspectors also noted that there was no approved NRC definition of out-of-service time for two of three detectors or how long the system could remain nonconforming while fissile operations continued. As a result, the inspectors indicated to the certificatee that clarification of the issue would be sought from the NCS staff at NRC Headquarters, a number of whom were also members of the American Nuclear Society Standards Subcommittee 8. The issue will be tracked as an **Inspector Followup Item (IFI 70-7001/2000005-03).**

c. Conclusion

The plant staff developed an engineering evaluation providing guidance to the operations staff in responding to criticality accident alarm fault conditions. The inspectors noted that the response for most of the conditions was reasonable, but the guidance for two of three detectors for a cluster in fault status raised issues for additional followup with NRC Headquarters staff.

E1.3 C-712 Acid Pit Review

a. Inspection Scope

The NRC staff reviewed the certificatee's development of NCSE 1493-25 against the criteria specified in procedure CP4-EG-NS1101, Rev. 0, dated October 31, 1996. Compliance with the following procedural requirements were examined: (1) normal case conditions based on available information are defined; (2) information is accurate; and (3) information documented in the NCSE is sufficient to enable independent analysis.

b. Observations and Findings

Normal Case Conditions Based on Available Information Are Defined

The NRC staff reviewed three nuclear criticality safety approvals/evaluations (NCSAs/Es), and one engineering evaluation governing activities affecting the C-712 Acid Neutralization Pit. The documents reviewed were as follows.

- NCSA/E 1493-02, "Liquid Uranium Salvage Operations in the C-710 Laboratory Facility," dated November 25, 1996;

- NCSA/E 1493-15, "UF_6 Subsampling Laboratory in the C-710 Building at the Paducah Gaseous Diffusion Plant," dated April 4, 1996;

- NCSA/E 1493-25, "The Drain System in the C-710 Facility at the Paducah Gaseous Diffusion Plant," dated March 20, 1997; and

- EV-C-832-00-002, "Credibility of a Criticality Accident in the C-712 Neutralization Pit," dated February 16, 2000.

NCSAs/Es 1493-02 and 1493-15 concerned fissile activities having the potential for introduction of uranium into the C-712 Acid Neutralization Pit via the C-710 drain system. NCSA/E 1493-02 established the nuclear criticality safety (NCS) basis for loading, handling, and hydrolizing cold traps. NCSA/E 1493-15 established the NCS basis for washing 2S cylinders, sample tubes, and straight tubes. NCSA/E 1493-25 established the NCS basis for the C-710 Acid Neutralization Pit which was designed to receive the effluent from the C-710 drain system.

The NRC staff noted that assumption 5.4(4) of NCSE 1493-25 considered the maximum total mass of uranium which could accidentally be disposed of into the drain system through one accident scenario to be 114.3 kg. NCSE 1493-25 identified three fissile activities having the potential to routinely introduce uranium into the drain system. According to NCSE 1493-25, these activities included 2S cylinder washing (2.44 kg U/month), sample tube washing (39.99 kg U/month), and straight tube washing (1.02 kg U/month). Based on these results from NCSE 1493-25, the staff determined that the normal condition for the Acid Pit allowed 43.5 kg U/month (2.44 + 39.99 + 1.02) to be routinely introduced to the Pit as part of C-710 Laboratory operations which impact the drain system. Since NCSA 1493-25 allowed up to 96.03 kg U in the Acid Pit at all times (based on the volume and concentration acceptance limit for monthly samples), the staff determined that the total uranium inventory, based on available information, for the Acid Pit under normal conditions was 139.48 kg (96.03 + 43.5), and the total uranium inventory under abnormal conditions was 253.8 kg (139.48 + 114.3).

