

February 10, 2014

Mr. Robert Van Namen, Sr. Vice President  
Uranium Enrichment  
United States Enrichment Corporation  
6903 Rockledge Drive  
Bethesda, MD 20817

SUBJECT: PADUCAH GASEOUS DIFFUSION PLANT – U.S. NUCLEAR REGULATORY  
COMMISSION INSPECTION REPORT NUMBER 70-7001/2014-201

Dear Mr. Van Namen:

The U.S. Nuclear Regulatory Commission (NRC) conducted a routine, announced nuclear criticality safety (NCS) inspection at the Paducah Gaseous Diffusion Plant in Paducah, Kentucky, from January 13-16, 2014. The purpose of the inspection was to determine whether activities authorized by your certificate involving special nuclear material were conducted safely and in accordance with regulatory requirements. Throughout the inspection, observations were discussed with your staff. An exit meeting was held on January 16, 2014, during which inspection observations and findings were discussed with your management and staff.

The inspection, which is described in the enclosure, focused on the most hazardous activities and plant conditions; the most important controls relied on for safety and their analytical basis; and the principal management measures for ensuring controls are available and reliable to perform their functions relied on for safety. The inspection consisted of analytical basis review, selective review of related procedures and records, examinations of relevant NCS-related equipment, interviews with NCS engineers and plant personnel, and facility walkdowns to observe plant conditions and activities related to safety basis assumptions and related NCS controls. Based on the inspection, your activities involving nuclear criticality hazards were found to be conducted safely and in accordance with regulatory requirements.

In accordance with Title 10 of the *Code of Federal Regulations* 2.390 of NRC's "Rules of Practice," a copy of this letter and the enclosure will be made publicly available in the public electronic reading room of the NRC's Agencywide Documents Access and Management System (ADAMS). ADAMS is accessible from the NRC Web site at <http://www.nrc.gov/reading-rm/adams.html>.

R. Van Namen

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If you have any questions concerning this report, please contact Greg Chapman of my staff at 301-287-9152, or via e-mail to [Gregory.Chapman@nrc.gov](mailto:Gregory.Chapman@nrc.gov).

Sincerely,

***/RA/***

Michael X. Franovich, Chief  
Programmatic Oversight and  
Regional Support Branch  
Division of Fuel Cycle Safety  
and Safeguards  
Office of Nuclear Material Safety  
and Safeguards

Docket No. 70-7001

Enclosure:  
NRC Inspection Report No. 70-7001/2014-201  
w/Attachment: Supplementary Information

cc w/encls: (See page 3)

R. Van Namen

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R. Van Namen

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cc w/encls:

Mike Buckner  
Plant Manager  
Paducah Gaseous Diffusion Plant  
United States Enrichment Corporation  
Electronic Mail Distribution

Vernon Shanks  
Manager, Nuclear Regulatory Affairs  
Paducah Gaseous Diffusion Plant  
United States Enrichment Corporation  
Electronic Mail Distribution

Steven R. Penrod  
Vice President, Enrichment Operations  
United States Enrichment Corporation  
Electronic Mail Distribution

Steven A. Toelle  
Director, Regulatory Affairs  
United States Enrichment Corporation  
Electronic Mail Distribution

R. M. DeVault  
Manager, Regulatory Oversight  
Department of Energy  
Electronic Mail Distribution

Dewey Crawford  
Manager, Radiation Health Branch  
Cabinet for Health and Family Services  
275 East Main Street  
Mail Stop HS-1CA  
Frankfort, KY 40601-0001

**U.S. NUCLEAR REGULATORY COMMISSION**  
**OFFICE OF NUCLEAR MATERIAL SAFETY AND SAFEGUARDS**

Docket No.: 70-7001

Certificate No.: GDP-01

Report No.: 70-7001/2014-201

Certificatee: United States Enrichment Corporation

Location: Paducah, Kentucky

Inspection Dates: January 13-16, 2014

Inspector: Greg Chapman, Criticality Safety Inspector

Approved by: Michael X. Franovich, Chief  
Programmatic Oversight and  
Regional Support Branch  
Division of Fuel Cycle Safety  
and Safeguards  
Office of Nuclear Material Safety  
and Safeguards

Enclosure

**UNITED STATES ENRICHMENT CORPORATION  
PADUCAH GASEOUS DIFFUSION PLANT**

**NRC INSPECTION REPORT 70-7001/2014-201**

**EXECUTIVE SUMMARY**

**Introduction**

The staff of the U.S. Nuclear Regulatory Commission (NRC) performed a routine, scheduled, and announced criticality safety inspection of the Paducah Gaseous Diffusion Plant (PGDP) in Paducah, Kentucky, from January 13-16, 2014. The inspection included an onsite review of certificate programs dealing with plant operations, the nuclear criticality safety (NCS) program, audits and inspections, and NCS-related corrective actions. The inspection focused on risk-significant fissile material processing activities, including those in Buildings C-310, C-335, C-337, C-337A, and C-360.