The NRC staff noted that Section 4.2.9 of NCSE 1493-25 considered the total uranium inventory under normal conditions to be 253.8 kg U, and the total uranium inventory under abnormal conditions to be 411.46 kg U. The normal limit of 253.8 kg U was the sum of 96.03 kg normally resident in the Acid Pit, 43.5 kg added monthly, and 114.3 kg from the bounding upset condition. This 114.3 kg was the result of multiple criticality safety limit violations (3.81 kg U/cold trap × 30 cold trap violations) and did not reflect the normal operation of the laboratory. Rather, it reflected what staff subsequently acknowledged was an "incredible upset." Staff found that the assumed upset case of 411.46 kg U was based on missing the monthly sampling requirement on top of the bounding upset (i.e., 253.8 kg normal + 43.5 kg added monthly + 114.3 kg upset).

NCSE 1493-25 presented the results of a sensitivity study showing that 426 kg U in the Acid Pit was subcritical as long as it remained in solution or in a slab configuration. The study assumed a constant mass of 426 kg while varying the height of solution in the Pit and thus also varying the concentration. Although this study showed that subcriticality would be maintained as long as the slab configuration remained valid, the analysis did not adequately describe the conditions in the Pit, or justify the assumption that the uranium would remain in solution or precipitate into a slab configuration.

Technical Safety Requirement 3.11.1 requires, in part, that the nuclear criticality safety program shall be established, implemented, and maintained as described in the Safety Analysis Report and shall address process evaluations and approvals. Safety Analysis Report Section 5.2.2.3, "Process Evaluation and Approval," requires, in part, that a nuclear criticality safety evaluation (NCSE) be prepared to: (1) document the analyses as specified in the NCSE procedure; (2) document potential upset conditions presenting nuclear criticality safety concerns; and (3) identify the assumptions and equipment needed to ensure criticality safety. Procedure CP4-EG-NS1101, Rev. 0, "Evaluation of Requests for Criticality Safety Approval," dated October 31, 1996, requires, in part, that normal case conditions based on available information be defined. The failure to define the normal conditions for the Acid Pit in the NCSE is a **Violation (VIO 70-7001/2000005-0A)**.

Information is Accurate

According to Section 4.3 of NCSE 1493-25, the Acid Pit was designed to precipitate material out of solution, generating regions of concentrated material. However, according to Appendix C of NCSE 1493-25, and EV-C-832-00-002, large deposits of uranium, settling to the bottom of the Acid Pit and accumulating into unsafe configurations, were not credible given the high flow rate to and from the Acid Pit. The staff noted that NCSE 1493-25 also assumed that the flow rate would be sufficient to prevent material from remaining in the Pit and would also prevent settling. In addition, the analysis credited turbulent flow with preventing material from settling out in the Pit. The staff observed the actual flow conditions in the Acid Pit and determined that the flow rate was neither substantial nor sufficient to accumulate large localized deposits in slow-flow regions of the Acid Pit (i.e., the corners), that the existing flow was not turbulent, and that flow rate conditions were favorable for long-term accumulation settling evenly across the bottom of the Acid Pit. NRC staff therefore agreed with USEC in its final conclusion, but disagreed with both the assumptions and the logical basis for drawing that conclusion.

According to Section 4.2.7 of NCSE 1493-25, a 3.81 kg U limit per trap is used to calculate the amount of uranium associated with 30 violations of an NCS requirement. Staff determined that the mass assumed in the model was not established numerically as a control in the evaluation. The staff therefore reviewed NCSE 1493-02 to determine the actual bounding amount of material that could be placed in a volumetrically full cold trap. NCSE 1493-02 calculated the volume of a cold trap to be 1168 cm^3. Assuming the UF_6 density considered in NCSE 1493-02, the staff determined that the mass of a volumetrically full metal cold trap was about 3.69 kg U. The fact, however, that the actual maximum mass in the cold traps was more conservative than that assumed in the model does not eliminate the concern over the manner in which the mass in the calculations was derived. The assumed mass was not derived by means of calculating the maximum mass in a volumetrically filled trap and then adding margin. Rather, the mass used was assumed based on typical laboratory procedure instead of documented criticality controls.

According to Section 4.2.5 of NCSE 1493-25, a 2.691 kg U limit per trap is used to calculate the amount of uranium associated with the spilling of five glass cold traps into the drain system. Since NCSE 1493-25 identifies the volume of the traps as a control over mass, the staff reviewed NCSE 1493-02 to verify the accuracy of the 2.691 kg U limit used in NCSE 1493-25. Based upon review of NCSE 1493-02, the staff concluded that the 2.691 kg U limit considered in Section 4.2.5 of NCSE 1493-25 was not accurate. According to NCSE 1493-02, the volume of a glass cold trap was 1071 cm^3. Assuming the UF_6 density considered in NCSE 1493-02, the staff determined that the mass of a volumetrically full glass cold trap was about 3.38 kg U.

According to Section 4.2.10 of NCSE 1493-25, a 37 g U limit per sample tube was used to calculate the amount of uranium associated with the use of the automatic tube washer, and a 22 g U limit was used to calculate the amount of uranium associated with the washing of straight tubes. The NRC staff found that neither the 37 g U limit or 22 g U limit was explicitly identified in either NCSA 1493-15 or 1493-25 for nuclear criticality safety. Rather, the NRC staff determined that the limits were administratively based on procedural requirements and not passively based on the limited volume of the sample tube itself.

According to Section 4.2.11 of NCSE 1493-25, the total mass of UF_6 that could be present in a 2S cylinder being washed was 30 g. NCSA 1493-15 administratively required that prior to loading 2S cylinders on the cylinder washing manifold, each cylinder shall be weighed and verified to contain less than 30 g of material. While touring the cylinder washing operations in Building C-710, the NRC staff found that the 30 g limit identified in NCSA 1493-15 was implemented by comparing differences in cylinder weights. According to Laboratory personnel, empty 2S cylinders were tare weighed and tagged with a serial number which Laboratory personnel could cross reference back to the empty tare weight when the cylinder was returned to the Laboratory for washing. Prior to placing on the cylinder washing manifold, the 2S cylinder weight was measured and compared to the recorded empty tare weight. As long as the difference in weights was less than 30 g (implying that the delta was due to the presence of uranium), the 2S cylinders were procedurally allowed to be washed.

Based on further discussions with Laboratory personnel, the NRC staff noted that differences in weight assumed to be entirely from uranium could be masked by differences in weight due to replacement of the cylinder end cap. The staff also noted that there was no requirement to ensure that the same end cap is used on cylinders before and after weighing. According to the laboratory personnel, end cap weights could vary by as much as 13 grams. Since end caps were not under configuration control, the NRC staff concluded that the cylinder washing acceptance criteria of the delta being less than 30 grams did not provide assurance that the amount of material in the cylinder would be less than 30 grams.

The NRC staff noted that Section 4.2.10 of NCSE 1493-25 developed a 39.99 kg U limit associated with washing 1075 sample tubes (1000 sample tubes in 4 weeks and 75 sample tubes in the remaining 0.3 weeks). The staff also noted that NCSA 1493-25 limited the total number of sample tubes which can be washed weekly to 250. Since NCSE 1493-25 did not justify the incredibility of washing all 250 sample tubes in the 0.3 weeks, the staff determined that the total number of sample tubes allowed to be washed over the course of a month could be as high as 1250. The staff, therefore, concluded that Section 4.2.10 of NCSE 1493-25 understated the maximum amount of uranium which could be introduced to the Acid Pit during normal operations.

Technical Safety Requirement 3.11.1 requires, in part, that the nuclear criticality safety program shall be established, implemented, and maintained as described in the SAR and shall address process evaluations and approvals. Safety Analysis Report Section 5.2.2.3, "Process Evaluation and Approval," requires, in part, that a nuclear criticality safety evaluation (NCSE) be prepared to: (1) document the analyses as specified in the NCSE procedure; (2) document potential upset conditions presenting nuclear criticality safety concerns; and (3) identify the assumptions and equipment needed to ensure criticality safety. Procedure CP4-EG-NS1101, Rev. 0, "Evaluation of Requests for Criticality Safety Approval," dated October 31, 1996, requires, in part, that information be accurate. The

failure to ensure that the information used to develop NCSE 1493-25 was accurate is another example of a **Violation (VIO 70-7001/2000005-04B).**