**Results**

- No safety concerns were identified regarding implementation of the NCS program.
- No safety concerns were identified regarding the certificate holder's NCS walkthroughs, assessments, and surveillances.
- No safety concerns were identified regarding the certificate holder's NCS training and qualification program.
- No safety concerns were identified regarding the certificate holder's internal NCS event reporting, investigation, and correction actions.
- No safety concerns were identified regarding the certificate holder's criticality alarm system.
- No safety concerns were identified during walkdowns of plant operations.

## **REPORT DETAILS**

### **1.0 Summary of Plant Status**

The U.S. Enrichment Corporation (USEC) is certified for the enrichment of uranium for domestic and international customers at the PGDP. On June 3, 2013, USEC notified the NRC of its decision to permanently cease uranium enrichment activities at the PGDP. USEC stated that in 2014, it will return the PGDP facilities to the U.S. Department of Energy (DOE), and that it would request termination of its Certificate of Compliance (CoC).

During the inspection, the certificate holder was performing consolidation, blending, and withdrawal of product along with support operations. No enrichment operations were being performed and feed materials had already been withdrawn from the process. Portions of the facility had already ceased operations other than necessary surveillance and maintenance. Staffing levels were also being reduced to reflect the reduction of operations.

The foreseeable operational plan, as communicated to the inspector, was to complete the consolidation, blending, and withdrawal operations, then pull negatives on the process equipment until the uranium hexafluoride (UF<sub>6</sub>) concentrations are less than 10 ppm in dry air. At which point, it is likely USEC would seek termination of the CoC. USEC and DOE are negotiating regarding the remaining safety controls, proprietary criticality safety assessments, and oxide accumulations in the process lines. The NCS group, over the past year, has worked to revise their nuclear criticality safety evaluation (NCSEs) to incorporate a new normal condition reflective of a cold shutdown with remaining accumulations of UO<sub>2</sub>F<sub>2</sub> materials. Tom Hines, of DOE's Nuclear Safety Oversight League, was contacted and he stated that there was ongoing good communication between the NCS group at USEC and his group with DOE.

### **2.0 Nuclear Criticality Safety Program (IP 88015)**

#### **a. Inspection Scope**

The inspector reviewed the certificate holder's NCS program. The inspector evaluated the adequacy of the program and analyses to assure the safety of fissile material operations. The inspector reviewed selected NCS analyses to determine that criticality safety of risk-significant operations was assured through engineered and administrative controls, with adequate safety margin and preparation and review by qualified staff. The inspector interviewed certificate managers, NCS engineers, system engineers, and facility operators during document review and facility walkdowns. The inspector reviewed NCS's administrative procedures and selected NCS controls to determine whether the procedures adequately implemented the NCS program described in the certificate. The inspector reviewed selected portions of the documents listed in Section 2.2 of the Attachment.

b. Observations and Findings

The certificate holder provided the inspector a listing of 20 revised NCSE/As of which 6 were selected for review. The inspector focused on cold shutdown conditions for the primary process buildings. These conditions are primarily discussed in NCSE 095, Rev. 8, "Operation and Shutdown of the Diffusion Cascade." The certificate holder demonstrates sub-criticality while assuming bounding accumulations of oxides in process equipment and bounding steady state hydration of the material (a H/U ratio of 3.2-4) due to humid air. The process equipment boundary itself is credited to make water intrusion unlikely. Condensation potential was also evaluated in NSE 095. Condensation impacts are estimated to be minimal as only those portions of the process in proximity to an opening would be likely to contain humid air and any excessive moderation should be limited to the outer portion of an accumulation due to crusting of the material. Also, condensation is presumed to be a temporary condition due to the evaporation/condensation cycle as the temperatures increase/decrease daily. Covers will be placed over any openings to the process equipment containing greater than a safe mass of fissile material. Some larger piping is acknowledged as potentially containing significant accumulations of fissile materials and will be maintained under either a fluorinating or dry air environment consistent with TSR 2.4.4.4 "Cascade Wet Air InLeakage."