Information Documented in the NCSE is Sufficient to Enable Independent Analysis

The NRC staff noted that NCSEs 1493-15 and 1493-25 lacked sufficient detail to ascertain the adequacy of the administrative controls and the assumptions and nature of the process to determine whether an immediate safety concern existed in the Acid Pit. The staff found that NCSE 1493-25 credited mass control for double contingency but did not ensure that the mass limits evaluated were consistent with NCSEs 1493-02 and 1493-15. As a result, the staff was unable to demonstrate mass control for the Acid Pit based on the information contained in NCSE 1493-25. The staff was also unable to evaluate NCSE 1493-25's assertion that the dynamic conditions of the Acid Pit preclude precipitation of uranium without further discussions with Laboratory personnel. Since factors which affect the ability to precipitate, such as pH, ratio of water to uranium, potential for introducing caustic agents into the drain system, and sampling methodology, were not addressed in NCSE 1493-25, the staff was unable to demonstrate double contingency for the Acid Pit based on the information contained in NCSE 1493-25, which was written as a stand-alone safety evaluation.

The NRC staff noted that the determination of the 426.8 kg U safe mass was based on the case results of KENO calculations included in Table C.1 of Appendix C of NCSE 1493-25. Although the results demonstrated subcriticality of 426.8 kg U for uranium bearing solutions, the staff found that Appendix C did not describe why the 426.8 kg U limit was chosen for the calculations and how compliance with the limit ensured criticality safety for both uranium bearing solutions and precipitates.

Technical Safety Requirement 3.11.1 requires, in part, that the nuclear criticality safety program shall be established, implemented, and maintained as described in the Safety Analysis Report and shall address process evaluations and approvals. Safety Analysis Report Section 5.2.2.3, “Process Evaluation and Approval,” requires, in part, that a nuclear criticality safety evaluation (NCSE) be prepared to: (1) document the analyses as specified in the NCSE procedure; (2) document potential upset conditions presenting nuclear criticality safety concerns; and (3) identify the assumptions and equipment needed to ensure criticality safety. Procedure CP4-EG-NS1101, Rev. 0, “Evaluation of Requests for Criticality Safety Approval,” dated October 31, 1996, requires, in part, that information documented in the NCSE be sufficient to enable independent analysis. The failure to ensure that NCSE 1493-25 was sufficiently documented to enable independent analysis is another example of a **Violation (VIO 70-7001/2000005-04C)**.

c. Conclusion

The NRC staff identified a violation involving a failure to follow procedure CP4-EG-NS1101, Rev. 0, dated October 31, 1996, during the development of NCSE 1493-25. The staff concluded that the operation as actually conducted would require at least two unlikely and independent process upsets before criticality was possible, and thus met the intent of the double contingency principle. However, the documented safety basis established by the Acid Pit NCSA/E assumed a much larger mass loading as part of normal conditions than enveloped by the three Laboratory NCSA/Es. With this documented “normal condition” as defined in the evaluation, the staff could not adequately demonstrate that the Acid Pit would remain subcritical under normal and all credible abnormal conditions. The staff

determined that an immediate safety concern did not exist, however, because the laboratory criticality safety mass limits, and the actual masses flowing into the Pit, were less than the safe mass limit established by the Acid Pit NCSA/E. Specifically, the staff concluded that there did not appear to be a credible concentrating mechanism that could invalidate the calculation's assumptions that material remained in a slab configuration. On this basis, the staff concluded that no immediate safety concern existed at the currently authorized 5.5 weight percent ^{235}U, and that the operation of the Acid Pit as actually conducted could be shown to meet the double contingency principle.

E8 Miscellaneous Engineering Issues

E8.1 (Closed) URI 70-7001/97007-08: The Unresolved Item was open to determine if the plant staff's actions to resolve Compliance Plan Issue 45 were properly completed. Specifically, the inspectors could not conclusively determine if the codes and standards identified in Chapter 1 of the Safety Analysis Report were sufficient to ensure that safety-related activities were completed consistent with the original engineering controls and standards.