The inspector observed that the certificate holder had an NCS program which was independent from production. The inspector determined that the licensee's NCS program was conducted in accordance with written administrative procedures that reflected the program described in the certificate. The inspector also observed that the NCS program reviewed process changes affecting criticality safety. The inspector determined that, for the NCS analyses reviewed, the analyses were: performed by qualified NCS engineers, that independent reviews of the evaluations were completed by qualified NCS engineers, and that the analyses provided for subcriticality of the systems and operations through appropriate limits on controlled parameters. NCS analyses and supporting calculations demonstrated adequate identification and control of NCS hazards to assure operations within subcritical limits.

c. Conclusions

No safety concerns were identified regarding implementation of the NCS program.

### **3.0 Nuclear Criticality Safety Inspections, Audits and Investigations (IP 88015)**

a. Inspection Scope

The inspector reviewed the certificate holder's internal procedures for walkthroughs and assessments, and records of previously-completed NCS walkthroughs. The inspector reviewed selected portions of the documents listed in Section 2.3 of the Attachment.

b. Observations and Findings

The inspector observed that the certificate holder's NCS walkthroughs and assessments



were conducted within the required time limit and were performed in accordance with written procedures. The inspector determined that certificate holder's NCS engineers observed plant operations to determine adequacy of implementation of NCS requirements and ensured that implementation weaknesses were identified and entered into the corrective action system. The inspector noted that the walkthroughs and assessments were performed by NCS engineers who: (1) reviewed NCS issues from previous audits; (2) reviewed the adequacy of control implementation; (3) reviewed plant operations for compliance with certificate holder's requirements, procedures, and postings; (4) examined equipment and operations to determine that past evaluations remained adequate; and (5) interviewed operators to verify understanding of controls. The inspector confirmed that deficiencies identified during walkthroughs were captured in the corrective action program and resolved in a timely manner.

c. Conclusions

No safety concerns were identified regarding the certificate holder's NCS walkthroughs, assessments, and surveillances.

**4.0 Nuclear Criticality Safety Training and Qualification (IP 88015)**

a. Inspection Scope

The inspector interviewed the certificate holder's NCS manager as well as reviewed the PGDP personnel training and qualification records to verify that persons performing, reviewing, or supervising NCS-related activities established and maintained proficiency in the technical disciplines needed to perform their job functions. The inspector reviewed selected portions of the documents listed in Section 2.4 of the Attachment.

b. Observations and Findings

The inspector, through a review of selected personnel records and personnel interviews, verified that NCS staff managing, performing, or reviewing NCSEs, analyses, or activities possessed the requisite education and experience for their position and adequate knowledge of the PGDP, criticality safety principles, and plant operations. The NCS staff, similar to the general staffing at PDGP, has begun to be reduced to reflect shrinking operations so no new staffing had been added since the previous inspection. The inspector verified that personnel continued to receive periodic training to ensure the maintenance of proficiency and sharing of knowledge gained from lessons learned.

c. Conclusions

No safety concerns were identified regarding the certificate holder's NCS training and qualification program.

## **5.0 Nuclear Criticality Safety Event Review and Follow-up (IP 88015 & 88016)**

### a. Inspection Scope

The inspector reviewed the certificate holder's response to a selection of recent internally-reported events. The inspector reviewed the progress of investigations and interviewed staff regarding immediate and long-term corrective actions. The inspector reviewed selected portions of the documents listed in Section 2.5 of the Attachment.

### b. Observations and Findings

The inspector reviewed selected internally reported events. Of the incidents reviewed, only one, NCS-INC-13-007, where a low oil flow switch failed, had corrective actions to restore compliance such that the inspector was able to verify them. The switch was replaced, tested, and a preventative maintenance, PMR 106650, established to change out the switch on the three pumps in C-310 after each biennial testing cycle. The inspector determined that the licensee adequately evaluated whether or not these events were reportable to the NRC. The inspector observed that internal events were investigated in accordance with written procedures and appropriate corrective actions were assigned and tracked.

### c. Conclusions

No safety concerns were identified regarding the certificate holder's internal event reporting, investigation, and correction actions.

## **6.0 Criticality Alarm Systems (IP 88017)**

### a. Inspection Scope

The inspector interviewed engineering and maintenance staff, and performed facility walkdowns to determine the adequacy of the certificate holder's criticality alarm system. The inspector reviewed selected portions of the documents listed in Section 2.6 of the Attachment.