In response to the inspectors' questions, the plant staff initiated a review of past engineering efforts and potentially applicable codes and standards. The effort identified a large volume of codes and standards that could and may have been used in the design and installation of systems currently relied upon for safety. However, the effort also determined that conclusive records of the codes and standards applied to the original design were not available. As a result, the plant staff could not determine with absolute certainty the full scope of codes and standards applicable to each system without a detailed system design reconstitution.

In an effort to ensure that applicable codes and standards were applied to repairs and modifications of current safety systems, engineering management incorporated by reference the list of potentially applicable codes and standards into the plant system repair and design modification process procedures. The applicable procedures required the engineering staff to identify the applicable design codes and standards or the current standards necessary to ensure that the safety function of the systems remained consistent with the original design quality.

The inspectors determined that the process used by the plant staff to identify and incorporate past or currently applicable codes and standards into the repair and design of plant safety systems was consistent with the requirements included in the Compliance Plan. The inspectors had no further questions and this item is closed.

X1 Exit Meeting Summary

The inspectors presented the inspection results to members of the certificatee's staff and management at the conclusion of the inspection on June 29, 2000. The certificatee staff present for the exit meeting acknowledged the findings. The inspectors asked the certificatee staff whether any materials examined during the inspection should be considered proprietary. No proprietary information was identified.

PARTIAL LIST OF PERSONS CONTACTED

United States Department of Energy

G. A. Bazzell, Site Safety Representative

United States Enrichment Corporation

*M. A. Buckner, Operations Manager
*L. L. Jackson, Nuclear Regulatory Affairs Manager
*J. A. Labarraque, Safety, Safeguards and Quality Manager
*S. R. Penrod, Enrichment Plant Manager
*H. Pulley, General Manager

U.S. Nuclear Regulatory Commission

*J. M. Jacobson, Resident Inspector
*K. G. O'Brien, Senior Resident Inspector

*Denotes those present at the exit meeting June 29, 2000.

Other members of the plant staff were also contacted during the inspection period.

INSPECTION PROCEDURES USED

IP 88020: Nuclear Criticality Safety
IP 88100: Plant Operations
IP 88102: Surveillance Observations
IP 88103: Maintenance Observations

ITEMS OPENED, CLOSED, AND DISCUSSED

Opened

70-7001/2000005-01	VIO	Lack of timely corrective actions for condition adverse to qualtiy involving lack of procedures for seal dedication
70-7001/2000005-03	IFI	Clarification of impact of regulatory requirement for two criticality accident alarm detectors for monitored areas and operability of system
70-7001/2000005-04	VIO	Failure to properly document actual operations and normal case conditions for C-712 Acid Pit in governing nuclear criticality safety evaluation
36934	CER	Inoperable Building C-337 CAAS “X” Cluster
36985	CER	Freezer/Sublimer A-Valve failed to open
37080	CER	Building C-333 Sprinkler System A-9 inoperable due to corroded heads

Closed

70-7001/2000005-02	NCV	Failure to ensure NDA instrumentation calibration process was doubly contingent
70-7001/97007-08	URI	Compliance Plan Issue 45 submittal on codes and standards for Paducah

Discussed

NONE

LIST OF ACRONYMS USED

ATR	Assessment and Tracking Report
CAAS	Criticality Accident Alarm System
CFR	Code of Federal Regulations
DNMS	Division of Nuclear Materials Safety
EO	Executive Order
IFI	Inspector Followup Item
IP	Inspection Procedure
NCSA/E	Nuclear Criticality Safety Approval/Evaluation
NDA	Non-destructive Assay
NMSS	Nuclear Materials Safety and Safeguards
NRC	Nuclear Regulatory Commission
PDR	Public Document Room
PSS	Plant Shift Superintendent
SAR	Safety Analysis Report
TSR	Technical Safety Requirement
^{235}U	Uranium-235
USEC	United States Enrichment Corporation