### b. Observations and Findings

The inspector determined that the certificate holder had installed and maintained a system of criticality detectors that were capable of monitoring fissile material operations at the facility and reliably detecting the minimum accident of concern. The current system is to be maintained, as currently scheduled, until such time as it is transferred to DOE upon termination of the CoC. Training for response to criticality alarms will occur as scheduled, once per year on each shift, unless the CoC is terminated prior to the scheduled training.

c. Conclusions

No safety concerns were identified regarding the certificate holder's criticality alarm system.

**7.0 Plant Activities (IP 88015)**

a. Inspection Scope

The inspector performed plant walkdowns to review activities in progress and to determine whether risk-significant fissile material operations were being conducted safely and in accordance with regulatory requirements. The inspector verified the adequacy of management measures for assuring the continued availability, reliability, and capability of safety-significant controls relied upon by the certificate holder for controlling criticality risks to acceptable levels. The inspector reviewed selected portions of the documents listed in Section 2.7 of the Attachment, prior to performing walkdowns in Buildings C-310, C-337A, and C-360.

b. Observations and Findings

The inspector verified that controls identified in the NCS analyses reviewed were adequate to assure safety. The cognizant NCS engineers were knowledgeable and able to explain the basis for changes in operations and controls.

c. Conclusions

No safety concerns were identified during walkdowns of the facility and operations.

**8.0 Exit Meeting**

The inspector communicated the inspection scope and results to members of PDGP's management, including Steven Penrod, Vice President, Enrichment Operations, and staff throughout the inspection and during an exit meeting on January 16, 2014. PGDP's management and staff acknowledged and understood the findings as presented.

## SUPPLEMENTARY INFORMATION

### 1.0 Items Opened, Closed, and Discussed:

None

### 2.0 Key Documents Reviewed:

Inspector reviewed selected aspects of the following documents. Documents that apply to multiple sections are listed in the section that is most applicable.

#### 2.1 Plant Status

Not Applicable

#### 2.2 Nuclear Criticality Safety Program (IP 88015 & 88016)

- "Safety Analysis Report-Paducah Gaseous Diffusion Plant," Rev. 138
- CP2-EG-NS1031, Rev. 10, "Nuclear Criticality Safety," effective date: April 30, 2012
- CP4-EG-NS1101, Rev. 11, "Nuclear Criticality Safety Evaluations and Approvals," effective date: June 20, 2013
- CP4-EG-NS1107, Rev. 4, "Nuclear Criticality Safety Oversight Program," approved date: May 28, 2013
- NCSE 032, Rev. 15, "Product and Side Withdrawal in C-310 Building," approval date: April 4, 2013
- NCSA 310-004, Rev. 13, "Product and Side Withdrawal in the 310 Building," effective date: May 23, 2013
- NCSA GEN-051, Rev. 0, "Pre-Fill Requirements for Large UF6 Cylinders," effective date: May 23, 2013
- NCSE 032, Rev. 16, "Product and Side Withdrawal in C-310 Building," approval date: April 4, 2013
- NCSE 032, Rev. 17, "Product and Side Withdrawal in C-310 Building," approval date: June 6, 2013
- NCSA 310-004, Rev. 15, "Product and Side Withdrawal in the 310 Building," effective date: July 12, 2013
- NCSE 038, Rev. 3, Chg A, "Liquid UF6 Sampling and Refeed Operations in the C-360 Toll, Transfer, and Sampling Facility at the Paducah Gaseous Diffusion Plant," approval date: December 12, 2013
- NCSA 360-002, Rev. 2, Chg A, "Liquid UF6 Sampling and Refeed Operations in the C-360 Toll, Transfer, and Sampling Facility at the Paducah Gaseous Diffusion Plant," effective date: January 6, 2014
- NCSE 070, Rev. 8, "Operation and Maintenance of Autoclave Facility Process Piping, Evacuation Drums, and Relief Valves," approved date: January 31, 2013
- NCSA GEN-043, Rev. 7, "Operation and Maintenance of Autoclave Facility Process Piping, Evacuation Drums, and Relief Valves," effective date: August 15, 2013
- NCSE 088, Rev. 2, "NCS-Exemption of Items," approved date: May 30, 2013

- NCSA GEN-047, Rev. 2, “NCS-Exemption of Items,” effective date: July 18, 2013
- NCSE 095, Rev. 8, “Operation and Shutdown of the Diffusion Cascade,” approved date: June 6, 2013
- NCSA CAS-21, Rev 6, “Operation and Shutdown of the Diffusion Cascade,” effective date: July 12, 2013
- MCL-110-3, Experimental Results for the Study of Diffusion Rates of Moisture in Uranyl Flouride for Paducah Gaseous Diffusion Plant, July 2000
- USEC PGDP TSR, Rev. 5, Section 2.4.4.4 “LCO Cascade Wet Air InLeakage”
- PGDP Organizational Chart dated: September 9, 2013

### **2.3 Nuclear Criticality Safety Inspections, Audits, and Investigations (IP 88015)**

- CP2-BM-CI1030, Rev. 9, “Paducah Self-Assessment,” effective date: October 19, 2012
- 13-WS-006, “NCS Walkthrough of the PGDP Cascade,” dated October 24, 2013
- 13-WS-007, “2013 NCS Walkthrough of the C-310/C-310A Product Withdrawal Facility,” dated December 18, 2013.

### **2.4 Nuclear Criticality Safety Training and Qualification (IP 88015)**

- CP2-EG-NS1030, Rev. 1, “Nuclear Criticality Safety Training,” effective date: January 5, 2001
- CP4-EG-NS1108, Rev. 4, “Nuclear Criticality Safety Engineer Qualifications,” effective date: June 5, 2013

### **2.5 Nuclear Criticality Safety Event Review and Follow-up (IP 88015 & 88016)**

- CP4-EG-NS1104, Rev. 4, “Nuclear Criticality Safety Engineer Response to Emergency, Off-Normal, and Process Upset Conditions,” effective date: June 5, 2013
- Criticality Safety Incident Report: NCS-INC-13-007, Rev. 0, discovery date: July 29, 2013
- Criticality Safety Incident Report: NCS-INC-13-008, Rev. 0, discovery date: September 24, 2013
- Criticality Safety Incident Report: NCS-INC-13-009, Rev. 0, discovery date: September 24, 2013
- Criticality Safety Incident Report: NCS-INC-13-010, Rev. 0, discovery date: October 1, 2013
- Criticality Safety Incident Report: NCS-INC-13-011, Rev. 0, discovery date: November 5, 2013
- Issue Response/Data Sheet: C13101799 – ATRC-13-1634
- Issue Response/Data Sheet: C13102173 – ATRC-13-1983

**2.6 Criticality Alarm Systems (IP 88017)**

- CP2-EP-EP5038, Rev. 12, "Criticality and Radiation Emergencies," effective date: December 27, 2013
- CP2-CO-CA2030, Rev. 20, "Operation of the Criticality Accident Alarm System (CAAS)," effective date: May 16, 2009
- USEC-01-EP, Rev 140, "Emergency Management Plan for Paducah Gaseous Diffusion Plant, dated: September 20, 2013
- Preventative Maintenance and TSR Surveillance Task List for the Annual Surveillance of the CAAS system in Building 360
- Preventative Maintenance and TSR Surveillance Task List for the Preventative Maintenance of the CAAS system in Building 333

**2.7 Plant Activities**

Documents listed in other sections were reviewed related to facility walkdowns.

**2.8 Exit Meeting**

Not Applicable

**3.0 Inspection Procedures Used:**

IP 88015	Nuclear Criticality Safety Program
IP 88016	Nuclear Criticality Safety Evaluations and Analyses
IP 88017	Criticality Alarm Systems

**4.0 Partial List of Persons Contacted:**

**USEC**

T. Henson	Manager, Nuclear Criticality Safety
R. Beck	Engineer, Nuclear Criticality Safety
B. Chenier	Field Engineer, Nuclear Criticality Safety
S. Penrod	Vice President, Enrichment Operations
D. Stadler	Senior Engineer, Nuclear Regulatory Affairs
S. McKinney	Manager, Engineering
S. Shell	Manager, Production Support and Product Scheduling

**NRC**

Greg Chapman	Criticality Safety Inspector, Headquarters
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All attended the exit meeting on January 16, 2014.

## 5.0 List of Acronyms and Abbreviations:

ATR	Assessment Tracking and Reporting
ADAMS	Agencywide Documents Access and Management System
CAAS	criticality accident alarm system
CFR	Code of Federal Regulation
CSA	criticality safety analysis
DOE	U.S. Department of Energy
EN	Event Notice
FCA	Fissile Control Area
IP	inspection procedure
NCS	nuclear criticality safety
NCSA	nuclear criticality safety approval
NCSE	nuclear criticality safety evaluation
PGDP	Paducah Gaseous Diffusion Plant
PMR	Preventative Maintenance Record
SAR	safety analysis report
SRI	Safety Related Item
UF <sub>6</sub>	uranium hexafluoride
USEC	U. S. Enrichment Corporation (certificate holder)
VIO	violation